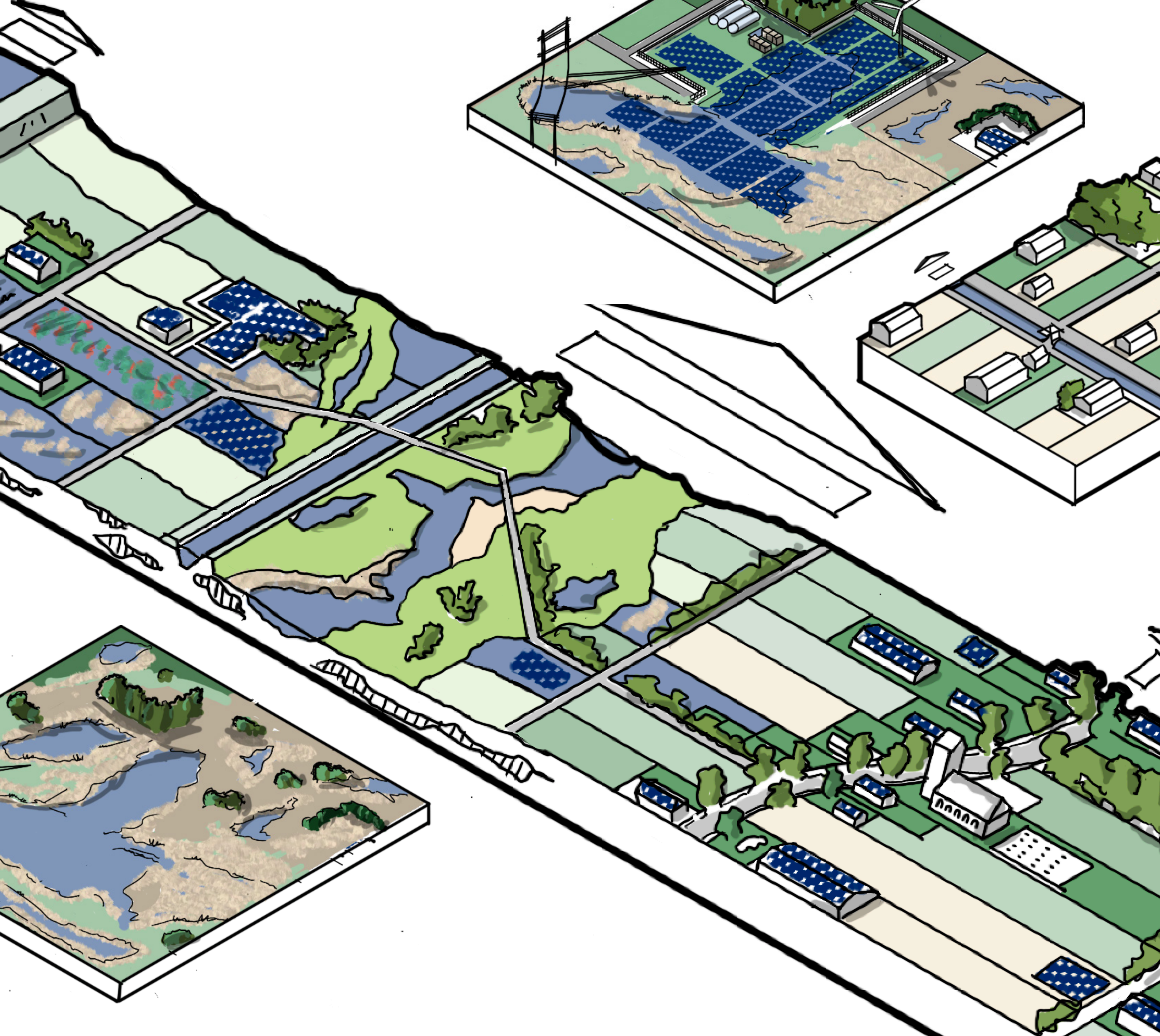
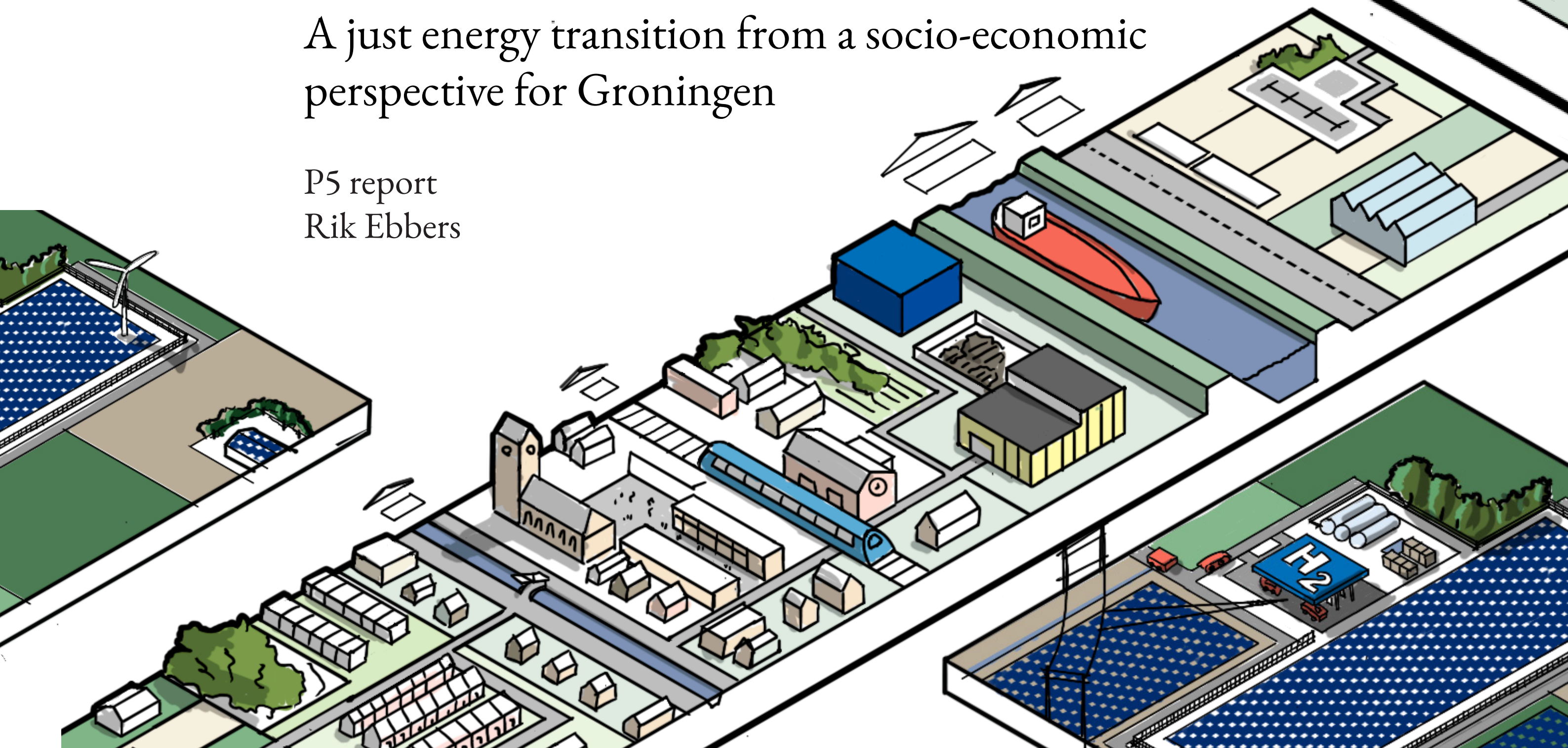


Regenerative energy

A just energy transition from a socio-economic perspective for Groningen

P5 report

Rik Ebbers



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P5 report

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All the drawings and photographs in this thesis are drawn by the author unless states otherwise

Abstract

Decarbonizing the energy sector to achieve climate neutrality by 2050 poses challenges, especially for regions heavily dependent on fossil fuel extraction. Groningen, a region highly dependent on gas extraction, faces significant socio-economic and spatial challenges. This thesis examines a strategy for Groningen based around the energy transition. The strategy includes repurposing the current energy infrastructure, placing renewables, regenerating nature, and shifting land-use change, all contributing to a new green economy for Groningen. Three scenarios are developed based on a set of different values. These scenarios present alternative futures and highlight areas with spatial competition. Different claims on the same space necessitate choices and smart design solutions. The strategy combines the three scenarios and shows a possible design outcome. An important aspect of the scenarios and strategy is to inform the local communities. Engagement strategies and proposals for more inclusive governance are developed, specifically focusing on marginalized groups, who are often most affected by the transition. This thesis aims to enhance knowledge about the energy transition in the context of Groningen and to promote more inclusive governance.

Keywords:
Energy transition, Groningen gas field, Just transition, Nature regeneration

Table of content

Motivation

I was born and raised in the Netherlands, where my studies fostered a deep appreciation and keen interest in the Dutch landscape. This landscape is profoundly shaped by human activities, and large parts of the Netherlands owe their existence to human intervention.

Like many other countries, the Netherlands grapples with significant challenges from climate change and the associated energy transition. Rising water tables, urban expansion, and integrating renewable energy sources are among the pressing issues. These transitions necessitate space, presenting a complex puzzle for a small and densely populated country like the Netherlands. These challenges make the field of urban planning particularly fascinating to me.

My interest extends across various project scales, from overarching strategies to intricate designs. I am particularly intrigued by the interplay between large-scale decisions and their tangible impacts at the local level. In my current graduation project, I delve into these different scales, acknowledging the interconnectedness of various elements within the landscape.

Foundations

1.1 Problem field

Human dependency on fossil fuels

Throughout the last two centuries, our societal, economic, and global frameworks have become deeply interwoven with the extensive utilization of fossil fuel energy. This has resulted in a daily per capita energy consumption of approximately 1,000 MJ in affluent regions, markedly contrasting with the fundamental 10 MJ required for basic health (Sijmons, 2014, p.27). While fossil fuels have facilitated prosperity and raised living standards, they have also engendered a substantial reliance on inexpensive and limited resources. This unprecedented reliance on fossil fuels has accelerated climate change and contributed to environmental deterioration. Consequently, there exists an urgent necessity to transition towards a new energy paradigm, gradually phasing out fossil fuels and embracing a diverse energy mix predominantly driven by renewable sources such as wind, hydro, solar, waste heat, and biomass (Sijmons, 2014, p.11).

Energy transition towards renewables

The need for an energy transition arises from several considerations. First, the finite nature of fossil fuels necessitates a shift to sustainable energy sources. The continued depletion of coal, oil, and gas supplies poses a potential threat to urban and rural areas. Despite the uncertainty surrounding the depletion timeline, the long-term consequences underscore the urgency of initiating the transition quickly. Although technological advances and new discoveries have temporarily slowed depletion, there is an observable pattern in which the energy required to extract these resources is escalating, leading to diminishing net returns. While clearer in the long term, this depletion motive becomes increasingly urgent in the short term, highlighting the need for a timely transition (Sijmons, 2014, p.12).

Second, geopolitical interests have historically influenced energy decisions, often pushing countries to pursue energy independence. While this motive does not inherently favor renewable energy sources, the decentralized nature of renewable energy, such as sunlight and wind, reduces dependence on unstable regimes and regions. The European promotion of renewable energy sources reflects the desire for greater energy security. However, geopolitics can also be counterproductive for countries that heavily rely on fossil fuels (Sijmons, 2014, p.14).

Third, the urgency of limiting global warming is one of the main drivers for the energy transition. Scientific consensus attributes Earth's rising temperature to man-made CO2 emissions from fossil fuels. The projected temperature increases, and associated climate impacts require rapid and comprehensive action. (Sijmons, 2014, p.15). International agreements such as the Paris Agreement are made to limit the temperature rise by 1.5°C and require a drastic reduction in the use of fossil fuels (The Paris Agreement | UNFCCC. (n.d.)). Failure to do so could have catastrophic consequences, including extreme temperature increases and rising sea levels, threatening vital coastal areas worldwide. In summary, the imperatives of resource depletion, geopolitical considerations and climate change jointly underscore the critical need for a rapid response (Sijmons, 2014, p.15).

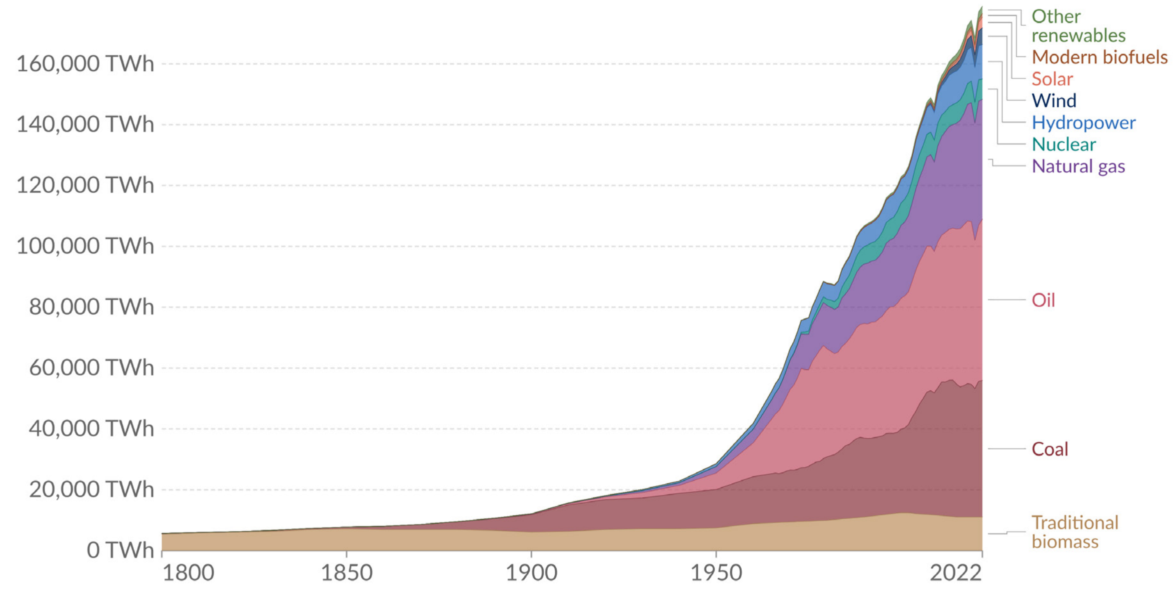


Figure 1 Global primary energy consumption by source, source: IPCC. (2023). Synthesis Report of the IPCC Sixth Assessment Report (AR6).

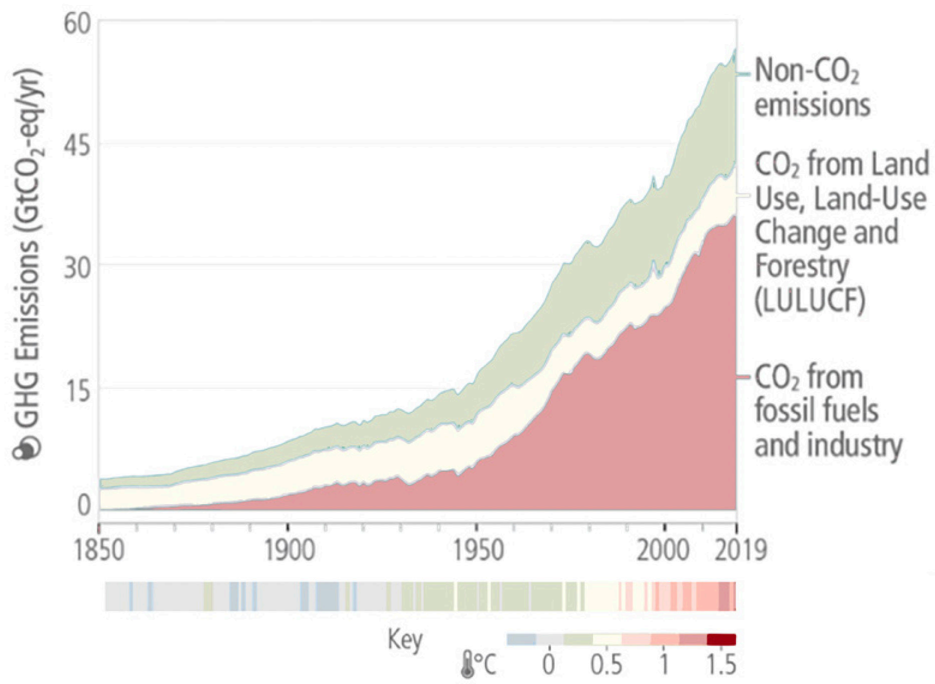


Figure 2 Greenhouse gas emissions resulting from human activities continue to increase, source: IPCC 2023 (adapted)

1.1 Problem field

Spatial dimension of the energy transition

Fossil fuel extraction and energy production are almost always carried out in monofunctional areas. The current energy system is highly centralized and distant from human living environments. Fossil fuels typically have a smaller spatial footprint, and extracting resources like gas and oil is often an underground affair. (Sijmons, 2014). Renewable energy production yields significantly less energy per square meter of land (Smil, 2016). At the same time do renewables require land that is already occupied with other functions, such as agriculture, nature, and the urban living environment of humans.

The transition to renewables will have a great spatial impact on both the operational and renewable landscapes. Solar panels and renewables are placed within the current landscape, and in countries like the Netherlands, the multiple-use approach is highlighted.

social dimension of the energy transition

The integration of renewable energy sources is imperative to attain a carbon-neutral society. In this broad sense, the placement of renewables holds significant importance for climate preservation, environmental conservation, and enhancing the quality of life for humanity. However, the deployment of renewables has an impact on the landscape, particularly in regions with a high density. This can result in people being against renewables. Therefore, it is essential to place renewables in coherence with existing landscape structures and minimize adverse effects (RES Groningen, 2021).

Day & Golubchikov (2016) emphasize the danger posed by land acquisitions for infrastructure development, even in ostensibly environmentally progressive projects like renewable energy. Such actions can lead to the displacement of vulnerable communities and the disruption of flora and fauna in their habitats and sources of sustenance. Renewable energy sources are frequently extended near urban areas. Local residents often have concerns regarding wind turbines due to visual impact and noise pollution, exacerbating the tension between human and environmental spaces. This phenomenon is commonly known as 'NIMBY' (Not In My Backyard).

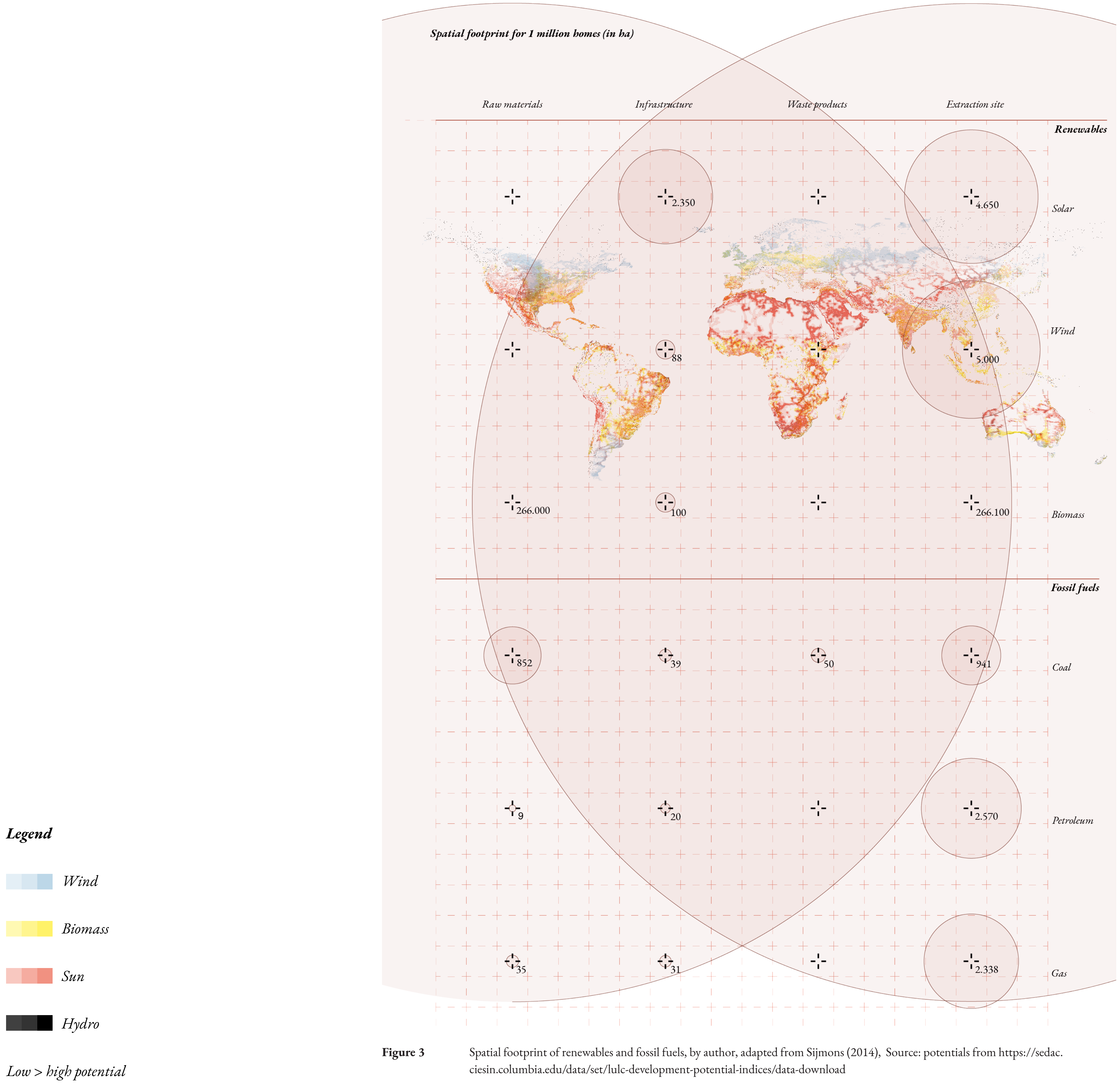


Figure 3 Spatial footprint of renewables and fossil fuels, by author, adapted from Sijmons (2014), Source: potentials from https://sedac.ciesin.columbia.edu/data/set/lulc-development-potential-indices/data-download

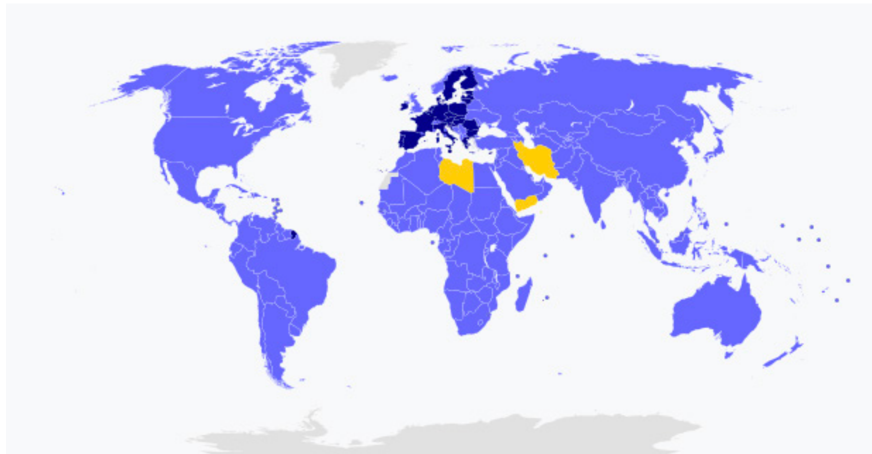
1.1 Problem field

The Paris agreement

The Paris Agreement, reached in 2015, is a binding international treaty to address climate change. It was ratified by 196 parties and entered into force in November 2016. Its main goal is to limit the increase in global average temperature to less than 2°C above pre-industrial levels, with additional efforts to limit the increase to 1.5°C (Brown et al., 2019). In recent years, there has been a growing emphasis on achieving the more ambitious target of 1.5°C by the end of this century. This urgency stems from the UN Intergovernmental Panel on Climate Change findings, which warn that exceeding the 1.5°C threshold could lead to more severe and more frequent effects of climate change, such as severe droughts, heat waves, and increased precipitation. To meet the 1.5°C goal, greenhouse gas emissions must peak by 2025 and be reduced by 43% by 2030 (The Paris Agreement | UNFCCC, 2024).

The European Green Deal

The European Green Deal consists of a comprehensive set of policy initiatives strategically designed to guide the European Union (EU) toward a sustainable transformation, aiming for climate neutrality by 2050. This initiative is based on promoting a just and prosperous society and fostering a modern and competitive economy within the EU. The European Green Deal emphasizes the need for a holistic and cross-sectoral approach, highlighting the integral role of different policy areas in contributing to the overarching climate-related goal. This cohesive package includes a wide range of climate, environmental, energy, transport, industrial, agricultural, and sustainable finance initiatives that are all strongly interlinked. Collectively, these policies should align with the overarching EU goal of promoting climate neutrality by 2050 (European Green Deal, 2023).



Legend

- *State parties*
- *Signatories*
- *Green Deal*
- *Agreement does not apply*

Figure 4 Countries that are involved in the Paris agreement en the European Green Deal, Source: https://en.wikipedia.org/wiki/List_of_parties_to_the_Paris_Agreement#/media/File:ParisAgreement.svg

Figure 5 Goals of the European green deal, source: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.espon.eu/sites/default/files/attachments/2.%20Presentation%20Sander%20Happaerts.pdf

1.1 Problem field

The just transition fund

The European goal of achieving climate neutrality by 2050 necessitates a fundamental shift in energy generation, impacting various regions and sectors differently (McDowall et al., 2023). Recognizing the uneven distribution of winners and losers in this transformation, the Just Transition Mechanism was established to implement climate and social policies in regions expected to be most affected by the phase-out of high-carbon activities. This mechanism addresses three critical aspects: 1) the uneven effects of the transition on different sectors, 2) the regional impacts of socioeconomic shocks, and 3) the transition's impact on the skills and educational levels needed for EU labor markets (Marty, 2020).

A distinction is made between regions where industries will shrink and regions where jobs will change (Marty, 2020). Industries that are disappearing include coal and lignite mining, oil and natural gas extraction, and some industrial processes related to fossil fuels such as fossil fuel processing (refineries) and the manufacture of internal combustion engines (McDowall et al., 2023). Conversely, transforming industries need to reduce their CO2 emissions, particularly energy-intensive industries such as the iron and steel and chemical sectors (Marty, 2020).

McDowall et al. (2023) quantify the vulnerability of each region based on the region's exposure, sensitivity, and adaptive capacity. An additional skills weight factor is later added since some jobs are more specialized, making it harder to find alternative employment or retrain workers. Fossil extraction jobs are considered more specialized than manufacturing and refining jobs. Financial support is necessary to preserve these industries, both for EU competitiveness and to protect regional jobs (Marty, 2020).

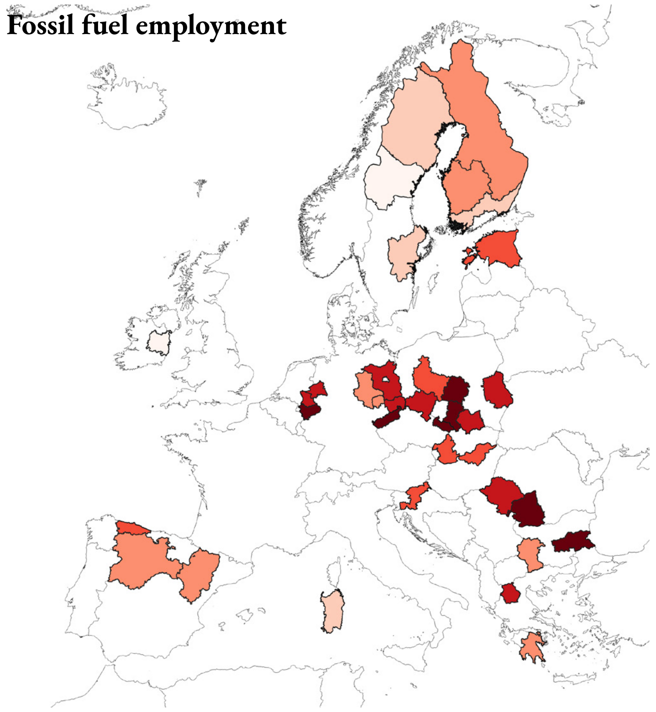


Figure 6 Fossil fuel employment, by author, source: (Alves et al., 2018)

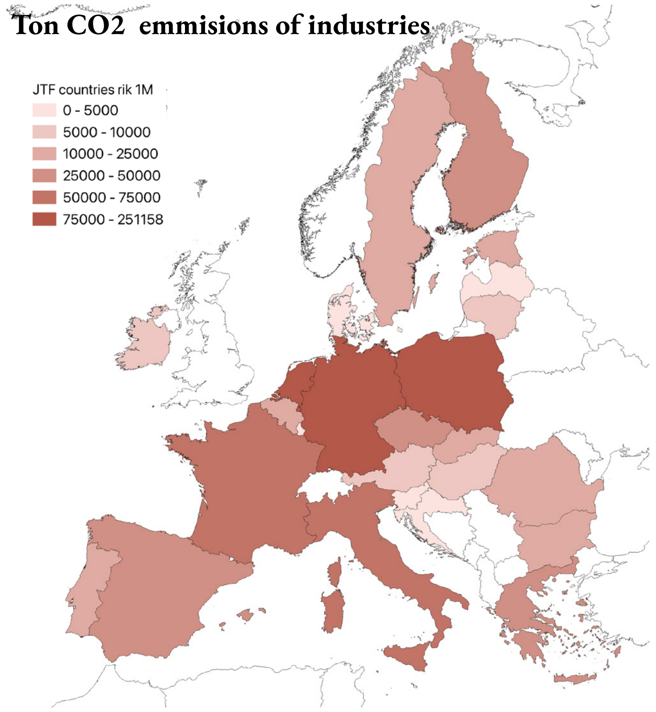


Figure 7 Ton CO2 emissions of industries, by author, (Just Transition Mechanism Allocation, n.d.)

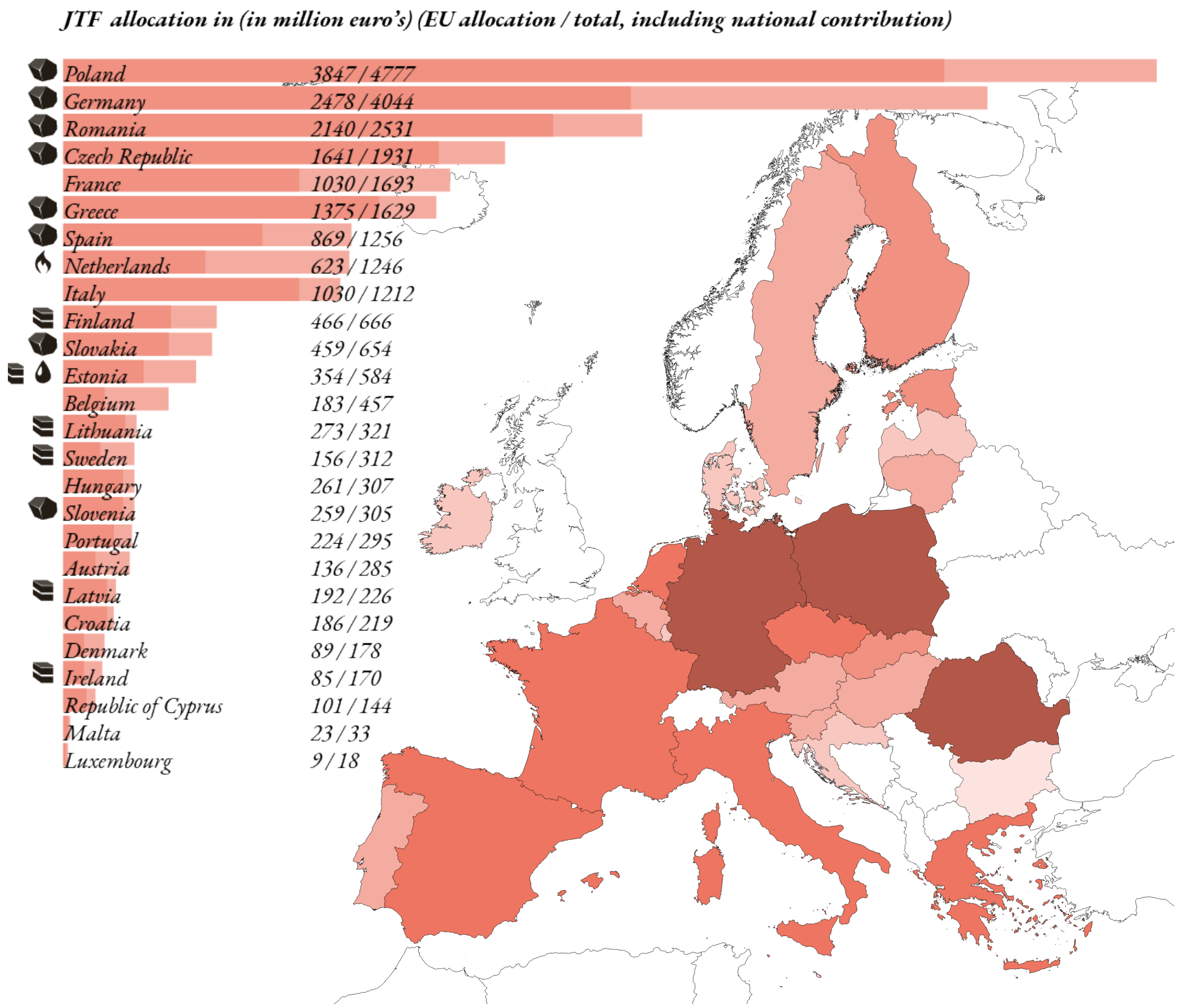


Figure 8 Budget allocation of the JTF, by Author, source: (Open Data Portal for the European Structural Investment Funds - European Commission | Data | European Structural and Investment Funds, n.d.)

1.1 Problem field

Regional vulnerability

The impact of the energy transition varies across regions. Even among regions identified as vulnerable, there exist distinct levels of vulnerability (McDowall et al., 2023). However, these regions also face similar challenges, which is notable because strategies proven effective in one region may hold merit for others. This study centers on Groningen in the Netherlands. Within the Dutch territory, the transition fund is primarily aimed at areas impacted by CO2-emitting industries. Noteworthy is the significant phase-out of gas extraction activities in Groningen, an aspect not explicitly addressed in the main documentation concerning the Just Transition Fund. This exclusion likely arises from the unique circumstances of Groningen, where gas extraction was prematurely ceased due to seismic events in the area. Despite its unique circumstances, Groningen shares common obstacles with fellow European regions. Therefore, studying Groningen's case could yield valuable insights for regions with similar profiles.

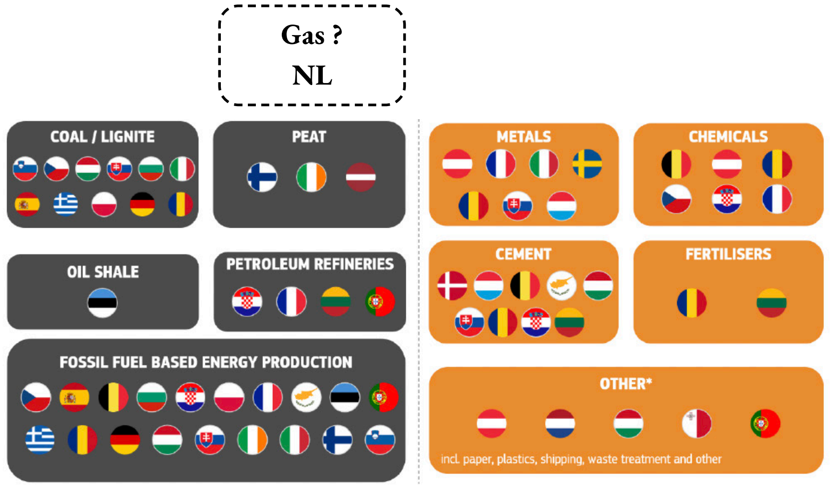


Figure 9 Declining and transforming sectors, source: Annexes D of the European Semester country reports of Feburari 2020

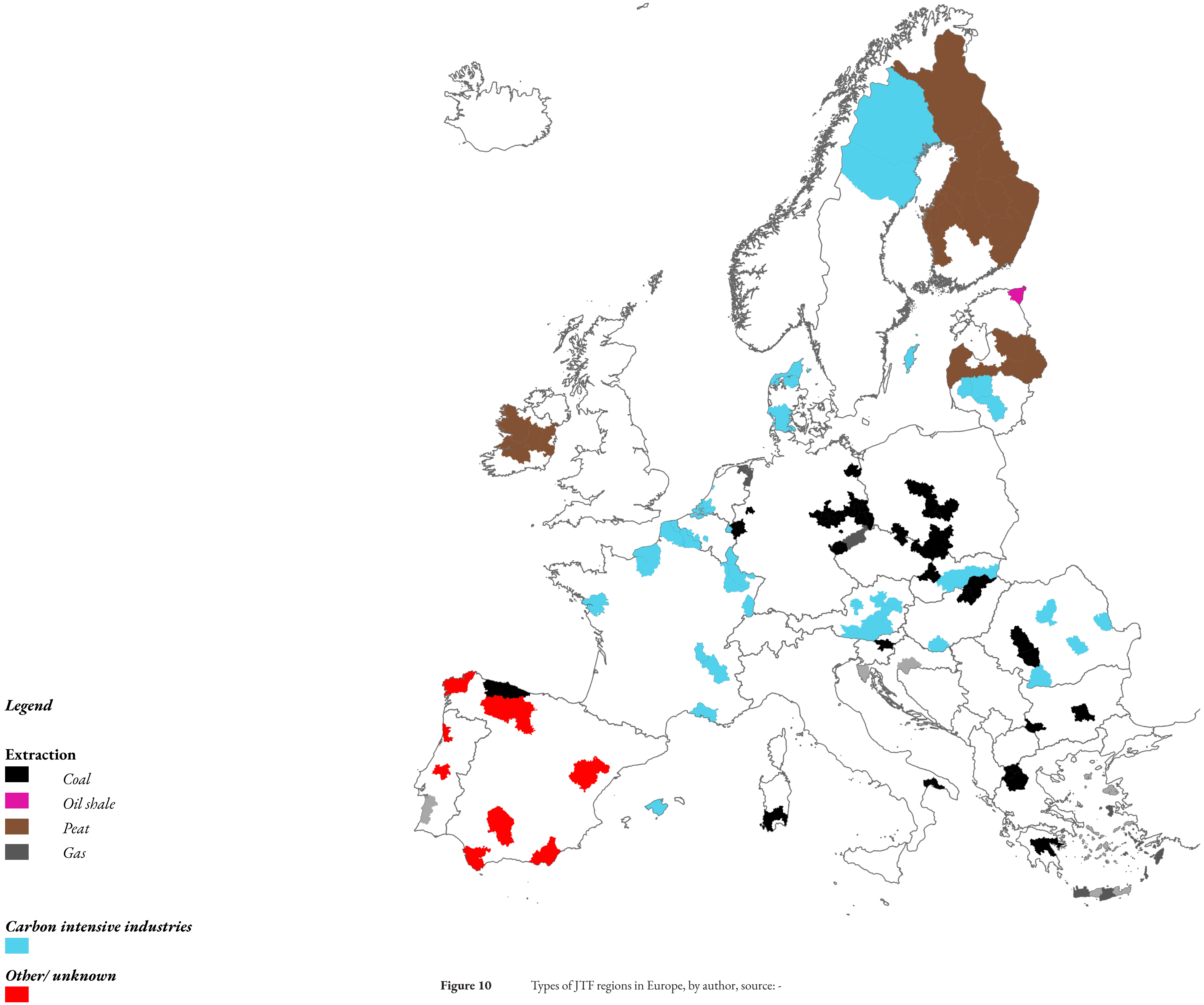


Figure 10 Types of JTF regions in Europe, by author, source: -

1.2 The site - The Netherlands

Regional vulnerability in the Netherlands
The allocated EU budget from the JTF for the Netherlands is 623 million euros. With national co-financing (50% public and private) the total budget is doubled to 1246 million. (Open Data Portal for the European Structural Investment Funds - European Commission | Data | European Structural and Investment Funds, n.d.)

The Just Transition fund has three tracks, that correspond with activities stated in the JTF regulation:
1. Investment in the renewal and strengthening of the local economy.
2. Investment in technology, systems, and infrastructure.
3. An agile and resilient workforce.

Below a short overview is provided why the regions are part of the Just Transition Fund. This part is adapted from (Programme JTF 2021 – 2027).

Groningen-Emmen:
Closure of the Groningen gas field, with negative economic impact for the region. Additionally, incomes and work participation is low.

IJmond:
Fossil jobs at TATA Steel and transformation towards green steel industry.

Groot-Rijnmond:
Industry and harbor area of Rotterdam. The focus is on jobs, employment and re-schooling of the workforce.

Zeeuws-Vlaanderen:
High risk of job loss, causing a negative spiral for people to move away. Re-schooling and diversification of the economy and jobs are necessary.

West- North Brabant:
Chemical industry sector (re-schooling, sustainable infrastructure, and innovation)

South Limburg:
Chemical industry sector, mismatch in the job market

Prioriteit	Regio	Bijdrage Europese Unie vanuit JTF	Nationale cofinanciering (50% publiek en privaat)	Totaal
1	Groningen-Emmen	330.319.823	330.319.824	660.639.647
2	IJmond	58.556.695	58.556.696	117.113.391
3	Groot-Rijnmond	58.556.695	58.556.696	117.113.391
4	Zeeuws-Vlaanderen	58.556.695	58.556.696	117.113.391
5	West-Noord-Brabant	58.556.695	58.556.696	117.113.391
6	Zuid-Limburg	58.556.695	58.556.696	117.113.391
	Totaal Nederland	**623.103.298**	**623.103.304**	**1.246.206.602**

Figure 11 Types of JTF regions in Europe, Source: (Just Transition Fund, n.d.)

Legend

gasfields
Gas pipelines
JTF areas

Fossil industries
Coal plants
Coal terminals
LNG terminals
Gas powerplants
Refineries

Energy intensive industries
Non-ferrous metals
Non metalic minerals
Chemical industry
Iron and steel
Paper and printing

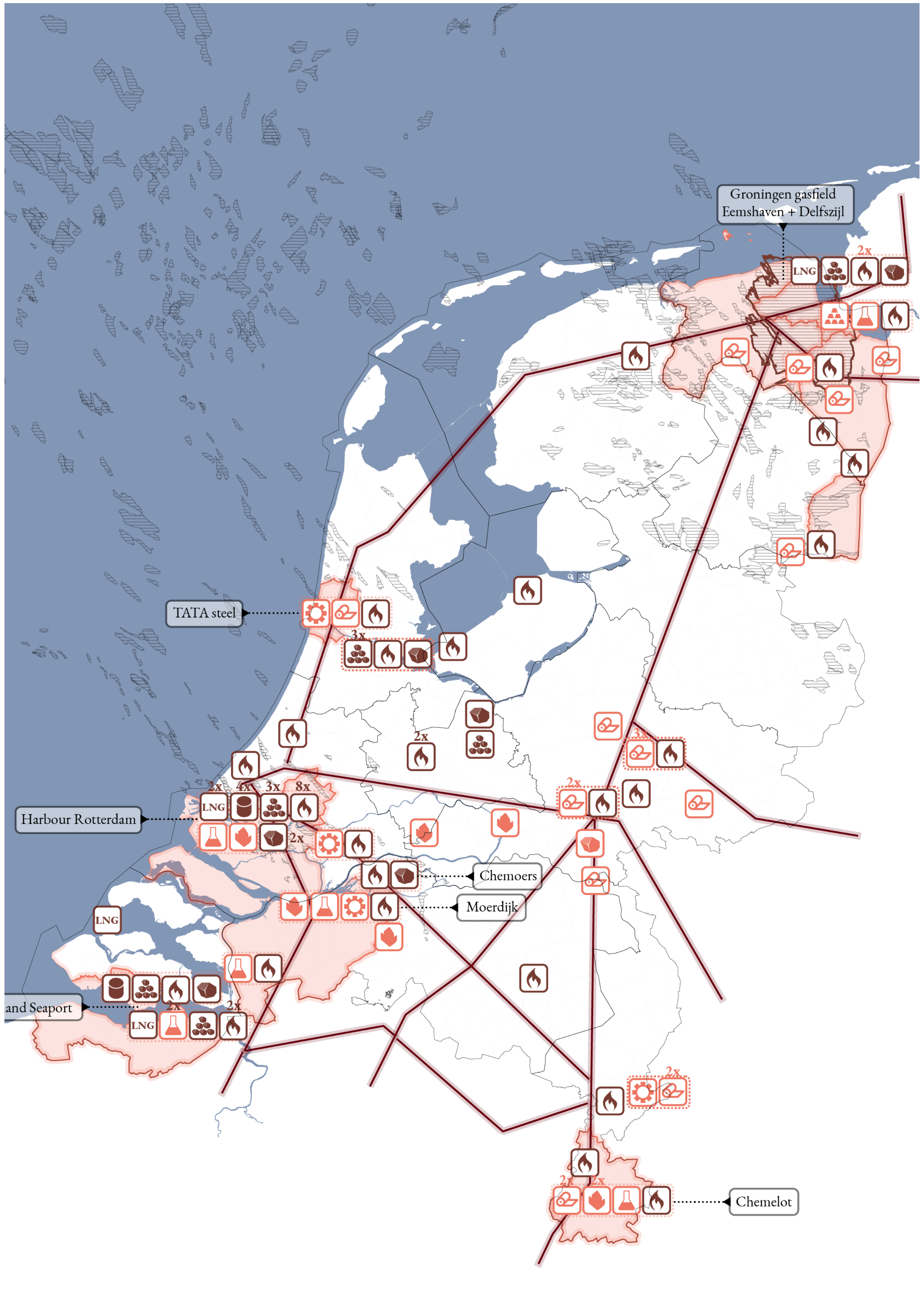


Figure 12 The regions that are part of the just transition fund and heavy industries, by author, sources: D5 1 industry dataset, CLCC2018, okt-2023-nlog-fields_utm shape, global coal power plants, https://globalenergymonitor.org/projects/global-oil-infrastructure-tracker/

1.2 The site - The Netherlands

Six regions in the Netherlands are selected for the Just transition fund. Combined, these regions account for 80% of the industry's national CO_2 reduction target. The energy-intensive industries play a major role in the local economy, making these regions vulnerable for the energy transition. underlying social-economic vulnerabilities such as relatively high (long-term) unemployment and demographic problems exacerbate these problems even more, since regions with existing socio-economic problems are less able to cope with the transition. Groningen-Emmen receives over half of the total Budget, whilst the rest of the budget is spread evenly across the regions (Programme JTF 2021 – 2027)

Broad prosperity
In the Netherlands, the Central Bureau of Statistics (CBS) defines a wide range of statistics on the municipality level. A combination of 42 indicators defines broad prosperity; the map shows how often a municipality is in the lowest quarter of one of these indicators. Areas with a low score are often large cities or decentral areas in the country. Most of the just transition fund regions score relatively low on broad prosperity. Groningen is the province with the lowest scores across various key welfare indicators, particularly in economy, employment, health, and societal well-being. The challenges confronting Groningen are unique in their magnitude and complexity, setting it apart from other regions in the country (KAW & Provincie Groningen, 2024).

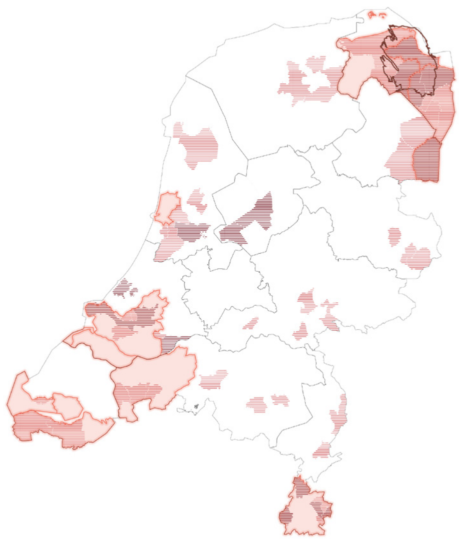


Figure 13 Overlap in regions who are low on the ranklist of broad prosperity combined with JTF regions, by author, source: Monitor Brede Welvaart van december 2022 (CBS).

Legend

gasfields
Gas pipelines
JTF areas

Fossil industries
Coal plants
Coal terminals
LNG terminals
Gas powerplants
Refineries

Energy intensive industries
Non-ferrous metals
Non metalic minerals
Chemical industry
Iron and steel
Paper and printing

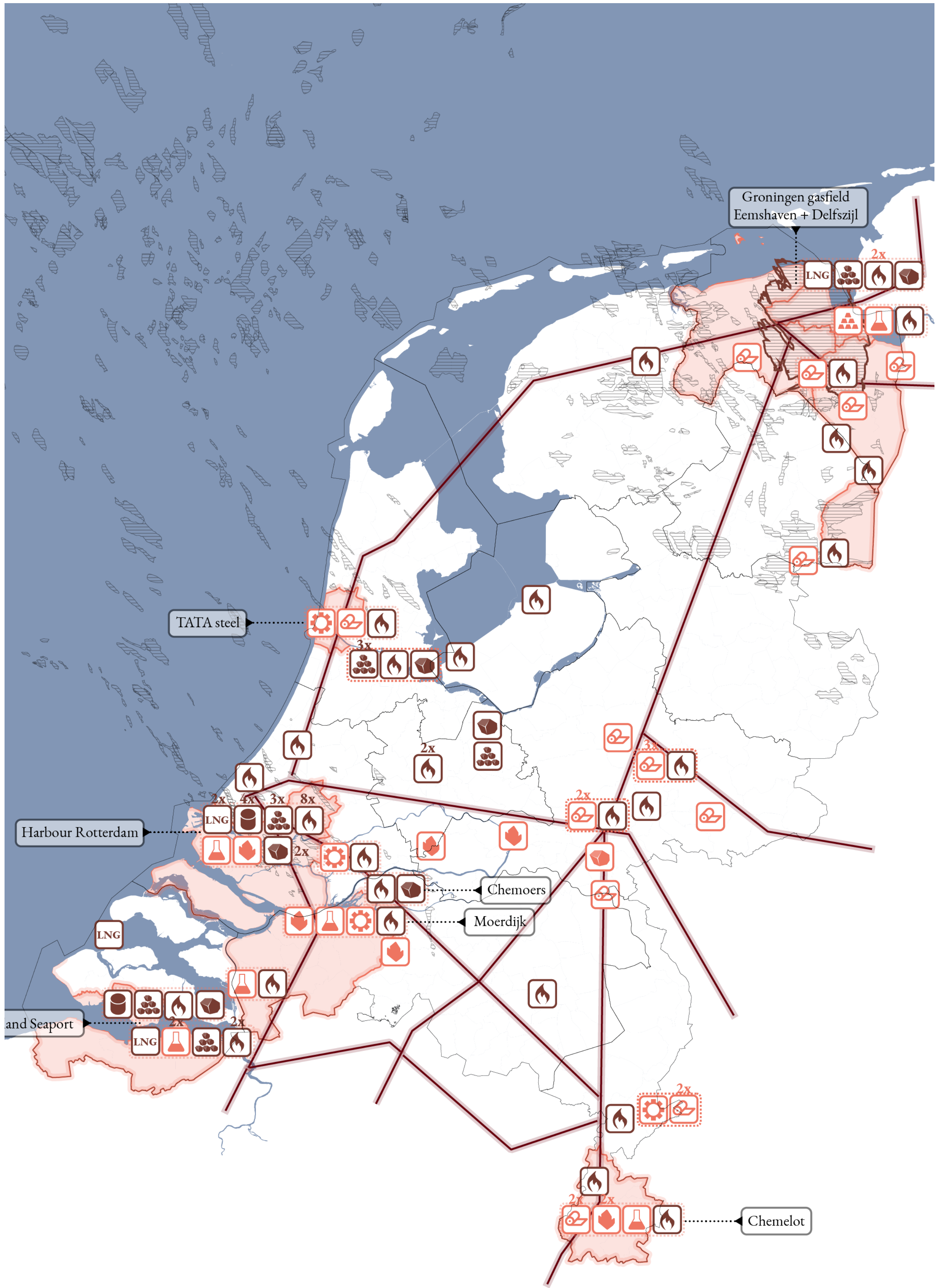


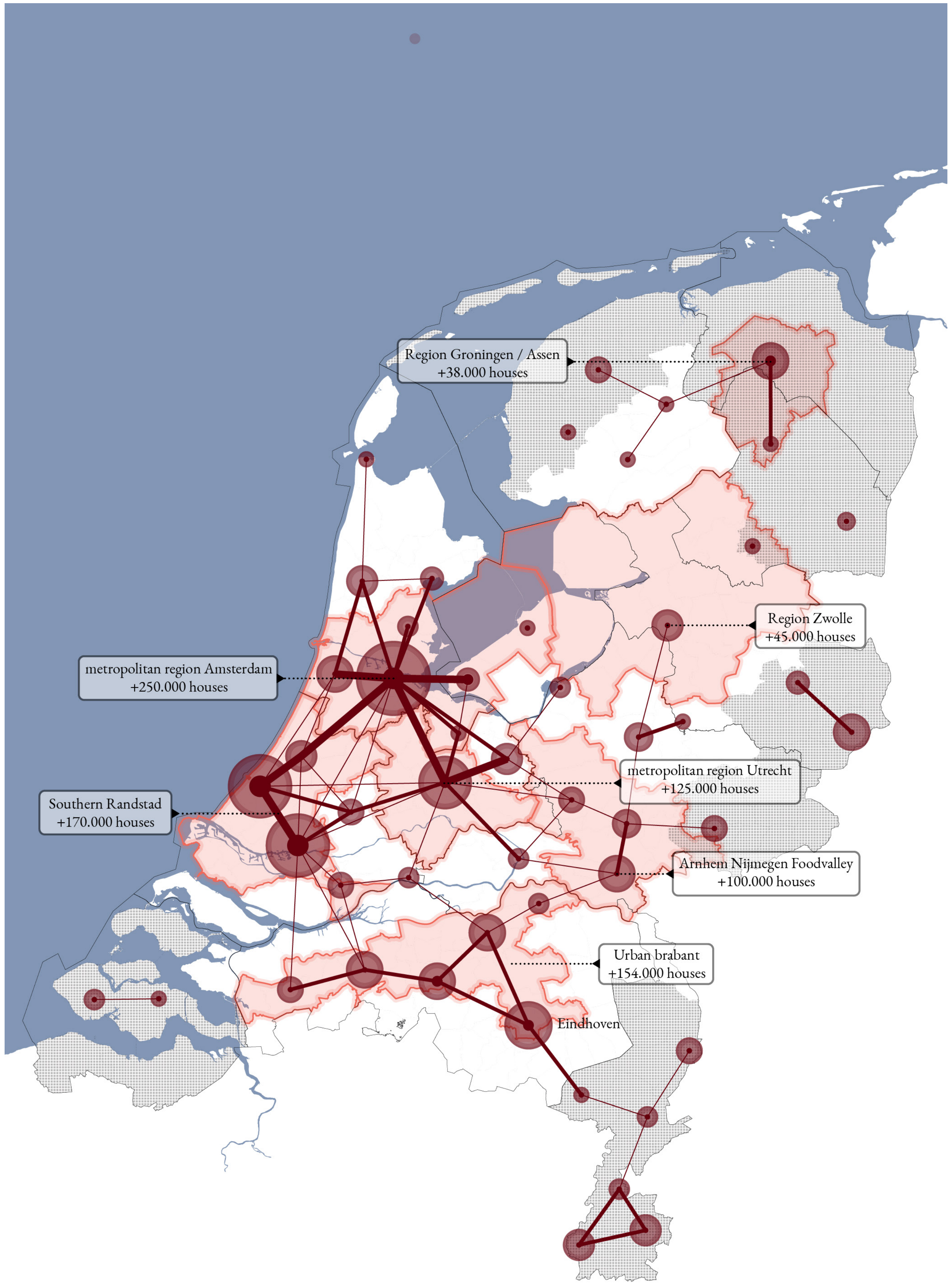
Figure 14 The regions that are part of the just transition fund and heavy industries, by author, sources: D5 1 industry dataset, CLCC2018, okt-2023-nlog-fields_utm shape, global coal power plants, https://globalenergymonitor.org/projects/global-oil-infrastructure-tracker/

1.2 The site - The Netherlands

Urban network

Groningen, situated in the northern region of the Netherlands, holds a relatively secluded position outside the densely populated Randstad area. An examination conducted by the Netherlands Environmental Assessment Agency (PBL) on transportation patterns between and within urban centers highlights the isolated characteristics of the Northern provinces, including Groningen (Eck et al., 2020). Consequently, there is a discernible trend of young adults migrating to the Randstad, enticed by its ample and varied assortment of highly skilled employment opportunities (Monitor Brede Welvaart Groningen 2022, 2023). This internal migration, particularly prevalent among younger demographics, is expected to contribute to population shrinkage, particularly in border areas. The National Environmental Vision (NOVI) thus identifies regions where a decline in housing demand is foreseen post-2030.

However, the Netherlands currently grapples with a significant housing shortage. In response, national and provincial authorities have collaboratively formulated urbanization strategies for seven regions undergoing the most acute urbanization pressures. The preponderance of the housing endeavor until 2040 is allocated to these regions. 600.000 housing units by 2030 and 900.000 by 2040 (Nationale Omgevingsvisie Duurzaam Perspectief Voor Onze Leefomgeving, 2020). It is worth noting that the Groningen-Assen region has been encompassed within these seven areas, notwithstanding the NOVI's prognosis of diminishing housing demand for the entire region after 2030.



Legend

Transport within city

50.000

100.000

Transport between cities

10.000

25.000

Housing

Predicted decling in housing demand after 2030

Seven major regions for new housing (part of regiodeals)

Figure 15 Groningen in the city network of the Netherlands, by author, sources: (Nationale Omgevingsvisie Duurzaam Perspectief Voor Onze Leefomgeving, 2020), (Eck et al., 2020)

1.2 The site - The Netherlands

Improved connectivity as an opportunity
The northern regions of the Netherlands suffer from inadequate connectivity to the Randstad and central Netherlands, coupled with a local dispersed economic and spatial structure. Consequently, economic development in the north lags behind the national average, with GDP figures below the European average, while the Netherlands as a whole is well above the avarge.

The Lely Line is crucial for improving national and international accessibility, connecting Amsterdam, Groningen, Bremen, and Hamburg, and easing congestion on the Meppel-Zwolle route. This high-speed line will reduce travel time from Groningen to Amsterdam to 1 hour and 30 minutes. Additionally, upgrading existing railway infrastructure can lead to faster, more reliable connections, saving 20 minutes on routes between Groningen/Leeuwarden and the Randstad.

The proposed Lower Saxony Line, linking Enschede to Groningen via Emmen, would enhance regional accessibility and connect to the German rail network, boosting the regional economy.

Improved accessibility in the northern Netherlands would attract businesses, reduce commuting times, and expand job opportunities, particularly benefiting highly educated professionals. It would also make the northern provinces, especially Groningen, a more attractive and affordable alternative to the expensive Randstad housing market, helping to address housing shortages and mitigate population decline.

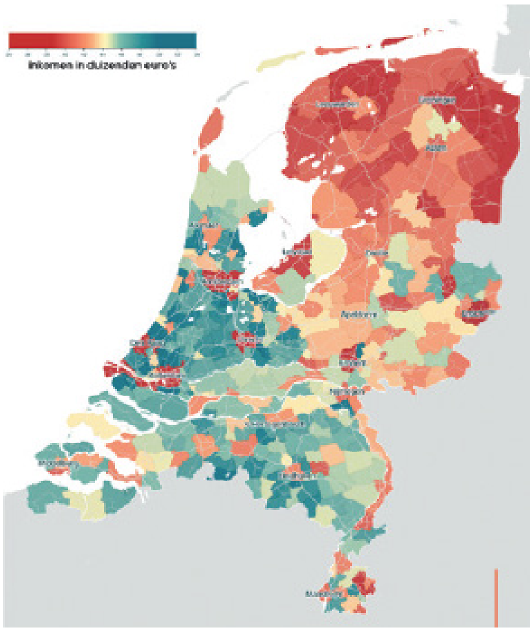


Figure 16 Income in the Netherlands (red low), source: (Bouwstenen Voor Het Deltaplan, 2021)

Legend

Transport within city
50.000
100.000
Transport between cities
10.000
25.000

Housing
Predicted decling in housing demand after 2030
Seven major regions for new housing (part of regiodeals)

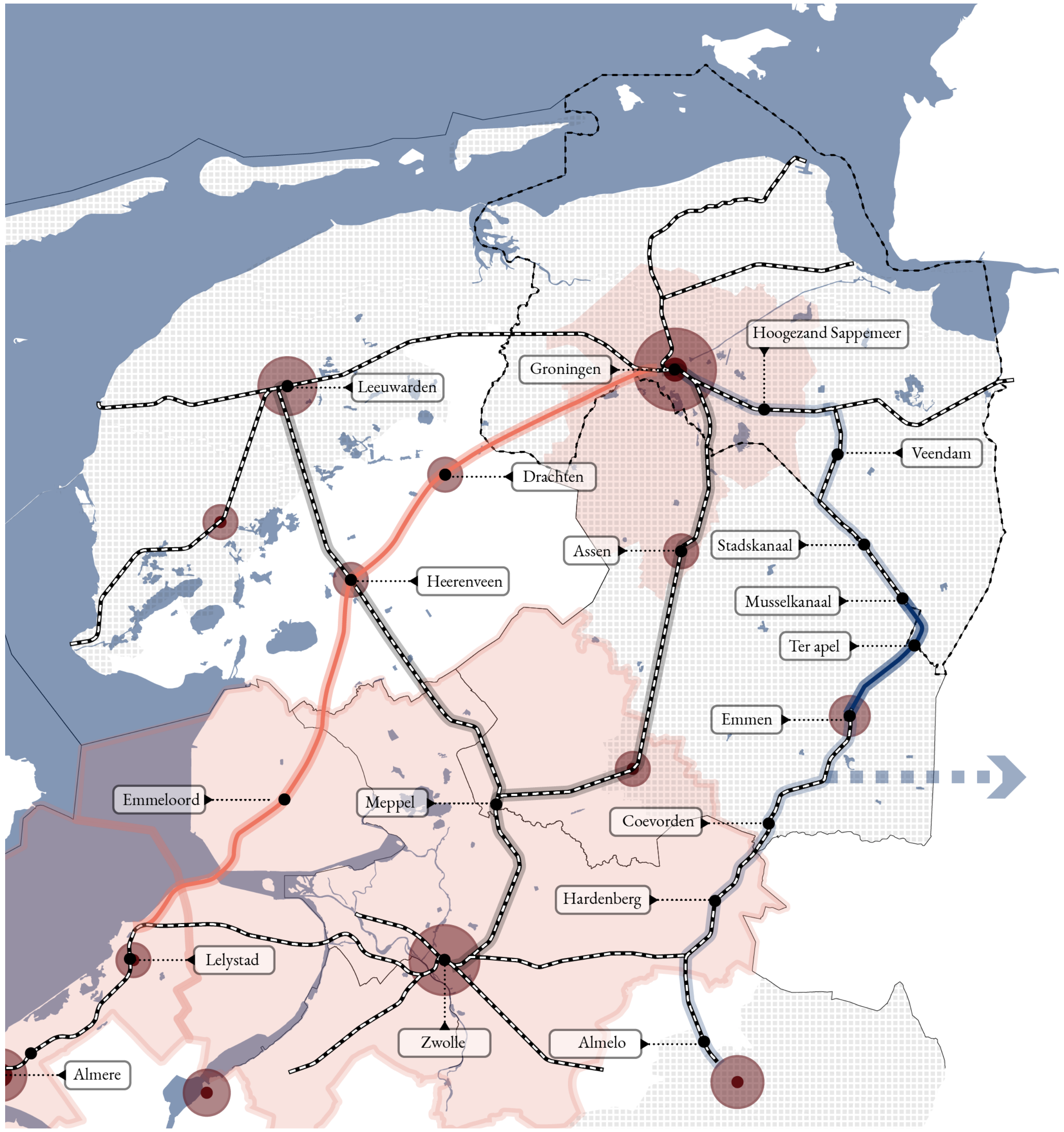


Figure 17 Development of new trainroutes will improve the connectivity in North-Netherland, by author, source: (Bouwstenen Voor Het Deltaplan, 2021), (Nationale Omgevingsvisie Duurzaam Perspectief Voor Onze Leefomgeving, 2020), (Eck et al., 2020)

1.3 The site - Groningen

Groningen has a history with energy production
The northern provinces of the Netherlands, particularly Groningen, have historically played a significant role in providing energy for the Netherlands. Peat extraction started in the sixteenth century to provide peat for the city of Groningen, but over time, it evolved into an export product for much of the Randstad. During the nineteenth century, coal emerged as a competing fuel source, gradually overtaking the peat extraction business. The discovery of the gas and oil fields in the latter half of the twentieth century gave Groningen the status of an energy-exporting region (Sijmons, 2014). It is estimated that the total profit from gas extraction over the last 70 years, adjusted for inflation, was 428 billion euros (NOS, 2022).

The peat landscape can be considered the first energy landscape that is still clearly recognizable as an open linear landscape characterized by long lines (Ruimtelijk ontwikkelingsperspectief Pekela -Veendam, 2016). In contrast to these distinct spatial characteristics, the influence of oil and gas extraction on the landscape is far less prominent. Gas extraction is an underground affair; the only spatial impact is the gas extraction sites, but they do not contribute to developing a new landscape (Sijmons, 2014). With the phasing out of gas and oil extraction and the closure of the Groningen gas field in 2023, the province is now moving to a new economy based on renewables (Ministerie van Algemene Zaken, 2023). The open landscape of Groningen offers opportunities for this more decentralized landscape of renewables (nationaal toekomst perspectief Groningen, 2018). This landscape of windmills and solar panels has a spatial implication on the existing landscape. Therefore, it is important to ensure that renewables are well integrated into the existing landscape structures.

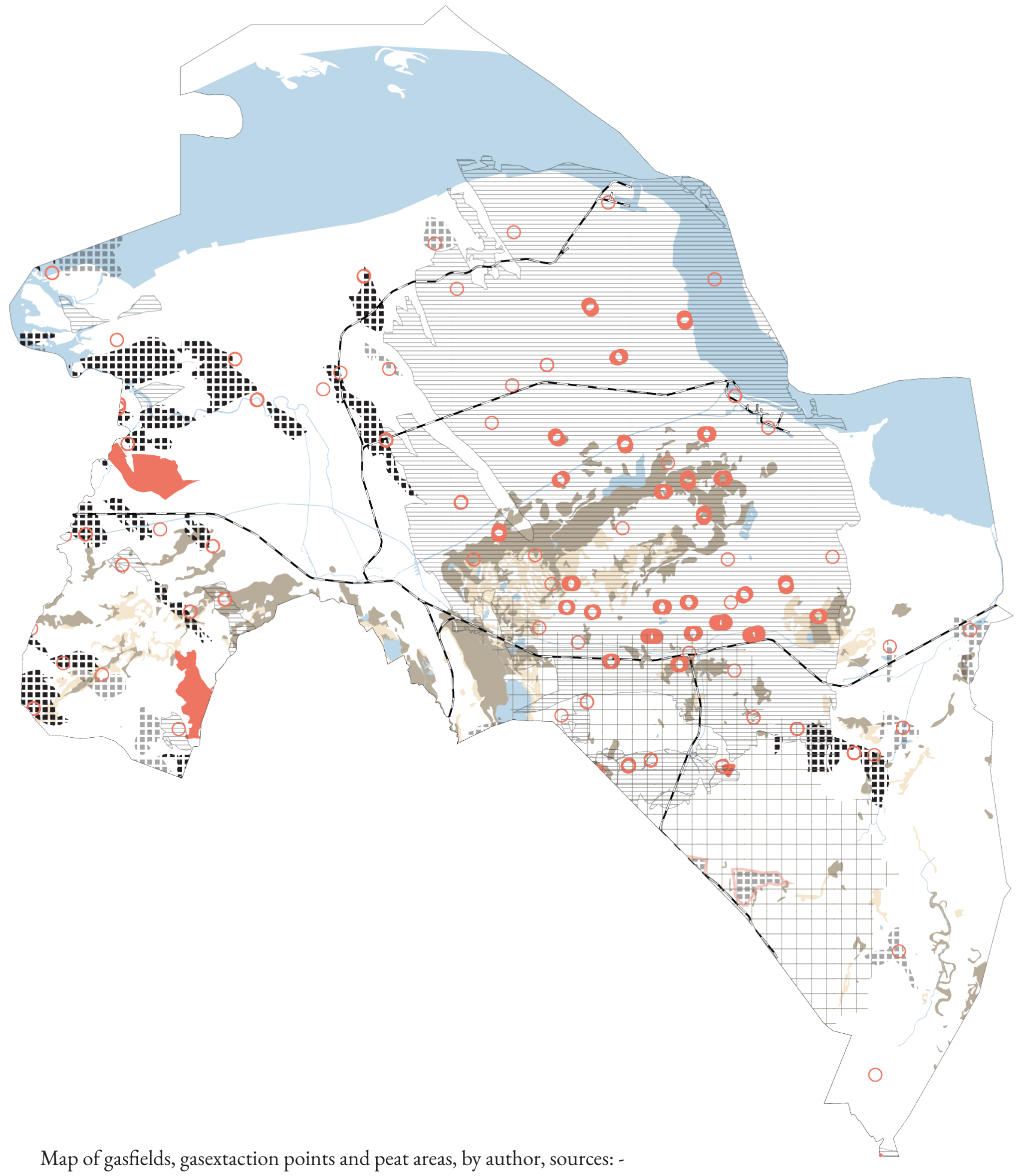


Figure 18 Map of gasfields, gasextaction points and peat areas, by author, sources: -

Energy landscape of Groningen

Legend
- *Producing gasfields*
- *Undeveloped gasfields*
- *Out of production gas fields*
- *Out of production oil fields*
- *Undeveloped oil fields*
- *Underground gas storage*
- *Peat*
- *Swampy sand ground*
- *Veenkolonien (peat colonies)*
- *Boreholes gas*

Figure 19 peatexclavation area patern, source: Google maps

Figure 20 Nam extraction location, source: Google maps

1.3 The site - Groningen

Impact of the gaswinning

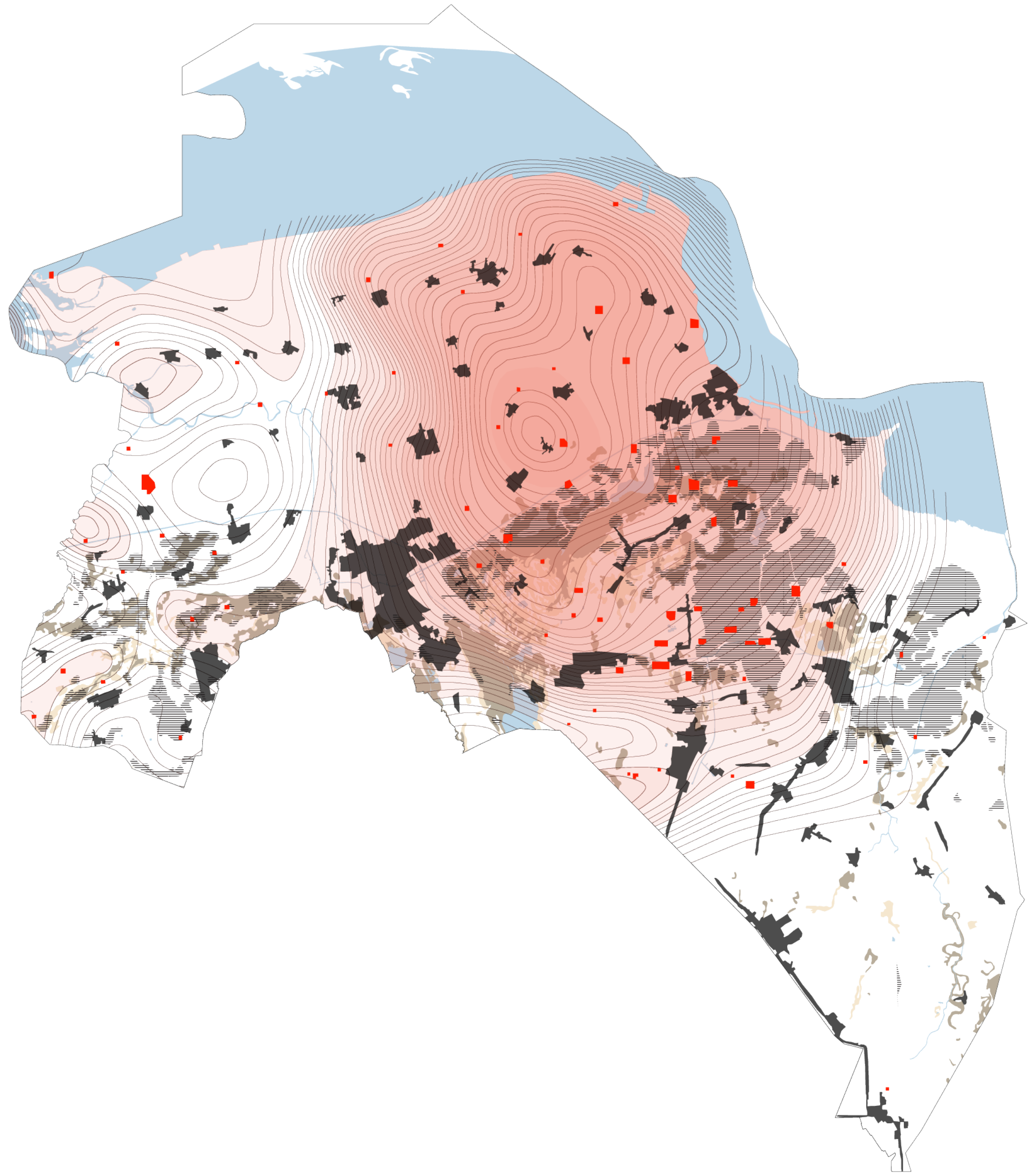
Discovered in 1959, the Groningen gas field initially held the status of the world's largest natural gas reserve, with an estimated capacity of 2900 billion cubic meters. The field was operationalized in 1963 by the Nederlandse Aardolie Maatschappij (NAM) (Groningen Gasfield | NLOG, n.d.). The extensive gas extraction has resulted in earthquakes and ground subsidence, which have detrimental consequences for the province of Groningen.

Seismic activities have substantially damaged residential houses. Furthermore, about 1450 national monuments and numerous protected "town and village scapes" have been damaged, comprising Groningen's cultural landscape and identity. This can conflict with preserving monumental values (Ministerie van Onderwijs, 2019).

The most significant subsidence is observed in Loppersum, where the soil has descended by 37 centimeters, with projections indicating a further 9-centimeter subsidence until 2080. The repercussions of soil subsidence predominantly affect water management, leading to increased water levels in ditches, lakes, and canals, and rising groundwater levels. These changes have the potential to adversely impact agricultural yields, reduce clearance for bridges, and lower the elevation of bank structures, quays, sea dikes, sea locks, and coastal lands in relation to sea level (Commissie Bodemdaling Door Aardgaswinning, n.d.).

Due to heightened induced seismicity, gas production volume has been regulated by the Ministry of Economic Affairs since 2014, gradually reducing extracted gas. The significant societal and environmental impacts prompted noteworthy policy interventions. Acknowledging the adverse effects, the Dutch government implemented measures in 2018 to expedite the cessation of gas production from the Groningen gas field. This involved decreasing gas exports, facilitating the transition of major consumers to high-caloric gas alternatives or alternative energy sources, and establishing a nitrogen facility in Groningen to convert high-calorific gas into low-calorific gas for household use. The closure of the last five production sites is set for October 1, 2023, marking the end of 60 years of gas extraction from the Groningen field (Ministerie van Algemene Zaken, 2023).

It is estimated that, adjusted for inflation, a total profit of 428 billion euros was generated, of which the state, through levies and profits from state participation, accrued 363.7 billion euros. However, a substantial portion of this financial gain is not allocated to the province of Groningen (Gaswinning in Groningen leverde 428 miljard euro op, 2022).



Land subsidence forecast (2080)

Subsidence in cm

- *42 - 46*
- *38 - 42*
- *34 - 38*
- *30 - 34*
- *26 - 30*
- *22 - 26*
- *18 - 22*
- *14 - 18*
- *10 - 14*
- *6 - 10*
- *2 - 6*

Legend

- *Urban, industrial/commercial and ports*
- *Swampy sand ground*
- *Peat*
- *Water*
- *Peat oxidation areas*
- *Nam locations*

Figure 21 Negative consequences of the gaswinning, by author, source: -

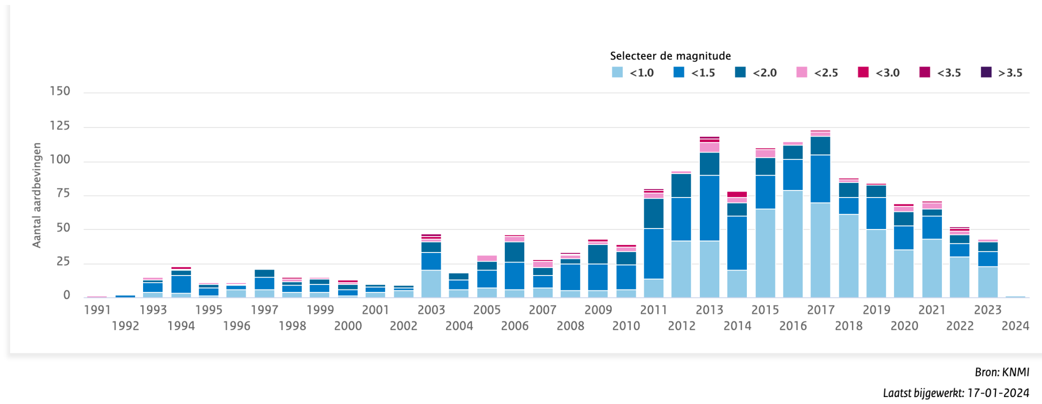


Figure 22 Earthquakes by year and there magnitude, Source: https://dashboardgroningen.nl/ (2024)

1.3 The site - Groningen

Economic challenges
Groningen's financial situation shows a mixed picture: the median disposable income increases annually but is structurally the lowest of all provinces. At 8.9%, the percentage of households below the low-income threshold in Groningen is higher than the national average of 6.8%, which is related to a relatively larger number of residents on welfare benefits. In addition, one in seven Groningers report difficulty making ends meet, and more children grow up in poverty than the national average. Vulnerable groups, including young people, the self-employed, people without further education, single-parent families, and single people under the state pension age, are especially financially vulnerable.

The problems of general poverty and energy poverty are closely linked. In Groningen, all municipalities score higher than average on this issue. Pekela (14.8%) and Oldambt (13.2%) stand out with the highest percentage of households experiencing energy poverty. The high energy poverty in these municipalities is due to a low average income, homes that are not energy efficient, and where the owner cannot afford to make them more sustainable. Consequently, gas consumption in the region is remarkably high. (Atlas van leefomgeving 2023)

Research on the socio-economic impact of closing gas fields indicates that approximately 20,000 direct and indirect jobs are associated with gas extraction. The discontinuation of gas production will significantly affect the economy in Groningen. However, certain occupations, like drivers, electricians, engineers, and administrative personnel, may experience less impact due to potential reassignment to other sectors. Moreover, the valuable expertise of experienced workers could be transitioned to emerging activities. Groningen aims to leverage its expertise to lead in the energy transition and adopt alternative energy technologies.
(socio economic impact of the gaswinning 2018)

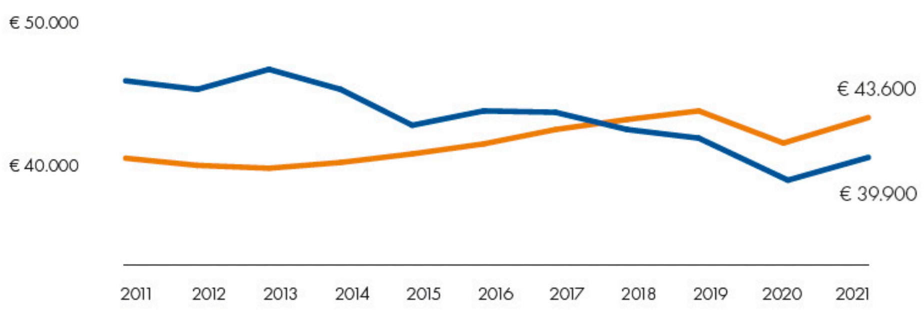


Figure 23 GDP 2011 - 2021, source: (Monitor Brede Welvaart Groningen 2022, 2023)

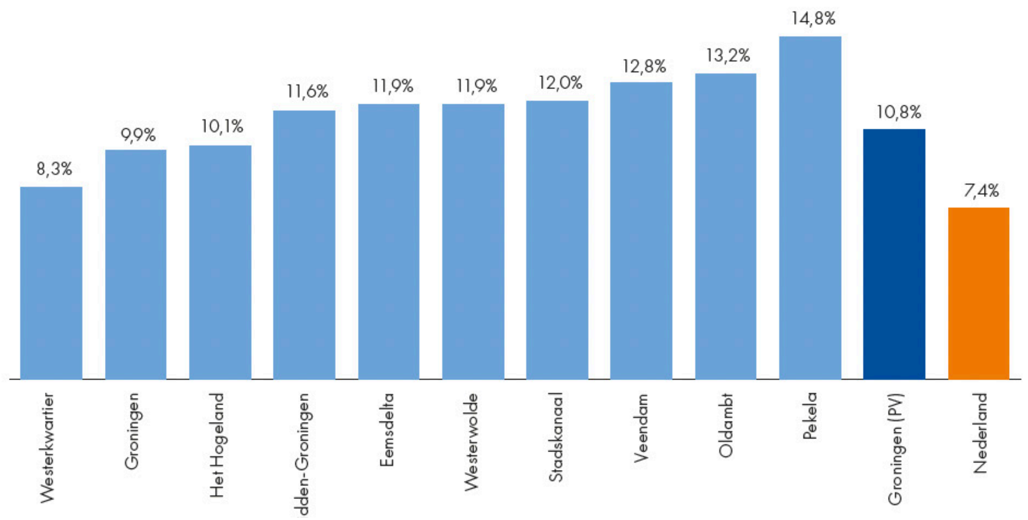


Figure 24 Percentage of energy poorness per municipalities, source: (Monitor Brede Welvaart Groningen 2022, 2023)

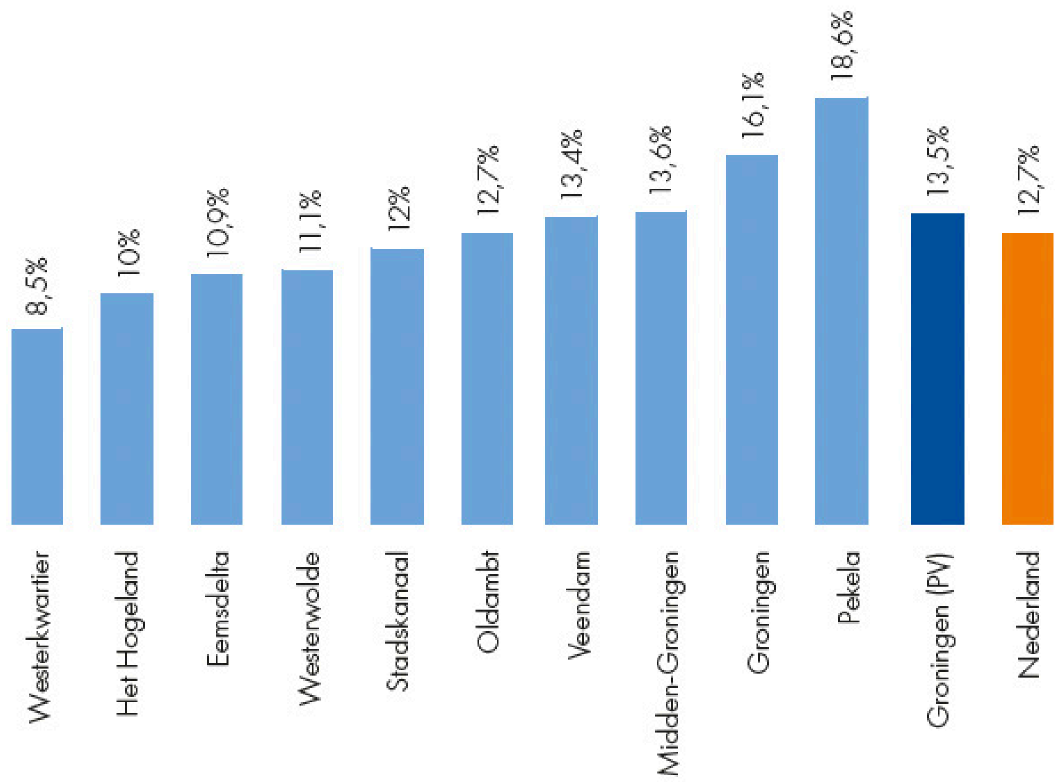


Figure 25 Percentage of people of 18 years and older that that has difficulty making ends meet, source: (Monitor Brede Welvaart Groningen 2022, 2023)

1.3 The site - Groningen

Social challenges

The Province of Groningen has experienced slight growth in recent decades, primarily attributed to immigration from other countries. However, the natural population has declined since 2015, and Groningen faces significant outmigration, especially among young adults.

In 2012, about 21.8% of Groningen residents were under 20 years old, but by January 1, 2022, this decreased to 19.6%. Meanwhile, the share of residents aged 65 and older rose from nearly 16.5% to around 20.6%. The demographic shift varies across municipalities, with the city of Groningen having a relatively younger population due to educational institutions attracting those aged 18 to 25. Demographic pressure, calculated based on the number of young and elderly people compared to those aged 20 to 65, is increasing due to population decline and aging, leading to fewer working individuals than non-working ones.

Over the next 30 years, Groningen's population is expected to decline while the Netherlands overall continues to grow. Forecasts indicate a decrease in the Groningen population, with a slight increase in the next five years followed by a more substantial decline. Population changes are unevenly distributed, with the city of Groningen expecting growth until 2031 while other municipalities must deal with shrinkage. Eemsdelta, Oldambt, Pekela, and Stadskanaal must anticipate a population shrinkage of roughly 15 to 25%. The household decline is also projected, starting later than the population decline, with an expected decrease of -15.360 households by 2050, mainly affecting municipalities like Eemsdelta, Oldambt, Pekela, and Stadskanaal, with declines between 10% and 20% (Delfmann, 2024).

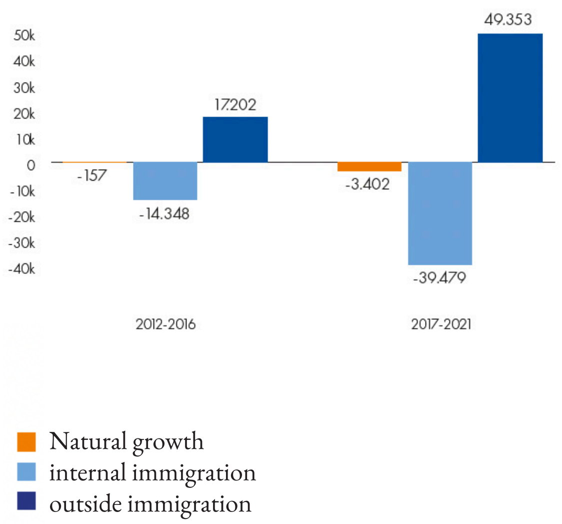
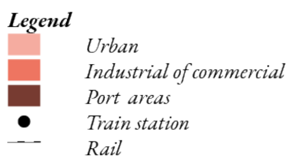


Figure 26 Population growth devided in natural saldo and migration saldo 2012-2021, source: (Monitor Brede Welvaart Groningen 2022, 2023)



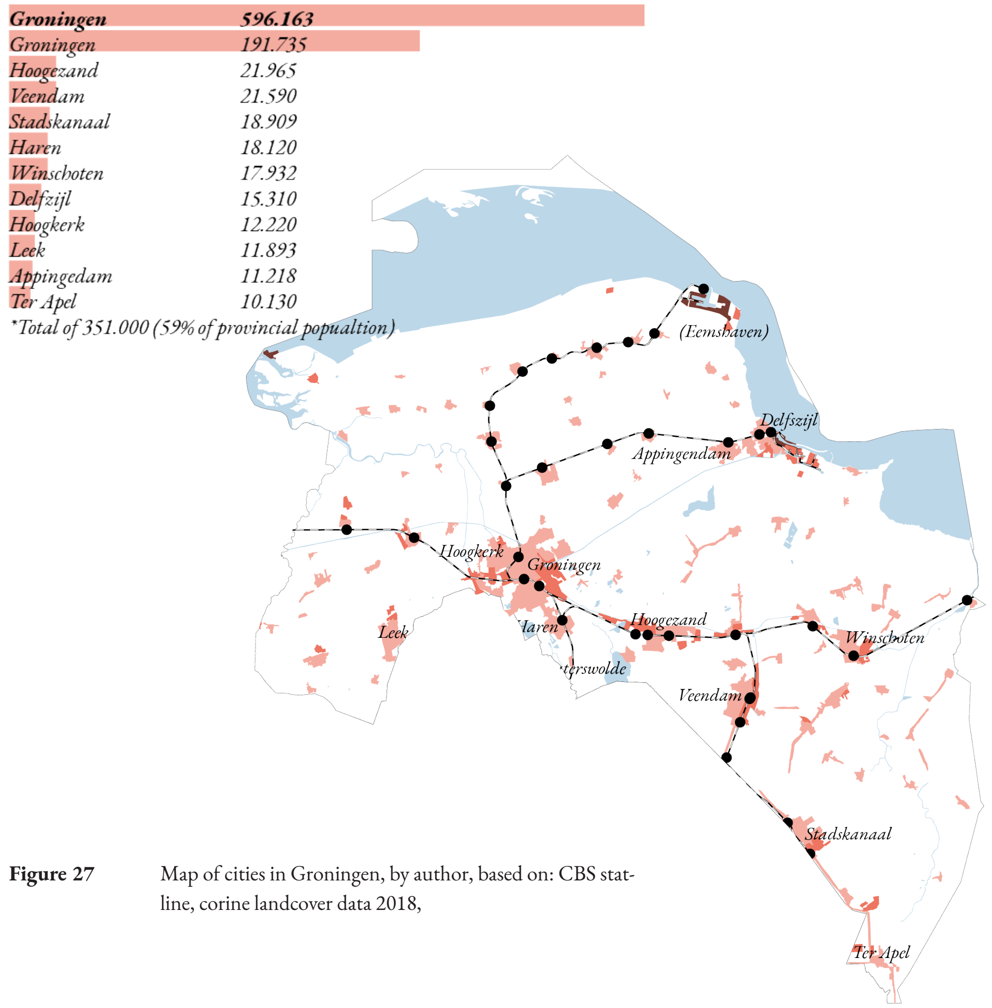


Figure 27 Map of cities in Groningen, by author, based on: CBS statline, corine landcover data 2018,

Shrinking population for 2050

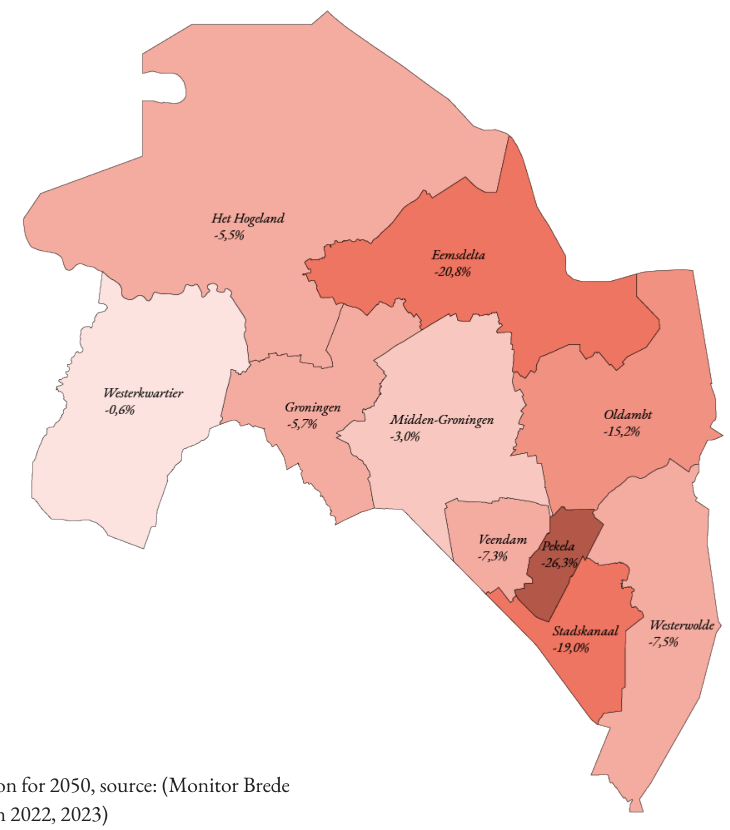


Figure 28 Shrinking population for 2050, source: (Monitor Brede Welvaart Groningen 2022, 2023)

1.4 Problem statement

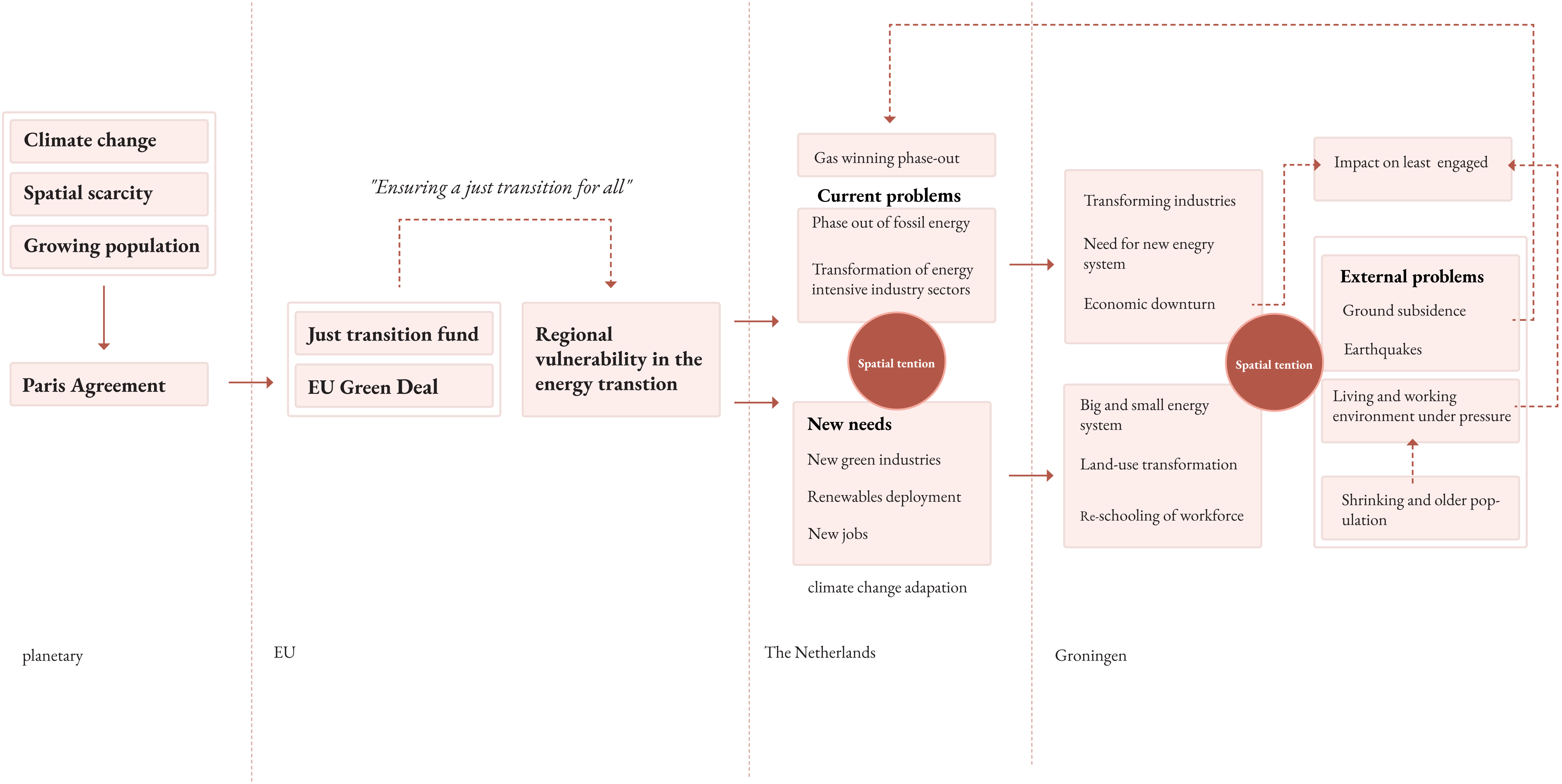


Figure 29 Problem statement, source: author

1.4 Problem statement and research outcome

Problem statement
Decarbonizing the energy sector is essential to achieving climate neutrality in 2050. Regions with a strong economic dependency on energy-intensive industries or fossil extraction are vulnerable to this transition. The EU introduced the Just Transition Fund as part of the Green Deal to ensure a just transition for all.

Groningen's economy is currently heavily dependent on fossil fuels, especially gas extraction. It is estimated that about 20,000 direct and indirect jobs will be affected by this transition. Furthermore, the province has underlying socio-economic vulnerabilities, such as a declining and aging population due to the outmigration of young adults and relatively high (long-term) unemployment. Lastly, gas mining has caused earthquakes and ground subsidence, damaging buildings and the cultural and natural landscape.

The energy transition will have a major impact on Groningen's landscape. It is important to preserve this landscape's cultural and landscape qualities, create space for economic development and the placement of renewables, revitalize the landscape where it is damaged because of the gas extraction, and address the population shrinkage that puts the quality of the villages under pressure.

Research outcome
Using the problem statement of this thesis, this thesis aims to research how to create a strategy for Groningen, envisioning the new energy landscape while revitalizing and regenerating the natural and cultural areas. This is done within the context of economic and population shrinkage, where it is crucial to maintain a vital living and working environment.

By constructing a series of explorative design scenarios, different development paths for the future of the Groningen nature and energy corridor can be explored. The scenarios will be evaluated on the socioeconomic impact and natural, cultural, and energy parameters. Based on the different scenarios with their own qualities and focus points, a final territorial vision can be constructed using either the best scenario or combining qualities of the different scenarios.

Within this scenario and design, special attention should be paid to the unseen groups that are often the most impacted by this big transition. The aim of this thesis is to inform these groups better about the problems and possible solutions in the region. In addition, engagement strategies have been developed to ensure that all groups of society are involved.

At the end of the thesis, recommendations, strategies, and approaches for similar European areas that are also part of the Just Transition Fund should be included.

1.5 Research questions

Main-question

How can Groningen, a region vulnerable to the energy transition, facilitate a just energy transition strategy that combines spatial planning, heritage, and the inclusion of the least engaged groups?

Sub-questions

1. What is the Just Transition Fund and how can "types of regions (similar to Groningen)" be defined based on social, economic, and spatial elements?

2. What are the challenges for the province of Groningen in the energy transition?

3. What are the current strategies and policies for Groningen and what opportunities does it already offer?

4. How can the least engaged groups and stakeholders get a voice in just energy strategy?

5. How can local spatial qualities work as a vector of change for a just sustainability transition?

6. How can these local spatial qualities and local "voices" help to create a strategy and design for Groningen?

7. How can the Groningen strategy help formulate a strategy for similar European regions?

Methodology

2.1 Theoretical framework

Justice

The involvement of vulnerable communities and marginalized groups in shaping local policies for sustainability transitions faces many obstacles. These challenges are especially difficult in areas that heavily rely on carbon-intensive industries or fossil fuel extraction, where changes disproportionately affect older, less-educated, and male-dominated workforces. Women, who often work in declining sectors, should have more opportunities to participate in emerging science, technology, and engineering fields. In addition, young people, who are negatively impacted by economic changes, face high levels of unemployment and emigration. Despite being heavily affected, these groups are less politically engaged. Citizen participation tends to be higher in areas where social capital is more prevalent, favoring wealthier and better-educated groups. Decision-making practices further disempower the least-engaged communities, fostering skepticism, limiting awareness, and hindering organizational capacity. Additionally, divisive climate-change-skeptical discussions in the media worsen dissatisfaction and disappointment with democracy instead of encouraging broader participation (Verena Balz et al., 2023 p.10-11).

The least engaged

The focus on the least-engaged communities (LEC) in sustainability transitions is justified for several reasons. Firstly, LECs are often the most affected by transitions, experiencing inequitable dis-tribution of costs due to the decline of carbon-intensive industries. This decline affects individuals employed in these industries and the broader communities. Secondly, LECs bear the brunt of transition policies, with uneven distribution of benefits and costs across households and potential impli-cations for jobs at sectoral or regional levels. Thirdly, from a normative perspective, focusing on LECs is essential for achieving equality in democratic societies, ensuring the equitable distribution of benefits and burdens. This alignment with democratic values is crucial for building truly just and sustainable societies. Fourthly, a pragmatic reason to focus on LECs is to garner their support for socially acceptable implementation of collective planning for sustainability. Finally, the development of transition policies offers an opportunity to (re) politicize sustainability (Verena Balz et al., 2023 p.33-34)

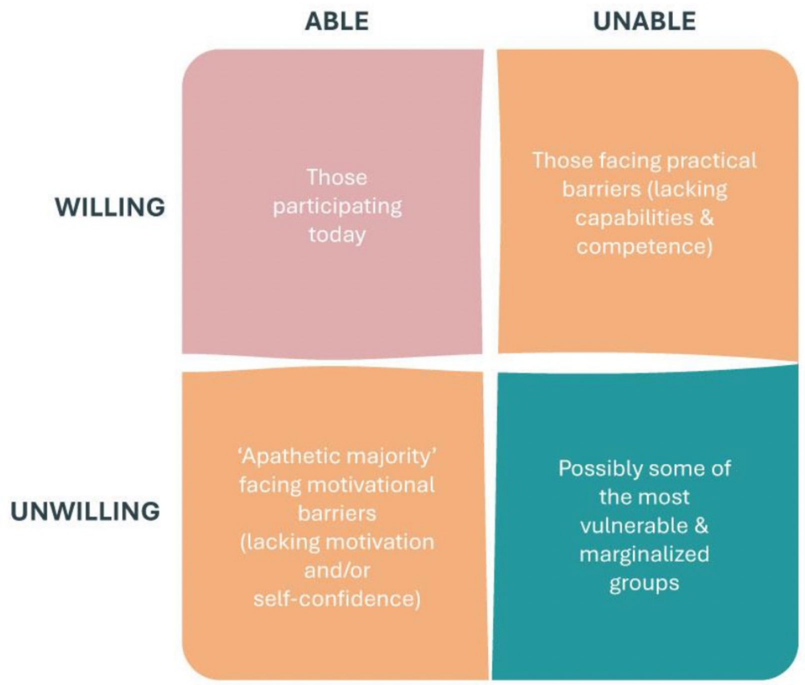


Figure 30 Analytical framework for distinguishing least engaged communities, source: (Verena Balz et al., 2023 p.36)

Direct factors explaining lack of engagement	
Being unable	**Being unwilling**
Cultural barriers	Not seeing any personal benefit or relevance
Language barriers	Difficulty of focusing on regional issues
Geographical distance	Trust that someone else will look after their interests
Physical or mental impairment	Lack of trust in government to make good use of their input
Socio-economic status	Discontent and disillusionment with democracy
Lack of time, schedule conflicts	Perception of powerlessness and limited agency
Challenging life circumstances	Lack of self-confidence
Technological illiteracy	
Difficulty understanding technical elements	
Lack of interpersonal skills	
(based on Dijkstra et al., 2020; Kelleher et al., 2014; Kitchen & Whitney, 2004; Loopmans et al., 2022; OECD, 2009; Rodríguez-Pose, 2018; Scottish Government, 2017)	

Figure 31 Factors explaining lack of engagement, source: (Verena Balz et al., 2023 p.37)

2.1 Theoretical framework

The cultural and natural landscape

Landscapes serve as dynamic expressions of biophysical, cultural, and economic processes, undergoing continuous change caused by human interaction with their environment. The landscape has tangible and intangible dimensions that provide us with goods and services but are also a part of our identity, contributing to our natural and cultural heritage (Landscape Values and Perceptions – Environmental Geography, n.d.). Every individual uses that landscape differently, creating their range of landscape values. This diversity of demands, perceptions, and uses of landscapes makes planning a resilient landscape able to cope with societal and environmental changes (Scholte et al., 2015). In landscape ecology, long-term planning and cross-disciplinary design is emphasized to find synarchies between the ecological and human systems (Waldheim, C. 2006). By doing so, the landscape's ecosystem functions, and socio-cultural values can be addressed.

Groningen's landscape is primarily a man-made system; only 6% is nature, compared to 15% in the Netherlands ('Milieu', 2023). Climate change, the energy transition, and the issue of declining soil will have far-reaching effects on this landscape. Preserving cultural values, connecting natural areas, and improving water management are essential tasks for Groningen that require an integrated approach.

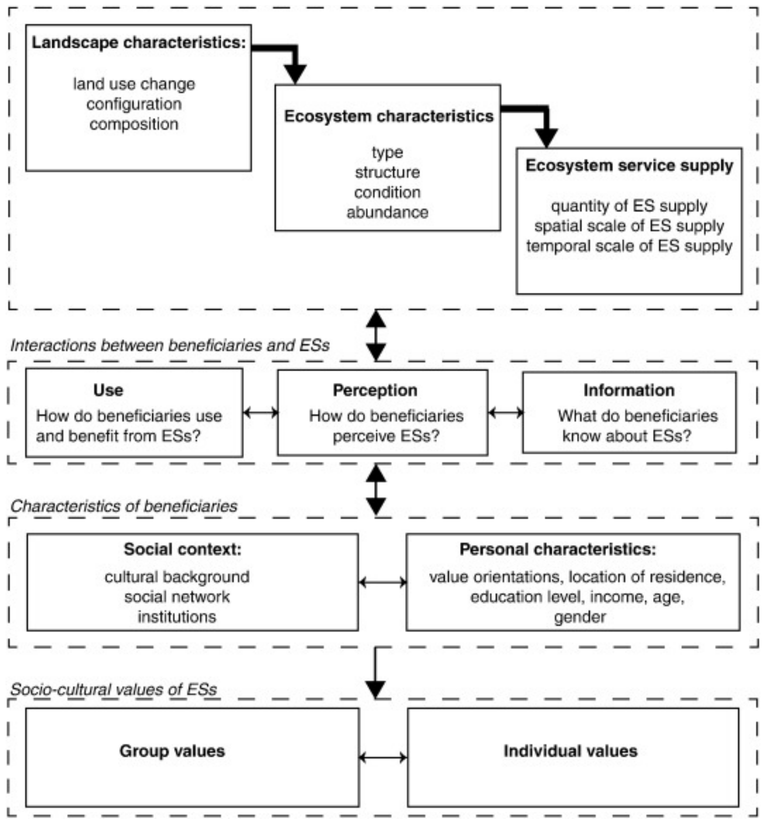


Figure 32 charactiristics of the natural environment, source: Scholte et al. (2015 p.69)

Nature regeneration

Reed (2007) emphasizes the imperative co-existence of natural and human systems, underscoring a historical imbalance where excessive attention was directed toward economic and technical aspects. In contrast to focusing on sustainability, which aims to prevent deterioration, Reed advocates for a paradigm shift towards regeneration, promoting the capacity to restore and enhance the natural system (Reed, 2007). This shift aligns with Osborn et al.'s call to transition from conventional policy incentives to regenerative economic development, emphasizing long-term restoration, sustainable livelihoods, community well-being, and social and environmental justice (Osborn et al., 2021, p.5).

Groningen must deal with ground subsidence, which is causing CO_2 emissions and land degradation; the challenge now is to transform these areas into sustainable areas that help nature.

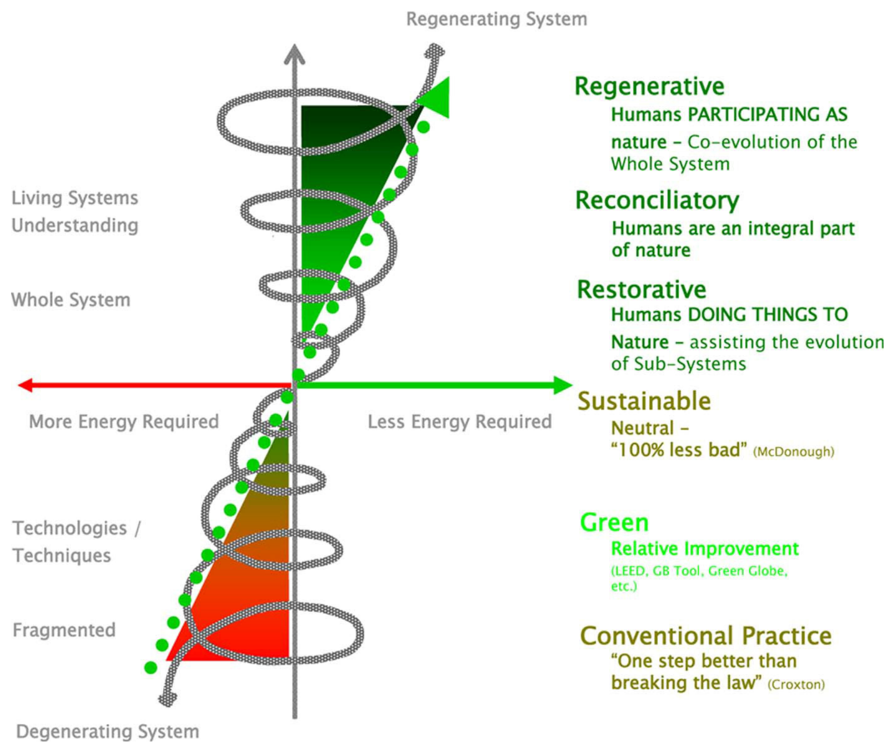


Figure 33 Regeneration system, source: Reed (2007 p.4)

2.1 Theoretical framework

Heritage
According to Janssen et al. (2017), the conceptualization of heritage has undergone a transformative evolution. They delineate three distinct approaches. There is no one correct approach; it is essential to recognize the right approach for each situation.

Heritage as a sector
The traditional perspective, denoted as 'heritage as sector,' revolves around isolating heritage from spatial development to safeguard cultural assets. However, the paradigm shifted during the 1980s and 1990s, ushering in a dynamic concept of heritage characterized by integrated conservation and a broader heritage planning framework.

Heritage as a factor
The evolution of heritage conservation in the 1980s and 1990s marked a transformative period, shifting from static preservation to a more dynamic and integrated approach to spatial development (Janssen et al., 2014). In these predominantly market-driven developments, heritage revitalization emerged as a negotiable factor, emphasizing heritage as an intrinsic quality that could be capitalized upon to enhance the attractiveness of cities and regions (Kloosterman & van der Werf, 2009).

Heritage as a vector
The cultural shift in the perception of heritage became evident in the early twenty-first century, marked by introducing the concept of "intangible heritage. This inclusive concept expanded the heritage domain to include stories, traditions and performed culture. The approach to heritage as a vector builds on these transformative ideas and frames current activities and initiatives within a dynamic spatial and temporal setting. The city and the landscape are seen as layered systems where historical qualities can exist or emerge alongside a dynamic essence. This approach encourages a nuanced understanding of heritage, recognizing its multifaceted layers and emphasizing the ongoing interaction between the past and the present Janssen et al. (2017).

Energy landscape
The energy transition is the central theme in this thesis and explores the impact of this transition on the landscape of Groningen. Simons et al. (2014) have clarified that renewables and space are inseparable. However, the space needed for every source of energy varies.

The current system of fossil energy landscapes is centralized and needs a relatively small amount of space compared to the output of space. Renewables need more space and are often positioned in the landscape with cultural values. This can lead to people being against the deployment of renewables, especially in regions with a higher density. Careful spatial planning and design are crucial to successfully expanding the renewable energy sector.

Adaptive reuse
Adaptive reuse refers to repurposing buildings and infrastructure for alternative, often more efficient, and practical uses, extending their functional lifespan to meet user needs better (Douglas, 2006).

For Groningen, it can be used to repurpose industrial buildings and houses in areas that have to deal with shrinkage. In addition, could the NAM locations be repurposed for the energy transition. It is important to do this to maintain the quality of the living environment and cultural heritage.

2.2 Conceptual framework

The framework advocates a balanced approach that prioritizes important stakeholders and marginalized voices. Traditionally, governance structures tend to favor the interests of powerful stakeholders, with strong economic interests. This interest often ensures that they are actively involved and have great influence over policy, which works to their advantage. As a result, the interests of ordinary citizens and people who are least involved take second place.

Giving more space and actively involving so-called "unheard voices" can create a more balanced decision-making process that is truly inclusive.

The conceptual framework has indicated not only the different stakeholders but also the scale at which to work. Here it becomes apparent that large stakeholders are often more active at a large scale, while marginalized groups are often local.

To achieve balanced governance, planners/designe to inform local people about cross-scale projects while major stakeholders must be informed about local interests. This should include both economic and social factors. The framework should promote more effective and balanced governance.

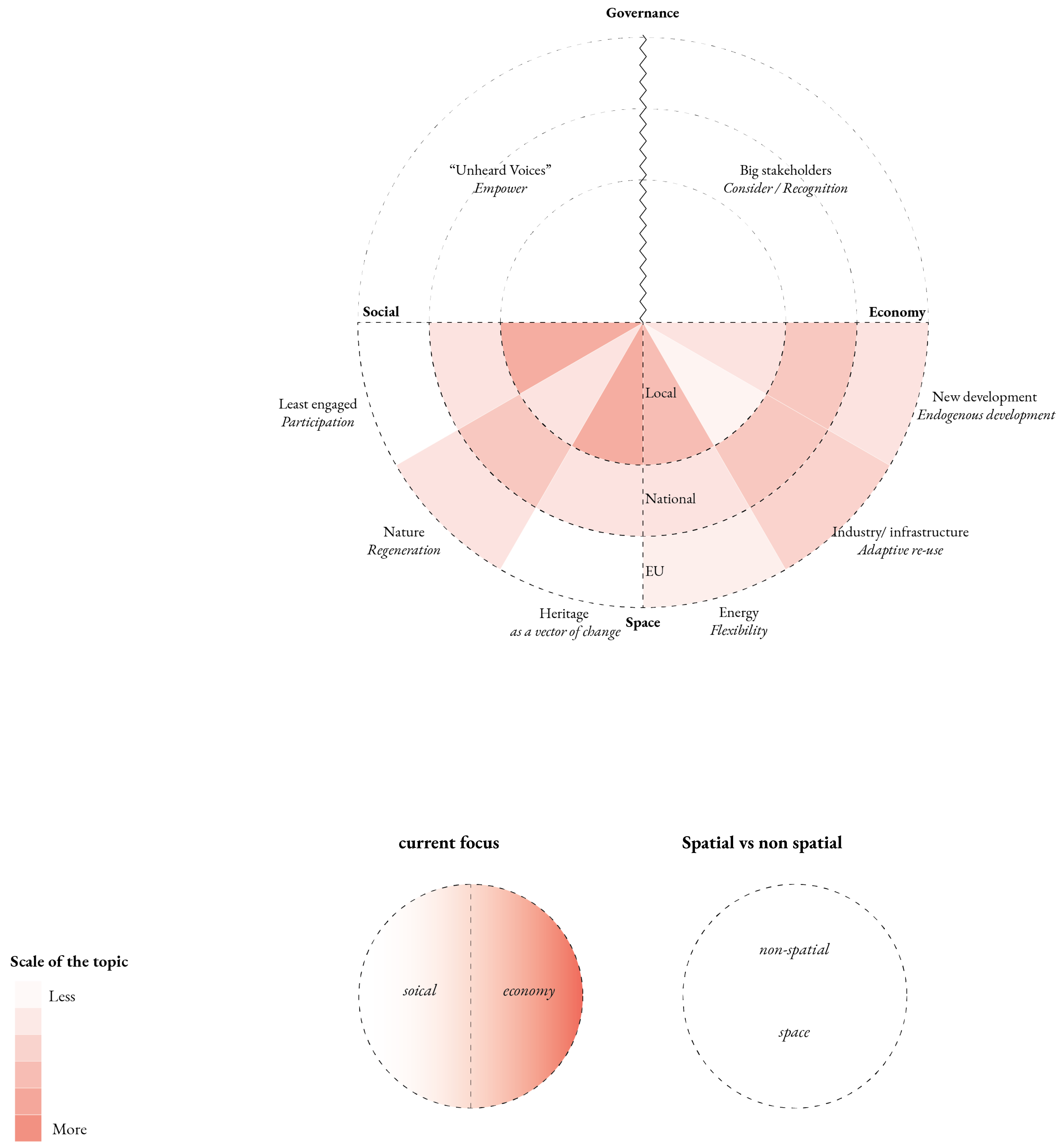


Figure 34 Conceptual framework, source: author

2.3 Methodological framework

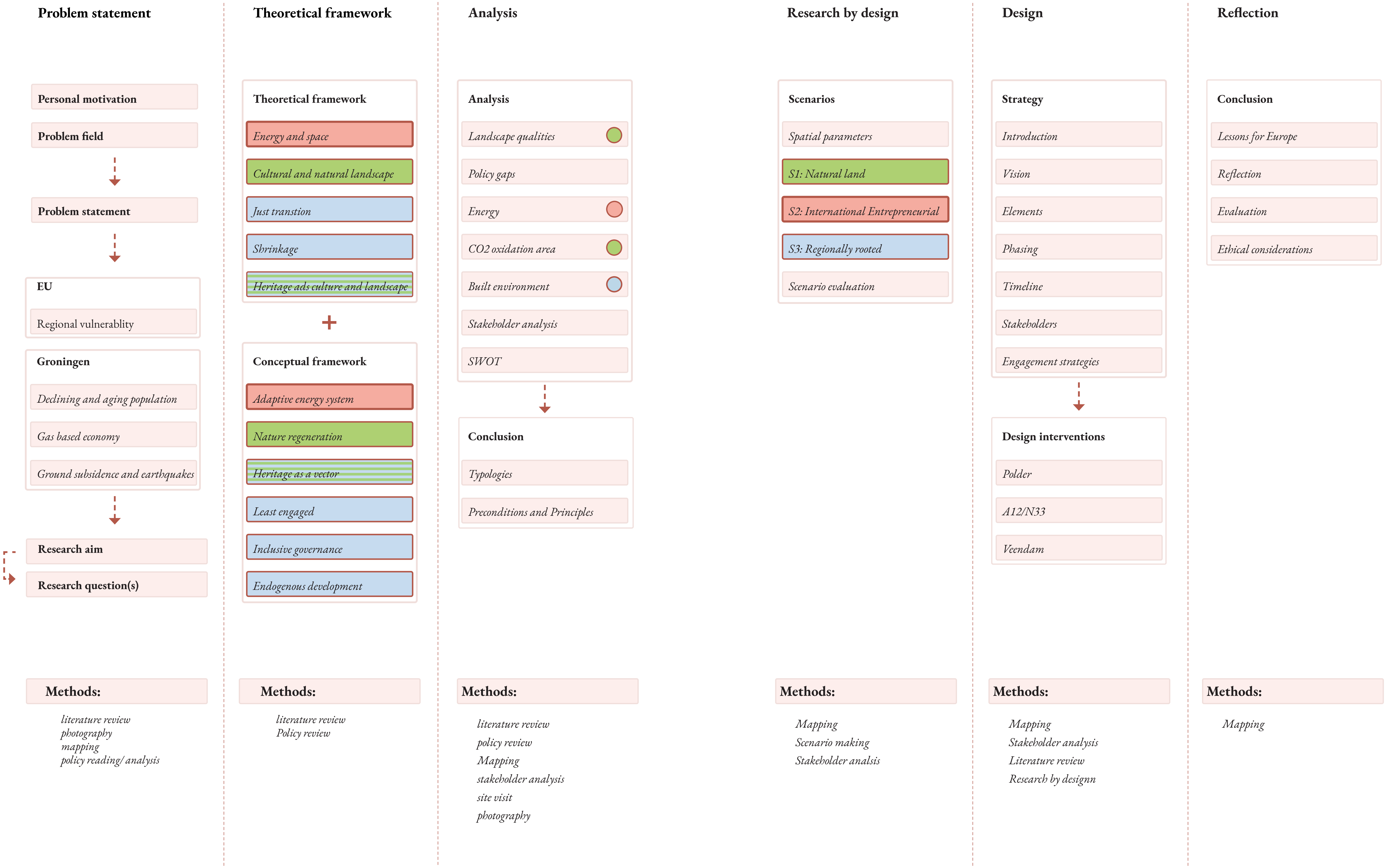


Figure 35 Methodology framework, source: author

2.4 Applied methods

This project utilized several methods at different stages of the process, either individually or in combination. Nine main methods were employed for research and analysis, serving as the foundation for the strategy and design. These methods are outlined below:

1. Literature review
2. Mapping
3. Policy reading and review
4. Analysis of the location
5. Photography.
6. Stakeholder analysis
7. Site visit
8. Scenario making
9. Research by design

The following sections elaborate on the nine research and analysis methods used in this project. First, the methods are briefly described. Followed by an explanation of what section the project was used, and the section ends with a formulation of the expected outcome of the given method.

Literature review
Gather information for the theoretical and conceptual framework of the thesis. The papers should either contribute to the technical understanding of a topic or help to understand a concept.

Mapping
Mapping gives a better understanding of the area. By combining and separating specific layers, relations of certain topics are shown in space.

Policy reading and review
Reading and reviewing current policies of the EU, Groningen, and the territorial level helps to understand the current knowledge, goals, and challenges. Gaps in these policies can be used as a starting point for the research of this thesis.

Analysis of the location
By mapping particular elements of the landscape, a better understanding of the landscape can be achieved. Together these maps should provide a coherent story of problems and opportunities within the area, ultimately creating a foundation for the scenario making and the design.

Photography
To document local qualities that should be preserved, the photos should give a better understanding of the problem to "normal people". The photography is an integral part of the fieldtrips.

Stakeholder analysis
the stakeholder analysis should give insight in the power matrix and the involvement and power of involved parties. Scenario making: By making scenarios different approaches and design opportunities can be explored, these scenarios are based the analysis outcome and bridge the gap between analysis and design.

Site visit
visiting the sites to gather documentation (photos and drawings), to get a better understanding of local circumstances, this can be done in combination with the analysis. Besides this does the project of DUST organize participation evenings, where I can also get an impression of local people.

Scenario making
By developing different scenario's, alternative futures are explored. This helps to understand what areas can have different uses based on different choices.

Research by design
By making a design, different reseraches can be done for an erea. > look this up.

Unraveling the spatial challenges of Groningen

Figure 36 Old example of landscape protection of the Groningen landscape, source: (Ven, 1941)

3.1 Mapping methods

The analysis is conducted for the central part of Groningen, where the municipalities of Midden-Groningen and Veendam are located.

First, the landscape of Groningen, with its characteristics and qualities, is introduced. Then, current policies for Groningen or areas within Groningen, relevant to this thesis are examined. The content of each policy document is summarized to provide an overview of the current knowledge and (design) strategies. The section concludes with the main gaps in the current policies.

The second part of the analysis unravels the challenges and opportunities that Groningen will have to deal with until 2050. It introduces the current energy system and the changes that are needed. Then, it introduces the challenges of the natural landscape, including water, nature, and biodiversity. Lastly, it introduces challenges for the built environment, such as damaged houses, new housing, and old industrial terrains. The section concludes with a SWOT analysis that summarizes the challenges

The different elements and future options are introduced at the end of the section. These elements form the basis for the scenarios and strategy, along with some preconditions and principles that are extracted from the analysis, which help to guide the strategy in the right direction.

"Residents of town and country"

"Protects the Groningen landscape"

"Guards against anything that threatens to spoil its character.
Spare the old natural beauty when clearing.
Spare the beautiful trees around your farms and churches;
When you cut down wood, take care of new planting, choose it with judgment, and keep to the good Groninger tradition.
Respect your ancient village churches and towers; they are your most precious possessions.
Preserve your windmills; new inventions gave them the right to exist again, while their power source is inexhaustible; they adorn the landscape.
Continue the proper, dignified character of thy ancient architecture, practice simplicity; thy farms and village houses should fit into the landscape.
Avoid senseless forms and decorations, gaudy paintings, and intrusive advertising.
Keep your mother tongue - the Groninger dialect - and your vernacular in honor.
Revive the old names of masters and houses.
Warn widely against the advancing flattening; help us to turn it around!"

Text of the poster on the p.57, translated from old Ducth.

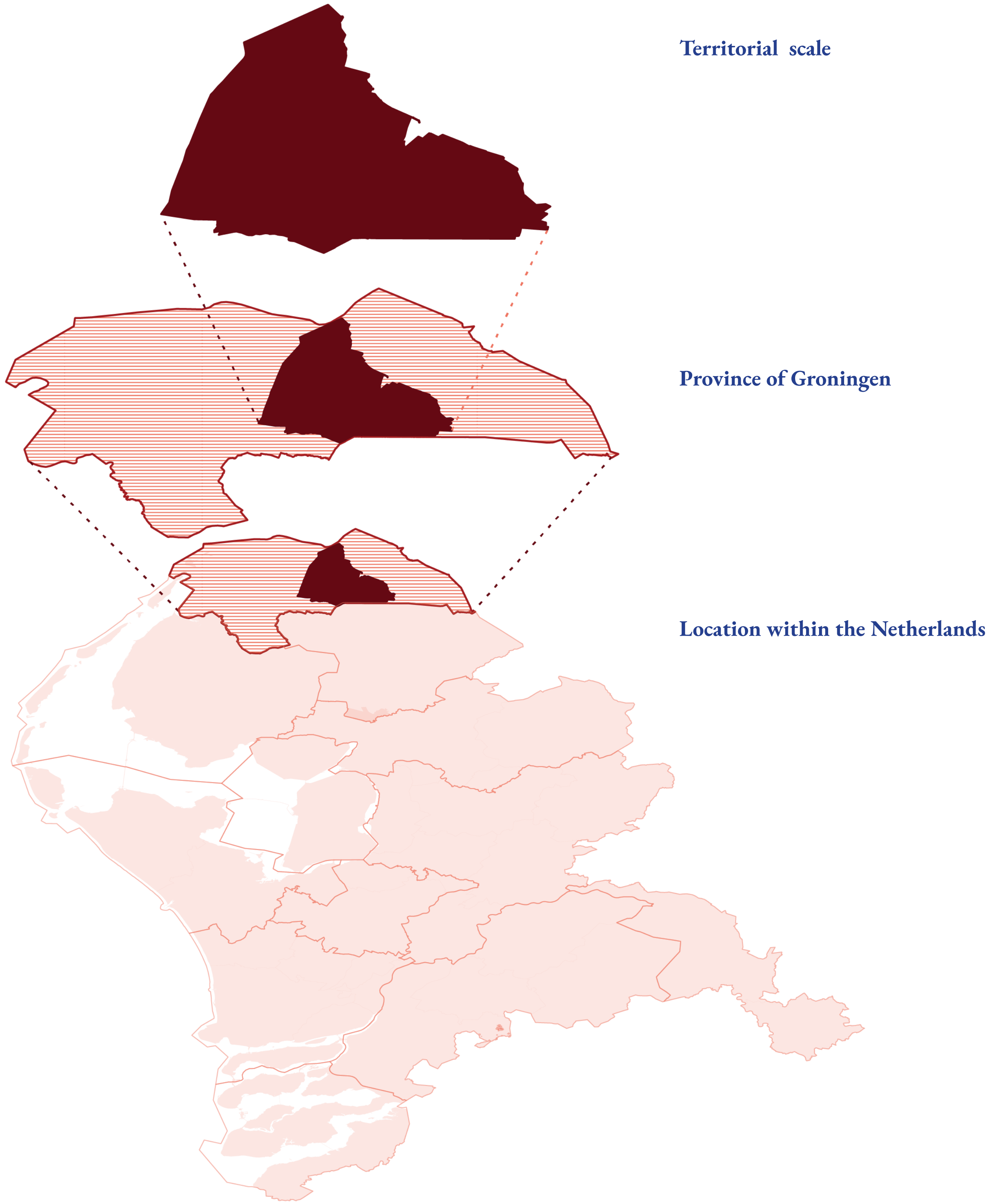


Figure 37 Location of the area within the Netherlands and Groningen, Source: author

3.2 Introduction of the current landscape

Landscape qualities

Groningen has a wide variety of landscapes; these historically evolved main landscape structures of Groningen each have essential characteristics that determine the character of the various underlying landscape types. These core qualities determine the spatial quality of the areas in question. Based on the history and current appearance of the landscape, the province can be divided into seven regions derived from (Provincie Groningen, 2021):

1. The Southern Westerkwartier
2. Wierdenland and Wadden Coast
3. De Gorecht
4. The Central Wold area and Duurswold
5. The peat colonies
6. Oldambt
7. Westerwolde.

The damage caused by gas extraction, the impact of climate change, the energy transition, and other processes such as shrinkage have a major impact on this landscape, putting pressure on spatial quality. It is, therefore, important to maintain the spatial quality in the area and use this as a basis for future change.

The strategy and design focused on the central part of Groningen, which consists of two of the seven landscapes, the central Wold area and the Veenkoloniën. The next page elaborates on both landscapes and provides an overview of the existing qualities.

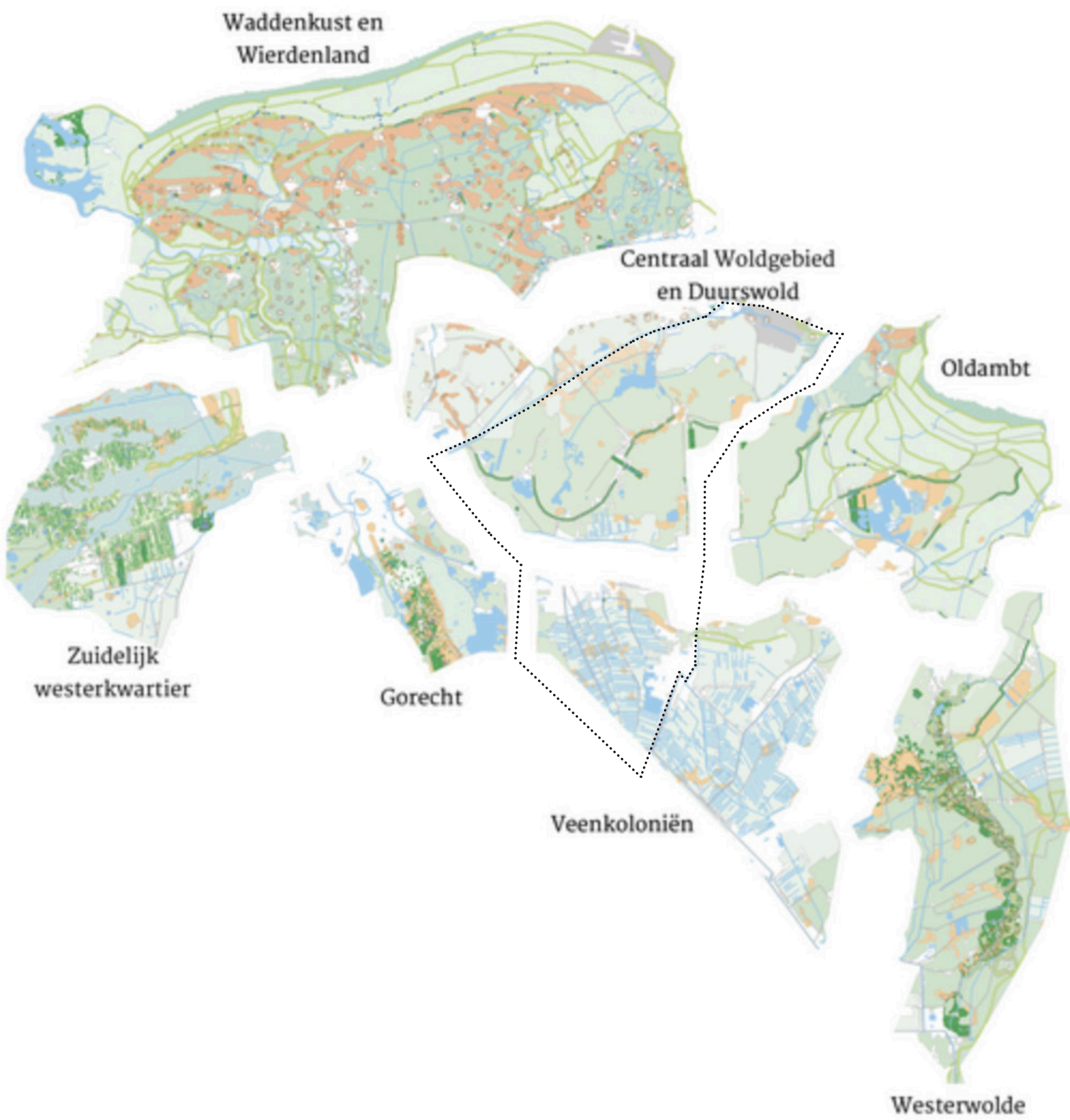


Figure 38 The landscape of Gronigen Source, (Provincie Groningen et al., 2023 p.65)

3.2 Introduction of the current landscape

Central Wold area and Duurswold

The region is characterized by its low-lying terrain and subsoil comprised of peat and sand. A distinctive feature of the area is the presence of elongated villages situated on naturally elevated sand ridges, surrounded by dense vegetation, which starkly contrasts with the vast openness of the landscape. Additionally, ‘t Roegwold, a nature reserve abundant in water, is situated within the area.

The most significant qualities, as outlined in the quality guide, include:

- The historic roadside villages are characterized by farms, winding gardens, and sometimes heavy planting along the roads.
- Along the ribbon, churches, cemeteries, monastery grounds, mills, and hamlets with estates are landmarks.
- The contrast between large-scale openness and small-scale buildings.
- A distinct hard transition, creating clear village silhouettes.
- The contrast between the robust new nature of ‘t Roegwold and the green ribbons with predominantly rationally organized agriculture.

(Quality Guide Province of Groningen, n.d.)

The region faces significant challenges due to climate change, compounded by its low-lying nature and ongoing ground subsidence caused by a combination of gas extraction and peat oxidation. This process naturally releases greenhouse gases. (Vision 2050) Consequently, the artificially maintained low water levels are increasingly straining the existing system, rendering current land use practices unsustainable for the future.

The main goals for the area, adapted from the vision 2050

- Strengthen wet connections from the Schildmeer to the Zuidlaardermeer
- Retaining water, raising the groundwater level and strengthening the sponge function of the landscape
- Preventing and reducing peat oxidation
- Protecting and strengthening nature in the Roegwold and the Zuidlaardemeer area
- Strengthening biodiversity, among other things, by creating water and forest/

Figure 39 Open landscape and closed ribbon, source: google maps

Figure 40 Wide an open landscape Source: Author

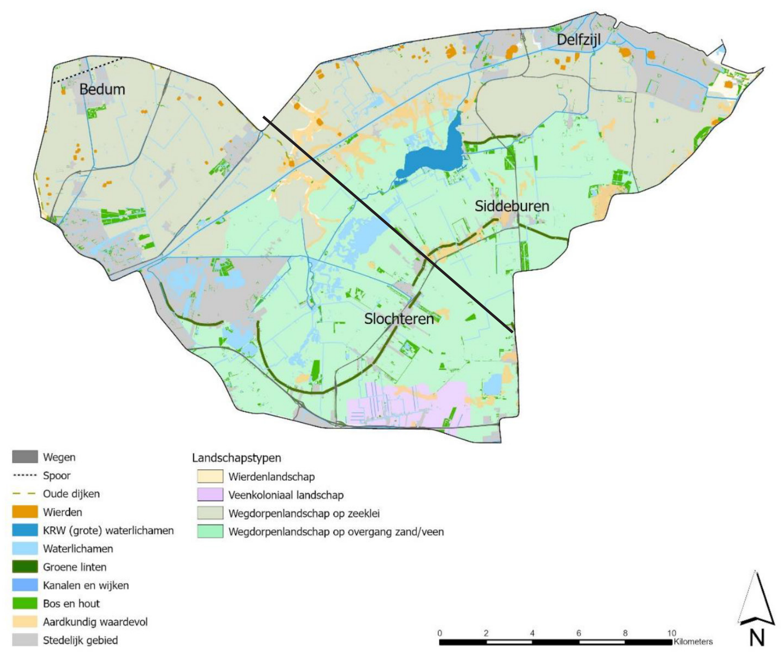


Figure 42 The central wold area map, source: (Provincie Groningen, 2023 p.15)

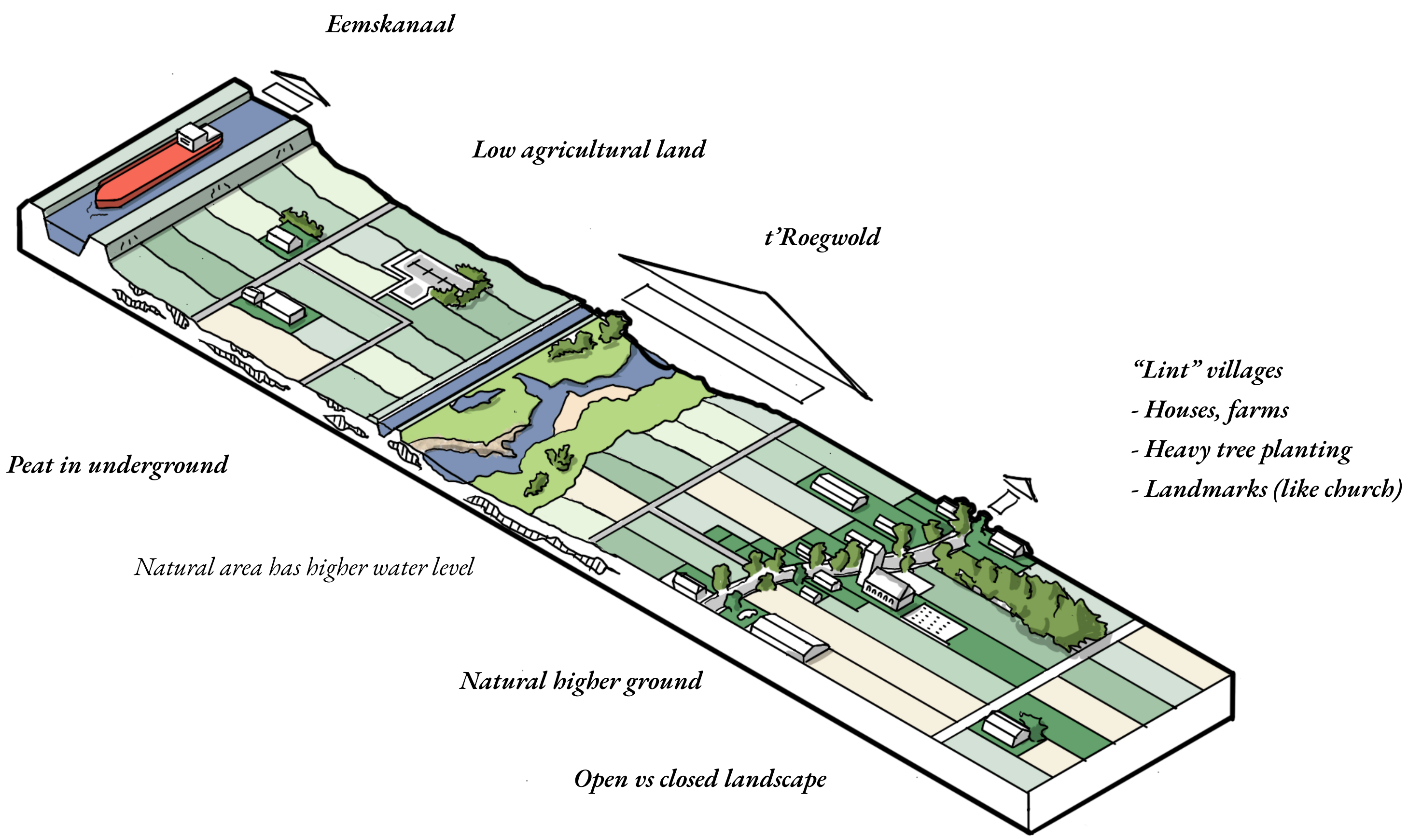


Figure 41 axometric section of the Central wold area

3.2 Introduction of the current landscape

De Veenkolonien

The characteristic landscape of the peat colonies is a young and rational landscape created by excavating peat in the 17th and 18th centuries. It is characterized by great openness, straight lines, and relatively private canal villages. In addition, the area has several larger villages, such as Veendam and Hoogezand, that play an important role as facilities centers.

The most significant qualities, as outlined in the quality guide, include:
- Contrast between the small-scale ribbon with some views and the large-scale open landscape
- The scale and character of the historically developed village structure:
- The strict organization and coherence of the buildings and plants with the canals and neigh.
- Large, very open and undeveloped plots at the 'backs' of the ribbons that form the transition to the open area behind.
- Presence of compactions and, therefore, landmarks within the ribbons at the bridges, locks, factories, and water towers.

Within the ribbons are Oldambtster farms, with a worker's house of the typical Veencolonial shrinkage type here and there.

The area is experiencing severe population decline, which has a major impact on regional centers and puts pressure on the spatial quality of the center areas and housing stock. Strengthening the connection between urban areas and the landscape is crucial.

The province focuses on innovative and multifunctional (supra)regional business parks, concentrated around Veendam, Zuidbroek, and Hoogezand at the A7/N33 interchange. Maintaining spatial quality and preventing cluttering are crucial in expanding this core zone, and the availability of renewable energy is essential for further development.

The old peat colonies consist of sandy soils after excavating the peat. Water retention is difficult, and many nutrients and fertilizers leach out due to the poor soil structure. Enrichment of the soil structure is needed to make the region suitable for arable and livestock farming, with less dependence on fertilizers. Additionally, the unique peat-colonial drainage structure offers opportunities for further recreational and natural enhancement of the area.

Recommendations from the future vision 2050
• Quality improvement for the regional centers Hoogezand, Veendam and Stadskanaal
• Incorporating plants into the spatial structure to prevent dust storms
• Retention of the water
• Improving the soil structure to prevent leaching
• Developing a green-blue structure based on the characteristic peat extraction structure

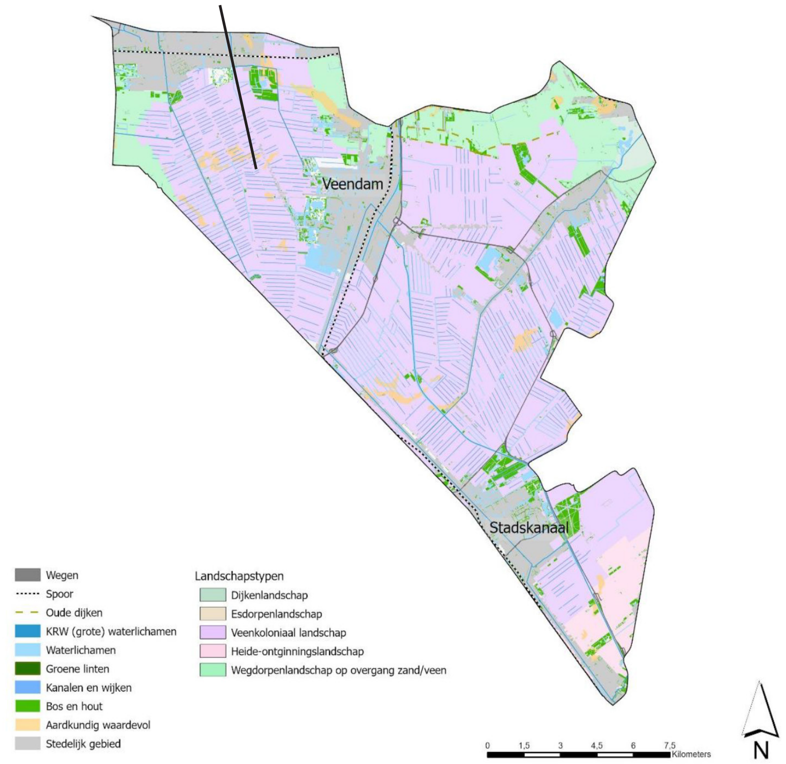


Figure 44 Map of the peat area, source: (Provincie Groningen, 2023 p.21)

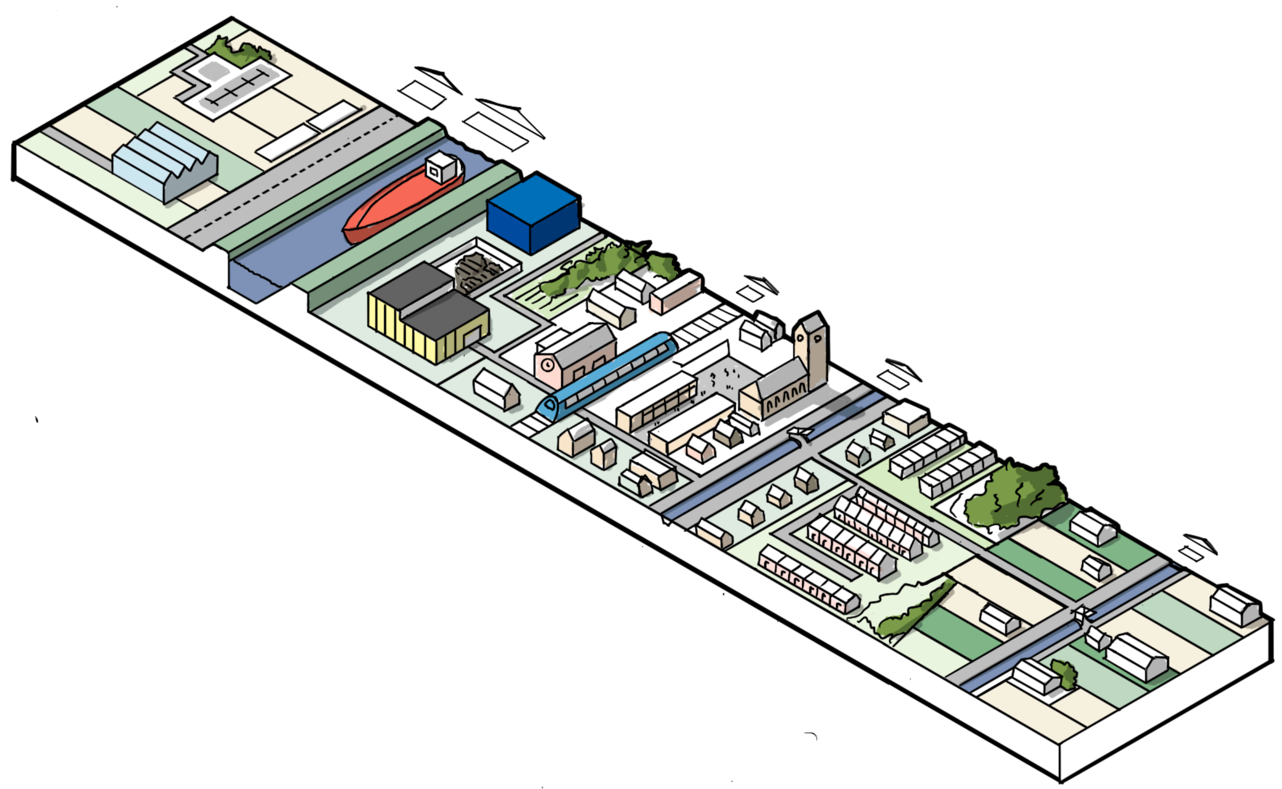


Figure 43 axometric section of the Peatcolony area

3.2 Introduction of the current landscape

Figure 45 Images from the Groningen landscape, source: author

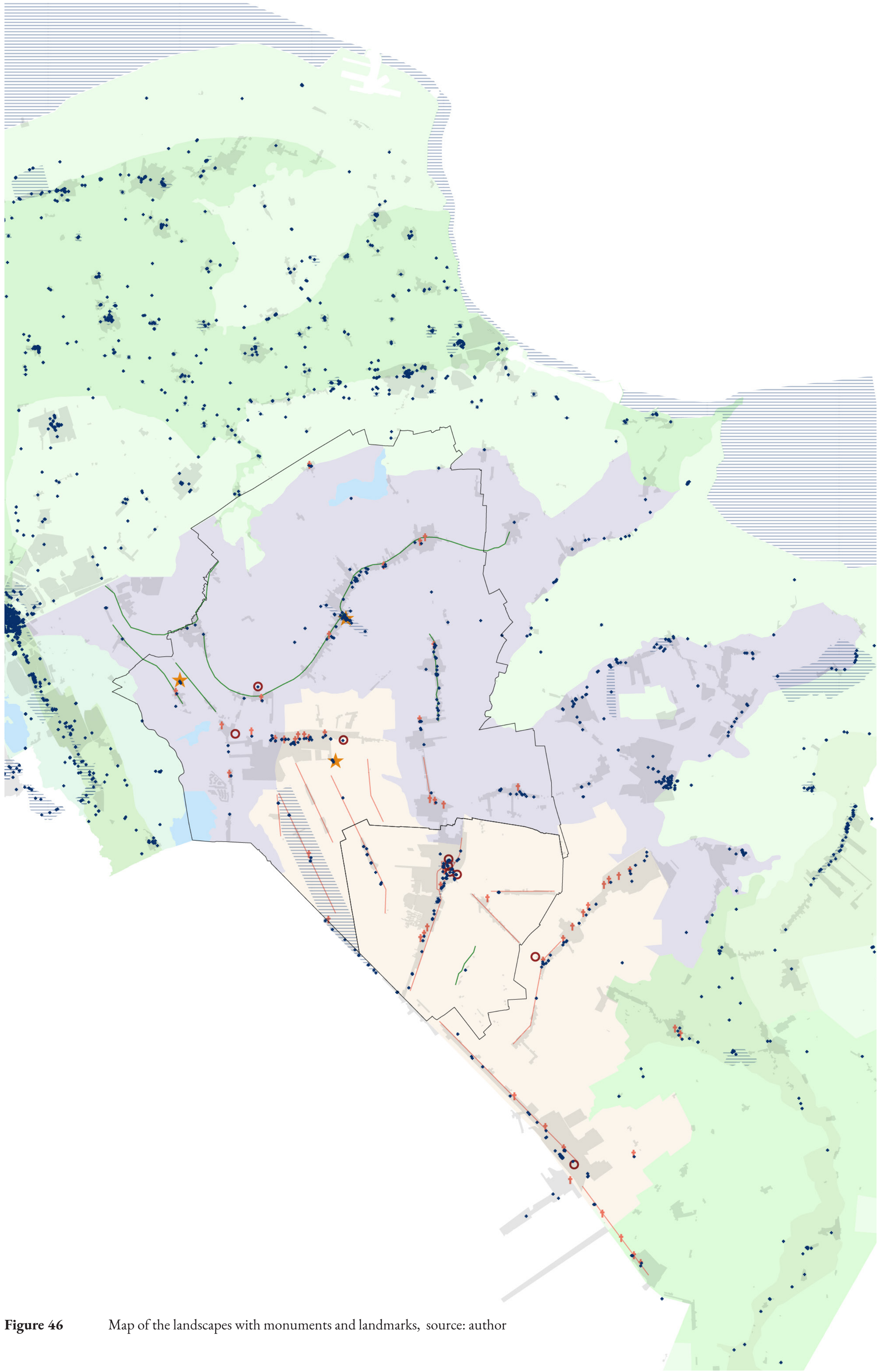


Figure 46 Map of the landscapes with monuments and landmarks, source: author

3.3 Policy overview

The Netherlands has a rich planning and urban design history, with various strategies developed for Groningen and its regions. These strategies serve as valuable resources and inspiration for this thesis. However, many existing strategies tend to focus intensely on specific issues or elements within the region. Analyzing these strategies allows us to glean valuable insights and identify gaps or areas requiring further research.

The scheme on the right page divides policy documents by topic, highlighting missing elements or a focus on a specific theme. On the next page, a brief description of all the policy documents is provided.

The primary source of inspiration for this study is the "Toekomst Vision 2050 Groningen," which represents a conceptual version of a strategic plan. However, a significant limitation of this document is its lack of detail.

One notable gap in existing policies is the absence of scenario building. This approach is essential for exploring alternative futures and considering different functions that the same space might serve in the future. Given the Netherlands' status as a densely populated country, such considerations are increasingly relevant.

Moreover, most strategies lack sufficient detail. To address this gap, examining the current strategy's implications on a smaller scale would be beneficial. Scenario building can help explore various futures in greater detail, which can then inform the development of strategies with specific design elements.

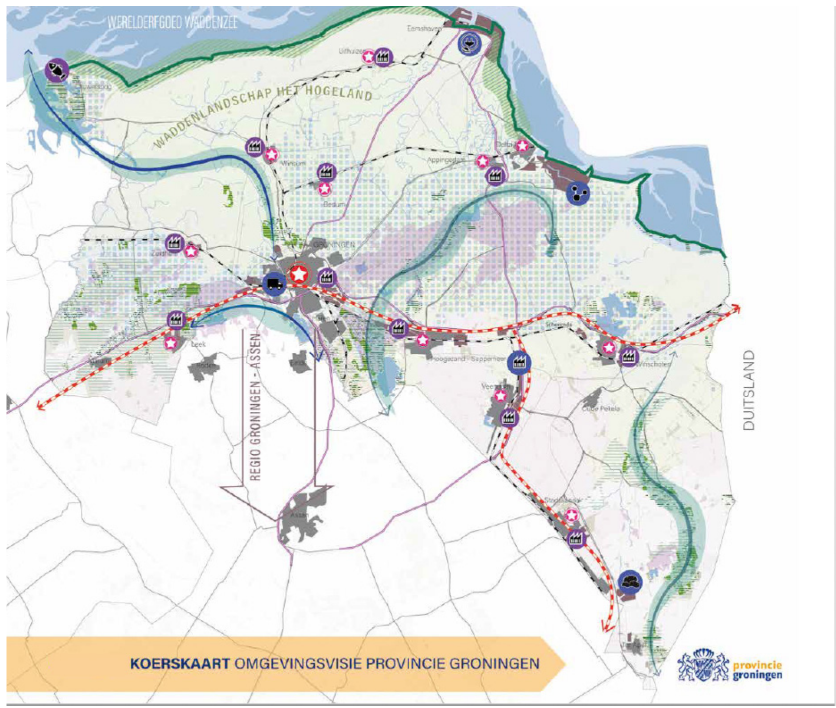


Figure 47 Concept vision 2050 Source: (Provincie Groningen, 2022)

Energy and economy	Housing/ social data	Water and nature challanges
Brede welvaart 2022	Brede welvaart 2022	
RES strategy / Concept RES		RES strategy
Ruimtelijk/ economisch ontwikkelperspectief A7/N3	Ruimtelijk/ economisch ontwikkelperspectief A7/N33	
Just transition plan		
	Regio deals	
		Startnotitie gebiedsplan Groningen
Nationaal program groningen	Nationaal program groningen	Nationaal program groningen
Concept Strategy 2050	Concept Strategy 2050	Concept Strategy 2050

Only focusses on / missing elements

Brede welvaart 2022	**Socio economic data - non spatial**
RES strategy / Concept RES	**RES Strongly energy focussed, but landscape is there**
Ruimtelijk/ economisch ontwikkelperspectief A7/N3	**Spatial economic - less attention to nature does not cover full area, energy is not included that much**
Just transition plan	**JTF non spatial, just economic policy**
Regio deals	**Regio deals , only focussed on housing**
Startnotitie gebiedsplan Groningen	**Start notitie gebiedsplan, describes the qualities of**
Nationaal program groningen	**Non spatial plans**
Veenweide strategie	**Concept, lacks detail for local area's**

3.3 Policy review

Brede welvaart 2022

The “Brede Welvaart 2022” document primarily provides socio-economic data on the province and municipalities. While informative, it lacks spatial planning or design proposals.

RES strategy

The focus of the regional energy strategy is on the placement of renewables, with plans outlined until 2030. Background documents, such as the spatial exploration by h+n+s landscape architects, offer valuable insights into the spatial dimension of the energy transition. However, challenges related to landscape and housing are not adequately addressed, and the spatial exploration does not align closely with the current goals of the Regional Energy Strategy (RES).

Ruimtelijk/ economisch ontwikkelperspectief A7/N3

The “Ruimtelijk Economisch Ontwikkelperspectief A7/N33” is a spatial-economic plan primarily focusing on new and existing business terrains, with limited consideration given to nature and housing. Energy aspects are excluded, and the document lacks detail, phasing, and emphasis on inclusive governance.

Just transition plan

The “Just Transition Plan” is an economic policy, primarily targeting the European and Dutch scales, offering monetary incentives. However, it lacks spatial considerations and detailed planning.

Regio deals

“Regio Deals” aim to build new houses until 2040 but primarily focus on housing without considering energy, landscape, or economy aspects, and lack specificity.

Startnotitie gebiedsplan Groningen

The “Startnotitie Landelijk Gebied” describes the qualities of seven areas in Groningen but lacks design and remains a preliminary document awaiting official release.

Nationaal program groningen

The “Nationaal Programma Groningen” emphasizes Groningen’s qualities and cultural heritage but lacks spatial plans and design, focusing more on socio-economic aspects.

Concept strategy 2050

The “Concept Strategy 2050” (Dit is Groningen) outlines challenges for 2050 and proposes five areas in Groningen. However, it lacks detail and requires further development.

	Only focusses on / missing elements
Brede welvaart 2022	**Socio economic data - non spatial**
RES strategy / Concept RES	**RES Strongly energy focussed, but landscape is there**
Ruimtelijk/ economisch ontwik-kelperspectief A7/N3	**Spatial economic - less attention to nature does not cover full area, energy is not included that much**
Just transition plan	**JTF non spatial, just economic policy**
Regio deals	**Regio deals , only focussed on housing**
Startnotitie gebiedsplan Groningen	**Start notitie gebiedsplan, describes the qualities of**
Nationaal program groningen	**Non spatial plans**
Veenweide strategie	**Concept, lacks detail for local area's**

Where are the gaps?

No scenario's
> To consider different futures
> Test spatial "claims" against eachother

Lack of zoomed in detail
> Translation strategy to design

3.3 Policy review

Organizations and several policy documents use different areas, which makes it difficult to apply or use data and compare plans with each other.

Municipalities

Social and economic data is primarily collected at the municipal level. An important document that is used in the thesis is the "Monitor Brede Welvaart" that gathers the statistics on municipality and provincial level. The borders are also the jurisdictional regions with employees per region.

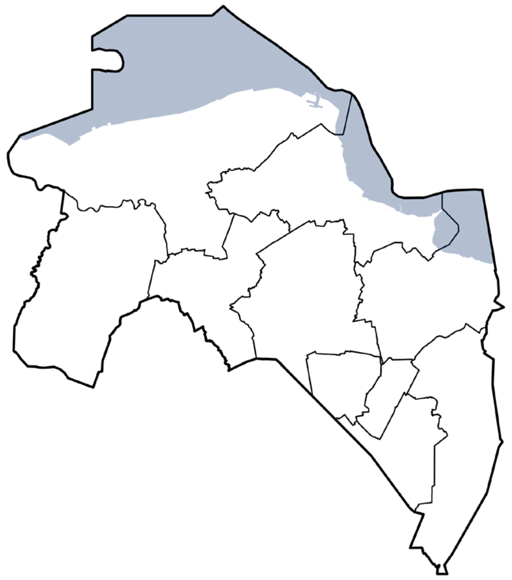


Figure 1 Municipalities in Groningen, source: author

Seven landscapes

The Groningen Quality Guide distinguishes seven landscapes in Groningen. Each landscape has its own character and dynamics based on its genesis, current spatial qualities, and the heritage present. These areas are used in the Regional energy strategy (RES), the Groningen quality guide and transformative landschappelijk gebied.

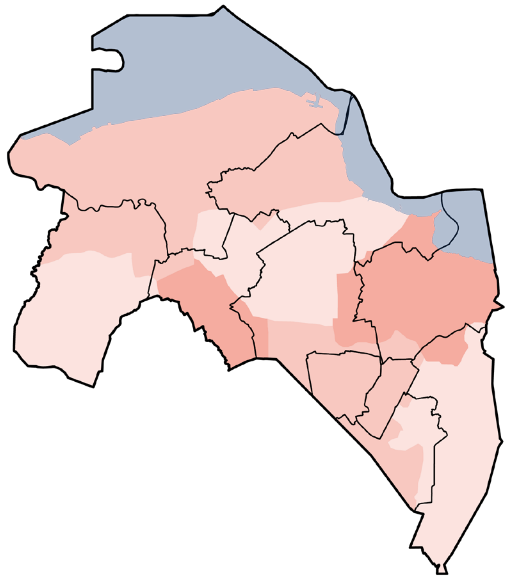


Figure 48 Seven landscapes in Groningen, source: author

Five areas based on soil

The Future Vision for Groningen (2030-2050) outlines five distinct areas categorized by soil composition: sandy soils, clay soils, peat colonies, low-lying peatlands and Groningen city. The starting document indicates that these areas serve as the basis for the partial elaborations in the future strategy Groningen 2050. The landscapes largely correspond to the seven landscapes of Groningen but there are minor differences.

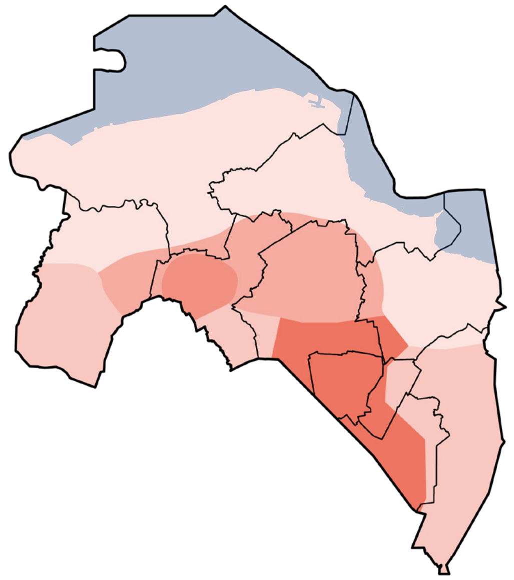


Figure 49 Five landscapes based on soil, source: author

Two water boards

There are 2 water boards for all of groningen and part of drenthe. The water boards again have just different boundaries than the other landscape areas.

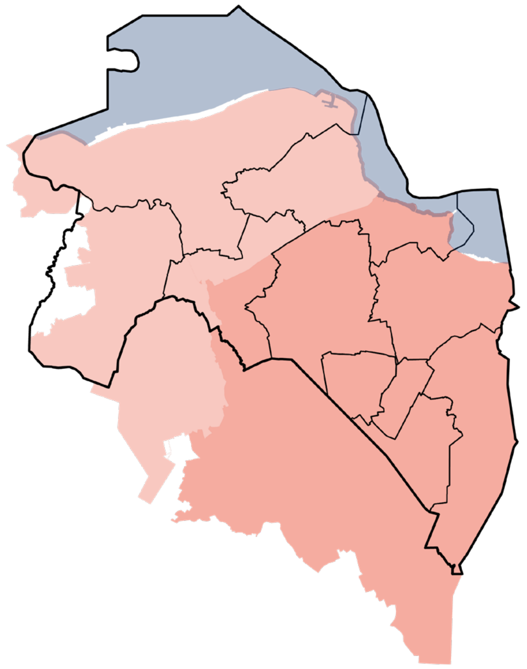


Figure 50 Two waterboards, source: author

3.4 Analysis of the energy system

The energy transition poses several challenges. Current fossil fuels need to be replaced by renewable sources, which occupy more space in the immediate environment (Simons, 2014). Given its small size and high population density, this presents a significant challenge for the Netherlands, where space is limited. Moreover, the current energy grid is saturated in many parts of the country, leading to waiting lists for new sustainability projects (Electricity Grid under Further Pressure: Cabinet and Grid Operators Take Drastic Measures, n.d.). Consequently, there's a pressing need to considerably expand the high-voltage grid. Additionally, hydrogen can potentially play an important role in transporting and storing large quantities of energy. To facilitate this, Gasunie is currently transforming part of the gas network to make it suitable for hydrogen. The national hydrogen network is expected to be operational by 2030 (Dutch National Hydrogen Network Launches in Rotterdam, 2023).

To address these challenges, the Netherlands has established the Regional Energy Strategy (RES), with a collective goal for 30 regions to generate at least 35 terawatt-hours (TWh) of sustainable electricity on land by 2030. (One terawatt-hour equals one billion kilowatt-hours).

The Regional Energy Strategy (RES) Groningen focuses on two critical aspects of the energy strategy, heating homes and buildings with sustainable energy and generating sustainable energy. Groningen aims to generate at least 5.7 and at most 6,4 terawatt-hours (TWh) of electricity sustainably through solar and wind power on land by 2030 (Regionale Energie Strategie (RES) Groningen, n.d.) With this offer, Groningen is the second largest energy-producing region in the Netherlands and thus also produces more than the province's annual consumption (5.5 TWh) (RES 1.0) After 2030, the ambition will be further increased. The current target aims to produce 70% of all energy needs sustainably. This means that an additional 30% increase in sustainable energy production is needed to reach 100% sustainable energy production by 2050, which is around 8,1 to 9,1 TWh for Groningen.

Groningen's ambition is divided by municipality. Groningen and Midden

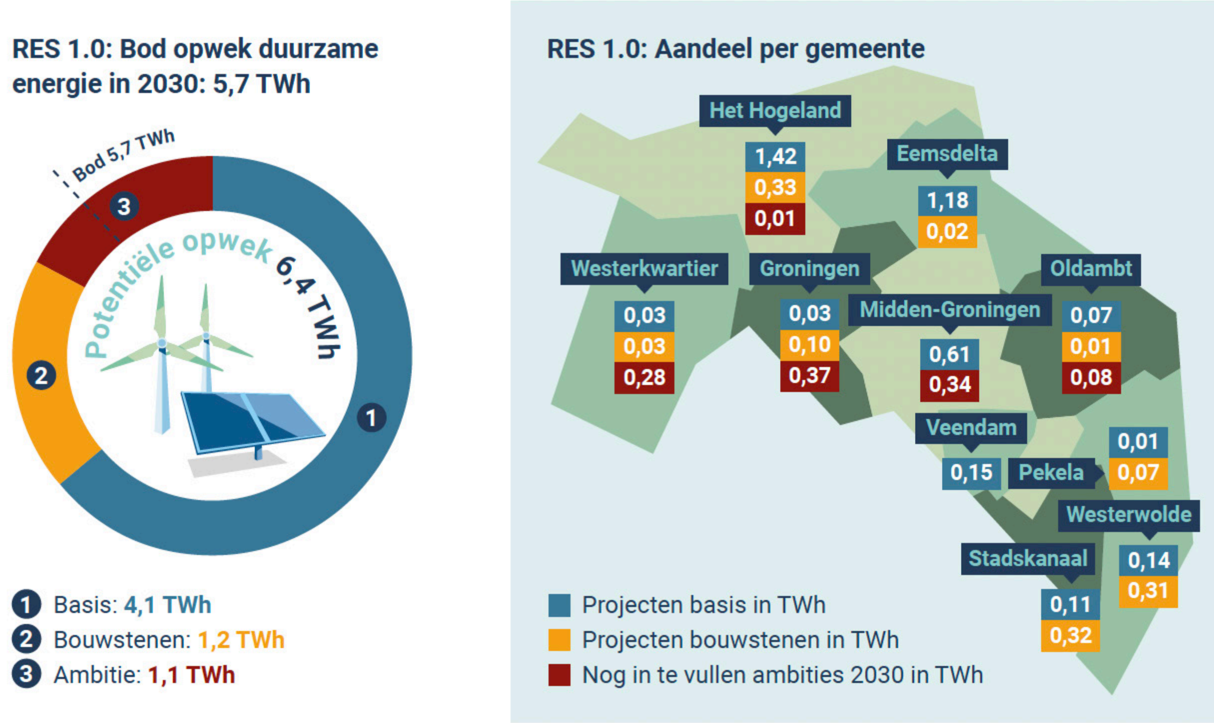
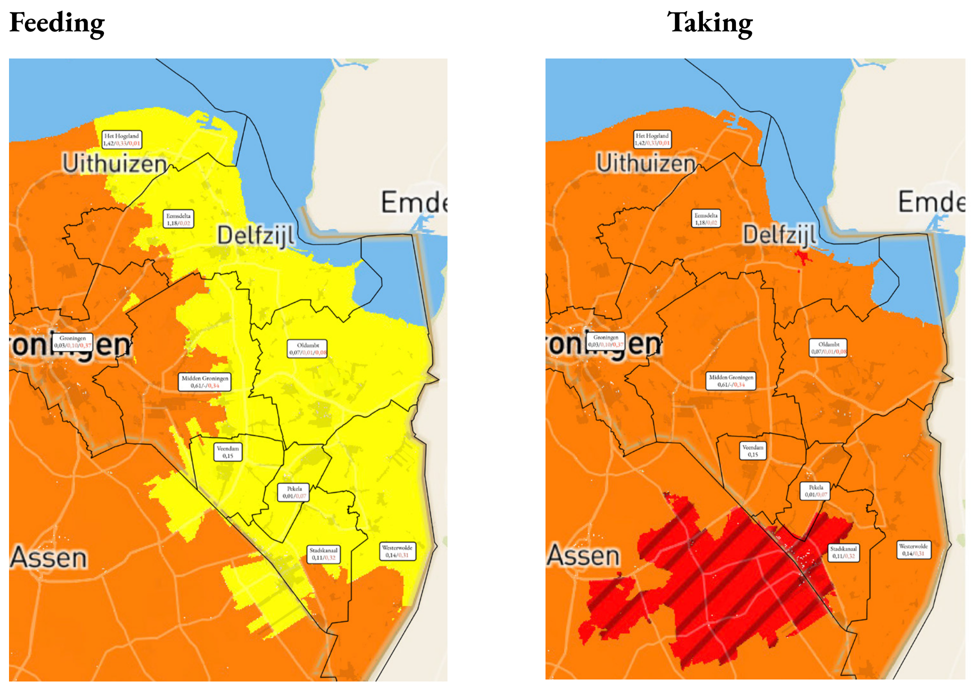


Figure 51 Current goal of energy production for Groningen and the individual municipalities, source: (RES Groningen, 2023)



Legend

- yellow: Limited transport capacity available
- Orange: No transmission capacity available for the time being pending congestion management investigation
- Red: No transmission capacity available: congestion management cannot be accommodated with congestion management inquiry

Figure 52 Feeding and taking capacity of high voltage cables in Groningen, source: (Capaciteitskaart Invoeding Elektriciteitsnet, 2024)

3.4 Analysis of the energy system

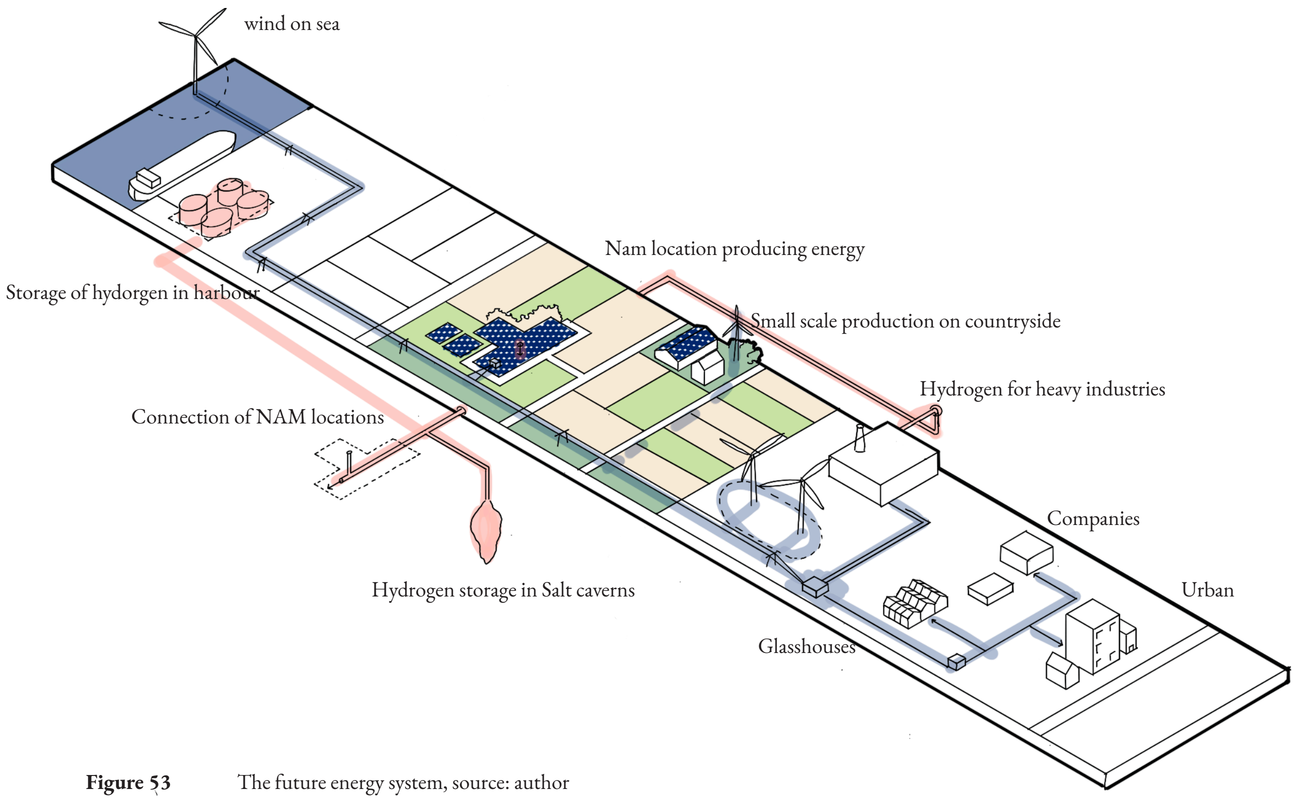
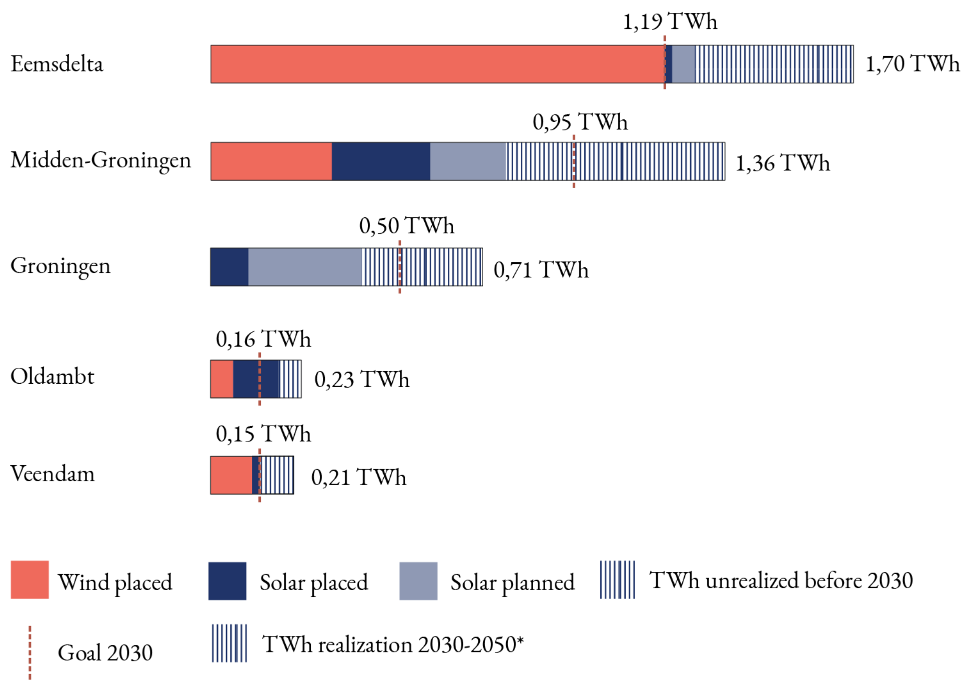


Figure 53 The future energy system, source: author

RES ambitions



**The realization for 2030-2050 is calculated bu the Author based on an asumption*

Figure 54 ambition RES by source, by author, source: (RES Groningen, 2023)

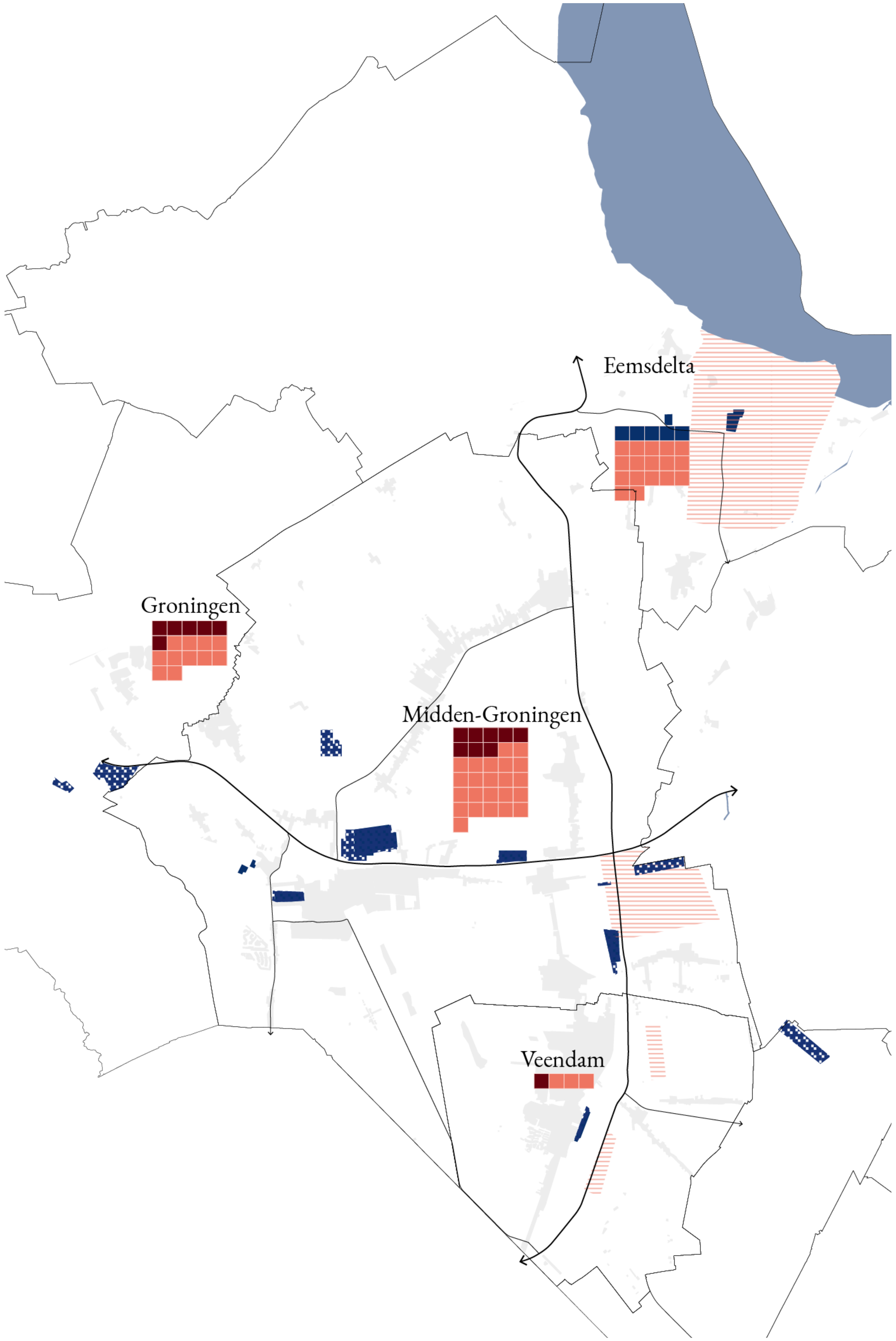


Figure 55 hectares needed for to realize the ambition for RES 2050 and 2030 with solar fields (one tile is 25 ha), source: Author

Legend

unrealizeded ambition 2030
unrealized ambition 2050
Solar fields

3.9 Typologies

Energy production
The Regional Energy Strategy (RES) focuses on energy production from solar and wind energy, which have the most potential in the Netherlands. This report also works with these two energy sources. Biomass is included as an additional energy source. However, its production capacity is limited by the fact that it takes over 50 times more space to produce a similar output as wind or solar energy (Sijmons, 2014).

Based on RES 2.0 and the author's calculations, Groningen's total production should be around 9.1 TWh in 2050 (see page 76). This means many new solar fields and wind turbines are needed.

Below are numbers on how many solar panels or wind turbines are needed for 1TWh.

Wind turbines
- for large wind turbines of 5,6 MW 50-65 are needed
- for smaller wind turbines 3MW 110-130 are needed.
- 500 small turbines that can be placed around on a farm is the equivalent of one large scale 5,6 MW windmill

Solar panels
- for solar parks, about 1.100 - 1.500 ha of solar parks
- Large scale solar fields (>2ha)
- Small solar fields (<2 ha)

These fields are typically on agricultural land and can be used to provide energy for smaller villages/ linten in addition to solar panels on buildings. The impact on the landscape is small.
- Solar panels large roofs (>40 panels)

These panels can be included in the RES strategy once they are built.

Types
A. Small scale production
B. Medium
    B1 Large roofs / small fields
    B2 Small windmills
C. Large scale
    c1 Windparks
    c2 Large solar fields

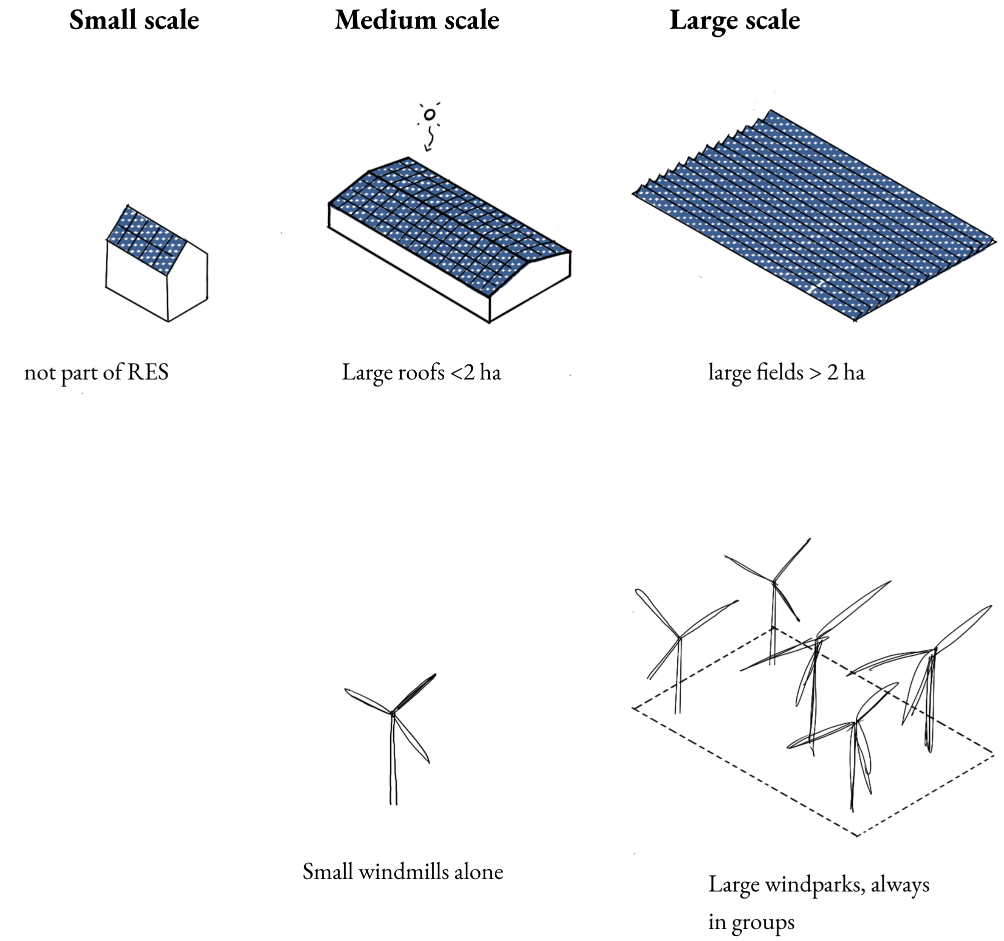


Figure 56 Types of energy production, source: author

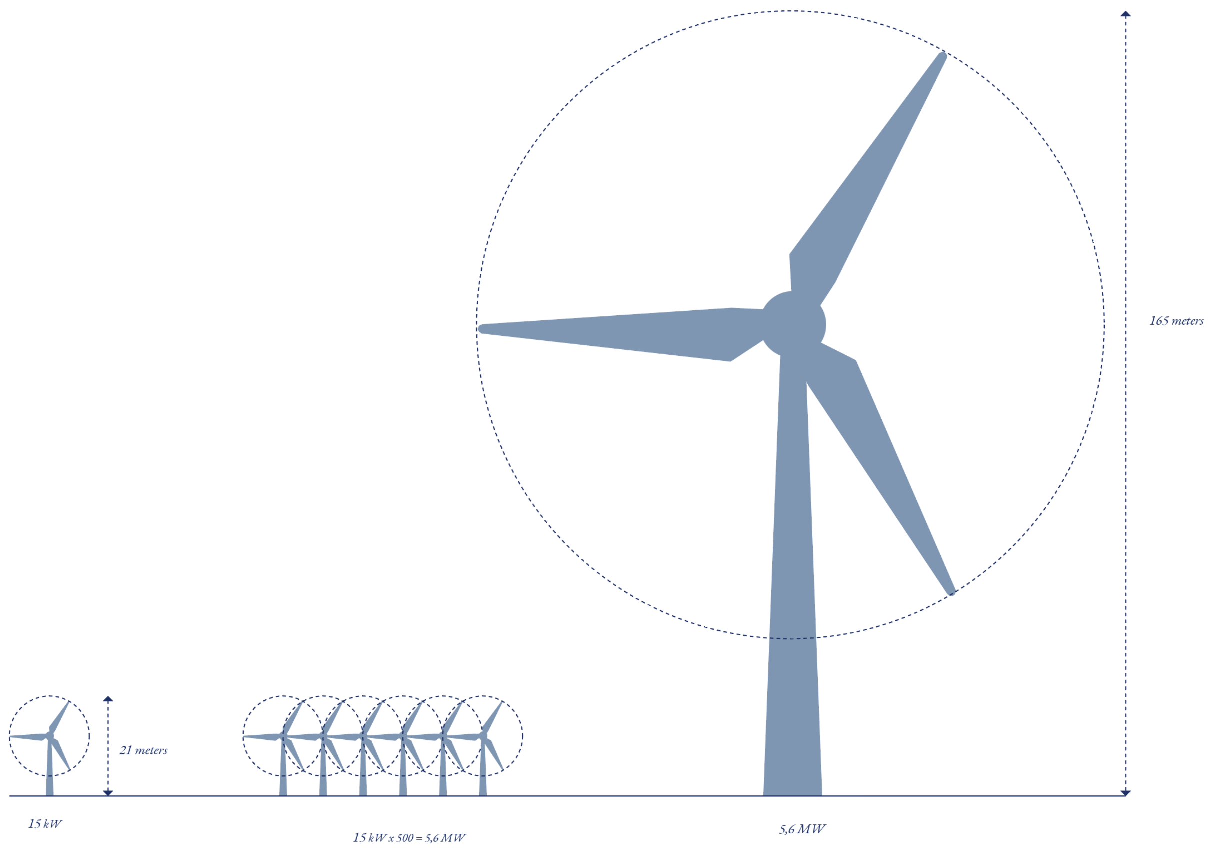


Figure 57 Large and small windmills, by author, adapted from RES 1.0

3.4 Analysis of the energy system

Hydrogen

Hydrogen (H2) serves as both a raw material and fuel in industrial processes, as well as a fuel for transportation. Additionally, it can be converted into electricity or heat through fuel cells. Currently, gray hydrogen, extracted from natural gas, is utilized in industrial applications.

The production of green hydrogen, which can be achieved on a large scale in the near future, involves electrolyzing water using renewable energy sources. This enables the storage of significant energy reserves, crucial for addressing the intermittent nature of solar and wind energy production, which often doesn't align with energy demand throughout the day. Moreover, hydrogen boasts efficient large-scale transportation capabilities, offering a cost-effective alternative to electricity. This potential shift can alleviate strain on the current electricity grid.

Repurposing old gas pipelines for hydrogen transportation is a viable option, with Gasunie, a Dutch governmental organization, planning to establish a national hydrogen network by 2030. In the Groningen region, NAM (Nederlandse Aardolie Maatschappij) sites, coupled with salt caverns in the municipality of Veendam, can play a pivotal role. Establishing a local hydrogen network in Groningen could confer a competitive edge over other regions in the Netherlands (What Is Hydrogen?, n.d.).

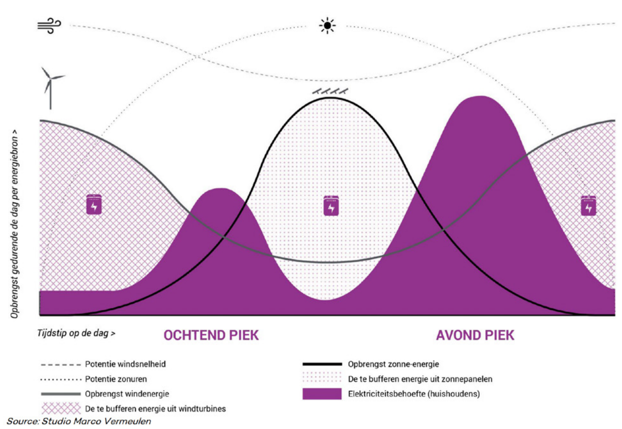


Figure 58 Energy need vs production, source: Marco vermeulen

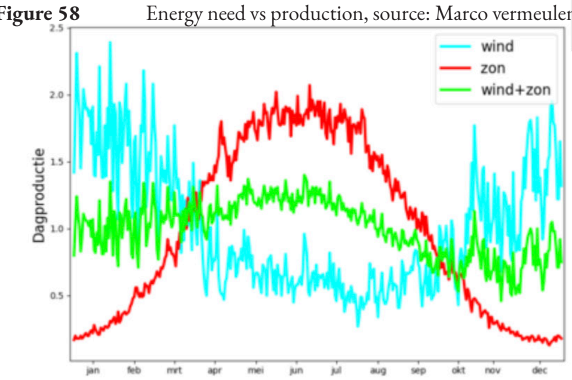


Figure 59 Available sun and wind through the year, avarage 1991-2020, source (Scheele, 2021)

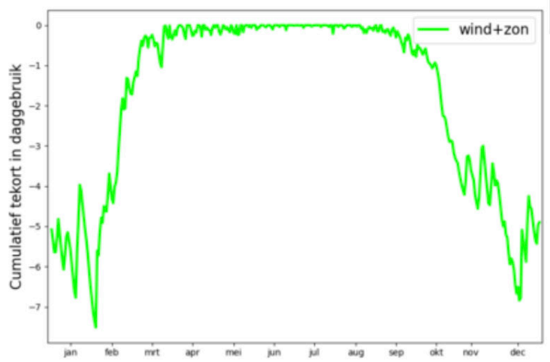


Figure 61 Cumulative shortage in electricity production, shortage is in daily uses Source: (Scheele, 2021)

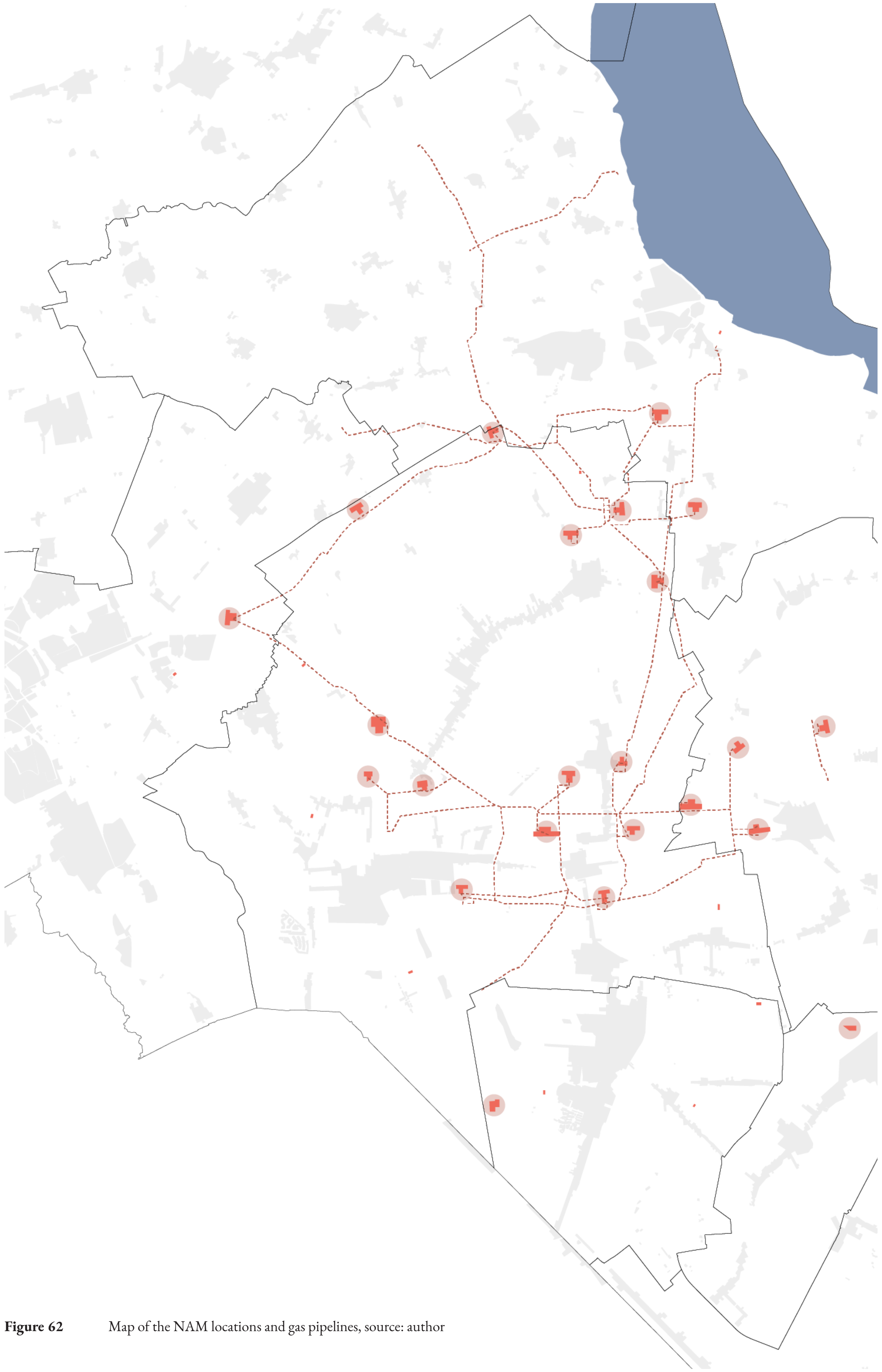


Figure 62 Map of the NAM locations and gas pipelines, source: author

3.4 Analysis of the energy system

NAM locations

NAM facilities are locations where gas was extracted and processed from the Groningen gas field. These facilities typically include drilling pumps and intermediate stations, holding significant potential to facilitate the transition to new energy sources. They are well-connected to the energy grid via high or medium-voltage lines. These sites could serve as hubs for renewable energy production, storage, and transmission. They could be integrated with solar and wind farms to meet local energy demands. With the increasing efficiency of hydrogen production post-2030, these facilities could be repurposed into hydrogen plants for energy storage and distribution via existing gas pipelines. It is conceivable that biomass plants could be established in rural areas to supply green gas to local homes, particularly those in outlying areas, for heating purposes.

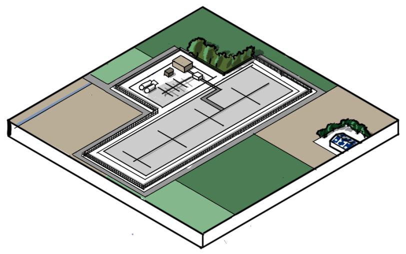


Figure 63 NAM location typology, source: author

Figure 64 Photo from above a NAM location, source: https://nos.nl/artikel/2412178-nog-meer-gas-uit-groningen-nodig-dit-jaar-want-duitsland-heeft-te-weinig

Legend

NAM locations
Existing solar fields
Solar fields
Hydorgen
High voltage cables

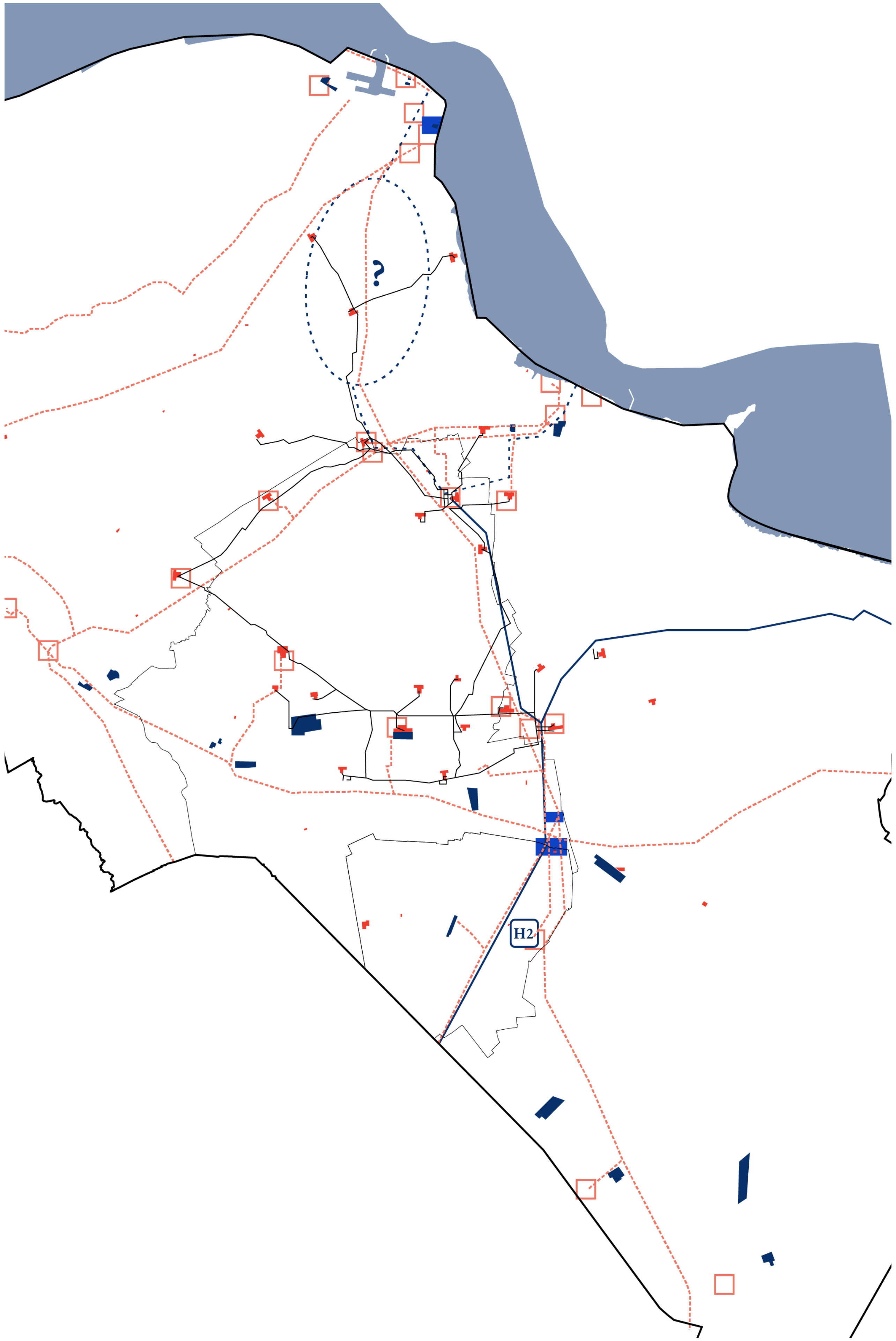


Figure 65 The energy and hydrogen network, source: author

3.5 Analysis of the natural landscape

Water problematics

During periods of drought, Groningen relies extensively on water sourced from the IJsselmeer to sustain agricultural, ecological, and industrial activities. The region possesses limited indigenous freshwater resources due to the predominant emphasis of the water system on expeditious water drainage. The province's water and soil system can be categorized into three main systems: the high sandy soils of the Drenthe plateau, the central low-lying area beneath NAP with heavy clay and peat soils, and the sea (clay) deposits along the northern coastal area. However, these systems face limitations such as drought in sandy soils, land salinization in coastal areas, and ongoing peat oxidation due to water level reductions.

The availability of freshwater from the IJsselmeer sustains agricultural activities in the productive clay shell in the north, vital for potato seed production, and supports starch potato cultivation in sand and peat soils for the Groningen starch industry. Furthermore, the low-lying peat areas in the middle and high sandy soils in the south also rely on water from the IJsselmeer, as do the two sea ports where part of the hydrogen economy will be established. An integrated approach transcending provincial boundaries

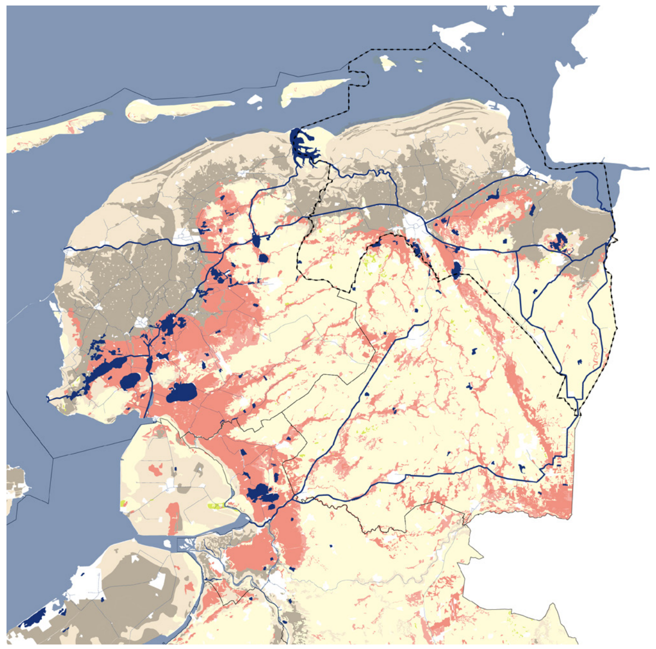


Figure 66 Soils in Northen part of the Netherland, source: Author

Legend

Water routes
Area bellow sea level
Waterboads
Slusses

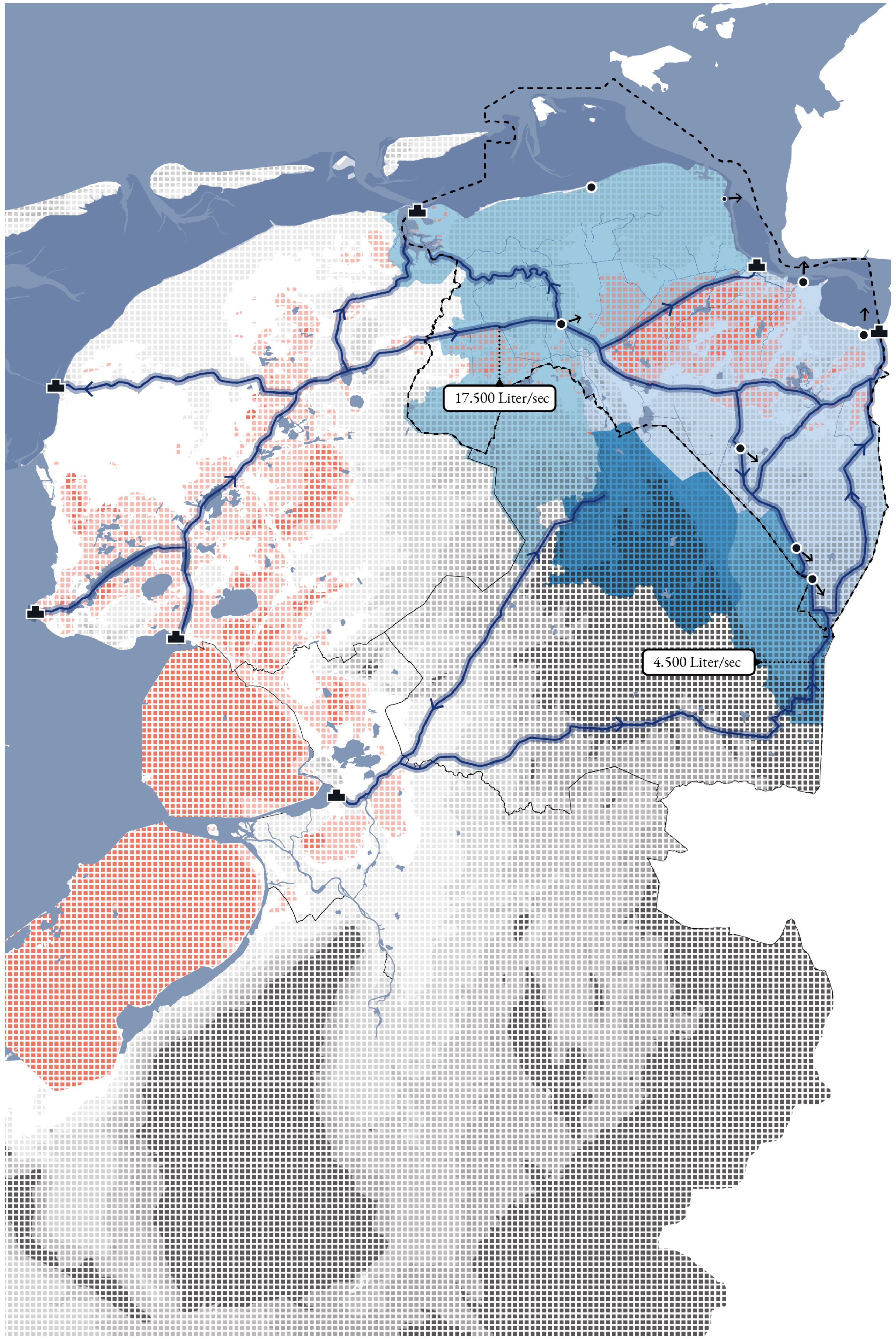


Figure 67 Water system for groningen with high and low areas, by author, source: (Provincie Groningen, 2023), height data NL

3.5 Analysis of the natural landscape

is imperative.
The primary objective of water and soil management is multifaceted: reducing vulnerability to extreme weather events, safeguarding and enhancing water supply, groundwater quality, biodiversity, and mitigating irreversible effects of land subsidence. Spatial planning guided by water and soil considerations should align with the natural characteristics of the water and soil system, prioritizing spatial quality and environmental improvement.

Future projections indicate further changes in the water and soil system due to climate change and land subsidence, resulting in decreased water safety, reduced freshwater availability during prolonged droughts, and increased waterlogging in low-lying areas. The most significant water and soil challenge is anticipated in the peat area between Groningen city and Delfzijl.

Addressing future freshwater demand for agriculture, nature, and industry necessitates additional measures. Alongside water from the IJsselmeer, strategies to retain water in the area longer, employing the principle of multiple land use, are proposed. Additionally, efforts are directed towards enhancing water efficiency in agriculture and industry.

Legend

Low area
nature
peat oxidation
sandy soil
Saltanization

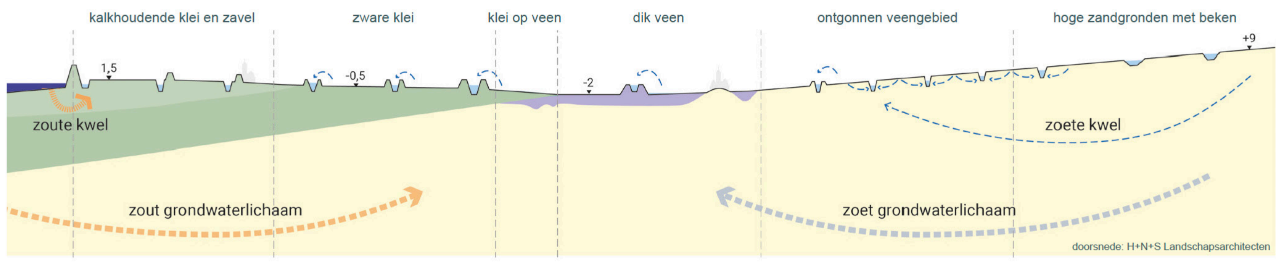


Figure 68 schematic section of the soil and waterhousehold source: (Provincie Groningen et al., 2023)

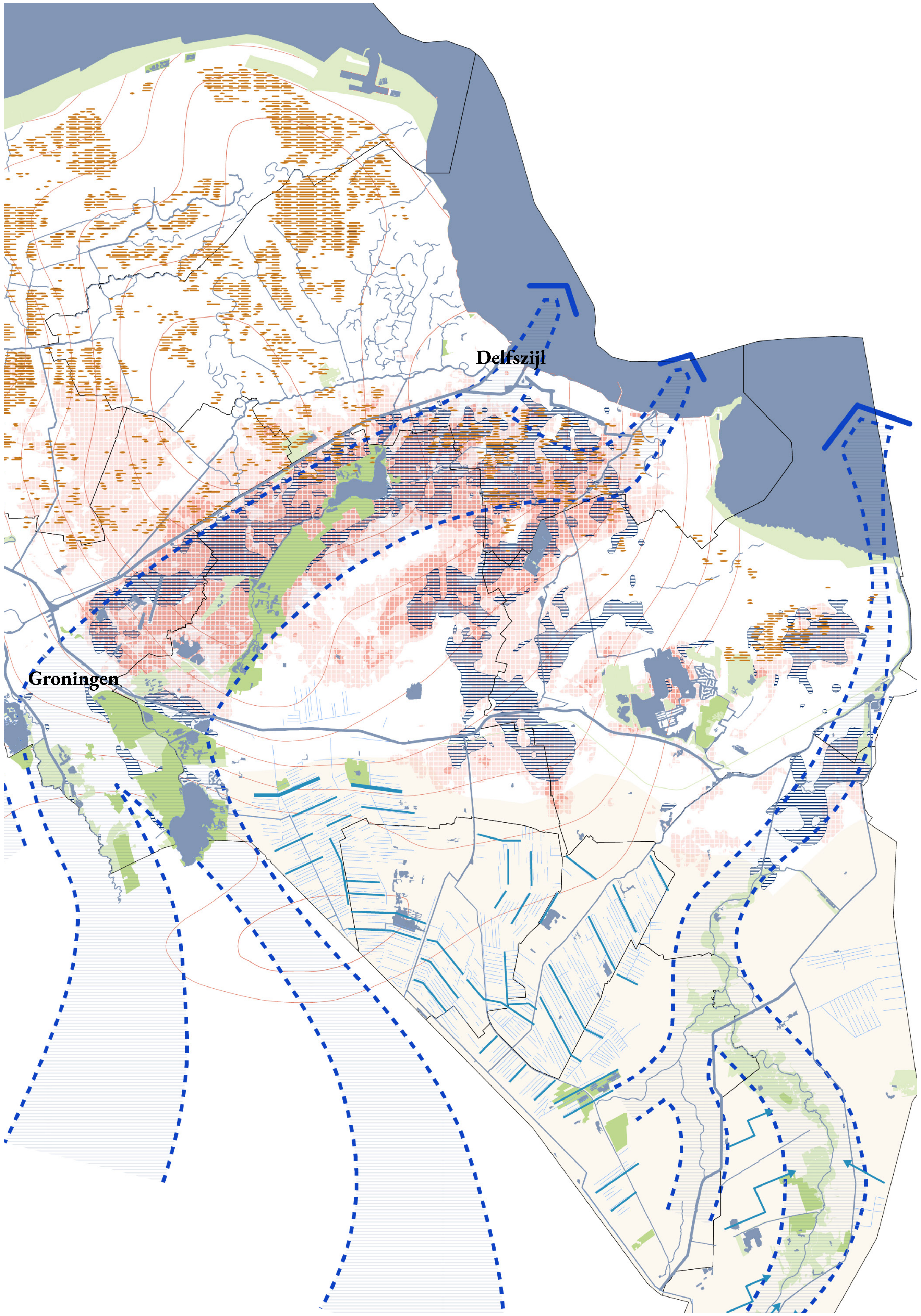


Figure 69 Problems with the soil, by author, source: (Provincie Groningen et al., 2023)

3.5 Analysis of the natural landscape

Peat oxidation

When peat is exposed to oxygen, it undergoes a process called oxidation, leading to the breakdown of organic matter. This releases carbon dioxide (CO2) and essential nutrients, causing the soil to sink gradually. On average, this phenomenon causes peat soil to subside at one or two centimeters per year.

Human activities contribute significantly to the subsidence of peat soil. For instance, the "level follows function" policy dictates keeping groundwater levels low in agricultural areas. Consequently, peat soil comes into contact with oxygen, accelerating its oxidation and causing further soil sinking. This process perpetuates as long as agricultural practices maintain low water levels, leading to ongoing subsidence and necessitating frequent adjustments to water levels and infrastructure.

This reliance on lowering water levels for agricultural purposes is unsustainable. It results in disparities in land height within water level areas, impacting the effectiveness of dams and culverts and impeding water flow. Therefore, a more sustainable solution is needed to address the long-term implications of peat soil subsidence on agricultural practices and environmental stability (Waterbeheerprogramma 2022 - 2027, 2022).

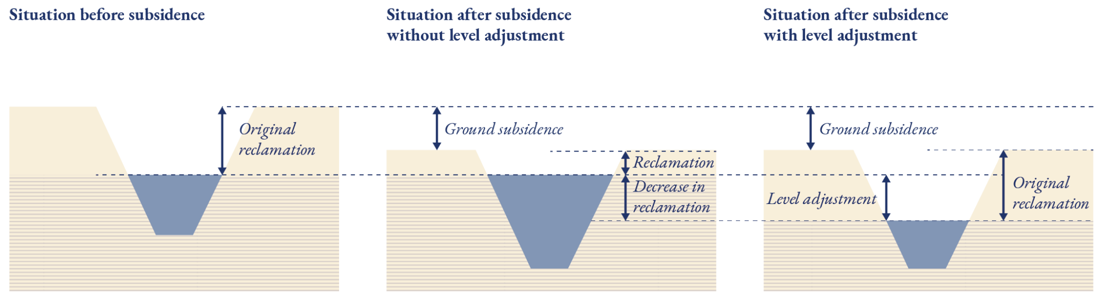
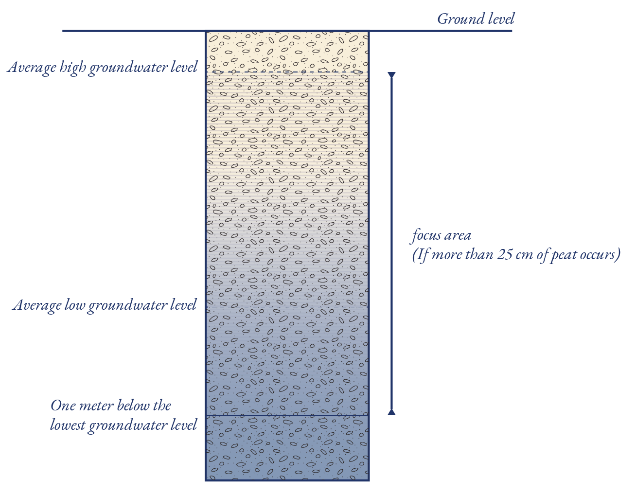


Figure 70 Process of ground subsidence Source: Author, adapated from: Source : https://commissiebodemdaling.nl/gevolgen/vernatting/



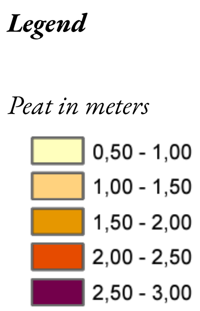


Figure 71 How is the peat in the ground measured source: Author, adapted from (Waterbeheerprogramma 2022 - 2027, 2022)

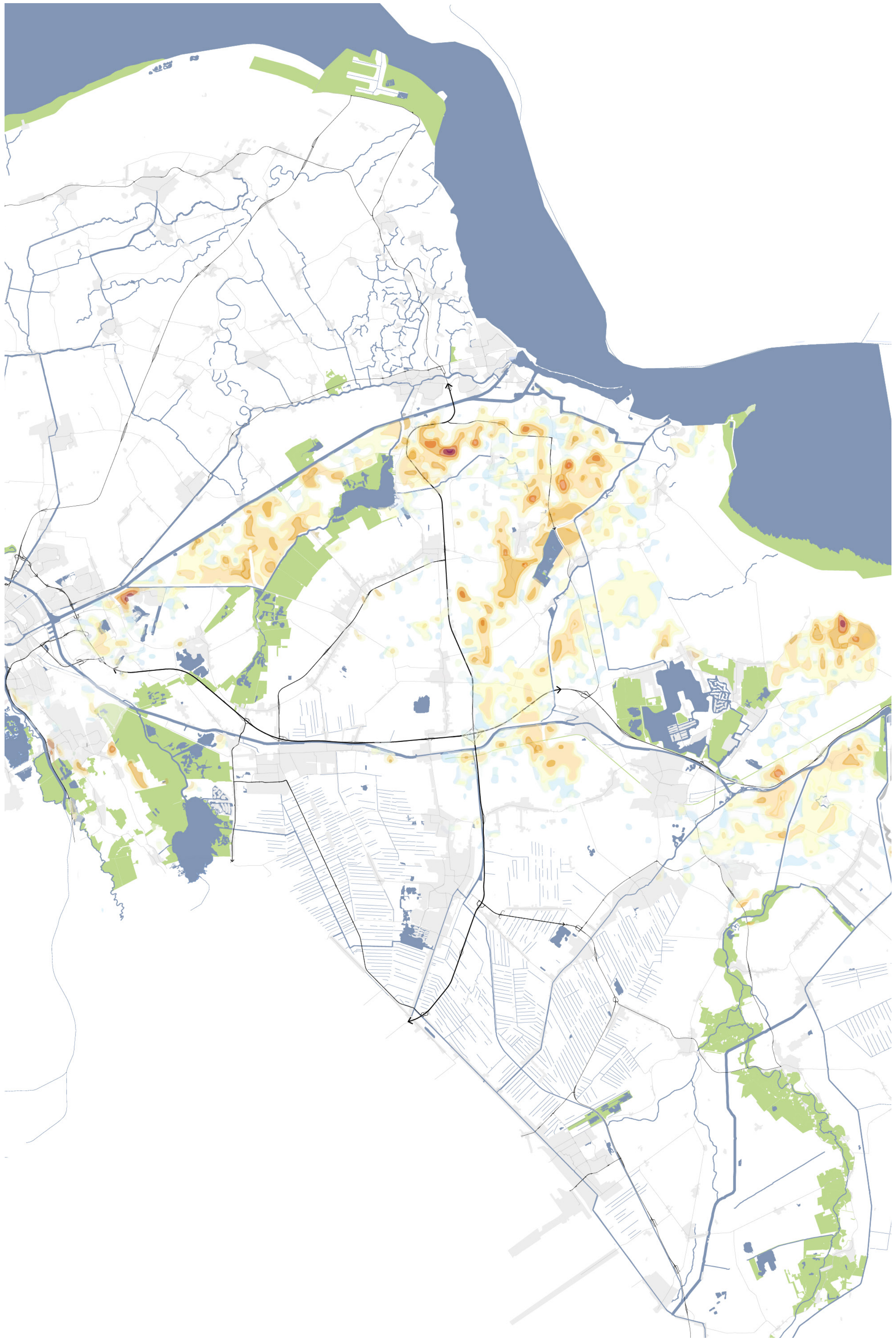


Figure 72 peat layer in the ground source: Author, adapted from (Waterbeheerprogramma 2022 - 2027, 2022)

3.5 Analysis of the natural landscape

Land-use changes

The area between Groningen and Delfzijl is the lowest region, where water storage is necessary, and a significant portion of peat oxidation occurs, leading to ground subsidence. This subsidence is exacerbated by the effects of gas extraction, creating an unsustainable situation for the area.

Consequently, a substantial portion of the area would require a new function, where increased water presence renders current agricultural practices unfeasible. Proposed new land uses could include wet agriculture, re-naturalization in the most affected areas, and energy production as a diversification of local farmers' portfolios. Over the past three decades, certain landscape areas have already transformed, such as the Roegwold, a natural area. Expanding this area could establish a large natural network in central Groningen, fostering nature regeneration, enhancing biodiversity, increasing energy production, and facilitating water storage. It is crucial to involve current farmers in addressing these challenges, as they are significantly impacted by these changes (Provincie Groningen, 2023).

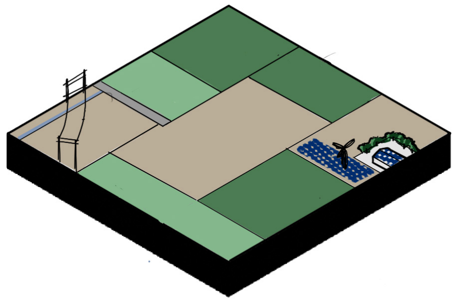


Figure 74 Peat oxidation areas Source: Author

Figure 73 landscape in Groningen Source: google streetview

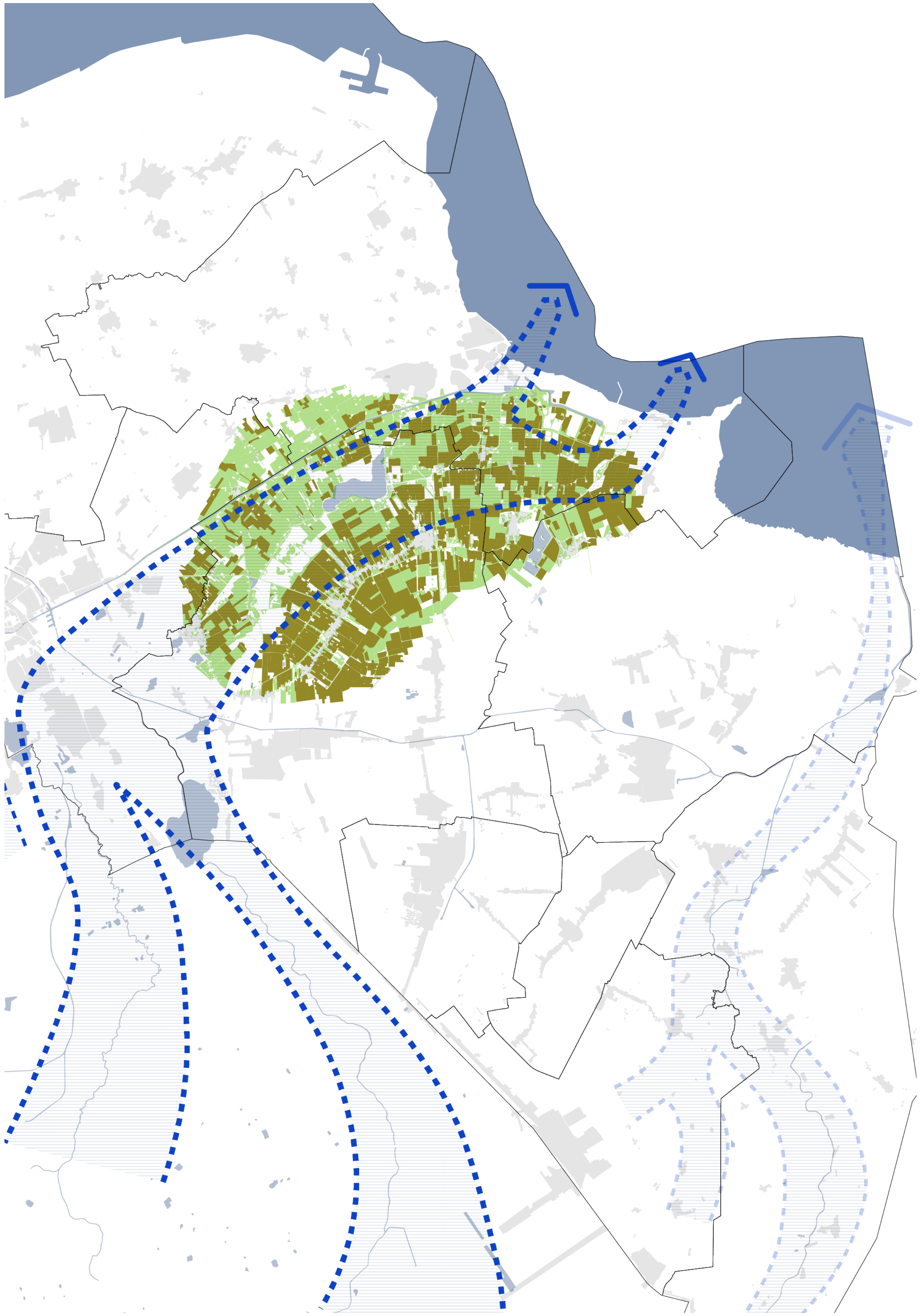


Figure 75 Area that needs to change its current landuse, source: author

3.6 Analysis of the built environment

Damaged houses

As a consequence of the earthquakes, over 26,000 houses were damaged (NU.nl, 2020). The Dutch government has started the "versterkingsoperatie" to repair the houses. This is an opportunity to make the houses more sustainable and repair them simultaneously.

The damaged area is mainly in the middle of Groningen and the clay area in the north; the regional centers of Delfszijl and Appingendam have the most damaged houses; many of these are demolished and built back.

In the area where the damaged houses are located, there are about 1.450 monuments, which often have damage, which can impact the original state of the buildings (Ministerie van Onderwijs, 2019).

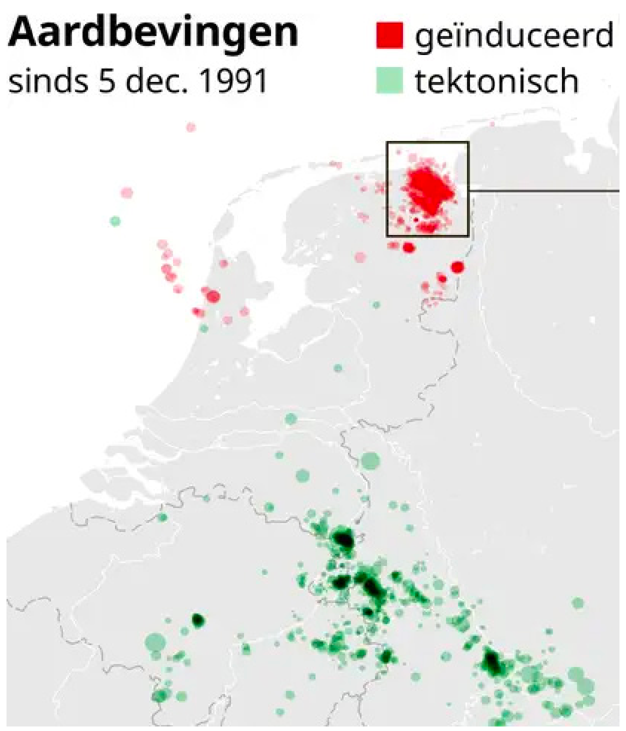
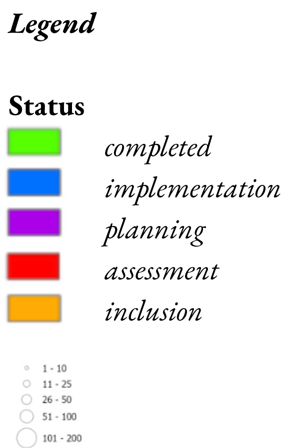


Figure 76 Earthquakes caused by gaswinning, source: (Schouten, 2021)



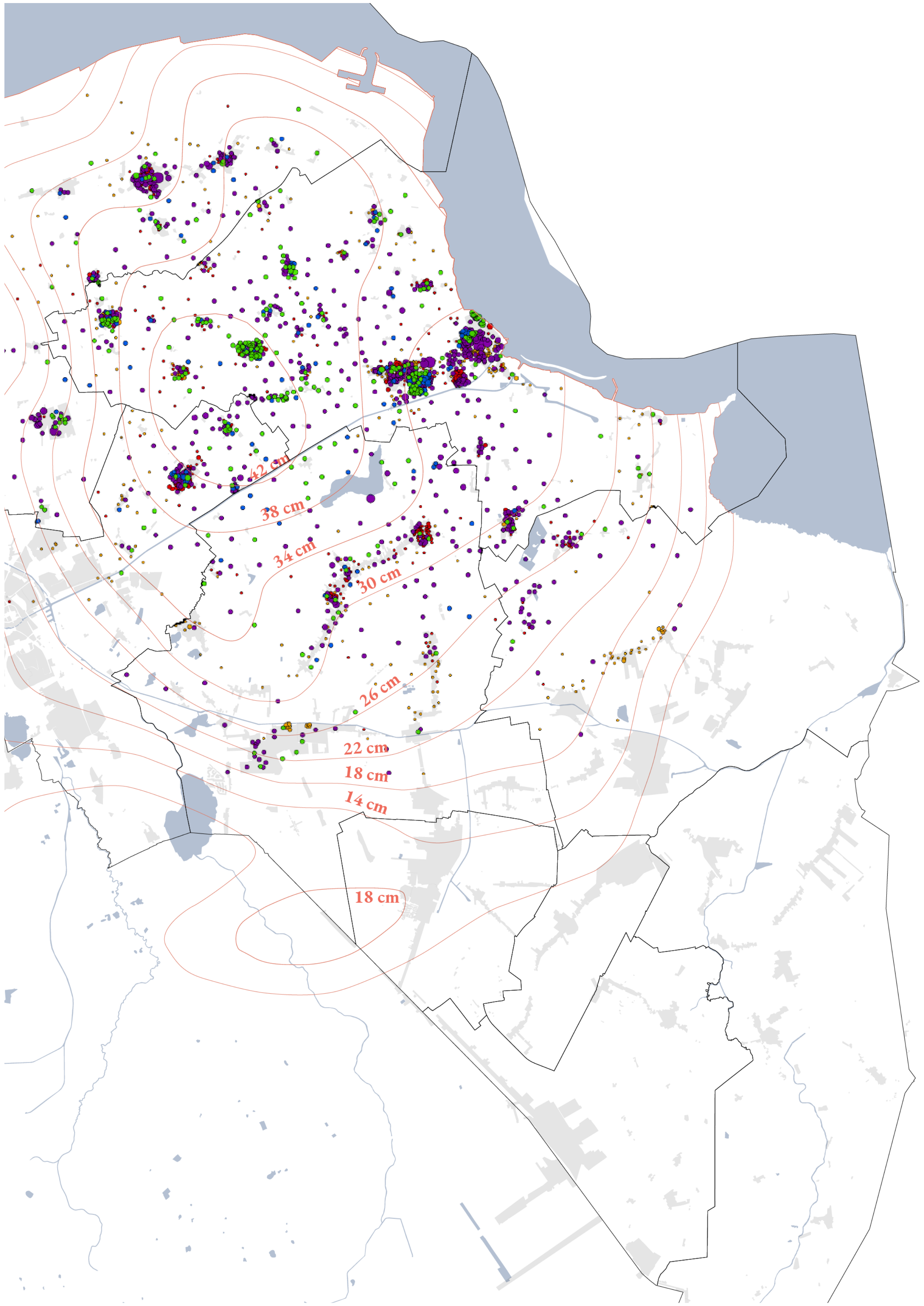


Figure 77 Map of all the damaged houses, by author, source: (rijksoverheid) -

3.6 Analysis of the built environment

	BRUTO NIEUWBOUW-AMBITIE	SLOOP[1]	NETTO UIT-BREIDING	NETTO PLAN-CAPACITEIT	HARDE PLAN-CAPACITEIT	BETAALBAARHEID SOCIALE HUUR	BETAALBAARHEID MIDDEN-HUUR (TOT €1.000,-)	BETAALBAARHEID GOEDKOPE KOOP (TOT € 355.000,-)	WONINGEN DOOR CORPORATIES (BRUTO)
Eemsdelta	3.293	2.733	560	415	3.029	2.432	16	209	2.448
Totaal	3.293	2.733	560	415	3.029	2.432	16	209	2.448

Figure 78 Ambition of building new houses Eemsdelta, source: (Provincie Groningen et al., 2023)

	BRUTO NIEUWBOUW-AMBITIE	SLOOP	NETTO UIT-BREIDING	NETTO PLAN-CAPACITEIT	HARDE PLAN-CAPACITEIT	BETAALBAARHEID GOEDKOPE HUUR	BETAALBAARHEID MIDDEN-HUUR	BETAALBAARHEID GOEDKOPE KOOP	WONINGEN DOOR CORPORATIES
Oldambt	1.682	224	1.458	1.446	538	374	52	75	304
Pekela	329	77	252	150	121	171	0	39	154
Stadskanaal	433	136	297	807	390	162	69	364	162
Veendam	739	64	675	937	305	218	265	315	223
Westerwolde	663	222	441	370	172	248	20	162	248
Totaal	3.846	723	3.123	3.710	1.526	1.173	406	955	1.091

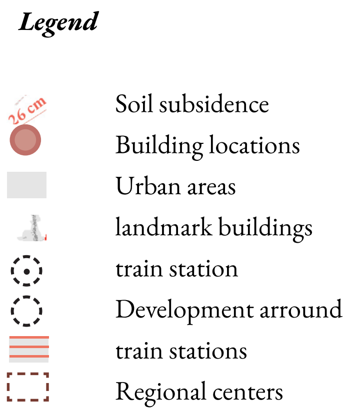
Figure 79 Ambition of new houses Region east-Grongen, source: (Provincie Groningen et al., 2023)

	BRUTO NIEUWBOUW-AMBITIE	SLOOP	NETTO UITBREIDING	NETTO PLAN-CAPACITEIT	HARDE PLAN-CAPACITEIT	BETAALBAARHEID GOEDKOPE HUUR	BETAALBAARHEID MIDDENHUUR (TOT €1000,-)	BETAALBAARHEID GOEDKOPE KOOP (TOT €355.000,-)	WONINGEN DOOR CORPORATIES
Groningen	15.276	3.533	11.743	17.032	3.806	7.681	2.500	2.656	8.766
Het Hogeland	1.710	748	962	1.369	782	993	10	91	991
Westerkwartier	2.417	328	2.129	1.943	616	482	54	726	455
Midden-Groningen	1.967	480	1.359	1.922	554	632	71	119	632
Totaal	21.370	5.089	16.193	22.266	5.758	9.788	2.635	3.592	10.844

Figure 80 Ambition of builing new houses region Groningen-Assen, source: (Provincie Groningen et al., 2023)

> Eemsdelta 3293 new houses
> Oost Groningen 3846 new houses
> Groningen-Assen ? less clear

+ oppertunity to combine trainstations and new building locations
+ oppertunity to make use of old industrial terrains > need a map for this
+ strengthen regional centers



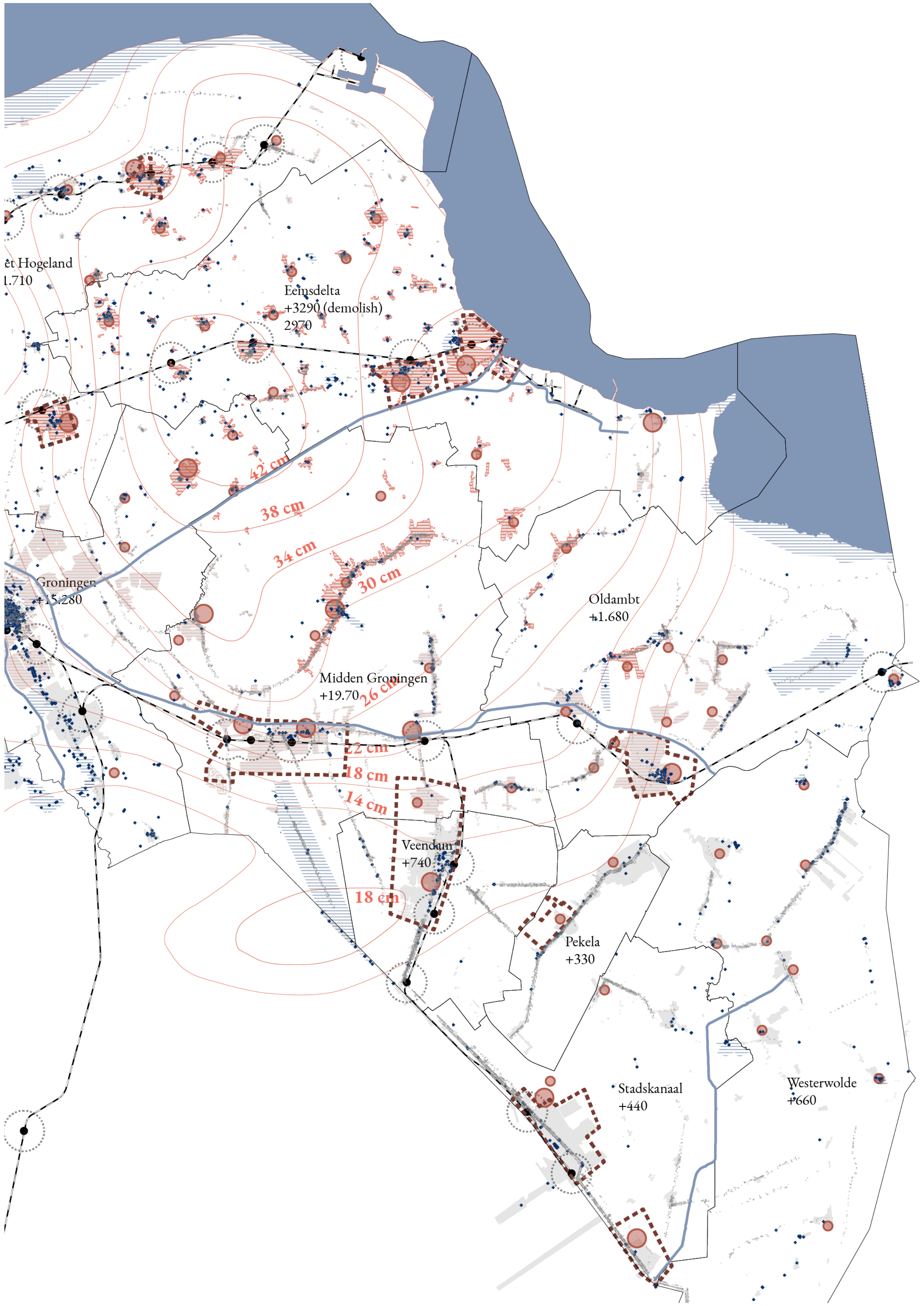


Figure 81 Map of new building locations, and area with damaged buildings, by author, source: (Provincie Groningen, 2022)

3.6 Analysis of the built environment

Smart to build at all?
The housing plans are until 2040; the current data from the Monitor Brede Welvaart 2022 shows that the area will most likely decline, although there will be some growth in the next 10 years in places like Groningen.

It is important to note that population predictions become less reliable over time, meaning that there is still some uncertainty about what the population will look like in the future.

Interestingly also is the municipality of Midden Groningen, the municipality with the lowest land area is predicted to need more housing, and the 2050 vision also includes the idea of building differently with water.

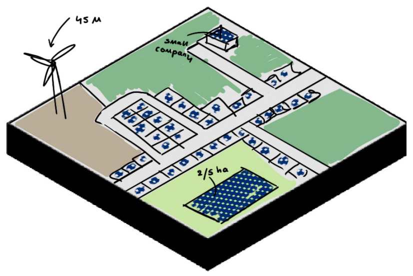


Figure 84 Typology the villages, source: author

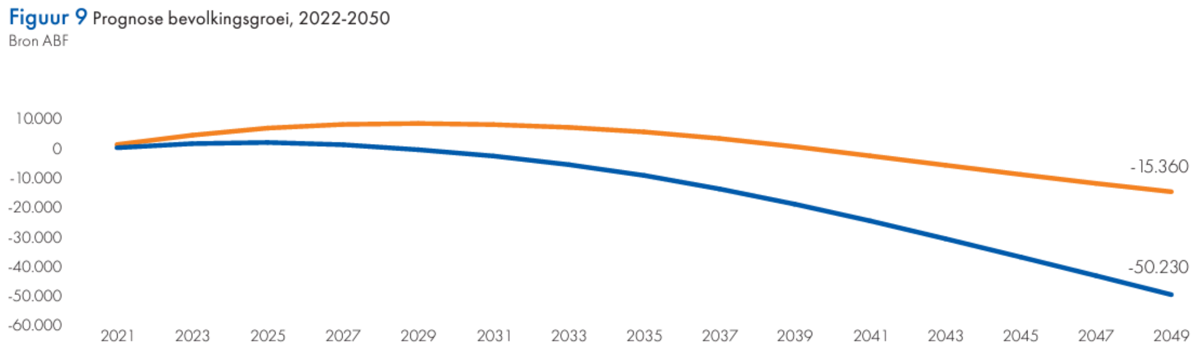


Figure 82 population growth projection 2022-2050, source: (Monitor Brede Welvaart Groningen 2022, 2023)

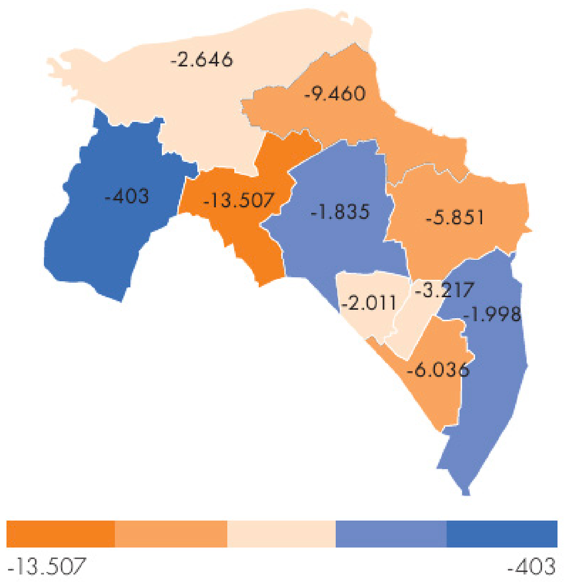
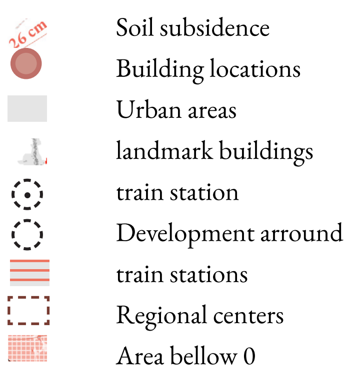


Figure 83 population growth projection 2022-2050, source: (Monitor Brede Welvaart Groningen 2022, 2023)

Legend



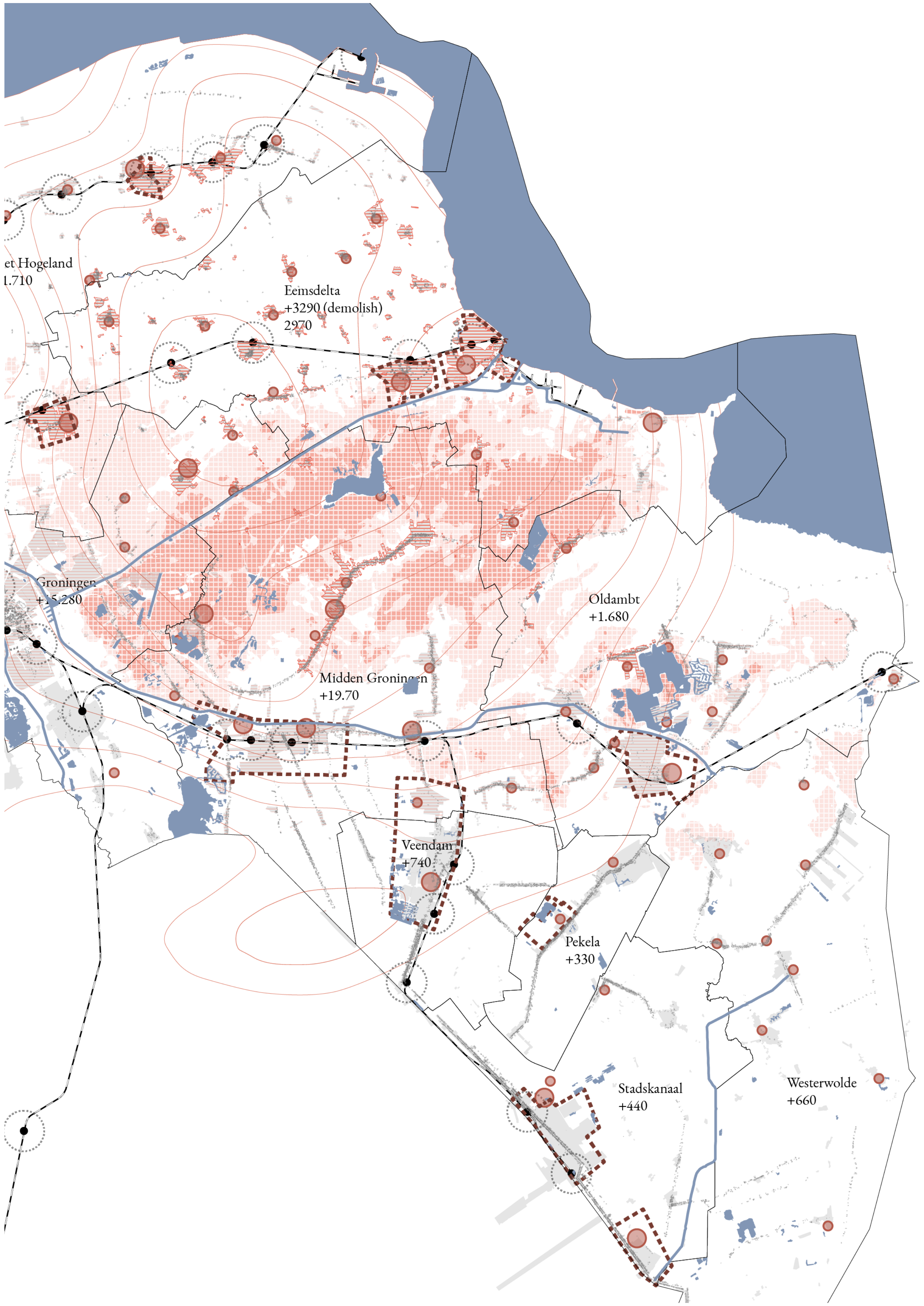


Figure 85 Map of building projects in combination with low area

3.6 Analysis of the built environment

	Reachability	Plot size	orientation	visable location	milieu category	high voltage
1.	Water/Rail/ Road	Large	National	No	6	Yes
2.	Water/Rail/ Road	Large	National	No	6	Yes
3.	Water/Road	Medium	Local/ Regional	Yes	4	Yes
4. Old	Water/Rail	Large	Local/ Regional	Partially	6	No
5.	Water/Road	Large	Regional	Yes	4	No
6.	Water/Rail	Mix	Local/ Regional	No	-	Yes
7. Old	Rail	Mix	Local/ Regional	no	-	No
8.	Road	Medium/ Large	Regional	Yes	4	No
9. Old	Water/Rail	Small	Local	No	4/6	No
10.	Water/Rail/ Road	Mix	Local/ Regional	Partially	3/4	No
11. Old	Water/Rail	Mix	Local	No	3/4	Yes
12.	Water/Road	Mix	Regional	Yes	3/4	Yes
13.	Water/Road	Mix	Regional	Partially	5	Yes
14.	Rail/Road	Mix	Regional/ Local	Partially	3/4	Yes
15. Old	Water/Road	Mix	Local/ Regional	No	4	No
16.	Road	Medium/ Large	Local/ Regional	Yes	4	No

Figure 86 Overview of all the industrial terrains in the central Groningen, by author, sources: IBIS dataset, (gemeente Midden-Groningen et al., 2021)

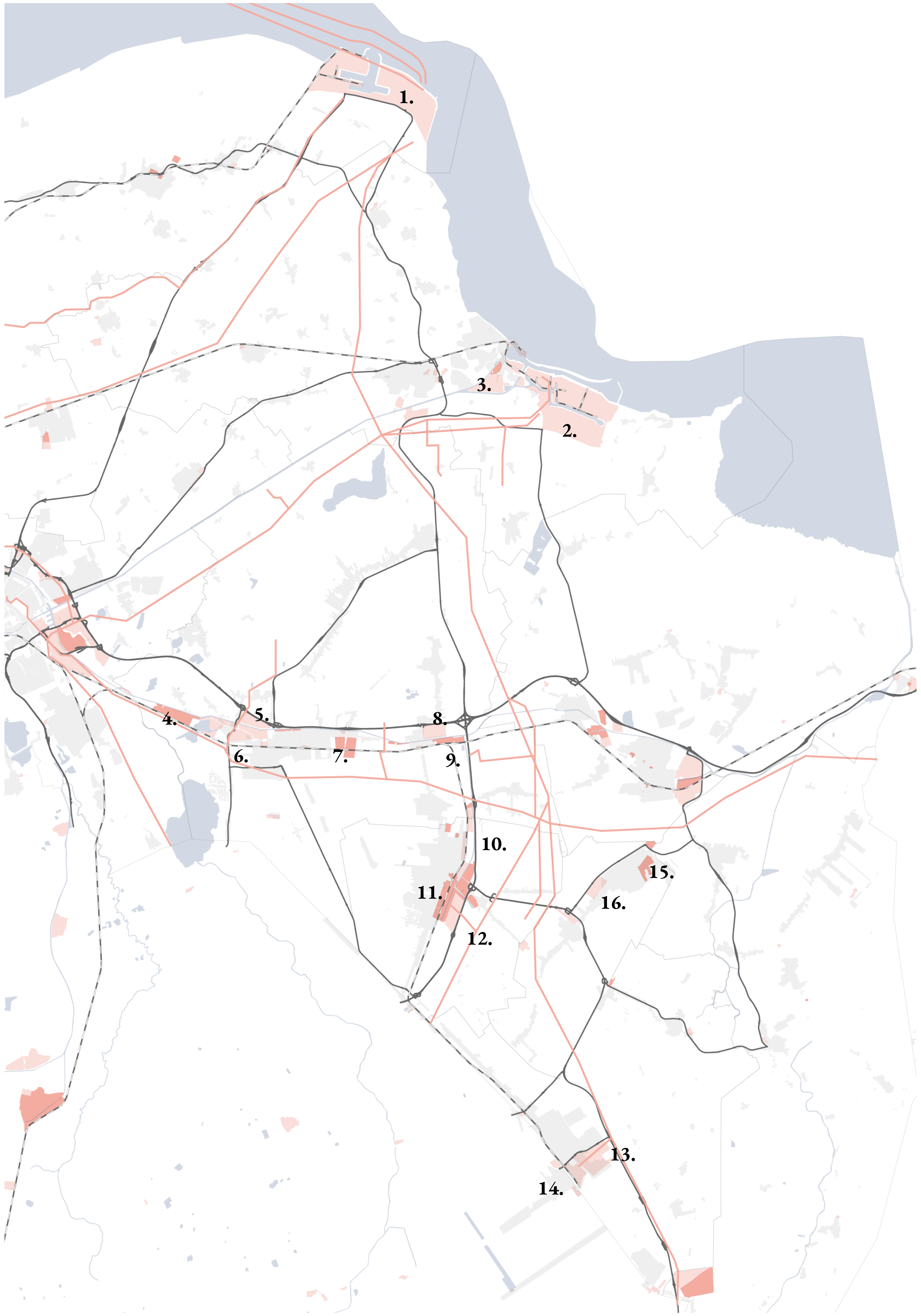


Figure 87 Map of all industrial terrains in the area, by author, sources: IBIS dataset, (gemeente Midden-Groningen et al., 2021)

3.6 Analysis of the built environment

Opportunities for old industrial terrains

The cities of Hoogezand-Sappenmeer and Veendam have a large cluster of industrial terrains. These terrains are often considered old. A good number of these old industrial terrains are in the proximity of train stations. This creates an interesting opportunity to develop these terrains into a more mixed environment for living and working. This would create a more vital city center for these cities with an important regional function.

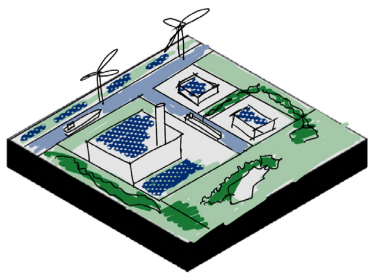


Figure 88 tyoplogy of industry, source: by author

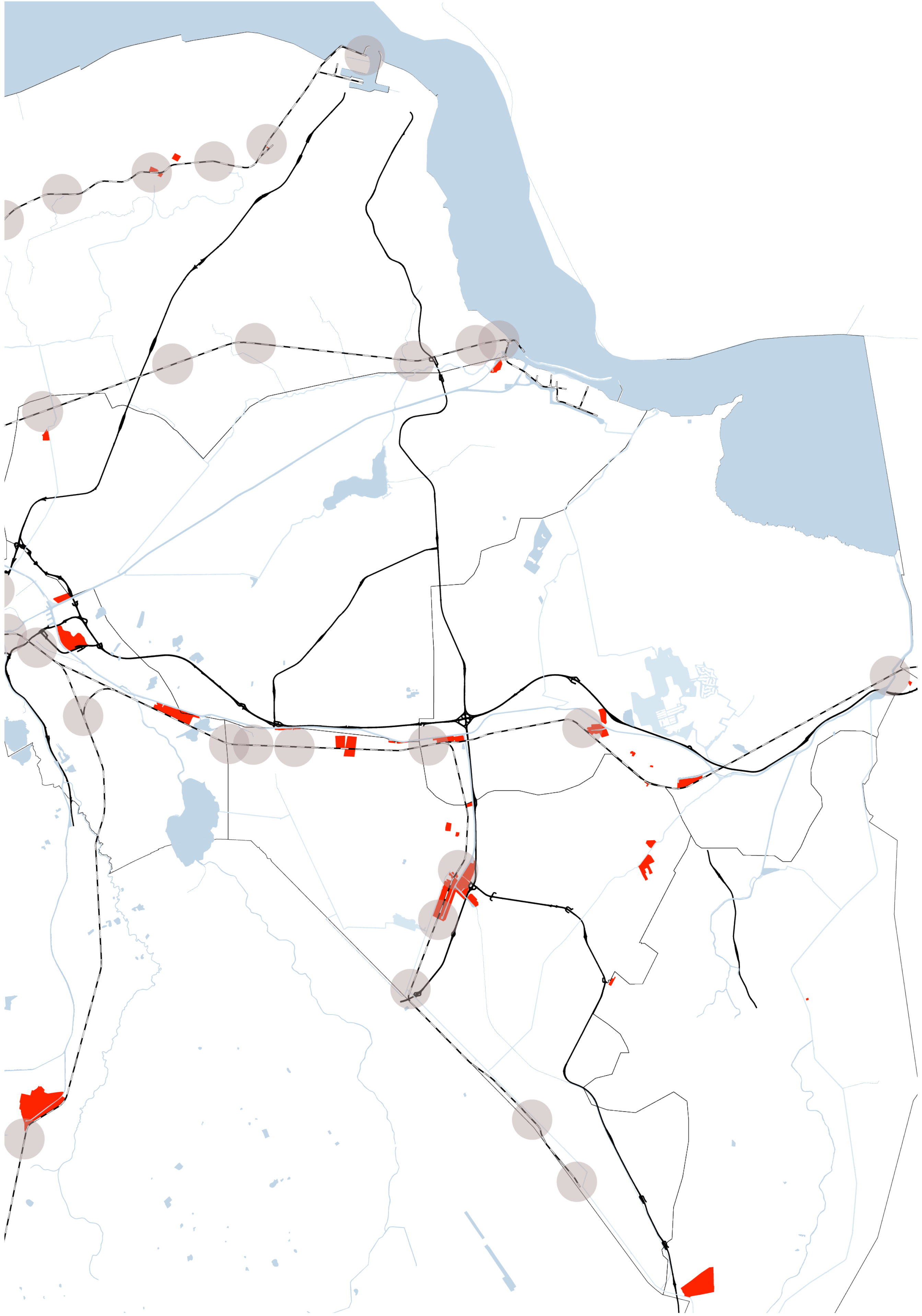


Figure 89 Map of the industries in Groningen by type and what areas are outdated, by author, source: IBIS dataset

3.7 Stakeholder analysis

The energy transition involves various stakeholders, with each falling into one of five categories, further divided into sub-categories based on scale.

The public sector comprises government institutions operating at different levels, each with its own agenda. Larger governmental bodies set rules, goals, and provide funding, while local government bodies translate these goals into strategies that consider local needs and the population.

The capital sector is crucial for the transition, involving investors and bankers providing financial support on a broader scale. Locally, this sector includes landowners who play a key role in project implementation.

The private sector consists of companies with interests in the area, with energy companies being particularly important for advancing the transition. On a regional scale, the involvement of small business owners and local companies is also vital for the success of the transition.

The knowledge sector is vital in providing expertise to support the energy transition and offering socioeconomic data to understand problems and contribute solutions. Sector collaboration is essential to inform and enhance the transition. Additionally, this sector contributes to our understanding of the non-human environment, which requires consideration.

The community comprises organizations and local individuals involved in the transition. Efforts are needed to better inform local communities, with organizations such as Nationale Nederlanden and Toukomst playing a key role. Engagement strategies are required to ensure the least engaged groups and youth participate in decision-making.

An important consideration is the tension that often exists between economic interests and community interests. Governmental bodies should balance these interests, while the knowledge sector and community organizations can help inform and guide discussions to ensure all perspectives are considered.

Public Sector
1.European Union (EU)
2. The Netherlands
3. The province of Groningen
4. Municipalities
5. Tennet
6. Waterboard hunze and Aa
7. Regional energy strategy (RES)
8. Staatsbosbeheer
9. Ministry of public housing
10. Gasunie

Capital
11. Farmers
12. Investors (banks)
13. Local landowners

Private Sector
14. Renewable energy companies
15. Nederlandse Aardolie Maatschappij (NAM)
16. Small companies
17. Groningen Seaport
18. Fossil energy companies
19. Hydrogen energy companies
20. Recreational bussiness owners

Knowledge Sector
21. Groningen University
22. Knowledge institutes
23. Central bureau of statistics (CBS)
24. Brede welvaart Groningen
25. Environmental organizations

Community
26. Nationale Nederlanden
27. Toukomst
28. Fossil industry workers
29. Future workers
30. Youth
31. Least engaged
32. People with damaged houses
33. Just Transition Fund (JTF)
34. Versterkingsoperatie

Non human
35. Nature
36. Animals

Figure 90 Stakeholder analysis, source: author

3.8 SWOT

A SWOT analysis has been conducted to provide an overview of all the challenges and opportunities that Groningen faces. The challenges and opportunities addressed in the strategy are highlighted. Then, the TOWS analysis is used to build further on this SWOT analysis. On the next pages, these opportunities and urgencies are mapped out and shown in relation to one another.

Strengths (internal)

> Landscape qualities
> Infrastructure and space renewables
> Frontier hydrogen
> Gas network
> Expertise in the energy sector
> Eemshaven + Delfzijl industrial terrains
> Cheap living, compared to the Dutch average
> City of Groningen is seen as a qualitative city
> Knowledge of Groningen University
> Strong agricultural sector
> Innovative province

Weaknesses (internal)

> Ground subsidence (peat + gas winning)
> Need for more water storage
> Earthquakes
> Job loss from the closure of the Groningen gas field
> Coal powerplants
> Old industrial terrains
> Damaged buildings
> Low income compared to the Dutch average
> Health is behind in peat areas
> Land-use transformation is needed (local economic activities are under pressure)
> Behind on natural area
> Peripherality

Opportunities (external)

> New energy economy
> Open landscapes, to place renewables
> The area has good accessibility by car
> Nam location, have a lot of potential for the energy transition
> Versterkingsprogramma to rebuild houses and make them future-proof
> Several government funds (JTF, Toukomst)
> Improved train connectivity Lelylijn, Nedersaksenlijn

Threats (external)

> C02 oxidation peat areas
> Houses are worth less
> Decentral location NL
> Water from Ijsselmeer, can cause dry periods.
> Energy network is full
> Least engaged are the most vulnerable in energy transitions
> Aging population
> Out-migration of young adults
> Quality of living environment under pressure
> Shrinkage

TOWS

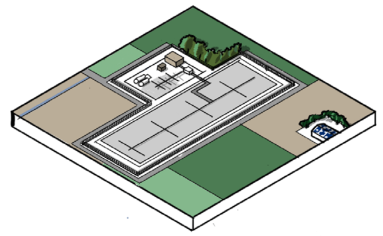
	Strengths	Weaknesses
Oppertunities	**S/O What strengths can you use to capitalize on your opportunities?** Gas infrastructure > Re-use for hydrogen Wind parks on sea > Renewables energy producer Landscape qualities > Tourism, qualitative living environment Open landscape > deployment of renewables is relatively easy. Good infrastructure > attract new companies Nam locations > Free space (300ha) for renewables + good infrastructure	**W /P What weaknesses must be mitigated to capitalize on your opportunities?** Old industrial terrains > restructuring job loss > New jobs in renewables subsiding ground > Increase the water level Low percentage nature > More nature Energy poorness + versterkingsoperatie > Make houses more sustainable. Not in my backyard > renewables JTF + “versterkingsprogramma > help least engaged (but need to include them)
Threaths	**S / T What strengths can you use to better handle your threaths?** Energy expertise > Start point of new economies New land-use> Energy, Wet agriculture and nature Fund government to fix house and make it sustainable > keeps houses from degrading in value Innovation sector > to keep young adults working in Groningen Guard landscape qualities	**W / T What weaknesses can be used by your external threaths?** job loss and decline as a consequence of the phase-out Earthquakes and the quality of towns already under pressure Decentral position > even more outmigration. People’s needs and houses are not the same

3.9 Typologies

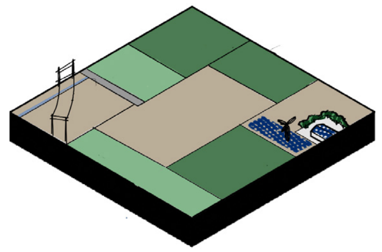
The basic elements

Basic elements derived from generic features or regions within the landscape of central Groningen. These elements have adaptable uses, contingent upon decisions made in the future. Here, we provide a detailed examination of these elements, including their current state, potential future trajectories, key stakeholders involved, and the associated processes and timelines for each element. These elements serve as foundational components utilized in the scenarios and strategy, offering flexibility in the decision-making process.

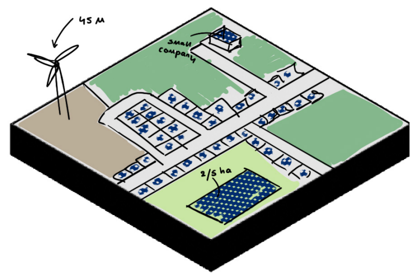
The nam location



CO2 oxidation areas



Urban area



Inndustry areas

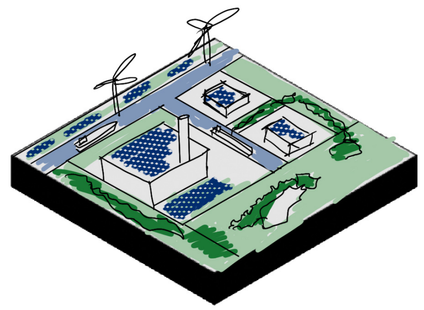


Figure 91 Basic elements, source: author

Figure 92 Photos of NAM location, source: author

Figure 93 Photos of NAM location, source: author

3.9 Typologies

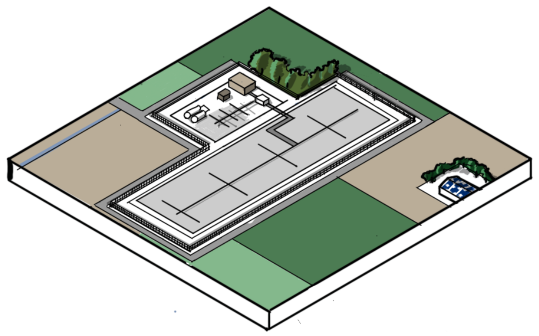
The Nam location

Current state
The locations are either closed, permanently or closed, but still on standby. The current procedure is that the location should be given back to the farmers in "farmable condition",

Process
The locations are built on agricultural land. In 2023, the Dutch government stopped the gas winning, and the last locations will be closed in 2024. The decommissioning of the sites will start no later than 2026 and will take about five years to complete (Locaties en activiteiten | Nederlandse Aardolie Maatschappij, n.d.). The NAM and other parties have suggested that the locations can be re-used for other purposes. However, the current procedure is to give the land back in farmable condition.

Values
The NAM locations are connected to high- or medium-tension cables. This network can be reused for renewables that need a connection to the high-voltage network. After 2030, gas pipelines can be re-used for hydrogen, which can be used to store energy or raw materials for industrial processes. An additional use case is hydrogen for mobility.

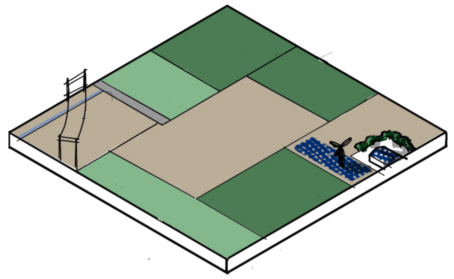
Types
A. back to agriculture (avoid this > inform farmer)
B. Re-naturalize the area
C. Energy production hub
    C1 Place renewables
    C2 Renewables + hydrogen
    C3 Renewables + re-naturalize
    C4 Renewables + hydrogen (remote)
    C5 Renewables + hydrogen (mobility)



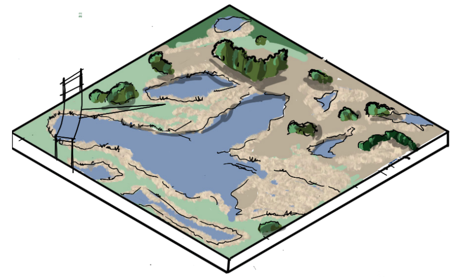
Process of closure takes 5 years

Figure 94 NAM loctaion typology, source: author

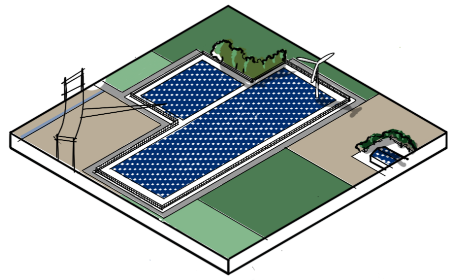
Figure 95 Proposal to rebuild a former NAM gas cleaning location towards an energy hub, source: ('Over GZI Next', n.d.)



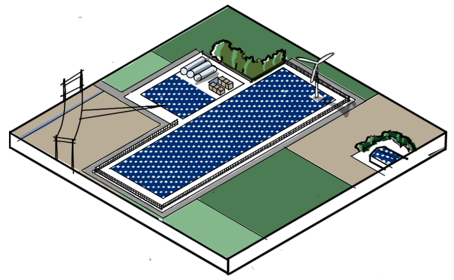
A. Back to agriculture
This option is available for farmers who decide they want to bring the gas extraction sites back to their original state. This option does not capitalize on the opportunities that are already in place.



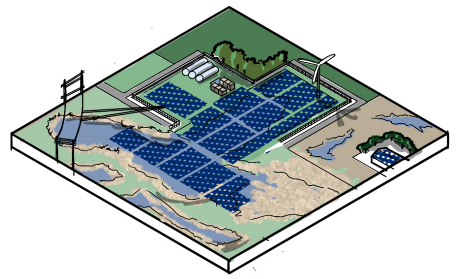
B. Natural area
When the gas extraction location is in the CO2 emission areas, the area can be re-naturalized. To become part of the natural corridor in the area.



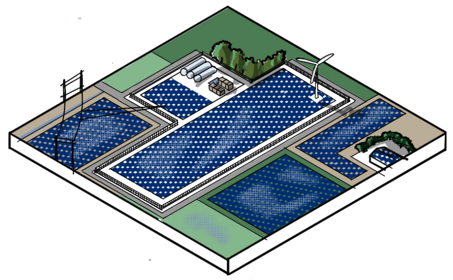
C1. Solar field
The preferred option is transforming the gas extraction to a renewable energy production location. This option is the initial stage of the NAM location; C2 – C5 are more developed versions of the energy production location.



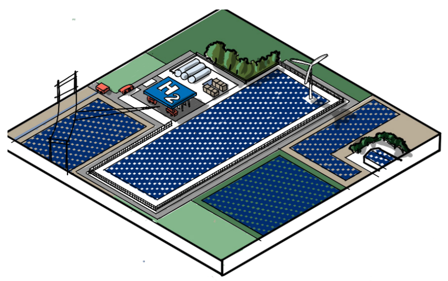
C2. Energy production + hydrogen
Possible after 2030



C3. Energy + re-naturalize
Is possible when the location to be close to or within the natural corridor



C4 Renewables + hydrogen (remote)
Creating more space for renewables, possible in combination with water areas or CO2 oxidation areas



C5 Renewables + hydrogen (mobility)
Possible when close to an urban area and well-connected to a main road.

Figure 96 Options for the typology NAM location, source: author

Figure 97 Photos of the peat oxidation areas, source: author

Figure 98 Photos of the peat oxidation areas, source: author

3.9 Typologies

Peat oxidation areas

Current state
For the CO_2 oxidating areas, there are several options, depending on the risk and potential of the areas. By increasing the water levels in the area, CO_2 oxidation and ground subsidence are prevented. These processes would, over time, result in agricultural land that is either too dry or too wet.

The area can be transformed into a natural area or an area with wet agriculture in different forms. Considerations for the choice of agriculture or natural area are 1) Is the area within the CO_2 emission area? 2) what is the agricltural potential according to Deltares? 3. Does it make sense to include the area in the natural corridor?

The process
To prevent CO_2 emissions is initially kept at the same level. At the same time, agricultural pilots are done to test different types of agriculture. After 2030, the water level can be gradually raised to create wet conditions and completely stop the CO_2 emissions.

Types
A. Keep the current agriculture
B Naturalize the area
    B1. Naturalize the area
    B2. Naturalize with energy production
C Wet agriculture
    C1. Extensive grazing
    C2 Farming with high water levels
    C3 Under water farming

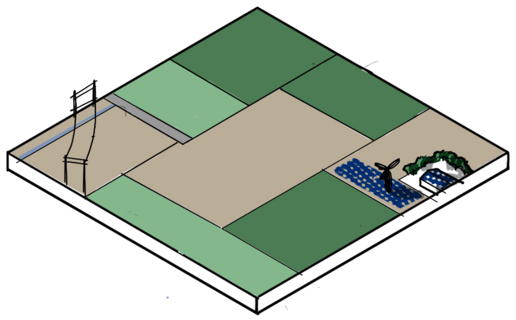
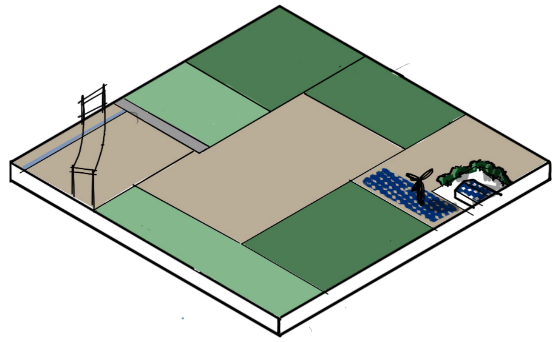
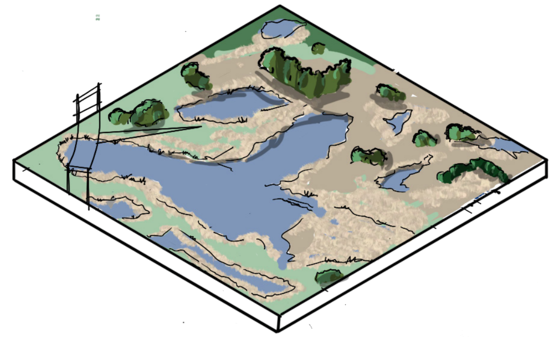


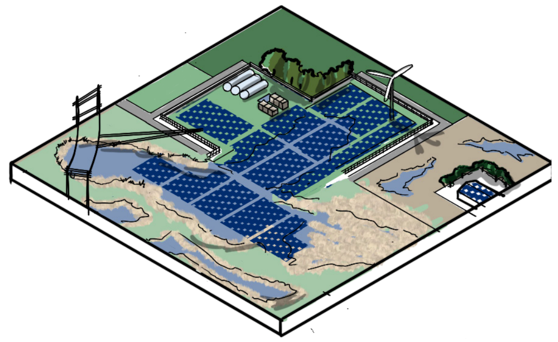
Figure 99 Typology peat oxidation area, source: author



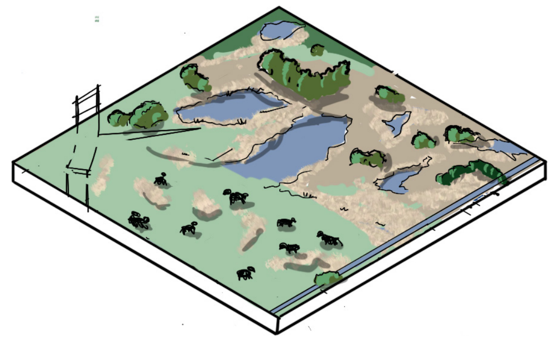
A. Keep the current agriculture
Keeping the current agriculture is not a preferable option since it would result in more CO_2 emissions, ground subsidence, and ultimately lead to either dry or wet land for optimal farming conditions.



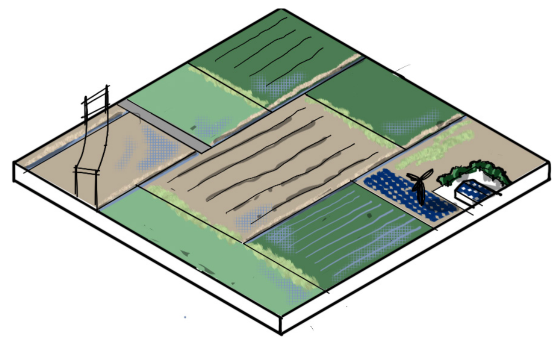
B1. Naturalize the area
The area could be included within the natural corridor



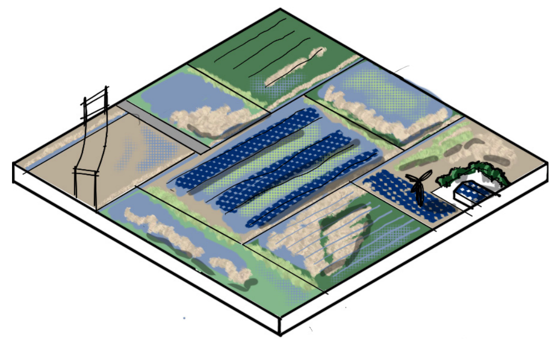
B2. Naturalize with energy production
When the area is within or on the edge of the natural corridor and close to a NAM location the area can be used for energy production in combination with nature.



C1 Extensive grazing
Extensive grazing can be done in areas with a higher water level, creating a semi-natural area.



C2. Farming with high water levels
Crops can be harvested on lands with a higher water level.



C3. Under water farming
Some crops grow well in areas that are fully under water; an additional source of income can be to combine this with floating solar panels.

Figure 100 Options for the typology peat oxidation area, source: author

Figure 101 photos of the industrial areas in Hoogeveen , source: author

Figure 102 Photo of monumental factory in Hoogeveen, source: author

3.9 Typologies

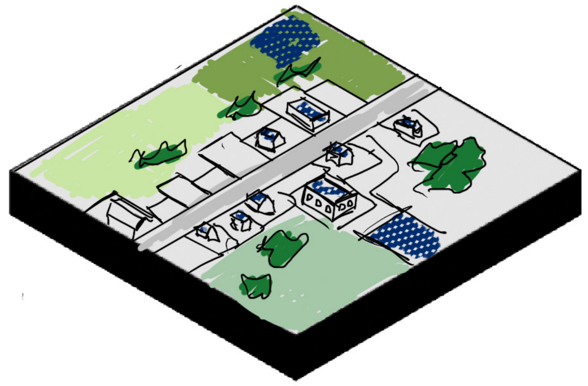
Industry possibilities
Industry locations in the region will have to deal with the energy transition and the socio economic impact of shrinkage in the region. These areas can deal with the energy transition and challanges on nature in a different way.

Self sustaining landscape
A. 1/2 in villages

Typologies dependend on large scale energy proction:
B. 3/4
  B1 industry
  B2 Mixed-use
C. 5/6
  c1 Energy production
  c2 Nature

Class 1/2 (offices, shops)

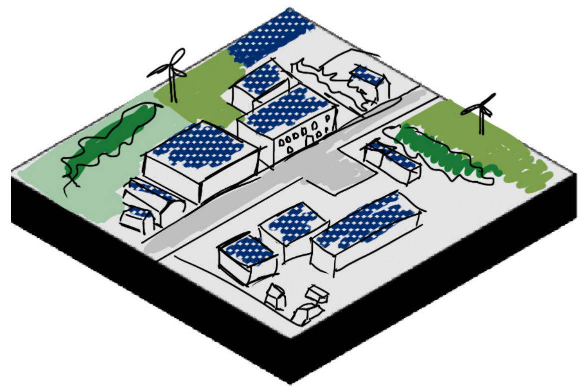
Class 1 and 2 industries are mostly shops, small businesses, and offices. These industries are vital to the local community. Most of the businesses are in urban areas and are important for the local economy. With solar panels on the roofs, these businesses can provide for their own energy needs.



Class 3/4 (small companies, maufacturing)
Mixed use development (need energy)

The class 3 and 4 industries are local and often have a local-to-regional focus. Due to small environmental complaints, there traditionally separated from the urban areas although in recent years there have been more experiments with a mixed-used environment, especially the old harbor and business terrain that were closely located in the city. This

This is inherited from the peat colonies, where a strong mix of functions was happening at the lint and around the canals. This offers an opportunity to explore these options again, especially around the areas with a train station.



5/6 heavy industry
Natural areas / industry (need energy)

Heavy industry has a large environemntal zone and the industrial activities cannot be combined with living activities, but within this area there could be more attention to re-naturilzations of part of the terrain and there is room for large scale energy production, that can be used by the local industries that often demand a high amount of enegry.

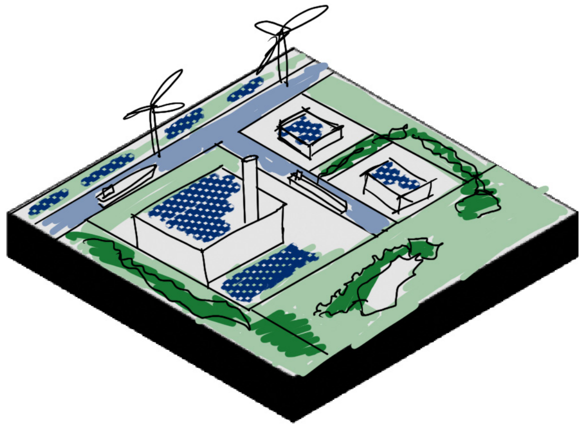


Figure 103 Typologies of industry, source: author

Figure 104 New buildings bellow the water level in Midden-Groningen, source: author

Figure 105 Urban typology of the lint, source: author

3.9 Typologies

Urban possibilities

The urban typologies are adapted from RES Groningen et al. (2020). Renewables need to be placed within these areas. There is a distinction between the smaller-scale typologies that can produce their own energy needs and the large-scale landscape dependent on other large-scale production facilities for energy production.

The villages and small towns are often part of the lint areas within the region; the qualities in these areas need to be protected, but shrinkage will also heavily influence them. The medium-sized towns and small cities are often part of the regional centers and are vital for the economic activities within the region.

Self sustaining landscape

A. yards

A1. Non agricultural yard

A2. Agricultural yard

B Village

C Small towen

Typologies dependend on large scale energy proction:

D Medium sized town

E Small city

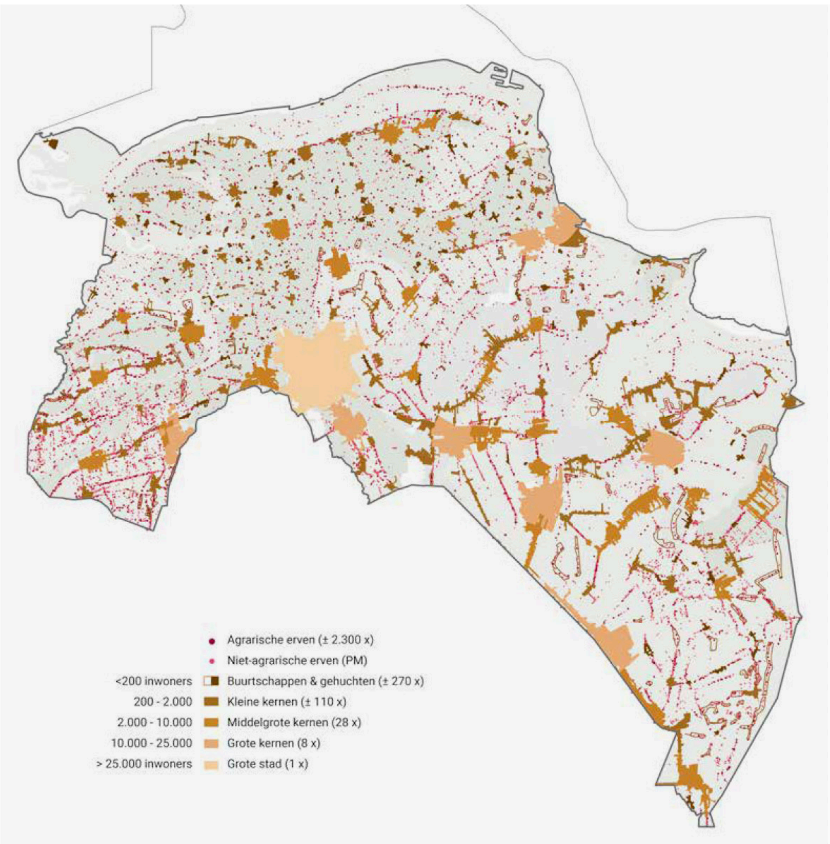
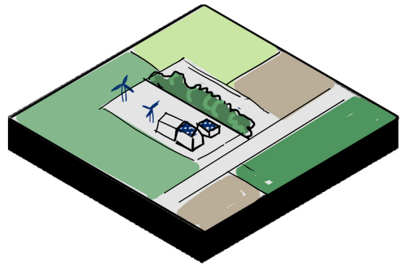
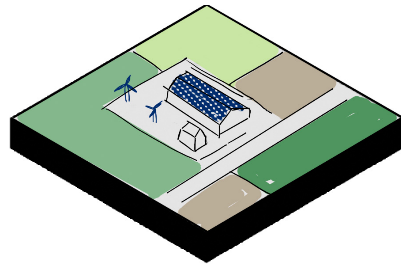


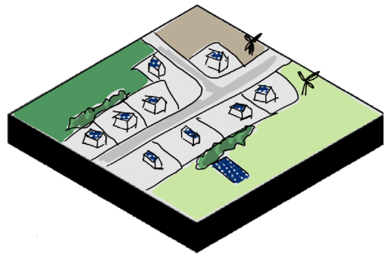
Figure 106 Urban typology in the region, source: (RES Groningen et al., 2020)



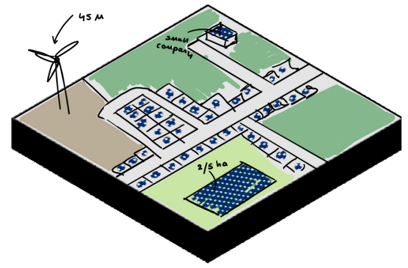
A1. Non agricultural yard
Solar panels on roofs / small windmills



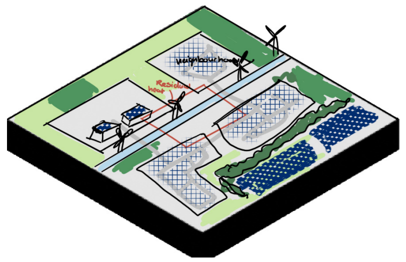
A2. Agricultural yard
Solar panels on roofs / small windmills



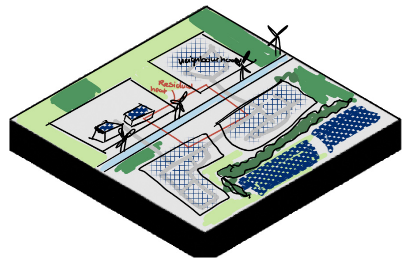
B. Village <200 people
Solar panels / comunity windmills / small solar fields



C. Small town <2000 people
Solar fields 2/5 ha / comunity windmill 45m



D. Medium sized town 2.000-10.000
Solar fields, windmills, heatnetwork



E . Small city 10.000-25.000
Solar fields, windmills, heatnetwork + external prodcution

Figure 107 Urban typologies, source: author

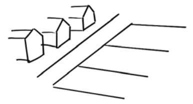
3.10 Preconditions and principles

"Preconditions are the essential requirements that must be fulfilled for a specific process to occur. They establish boundaries that cannot be exceeded during the execution of the process, providing a framework within which the process can operate effectively".

(Randvoorwaarden - de Betekenis Volgens Ensie Encyclopedie, n.d.)

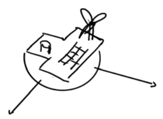
Preserving the Groningen landscape and identity

The landscape of Groningen is distinctive, encompassing various landscapes and unique building structures like the lint. It is imperative to protect and sustain these landscape features.



Placement of renewables and reuse of current energy infrastructure

Transitioning to sustainable energy production requires repurposing existing gas infrastructure and NAM locations. The placement of renewables must consider the current landscape characteristics and structures.

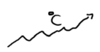


Ensuring economic competitiveness

As Groningen transitions away from gas towards renewable energy, its economy must rapidly evolve. The strategic goal is to foster new sustainable economies that enhance Groningen's competitiveness.

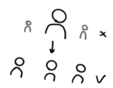
Addressing climate change challenges

The region faces significant challenges related to water storage, ground subsidence, and CO_2 emissions from peat oxidation. These issues require comprehensive addressing and management.



Inclusion of all groups in society

The energy transition in Groningen should be just and all groups, especially vulnerable groups, should be considered and actively involved in decision-making.

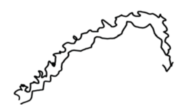


"Principles are guiding choices that shape the planning process, providing a framework within which deviations may be permitted under certain circumstances and with justification. "

(Uitgangspunt - de Betekenis Volgens Ensie Encyclopedie, n.d.)

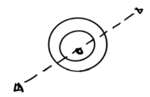
Establishing a nature network throughout Groningen

The Groningen area boasts numerous peat oxidizing areas that could be interconnected to form an extensive natural network spanning the entire region. This initiative aims to enhance biodiversity and water storage capacity, benefiting the entire central region of Groningen.



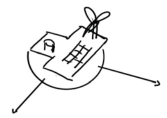
Transforming train stations into development hubs

Cities like Hoogeveen and Veendam are designated as development areas centered around train stations, serving as interconnected nodes within the network. Despite anticipated shrinkage, these development areas retain vital functions, ensuring continued vibrancy and connectivity within the region.



Repurposing NAM sites for renewable energy

NAM locations serve as focal points for renewable energy development in the strategy. Leveraging existing infrastructure provides Groningen with a competitive edge in transitioning rapidly towards hydrogen, thus enhancing its economic viability.



Enhancing opportunities for recreation and tourism

Expanding recreational opportunities enables small picturesque villages and natural areas to improve their economic standing and preserve their cultural heritage.

Scenarios

Figure 108 Painting of peatexclavations painted by Jacobus Sibrandi Mandadan: source: (De grote veenkolonisatie in de Middeleeuwen, n.d.)

4.1 Introduction

This chapter presents three scenarios that outline possible future paths for Groningen, each reflecting different values and objectives in spatial design and planning. The scenarios are inspired by the PBL (Planning Bureau of the Living Environment) future projections for the Netherlands in 2050. (Kuiper, Rienk et al., 2023) They provide insight into existing challenges and offer approaches and solutions to the problems.

Despite their differences, the scenarios share a common basis and encompass fundamental principles applicable to each scenario, albeit with slight differences. For instance, each scenario strives for 100% self-sufficiency in renewable energy generation, but the energy requirements and the location differ, leading to distinct spatial compositions. Additionally, each scenario introduces unique spatial interventions, which may vary based on the specific geographic location in different scenarios, necessitating future decision-making.

The scenario evaluation shows the areas with spatial competition. The preconditions and principles from the analysis are then used to provide insight into the strong and weak points of each scenario. The strategy developed in the next chapter is a combination of the scenarios.

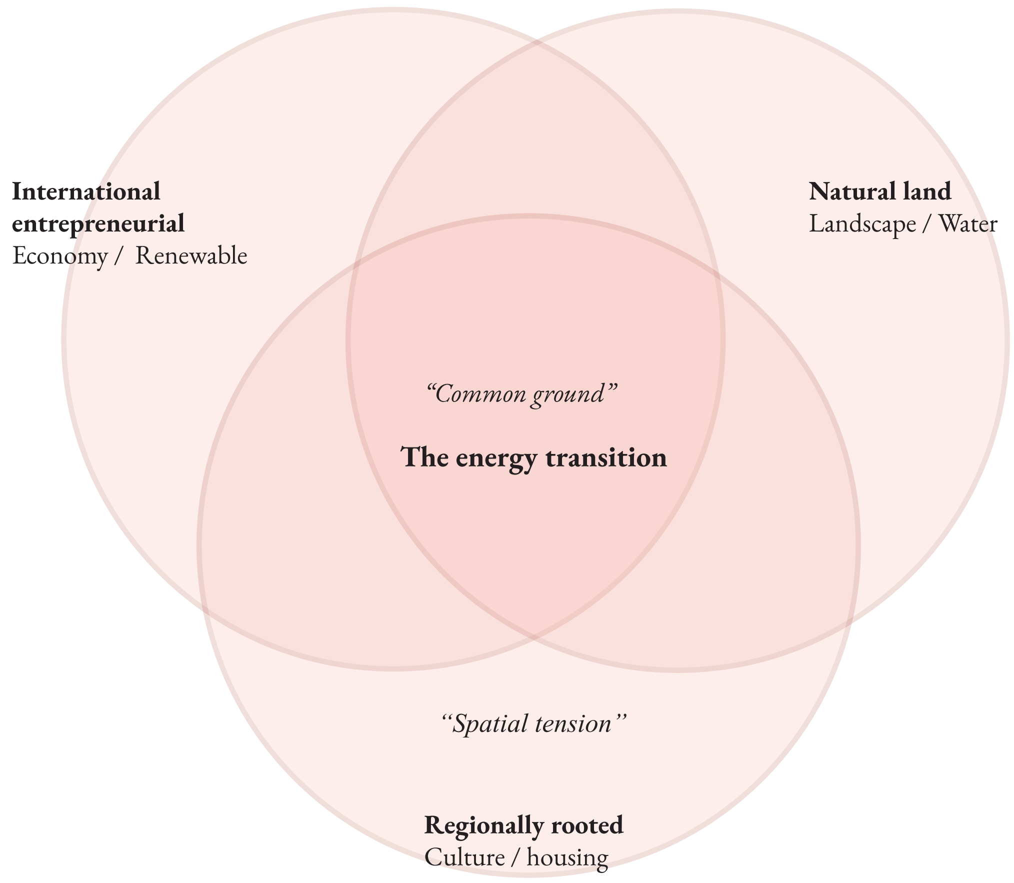


Figure 109 Three scenarios have common ground and spatail tention, source: author

4.1 Introduction

Parameters have been developed to understand better what values are important for each scenario. There are general values and planning and design values. The general values are closely linked to societal trends and values within society. To some extent, these values can be associated with political parties and agendas. For instance, left-leaning and progressive political factions prioritize aspects such as environmental conservation, support for local businesses, and fostering a compassionate society. Conversely, right-wing conservative parties emphasize economic prosperity, maintaining a conducive business environment, and ensuring societal efficiency.

Planning values, on the other hand, are more focused on decisions regarding spatial design. Many of these values revolve around the debate between concentration and dispersion. Industries concentrated in specific locations may benefit from enhanced knowledge exchange, access to optimal network positions, and economies of scale, which can bolster their competitiveness on a broader scale. However, this concentration may come at the expense of reduced economic activity in other localities.

The parameters and their associated advantages and disadvantages are further delineated within each scenario.

General values	**General values**
Local bussineses	Supra regional companies
Human in nature	Human above nature
Work with shrinkage	Work against shrinkage
Low energy production (5,7)	High energy production (+6,4)
Fallible	(Culture) Perfection
caring	(people) Efficient
Planning and design values	**Planning and design values**
Spread out local bussinesess	Concentrated industry
Spread out small nature	Nature is clustered
Expantion	Densification
Energy is spread out	Energy is concentrated

Figure 110 Parameters for the scenarios, source: author

4.2 Scenario: Natural Groningen

In the first scenario, Natural Groningen, the prioritization of nature and biodiversity is paramount. Efforts are directed towards minimizing CO2 emissions and ceasing human activities detrimental to natural ecosystems. In these areas, the focus shifts towards restoring natural habitats to their original state.

This scenario will have significant implications for agriculture and businesses in the region, requiring a shift in current practices towards working in harmony with nature. Farmers with land in high-risk peat oxidizing areas are bought out, after which the land is converted into nature reserves. Areas with minimal peat in the subsoil can adopt nature-inclusive agricultural practices.

Energy production in this scenario is moderate compared to others. While recognizing Groningen's potential for energy production, the scenario acknowledges a lower national energy requirement due to the limited attraction of companies. Moreover, energy generation is restricted to areas that are not crucial to natural structures, ensuring biodiversity preservation. NAM locations are utilized to their fullest potential, provided they are not in high-risk peat oxidation zones or protected nature reserves.

Human activities are concentrated in regional centers with enhanced public transport connectivity. Consequently, rural areas will gradually depopulate, leading to decreased vitality in small villages. However, this results in more space, nature, and biodiversity.

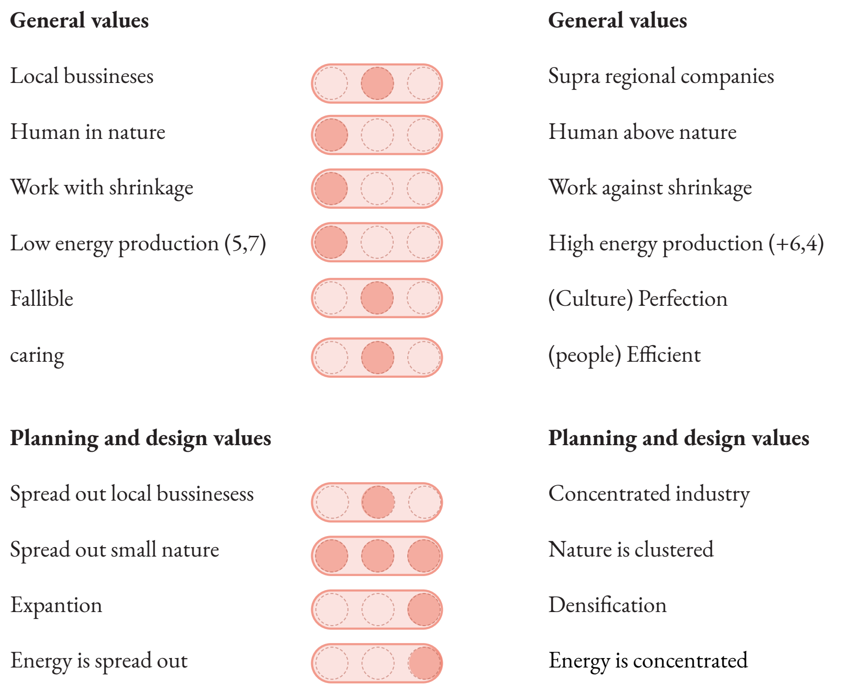


Figure 111 Parameters for the scenario natural land, source: author

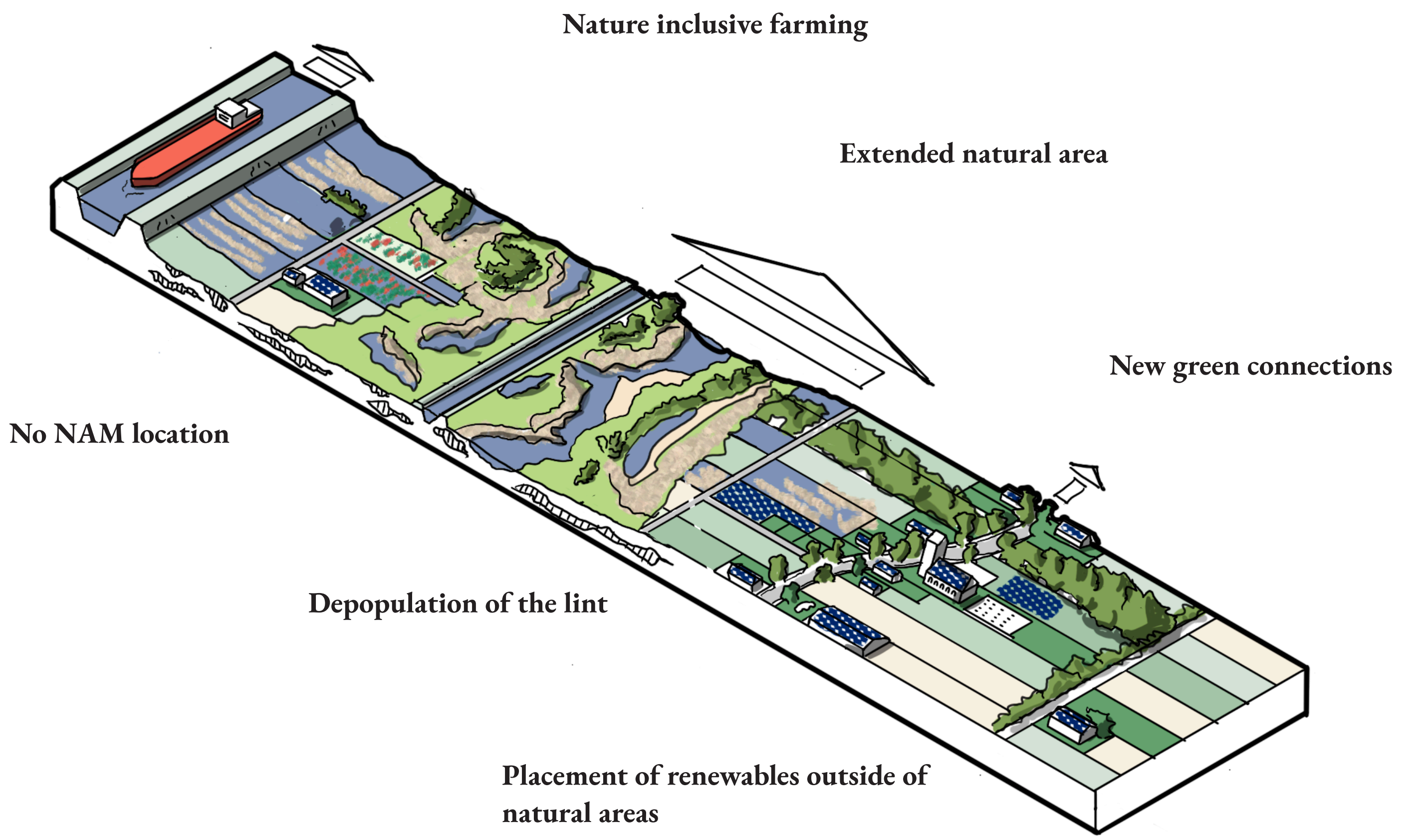


Figure 112 axonometric section central world area for scenario natural land, source: author

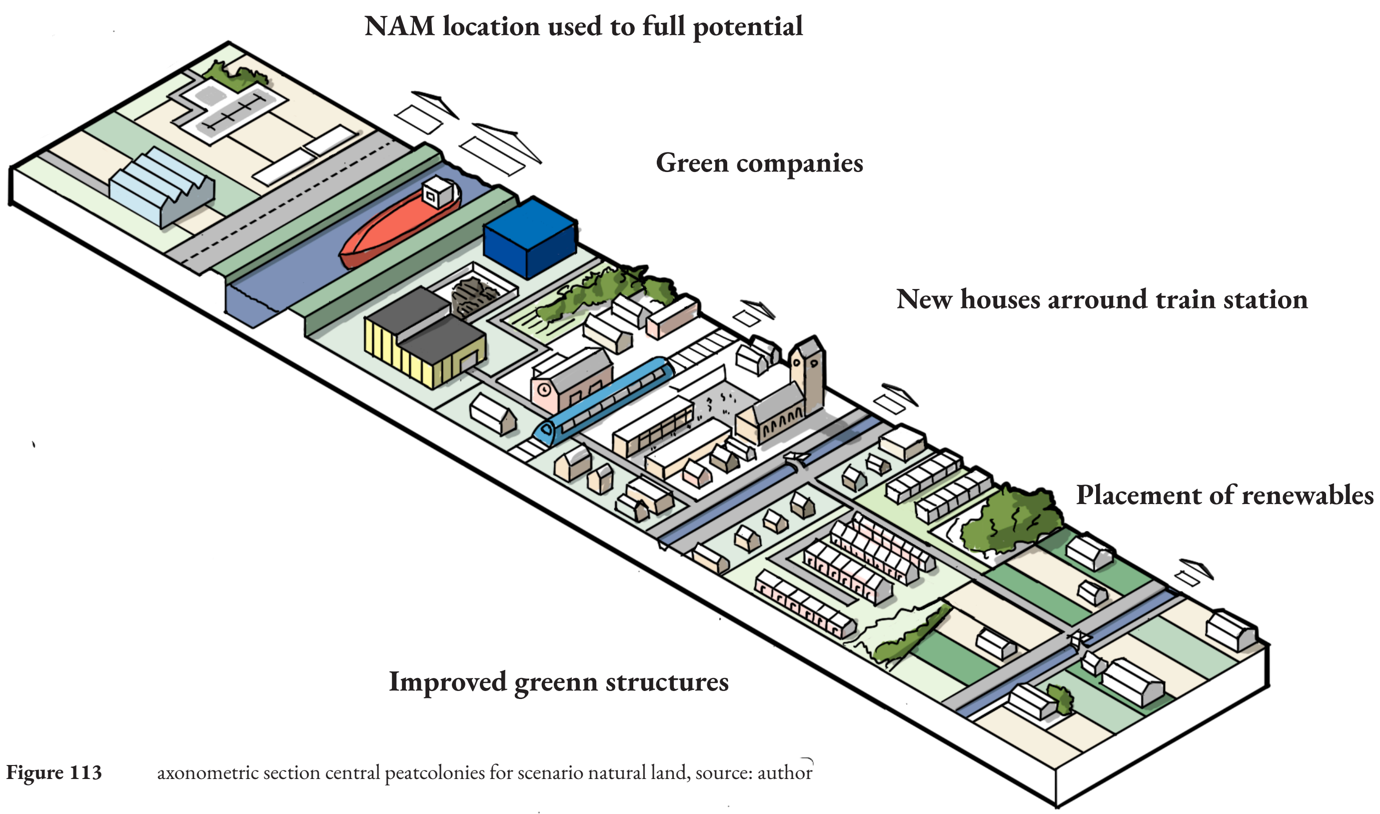


Figure 113 axonometric section central peatcolonies for scenario natural land, source: author

4.2 Scenario: Natural Groningen

Preconditions

- Preserving the Groningen landscape and identity
+ Placement of renewables and reuse of current energy infrastructure
- Ensuring economic competitiveness
++ Addressing climate change challenges
- Inclusion of all groups in society

Principles

++ Establishing a nature network throughout Groningen
+ Transforming train stations into development hubs
+ Repurposing NAM sites for renewable energy
- Enhancing opportunities for recreation and tourism

Important typologies

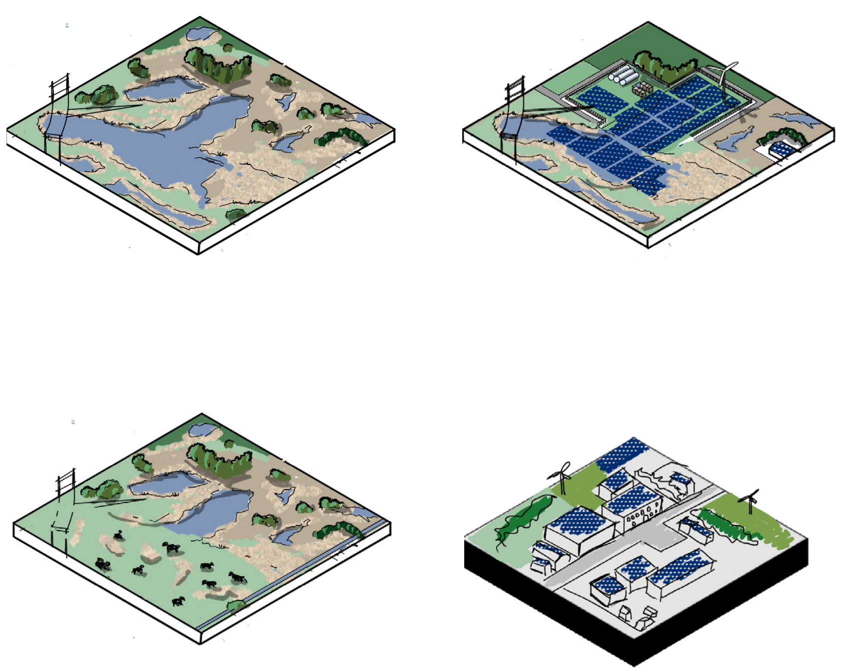


Figure 114 Important typologies for the scenario natural land, source: author

Legend

Wet agriculture
Re-naturalized areas
Nature corridor
Green corridors
NAM locations
Existing solar fields
Solar fields
Wind turbines
Hydorgen
Monuments
Protected areas

3/4 ind. class
5/6 ind. class

Water
Urban
Main roads
Trainlines
Nature areas
High voltage cables

Development arround train stations

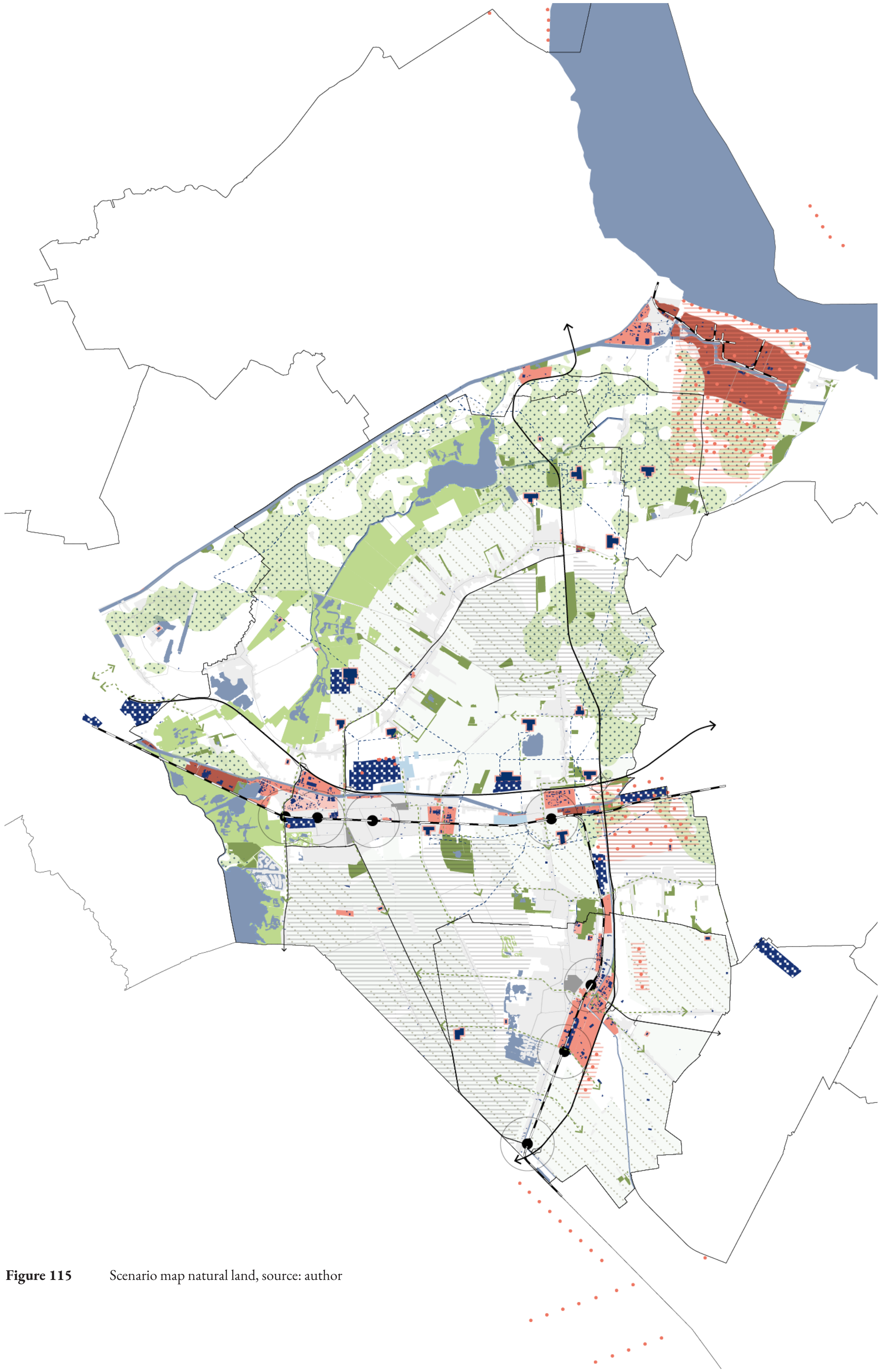


Figure 115 Scenario map natural land, source: author

4.3 Scenario: International entrepreneurial

In the scenario of international entrepreneurship, the emphasis shifts towards the economic vitality of the region and Groningen's economic standing within the Netherlands and Europe. Groningen is strategically positioned as a leader in energy expertise, possessing reusable infrastructure, and ample space for energy production. The goal in this scenario is to uphold Groningen's status as an energy-exporting region.

The region's abundant energy resources are anticipated to attract large corporations, leading to the clustering of these companies to reap economic advantages. Nature conservation takes a secondary role in this scenario, with measures to mitigate rising water levels and limit CO2 reduction primarily targeted at areas with significant peat deposits. Meanwhile, areas with limited peat content in the soil are preserved for agricultural use. The expansion of energy production also presents opportunities for establishing new greenhouses, maximizing the efficiency of agricultural land.

Areas earmarked for potential flooding could be repurposed for energy production through solar fields, with the consideration of additional wind turbine installations in the region. While preserving efficient agricultural land remains a priority due to its economic significance for Groningen, inherent risks such as land subsidence and CO2 emissions need to be managed.

The countryside is perceived as serving the larger economic centers, resulting in significant transformations within the region. Economic opportunities take precedence over natural qualities in this scenario.

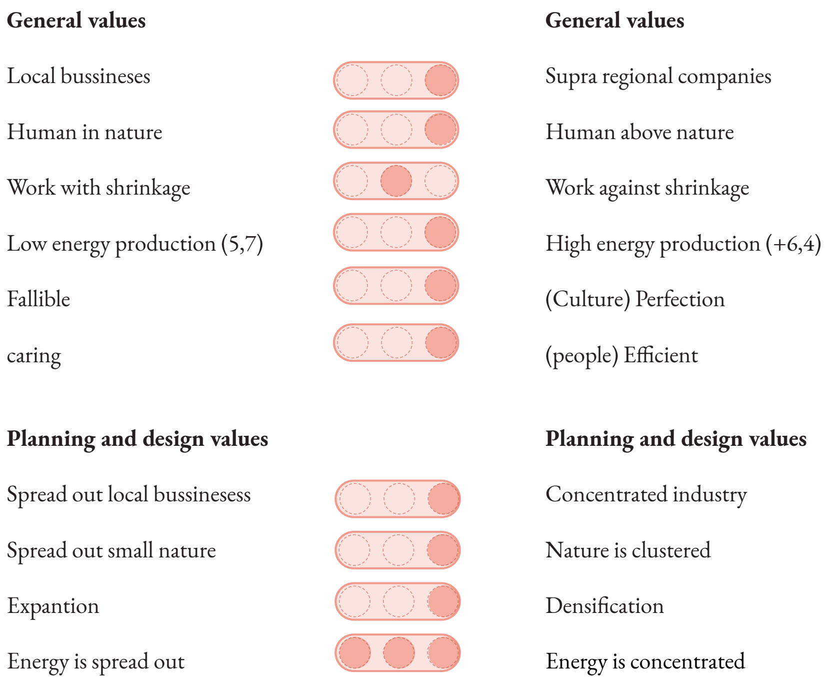


Figure 116 Parameters for the scenario International entrepreneurial, source: author

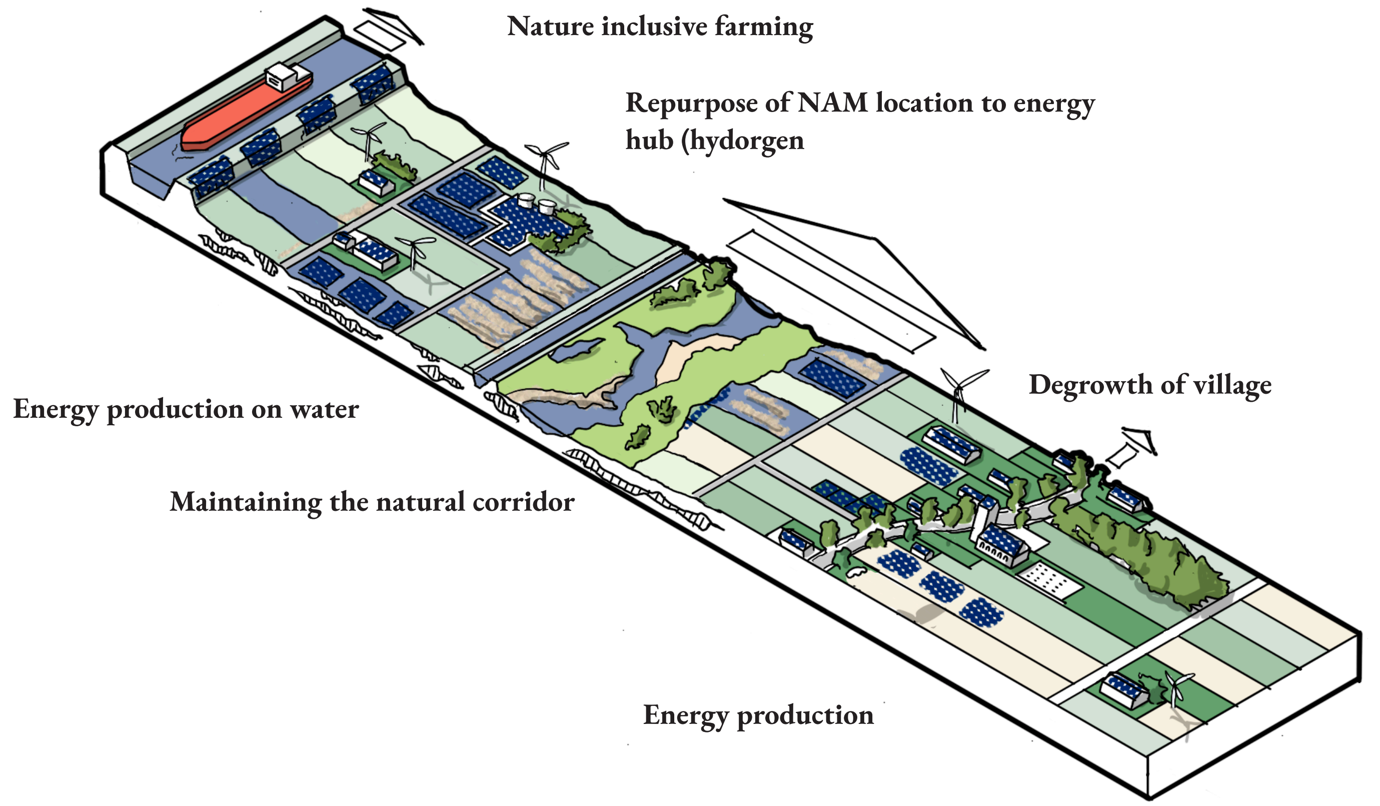


Figure 117 axonometric section central world area for scenario International entrepreneurial, source: author

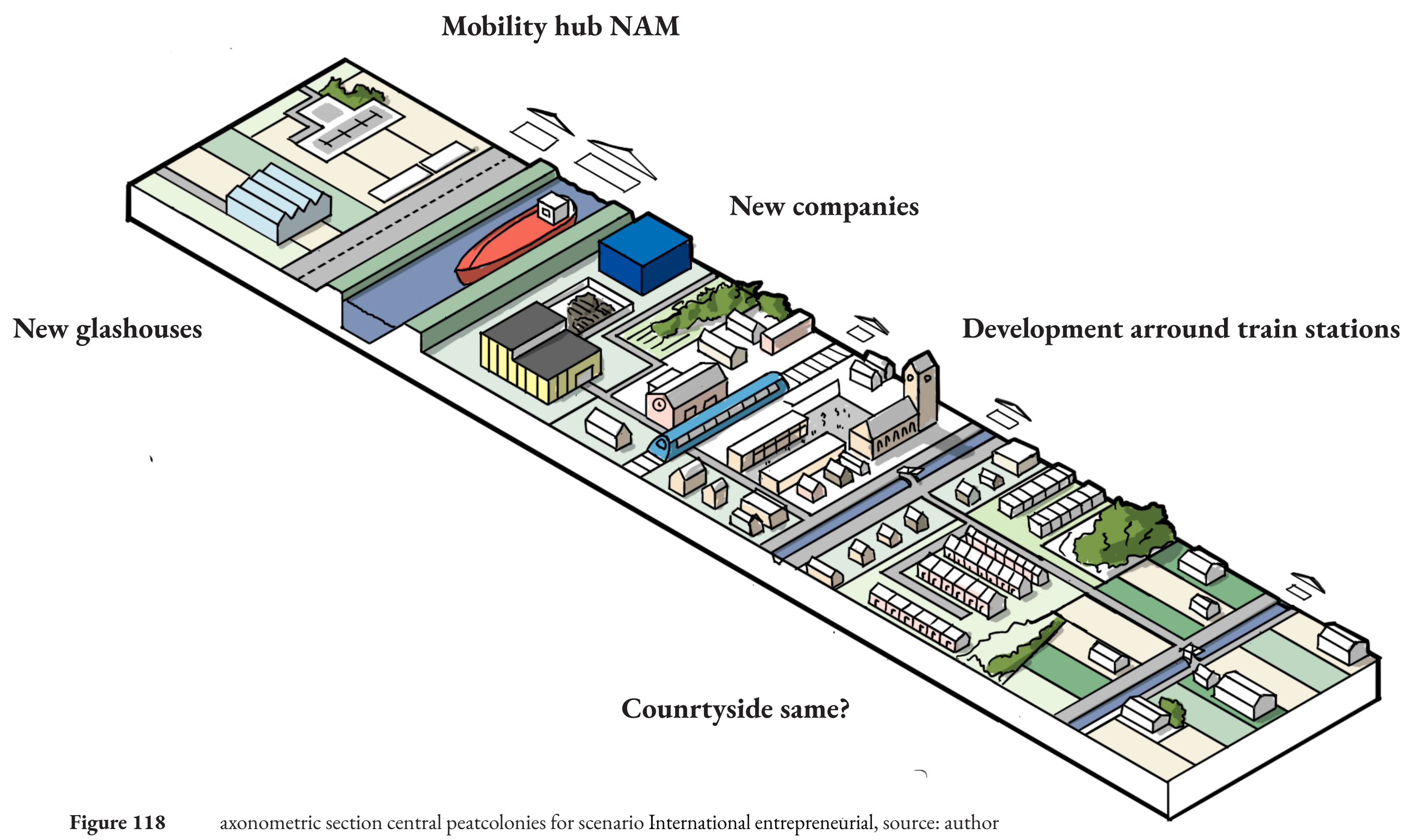


Figure 118 axonometric section central peatcolonies for scenario International entrepreneurial, source: author

4.3 Scenario: International entrepreneurial

Preconditions

- Preserving the Groningen landscape and identity
++ Placement of renewables and reuse of current energy infrastructure
++ Ensuring economic competitiveness
+ Addressing climate change challenges
- Inclusion of all groups in society

Principles

- Establishing a nature network throughout Groningen
++ Transforming train stations into development hubs
++ Repurposing NAM sites for renewable energy
- Enhancing opportunities for recreation and tourism
- Inclusion of all groups in society

Important typologies

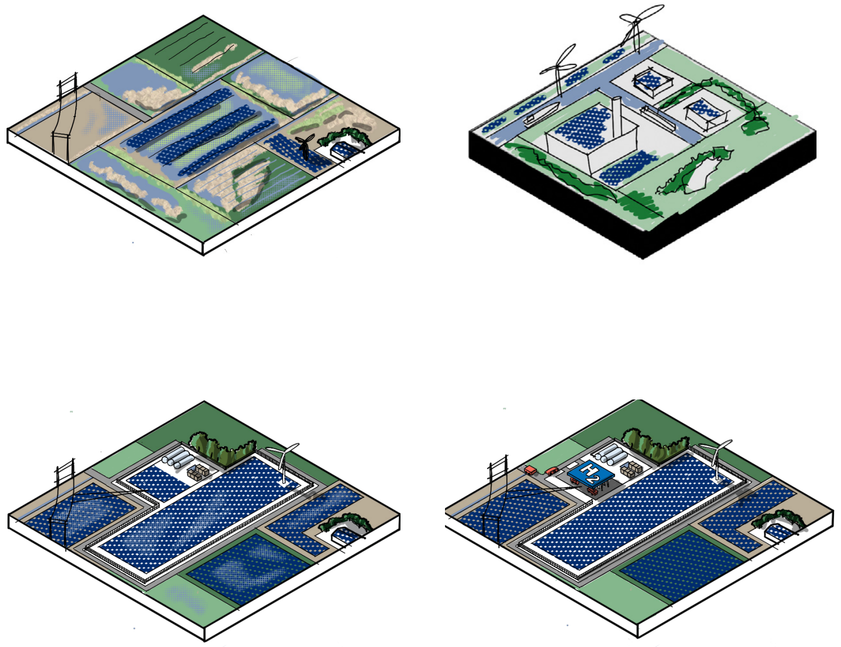


Figure 119 Important typologies for the scenario International entrepreneurial, source: author

Legend

Wet agriculture
Re-naturalized areas
Nature corridor
Green corridors
NAM locations
Existing solar fields
Solar fields
Wind turbines
Hydorgen
Monuments
Protected areas

3/4 ind. class
5/6 ind. class

Water
Urban
Main roads
Trainlines
Nature areas
High voltage cables

Development arround train stations

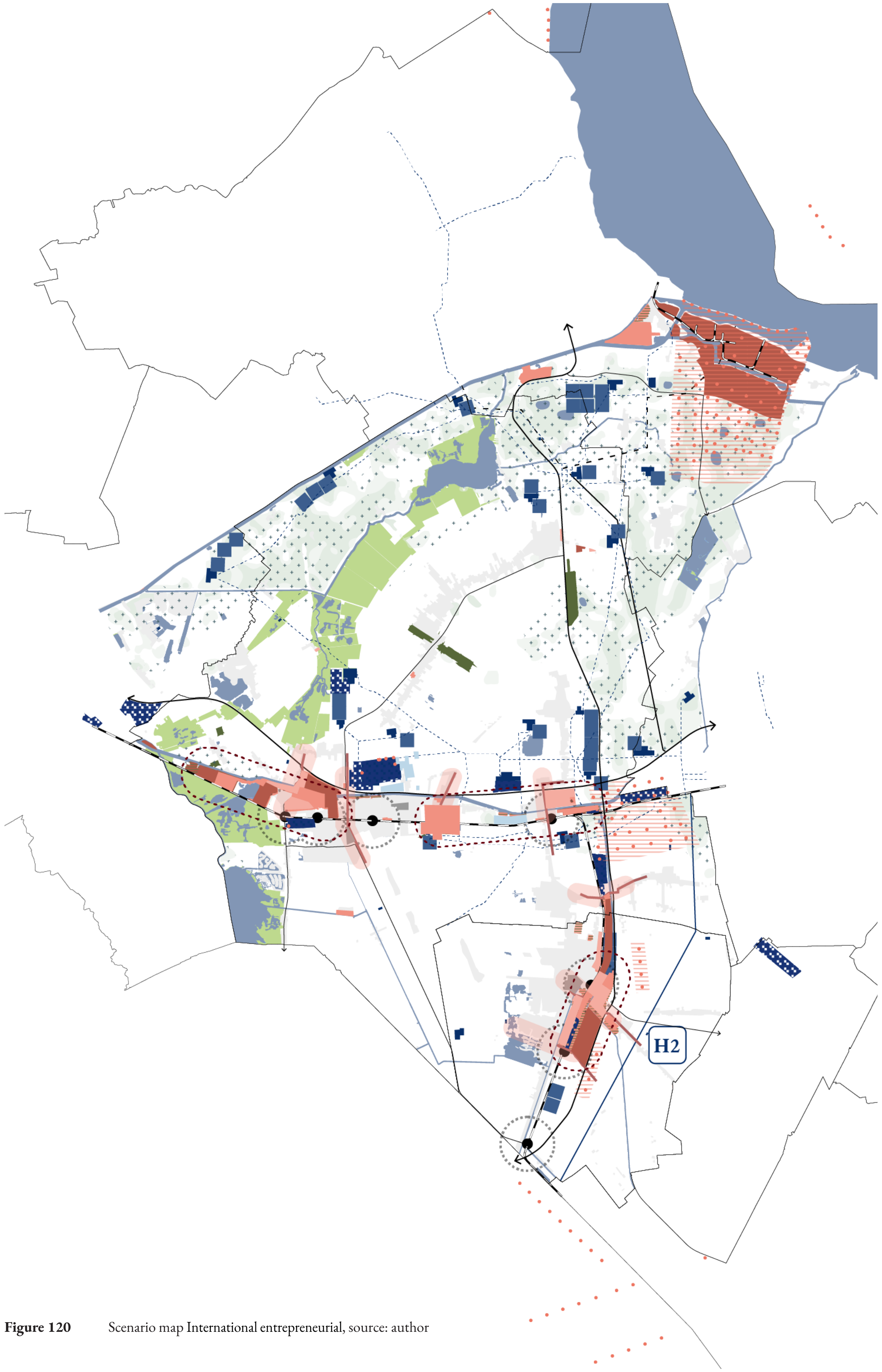


Figure 120 Scenario map International entrepreneurial, source: author

4.4 Scenario:Regionally rooted

In the regionally rooted scenario, the focus shifts towards leveraging specific local assets such as natural resources, cultural heritage, and human capital, while addressing the community's needs. Historically, this region and its inhabitants have often faced marginalization, bearing burdens while others enjoy the benefits.

Energy production is decentralized, with a strong emphasis on regional self-sufficiency. Groningen is already nearing its target for 2030, aiming for almost complete self-reliance. Areas with peat in the soil are transitioning to nature-friendly agriculture, while efforts to expand natural areas are underway. Community-owned energy production is prioritized, with local communities actively involved in the ownership and management of solar fields and wind turbines.

In this scenario, new businesses do not receive special incentives, and many may cease to exist. However, there is ample opportunity for local initiatives that bolster the regional economy without harming the environment. Tourism is a promising avenue for generating new income, complementing local enterprises and initiatives. This can be coupled with small, nature-inclusive farms that offer tourist experiences.

Attention is devoted to preserving local characteristics such as the ribbon, distinct buildings and diverse economic activities. These areas will be safeguarded to maintain their unique qualities, and initiatives will be taken to preserve them despite anticipated shrinkage in the future.

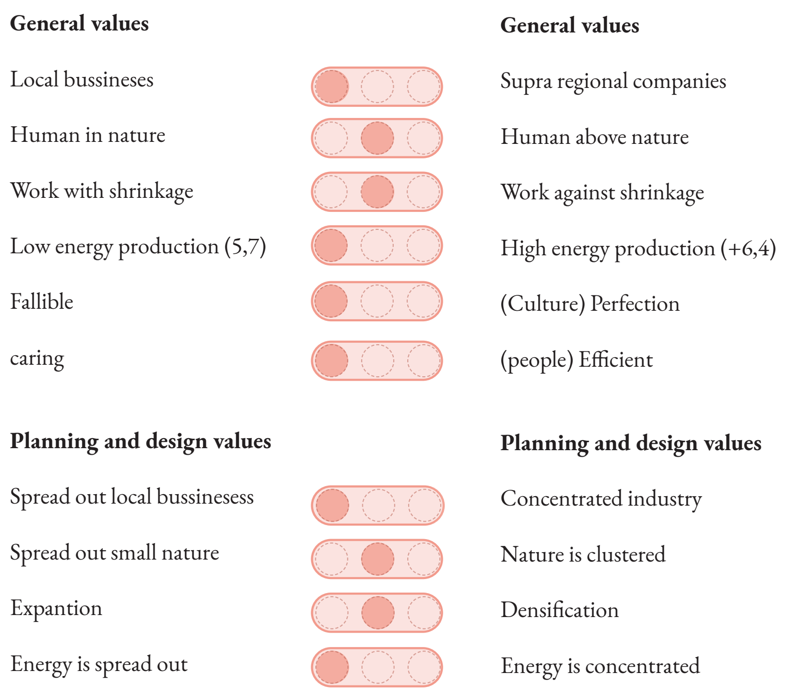


Figure 121 Parameters for the scenario regionally rooted, source: author

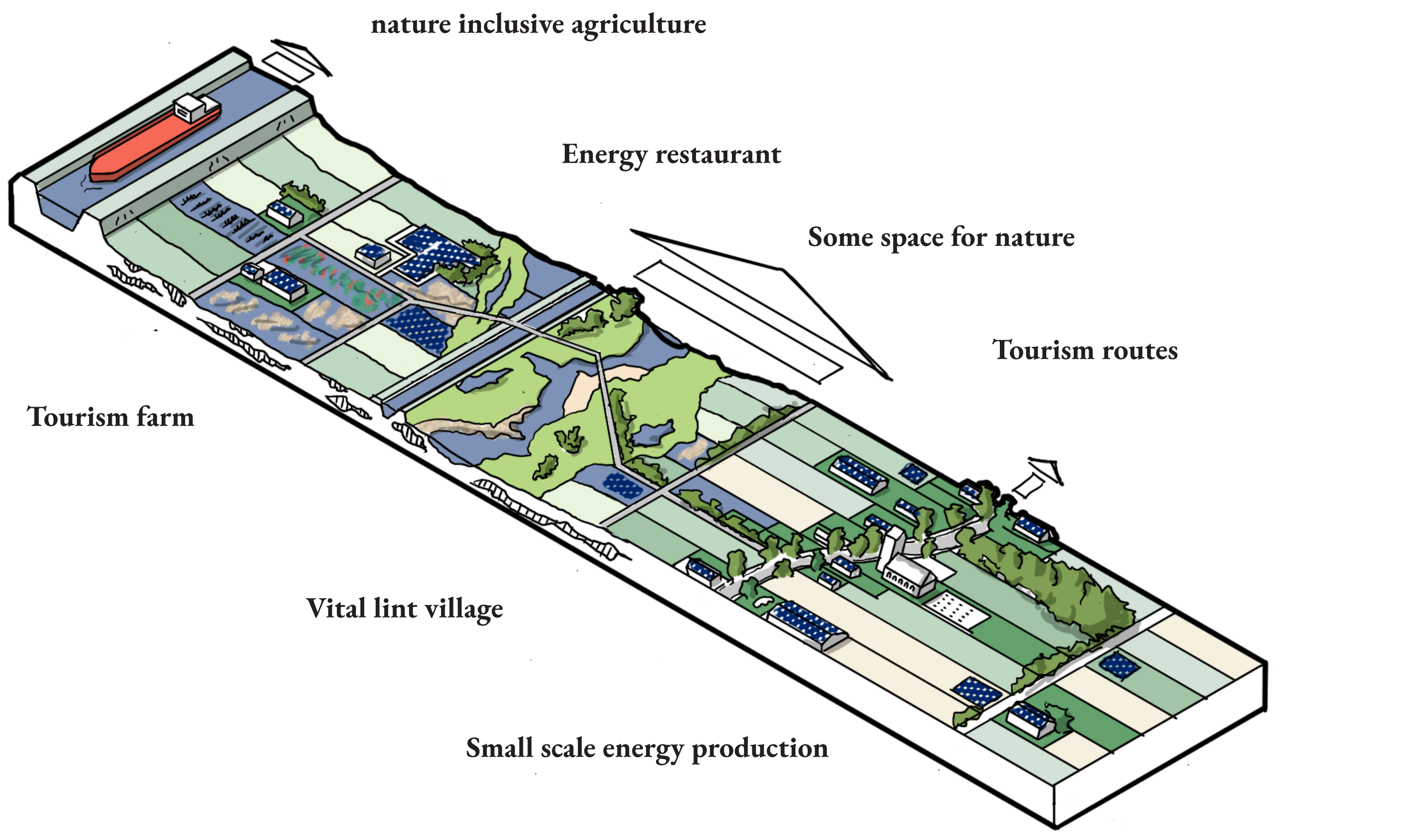


Figure 122 axonometric section central world area for scenario regionally rooted, source: author

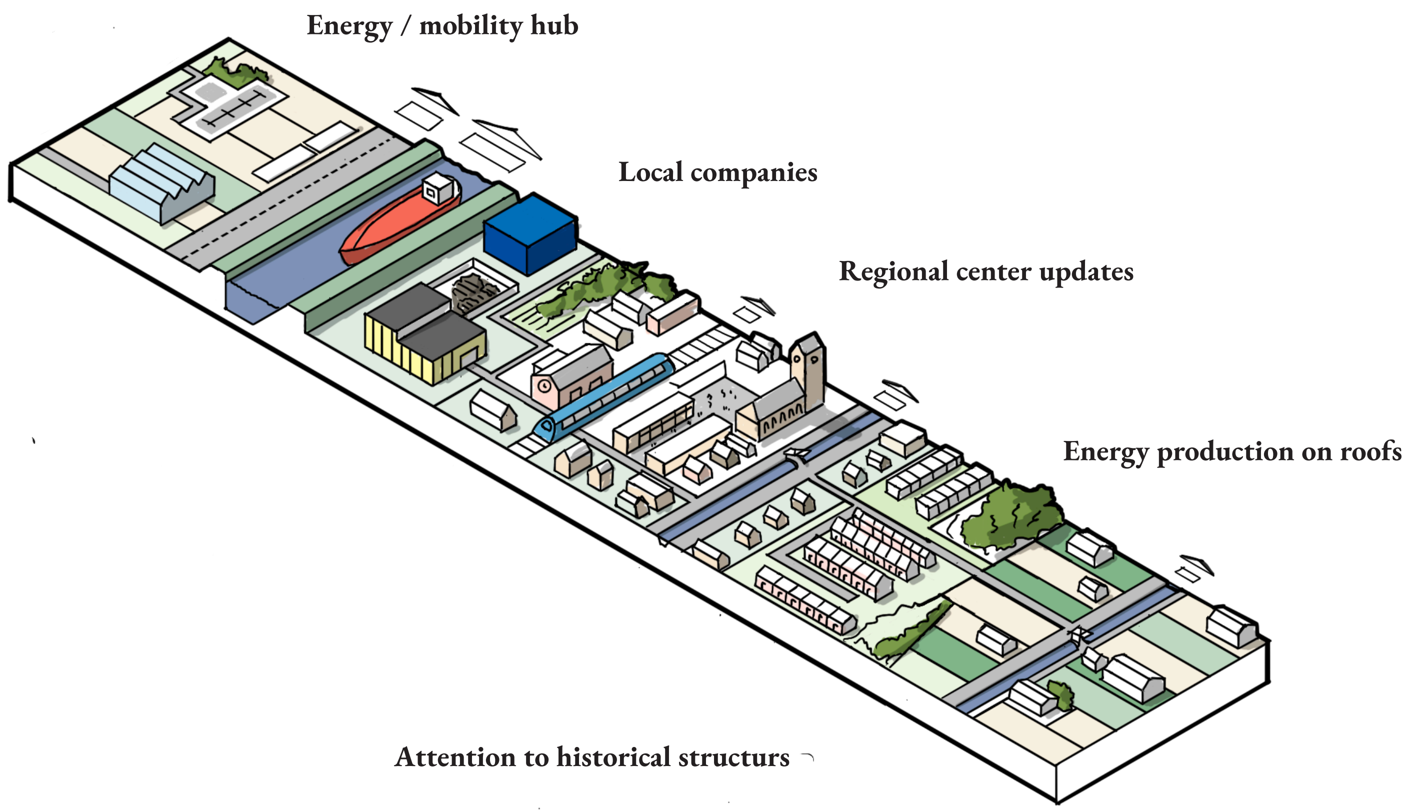


Figure 123 axonometric section central peatcolonies for scenario regionally rooted, source: author

4.4 Scenario: Regionally rooted

Preconditions

++ Preserving the Groningen landscape and identity
- Placement of renewables and reuse of current energy infrastructure
+ Ensuring economic competitiveness
+ Addressing climate change challenges
++ Inclusion of all groups in society

Principles

+ Establishing a nature network throughout Groningen
- Transforming train stations into development hubs
+ Repurposing NAM sites for renewable energy
++ Enhancing opportunities for recreation and tourism

Important typologies

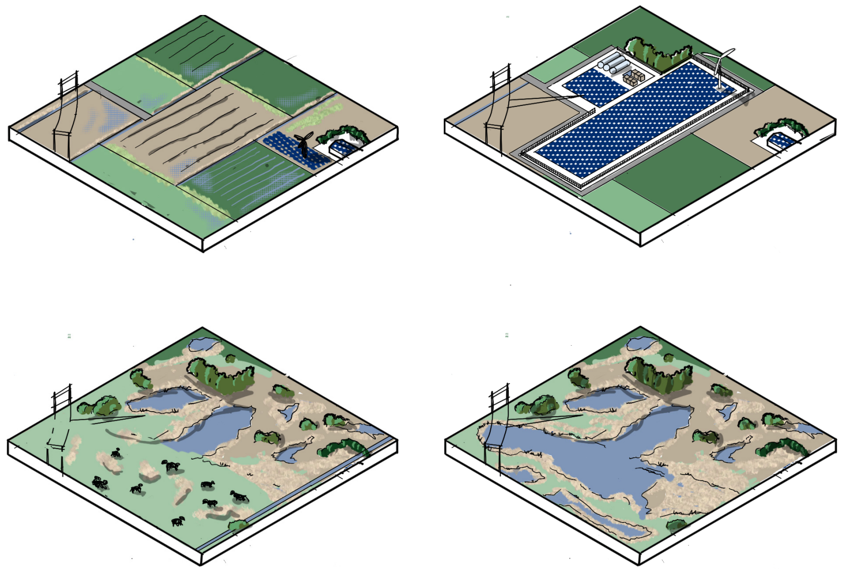


Figure 124 Important typologies for the scenario regionally rooted, source: author

Legend

Wet agriculture
Re-naturalized areas
Nature corridor
Green corridors
NAM locations
Existing solar fields
Solar fields
Wind turbines
Hydorgen
Monuments
Protected areas

3/4 ind. class
5/6 ind. class

Water
Urban
Main roads
Trainlines
Nature areas
High voltage cables

Development arround train stations

Figure 125 Scenario map regionally rooted, source: author

4.5 Scenario evaluation

The different prioritization of values and design choices results in different scenarios. The preconditions and principles help assess these scenarios. The strategy should consider all these preconditions and principles to score positively on all points. Below, the strong and weak aspects of each scenario are summarized.

Scenario: Natural Groningen
This scenario focuses on re-naturalization, creating more space for nature and biodiversity. It effectively addresses climate change by providing space for water storage and reducing CO2 emissions from peatlands. A large natural network is established, but the needs of farmers who own the land may be neglected. Furthermore, roughly a third of all NAM locations are transformed into natural areas, reducing space for nature and impacting the region's economic viability.

There is less attention to human needs and the inclusion of marginalized groups. The scenario emphasizes the concentration of urban areas and development around train stations. While beneficial for some, it neglects those living in the countryside, potentially leading to more shrinkage and less economic compatibility in the area.

Scenario: International Entrepreneurial
This scenario aims to create a favorable business environment for the region, including placing a substantial number of renewables. NAM locations are used to their full potential. CO2-emitting lands are almost entirely transformed into wet agriculture, keeping these lands productive and contributing to the economy. Train station areas are developed into mixed-use spaces for new housing and businesses.

Climate change is addressed but only minimally. The economy would grow stronger, but at the cost of local heritage and social structures. It is unclear if the benefits are local or mostly favor other energy-needing areas in the Netherlands.

Scenario: Regionally Rooted
The "Regionally Rooted" scenario is more balanced, focusing on energy production and climate adaptation. The local community and the region's qualities are central. This scenario preserves the Groningen landscape and identity. A natural network is created, and there is space for new forms of agriculture, combined with recreation and tourism, leveraging local qualities to create a regional economy.

However, the scenario lacks significant placement of renewables. This is not a problem for the region itself but could place more burdens on other regions with less space available. More energy production and a good hydrogen network could lead to a more attractive business environment, which this scenario neglects. Development around the train station could create an interesting living and working environment, which is also overlooked.

Conclusion
The scenarios have differences and overlaps in their approaches. The strong and weak points of each scenario are highlighted. The scores for each scenario are on the right page. The strategy elements used from each specific scenario are also highlighted. The strategy is often a compromise of two scenarios, but some elements are retrieved from one specific element.

NG	IE	RR	
			Preconditions
-	-	++	Preserving the Groningen landscape and identity
+	++	-	Placement of renewables and reuse of current energy infrastructure
-	++	+	Ensuring economic competitiveness
++	+	+	Addressing climate change challenges
-	-	++	Inclusion of all groups in society
			Principles
++	-	+	Establishing a nature network throughout Groningen
+	++	-	Transforming train stations into development hubs
+	++	+	Repurposing NAM sites for renewable energy
-	-	++	Enhancing opportunities for recreation and tourism

Figure 126 Scores of the scenarios for all the preconditions and principles, source: author

4.5 Scenario evaluation

The scenarios use space differently; in this thesis, this is called spatial tension. In these areas, different land uses, needs, or values will result in different outcomes. The map on the right shows areas where there is a spatial competition between different elements. The areas are global and within the areas spatial competition may vary locally. The elements are listed below. The NAM locations are not specifically mentioned in this map but are a part of energy production. On the next page the gaswinning locations are explained more in depth.

The different type of land-uses are listed bellow:

- Energy production
- Wet agriculture
- Nature
- Water storage
- Protection of cultural values
- Protection of natural values
- Living
- Business

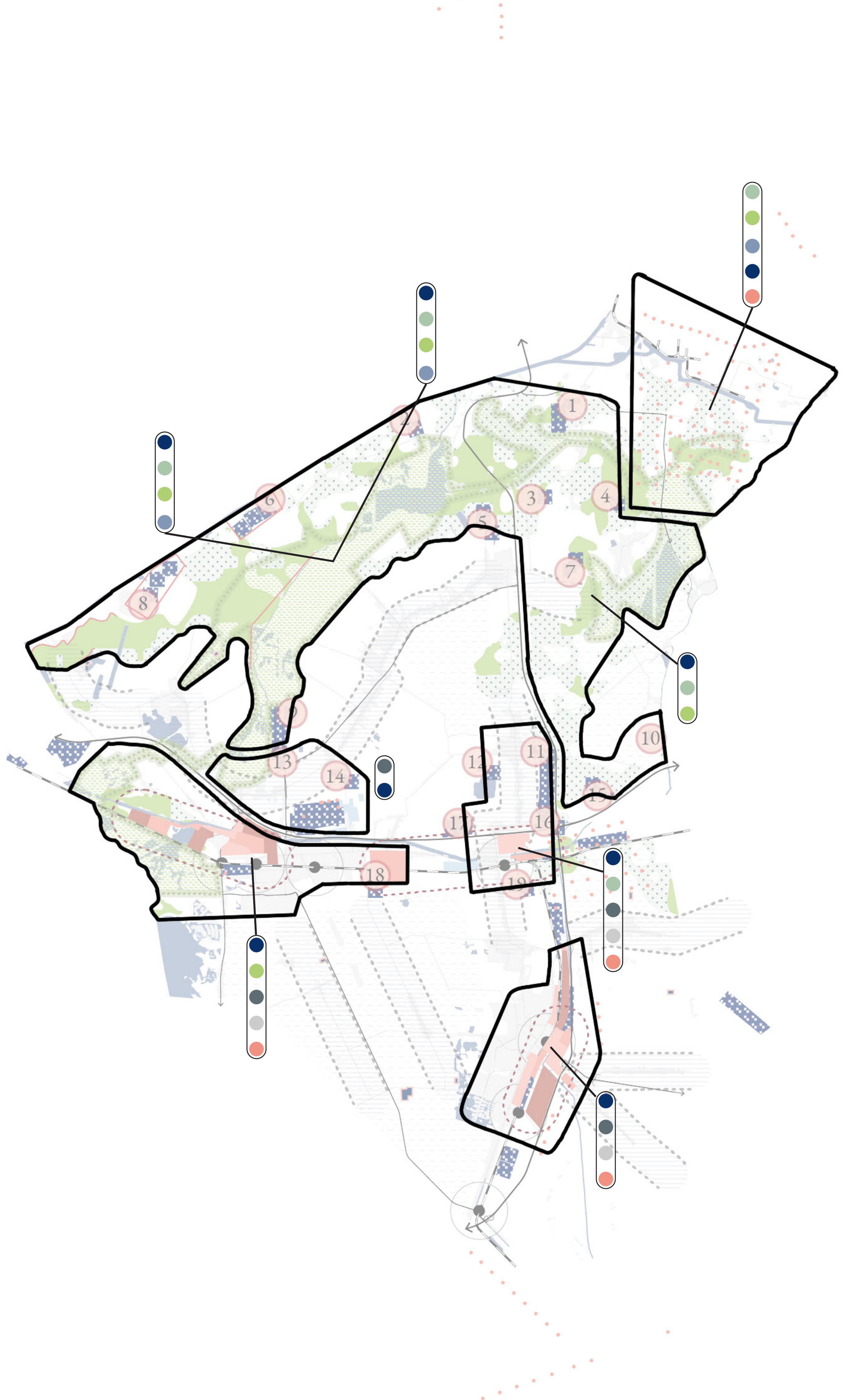


Figure 127 Spatial tention, source: author

4.5 Scenario evaluation

The diagram below provides insight into the options for each NAM site. It shows the possibilities and impossibilities. It also provides insight into how the typology is interpreted for each scenario and the choice of strategy. When there is a great deal of similarity between the scenarios and the strategy, there is little spatial competition; see, for example, number 16. On the other hand, there is a great deal of spatial competition when a location has many different interpretations; for example, number 1.

Returning the location to agriculture is always possible (option A) but not desirable. Renaturalization (option B) is only possible when the location is in or near a CO_2 emission area; creating a mobility HUB (option C5) is only possible when the location is on a major route and well connected in the network.

Legend

- Not possible
- Not wanted
- Possible
- S1 Natural Groningen
- S2 International Entrepreneurial
- S3 Regionally Rooted
- Strategy (prefered option)
- Spatial tention

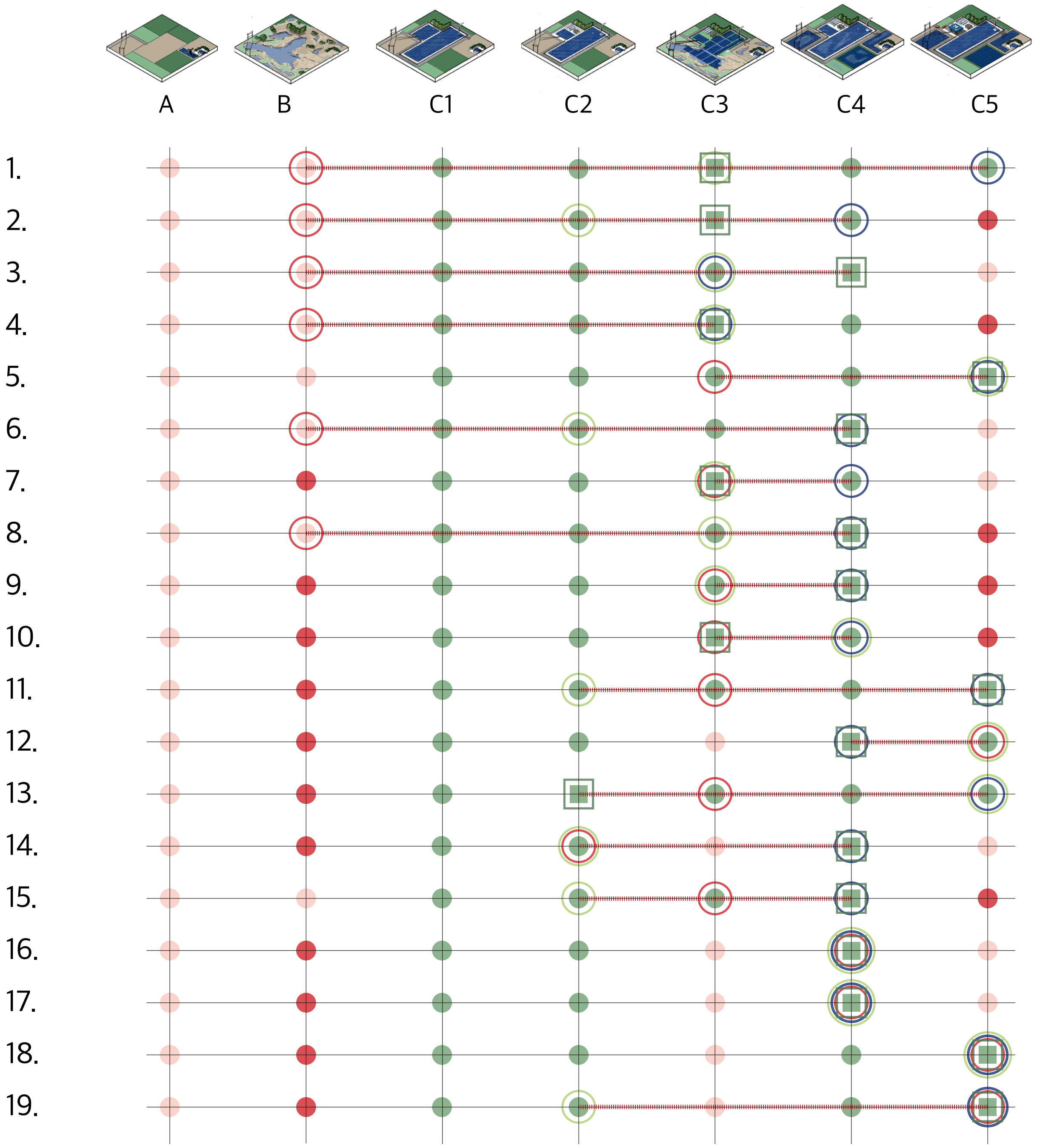


Figure 128 Possibilities for all NAM locations based on the NAM typology, source: author

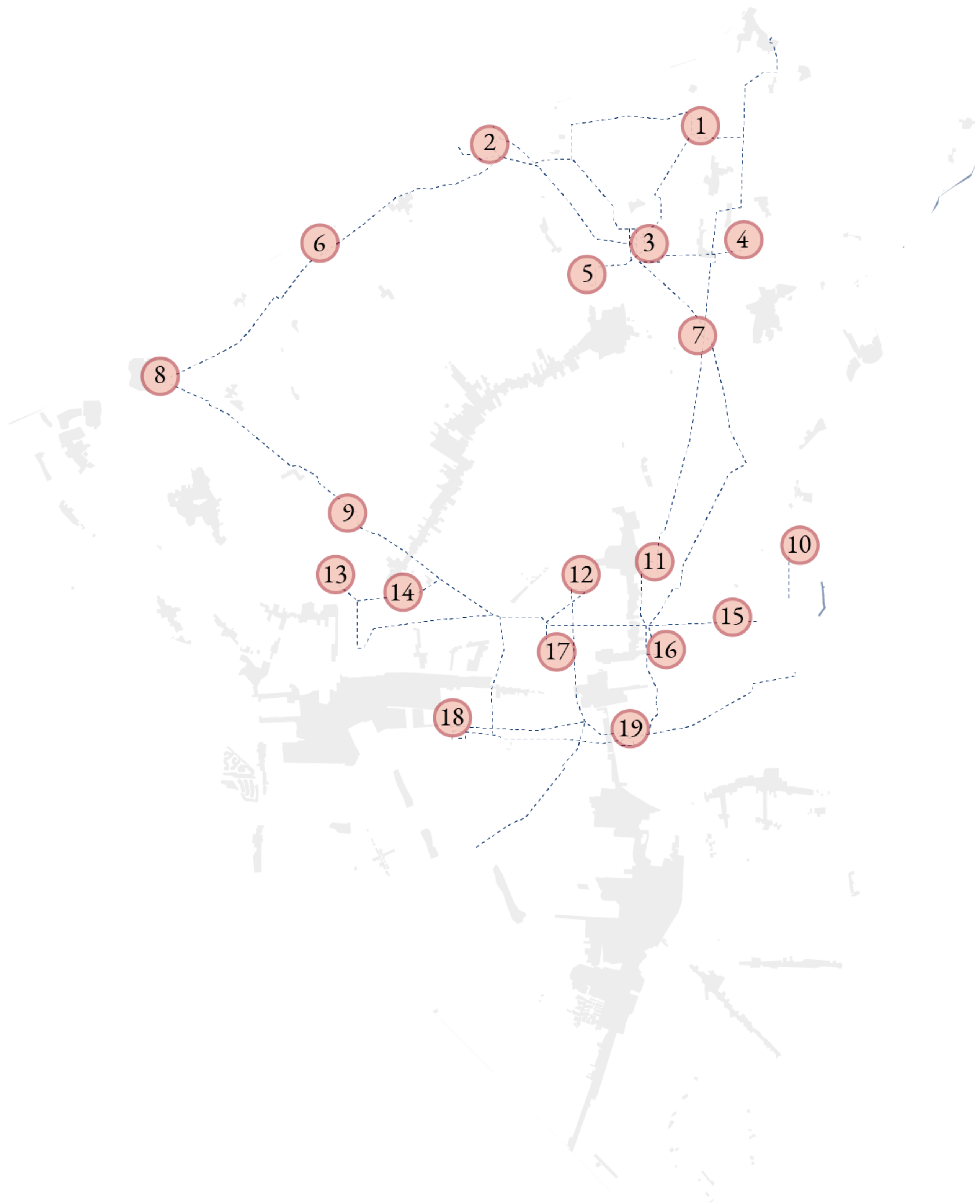


Figure 129 Map with all NAM locations numbered, source: author

Strategy

5.1 Introduction

The strategy represents a synthesis of the three scenarios, aiming for a more balanced approach to address the multifaceted challenges confronting Groningen in the future. This approach is grounded in the preconditions and principles established at the end of the analysis. Overall, the strategy leans towards a combination of the International Entrepreneurial and Regionally Rooted scenarios, with some small elements of the natural Groningen scenario.

The strategy draws inspiration from the international entrepreneurial scenario for initiatives such as the NAM location, establishing a hydrogen economy, and revitalizing business and industrial areas. Meanwhile, principles derived from the natural landscape inform certain aspects of the strategy's regenerative approach. At the same time, the Regionally Rooted scenario emphasizes the protection of regional landscape and cultural qualities and inclusive governance, with a focus on engaging the least engaged stakeholders.

It is important to note that the strategy may reflect the personal preferences of the author to some extent. Different preferences or choices could result in alternative strategies.

Preconditions			
Preserving the Groningen landscape and identity	-	-	++
Placement of renewables and reuse of current energy infrastructure	+	++	-
Ensuring economic competitiveness	-	++	+
Addressing climate change challenges	++	+	+
Principles			
Establishing a nature network throughout Groningen	++	-	+
Transforming train stations into development hubs	+	++	-
Repurposing NAM sites for renewable energy	+	++	+
Enhancing opportunities for recreation and tourism	-	-	++
Inclusion of all groups in society	-	-	++

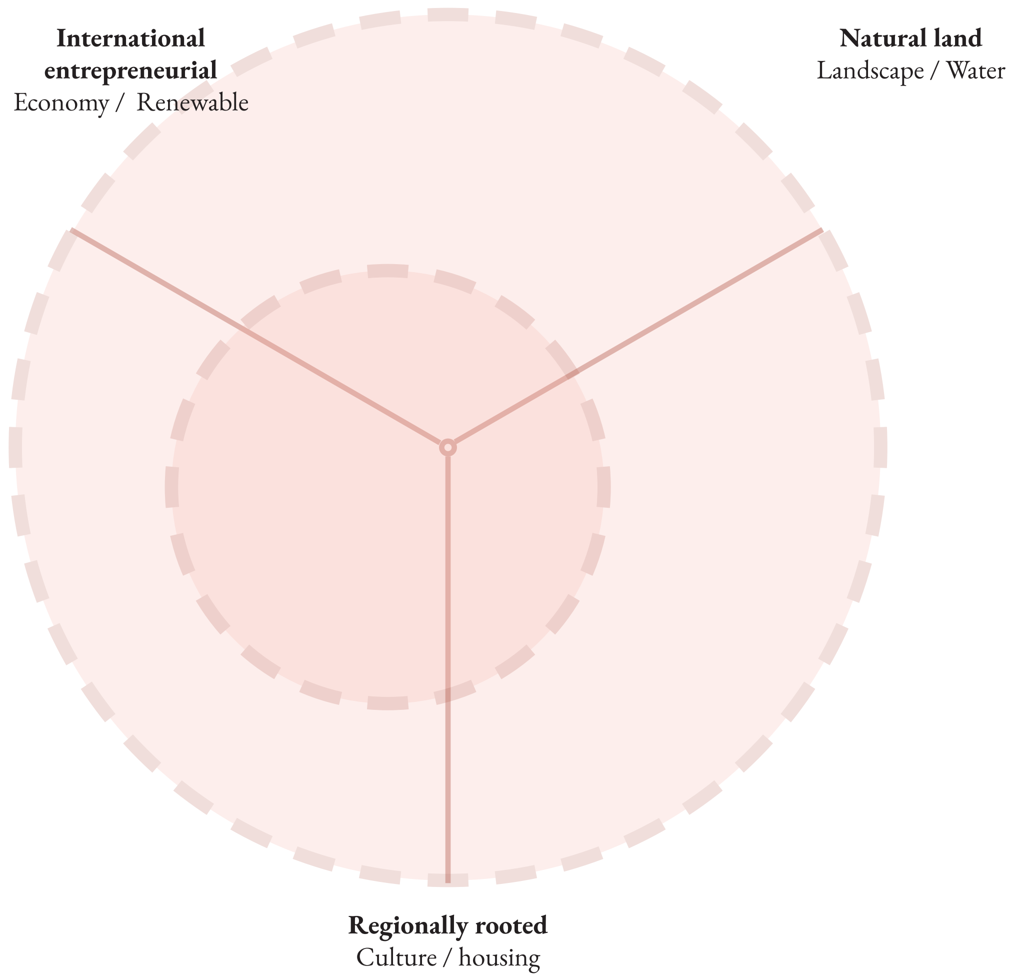


Figure 130 Importance of the scenarios in the strategy, source: author

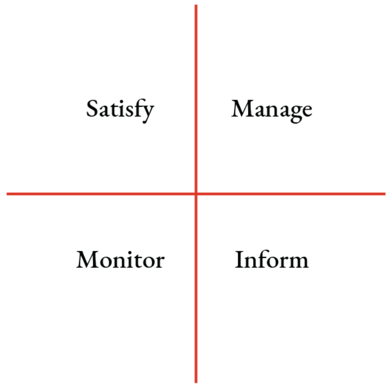
5.2 Stakeholder analysis

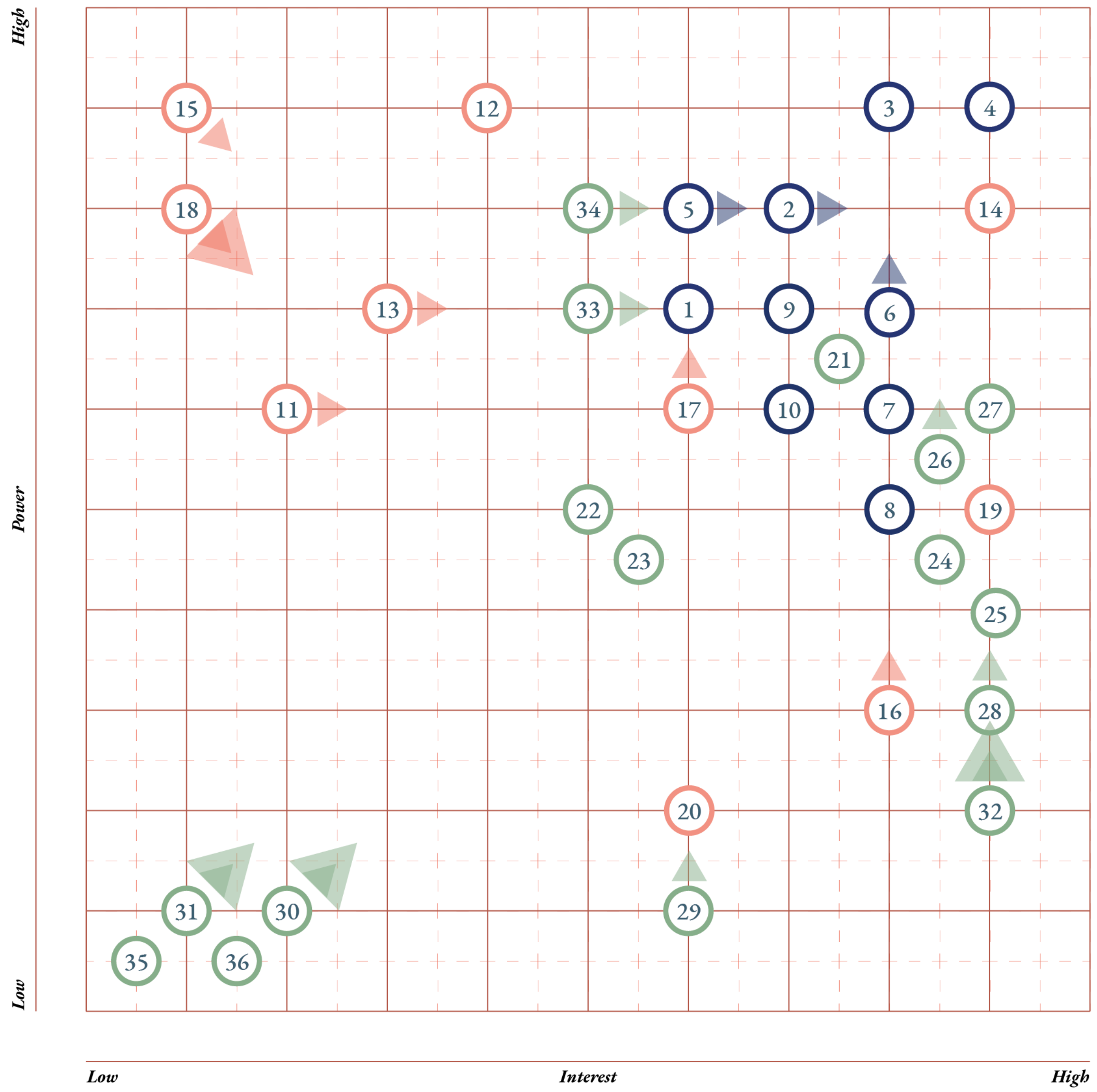
Stakeholder power interest diagram

By positioning stakeholders on the power/interest diagram, various actions tailored to different groups can be proposed. Creating a just governance systems, where the local and regional interest is considered more and marginalized groups are empowered.

Local stakeholders need to be empowered and integrated into the participatory process. Moreover, local and regional actors in the knowledge sectors should be integrated into the governance sector, playing a significant role in informing local stakeholders about issues and potential solutions. Large-scale energy companies must be regulated by policies that diminish their power. However, they should also be engaged in facilitating a smooth energy transition, providing new opportunities for these companies to transition into alternative roles in energy production.

Furthermore, nature and biodiversity considerations should be prioritized and incorporated into new development plans.





Public Sector
1.European Union (EU)
2. The Netherlands
3. The province of Groningen
4. Municipalities
5. Tennet
6. Waterboard hunze and Aa
7. Regional energy strategy (RES)
8. Staatsbosbeheer
9. Ministry of public housing
10. Gasunie

Capital
11. Farmers
12. Investors (banks)
13. Local landowners

Private Sector
14. Renewable energy companies
15. Nederlandse Aardolie Maatschappij (NAM)
16. Small companies
17. Groningen Seaport
18. Fossil energy companies
19. Hydrogen energy companies
20. Recreational bussiness owners

Knowledge Sector
21. Groningen University
22. Knowledge institutes
23. Central bureau of statistics (CBS)
24. Brede welvaart Groningen
25. Environmental organizations

Community
26. Nationale Nederlanden
27. Toukomst
28. Fossil industry workers
29. Future workers
30. Youth
31. Least engaged
32. People with damaged houses
33. Just Transition Fund (JTF)
34. Versterkingsoperatie

Non human
35. Nature
36. Animals

Figure 131 Power intrest matrix, source: author

5.3 Strategy

This project proposes to change the energy structure of central Groningen, while intergrating a natural corridor, wet agriculture and new bussiness oppertunities, redefining the role of Groningen in the Netherlands.

First, the strategy is explained with a phasing; after that, the strategy is decomposed into several elements, and the impact of these elements is explained. The strategy is until 2050 when the EU aims to be the first carbon-neutral continent. The design should be regenerative, flexible, and should redefine the energy system with the integration of heritage and agriculture.

Legend

- Wet agriculture
- Agricultural pilots
- Nature corridor
- NAM locations
- Solar fields
- Wind fields
- Hydrogen
- Information location

- Monuments
- Protected areas
- 3/4 ind. class
- 5/6 ind. class
- Mixed-use developement
- Urban attention zones
- Urban
- Main roads
- Trainlines
- Nature areas

- 2 Renewables + hydorgen
- 3 Renewables + nature
- 4 Renewables + hydrogen (remote)
- 5 Renewables + hydrogen (mobility)

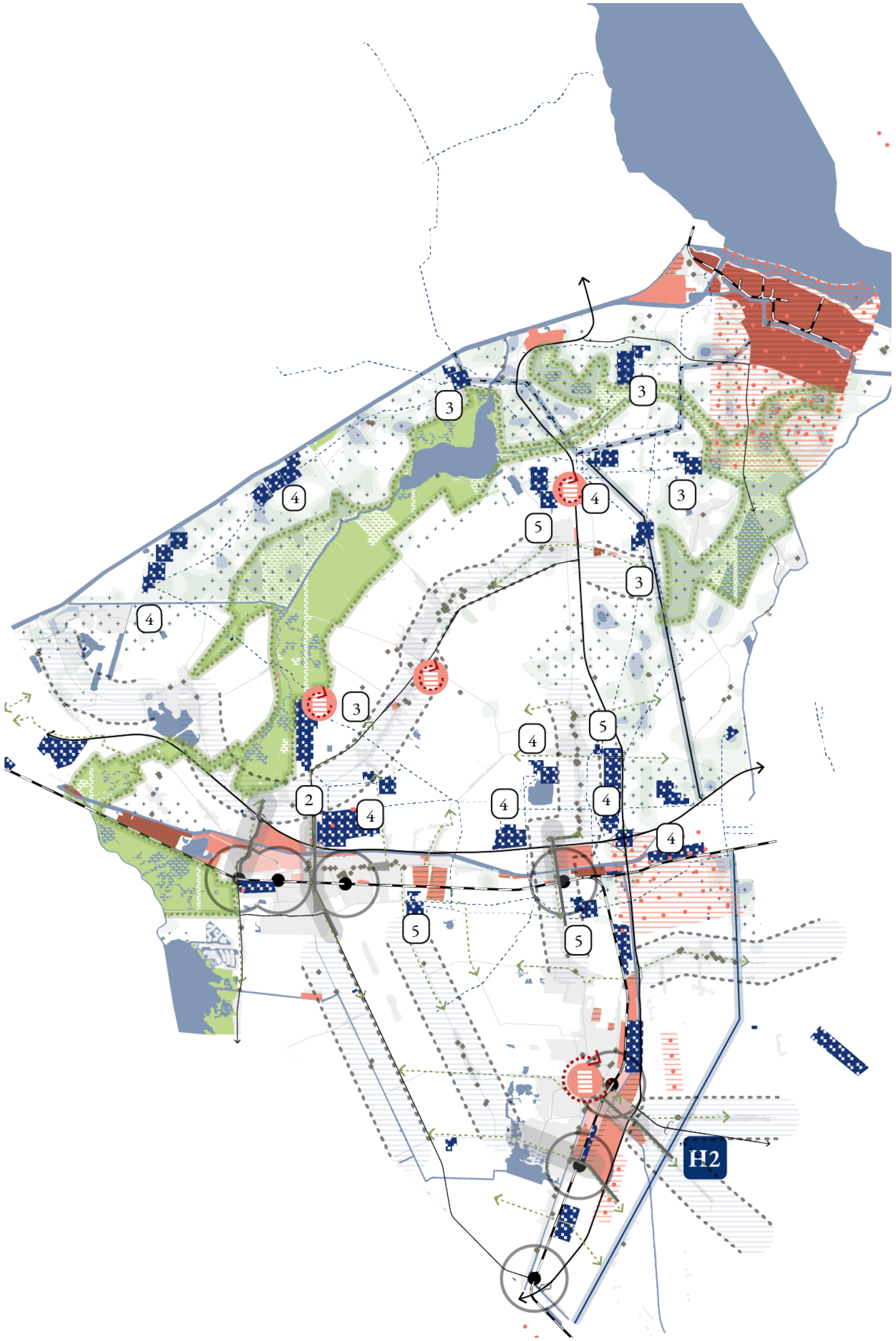


Figure 132 Strategy for 2050, source: author

5.3 Strategy

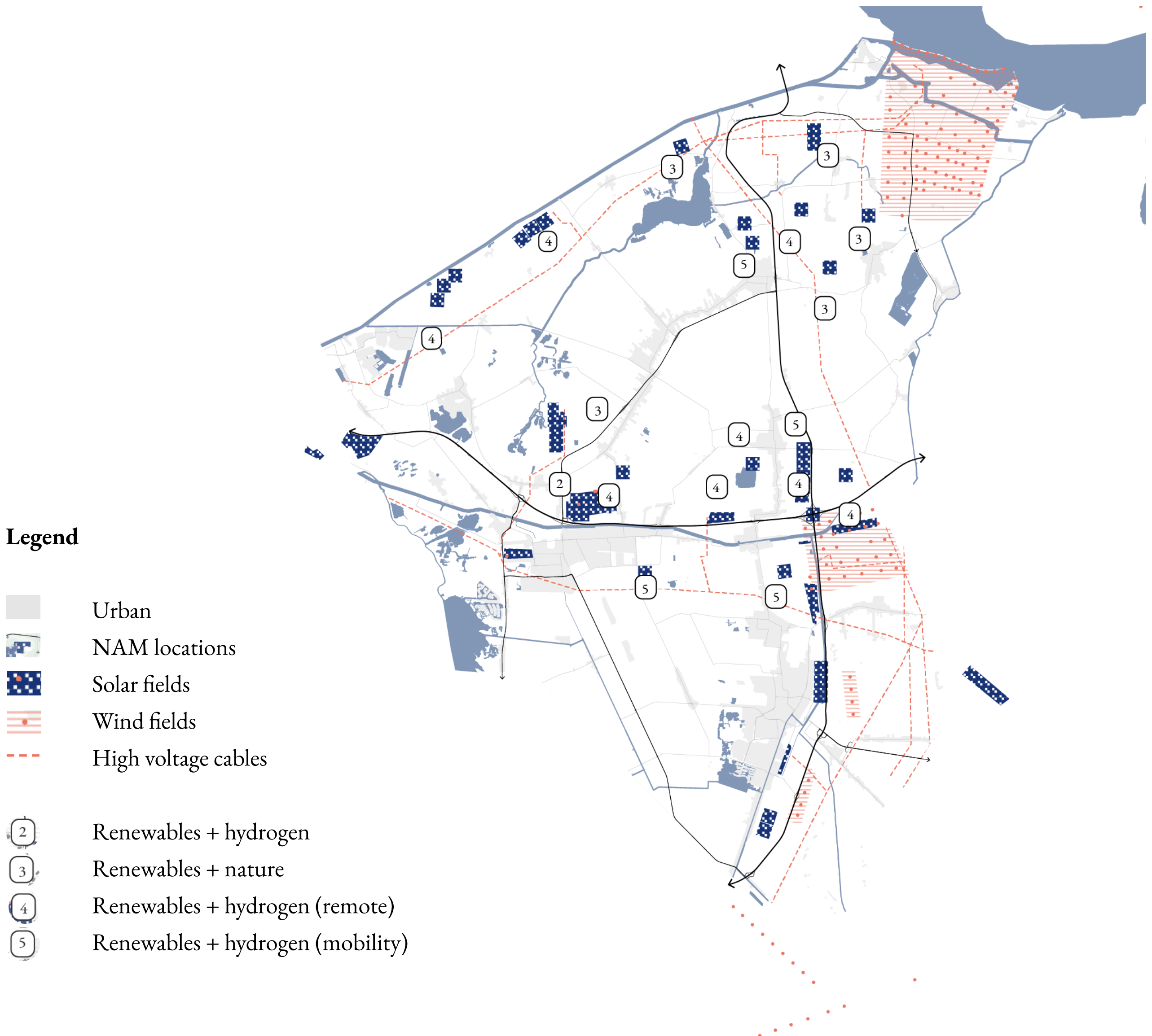


Figure 133 Energy production map, source: author

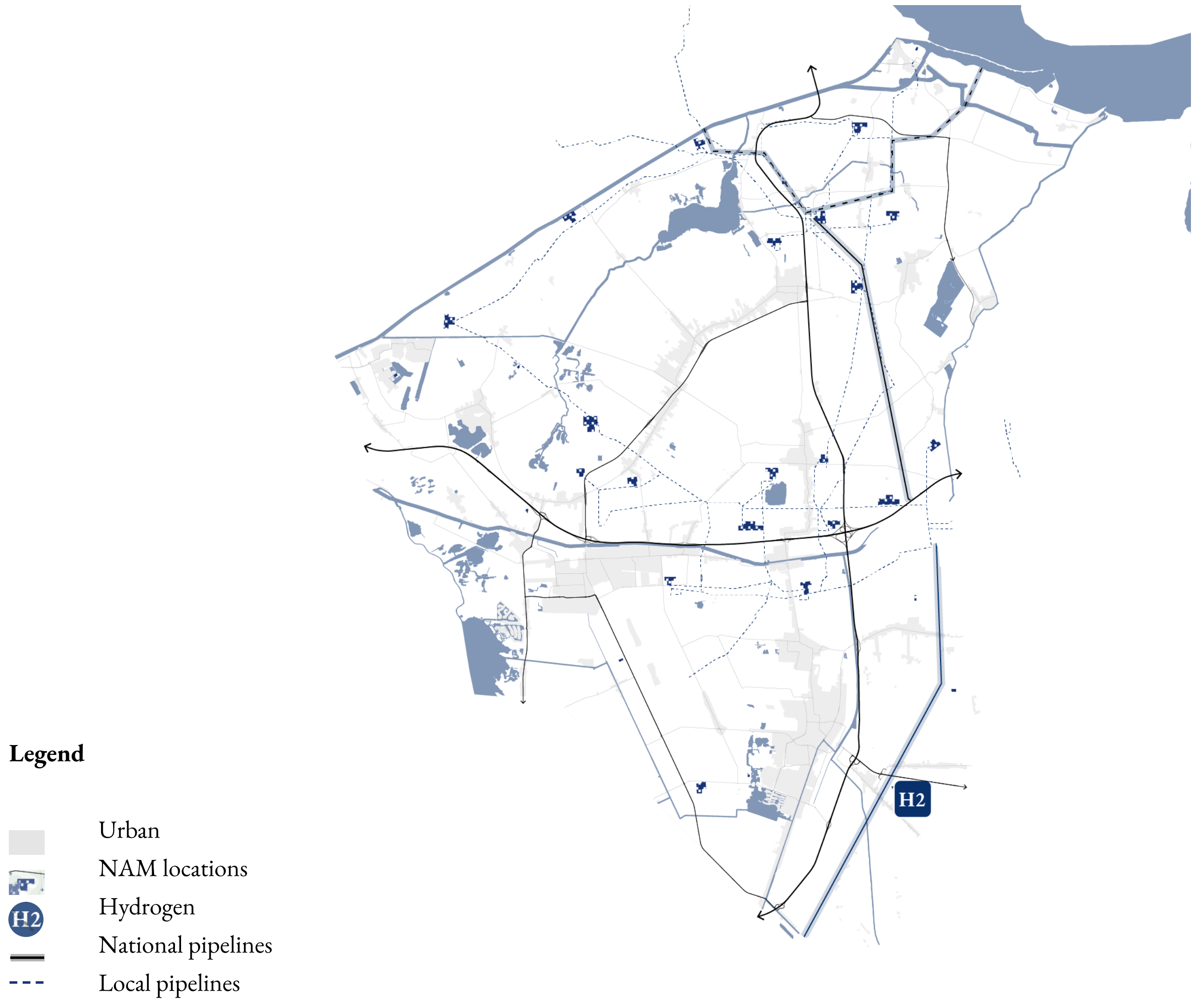


Figure 134 Hydorgen network map, source: author

Energy production landscape

The demand for renewable energy is based on the Regional Energy Strategy (RES). The logic of the current strategy is followed where concentration areas of energy production are close to the large consuming areas like industrial terrains and larger towns in the region.

Additional renewables are placed around the NAM locations, utilizing the energy infrastructure and gas pipelines that can be repurposed for hydrogen. Often, the area around the NAM location is seen as an expansion area, especially if there is peat in the ground.

The energy production locations are, in a wide sense, a reminder of the gas-winning and the impact on the region, functioning as a collective memory or heritage as a vector.

Hydrogen landscape

The gas-winning locations are transformed into energy production locations. The energy produced can be transformed into green hydrogen. This is necessary since there is a mismatch in demand and supply of energy, requiring storage throughout the day. In the municipality of Veendam is a large-scale storage facility in an old salt cavern. This storage is a part of the national network that should be finished by 2030.

The network brings advantages to the local region. The transportation of hydrogen will lower the pressure on the high-voltage cables. This makes it easier for local people to connect, for example, solar panels, to the energy network since this is now hard to do with the full network. Additionally, good connection to both the hydrogen and high voltage network might work advantageously in attracting new business and creating local jobs.

5.3 Strategy

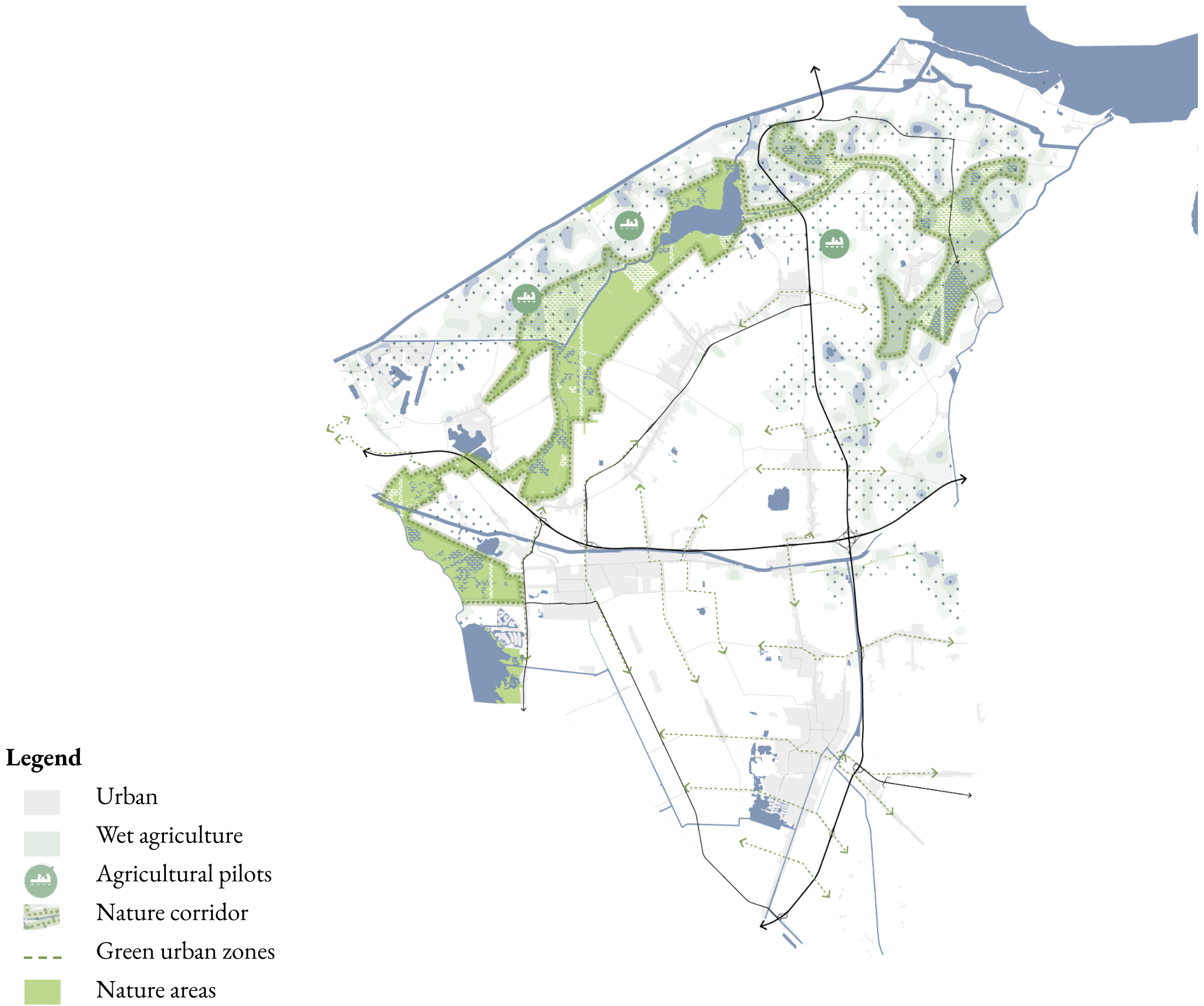


Figure 135 Green blue network, source: author

Natural landscape

A large-scale natural corridor is Developed in the central part of Groningen. The natural peatlands are recovered, and the biodiversity is strengthened. The CO2 emissions are avoided, and the area has a higher water storage capacity.

In the peatlands outside of the natural area, wet agriculture is introduced. The new forms of agriculture work with the higher water levels and pay more attention to biodiversity. The crops are used for food, local building materials, and food for cattle within the region. An additional source of income for the farmers is the new solar fields around the NAM locations.

In the urban areas, green corridors are established that are valuable for connecting parts of the countryside and natural areas.

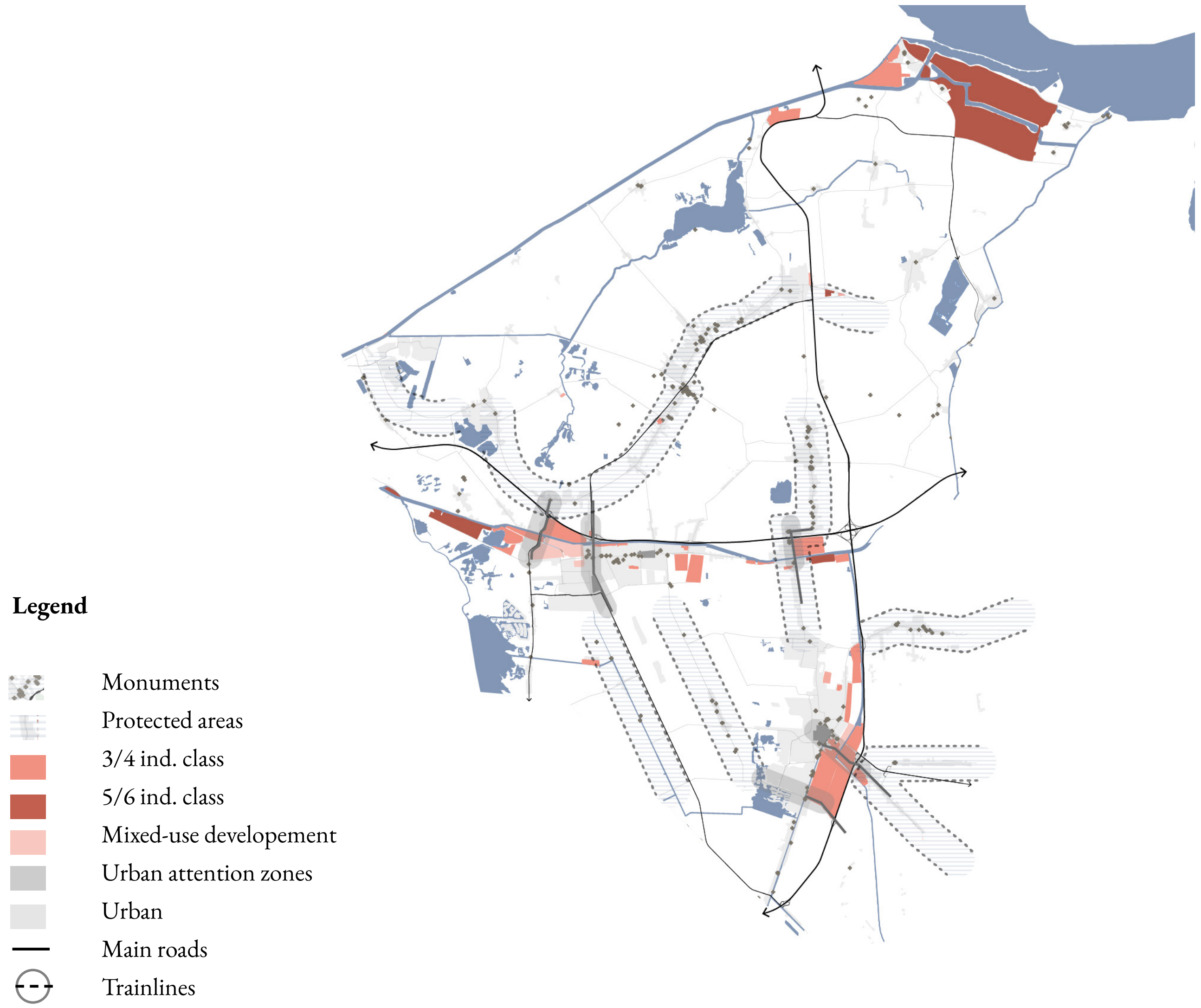


Figure 136 Built environement, source: author

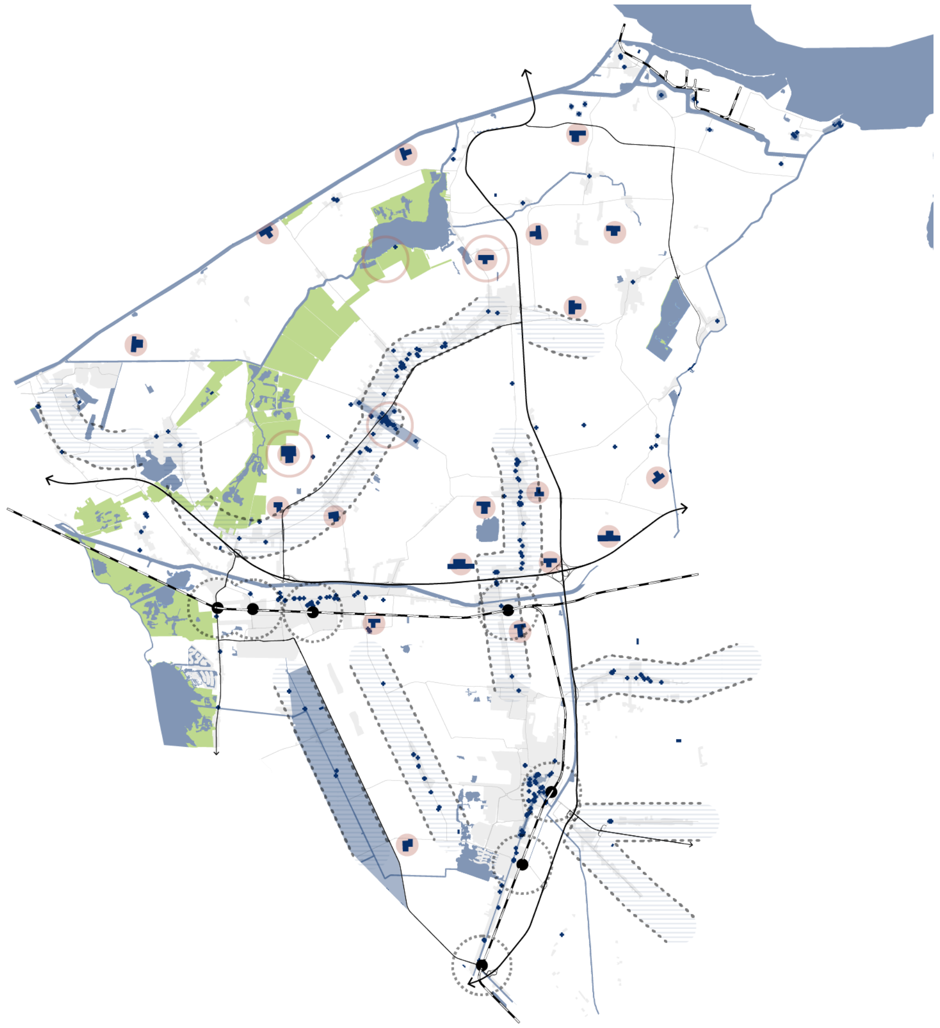
Built environment

The urban area is under pressure because of population shrinkage and a changing economic situation. The Regional care centers such as Veendam and Hoogezand-Sappemeer play a pivotal role in keeping facilities within the area. The strategy advocates more growth around the train stations in the area; this can be done in combination with old industrial terrains to transform them into mixed-use areas. It is also important to protect the characteristic ribbon villages from large-scale transformation.

Around the cities of Hoogeveen-Sappemeer and Veendam, many old industrial terrains are present. These areas are often well-connected by road, train, and water. These industrial terrains can be restructured to foster new economic activities, especially in the logistics and manufacturing sectors. A good high-voltage and hydrogen network can provide additional advantages.

Together, these approaches should provide for a good living and working environment, something that is important according to the Spatial-economic strategy A7/N33.

5.3 Strategy



Legend

Agricultural pilots
Information location
Route

Urban
Monuments
Protected areas
Nature areas

Figure 137 Energy heritage path, source: author

Energy heritage path

The energy and heritage path has two goals. The first is to provide information to the local community. Local people can visit activities in the area and get information about the re-naturalization, new wet agricultural practices, and the energy transition. This is done through permanent facilities such as the energy café, but there are also annual activities such as the energy festival.

The other goal of the energy and heritage path is to promote tourism in the area and provide an additional source of income for the local community.

5.4 Phasing

Phase 1: 2030 Preparation

Renewable Energy production
The first phase of the Renewable Energy Strategy (RES) aiming for 5.7 - 6.4 TWh for Groningen must be completed:

> By 2030, no further large-scale wind farms will be permitted.
> Small wind turbines will be installed on agricultural plots.
> Establishment of large solar parks along highways.
> Implementation of small-scale solar parks around villages and ribbons.

The NAM locations
The NAM locations are closed, and preparations are made to transform them to start as locations for renewable energy production and make them feasible for hydrogen.

Options are:
A. back to agriculture (want to avoid this > inform farmer)
B. Part of nature area (by high concentration of peat in the soil)
C. Energy production hub (preferable)

The peat oxidation area's
The water levels are maintained to avoid more ground subsidence and peat oxidation. In some areas, the water level is raised, and pilot projects are started here to do more research on wet agriculture, possibly in combination with energy production.

The boundaries of the larger Natural corridor are established, mainly based on high-risk areas of peat oxidation. Preparations are made to establish this corridor in combination with farmers.

Urban Areas
Urban development plans are being formulated for regional centers around station areas to enhance their structure and accommodate new housing developments aligned with demographic trends.

An image quality plan is being drafted for the ribbons to preserve their inherent qualities and actively manage them to achieve desired developments. Sufficient space must be allocated for local initiatives that contribute to the future vitality of the ribbon.

Industrial Areas
Industrial zones surrounding train stations are transitioning into mixed-use areas, while outdated industrial estates are undergoing restructuring to accommodate new sustainable enterprises.

Main actions per time frame
> Prepare NAM locations
> Placement of renewables
> Research on peat oxidation areas
> Remain groundwater levels
> Pilots with wet agricultrue
> Protect the ribbon
> Plan natural corridor

Legend

Wet agriculture
Agricultural pilots
Nature corridor
NAM locations
Solar fields
Wind fields
H2 Hydrogen
Information location

Monuments
Protected areas
3/4 ind. class
5/6 ind. class
Mixed-use developement
Urban attention zones
Urban
Main roads
Trainlines
Nature areas

2 Renewables + hydorgen
3 Renewables + nature
4 Renewables + hydrogen (remote)
5 Renewables + hydrogen (mobility)

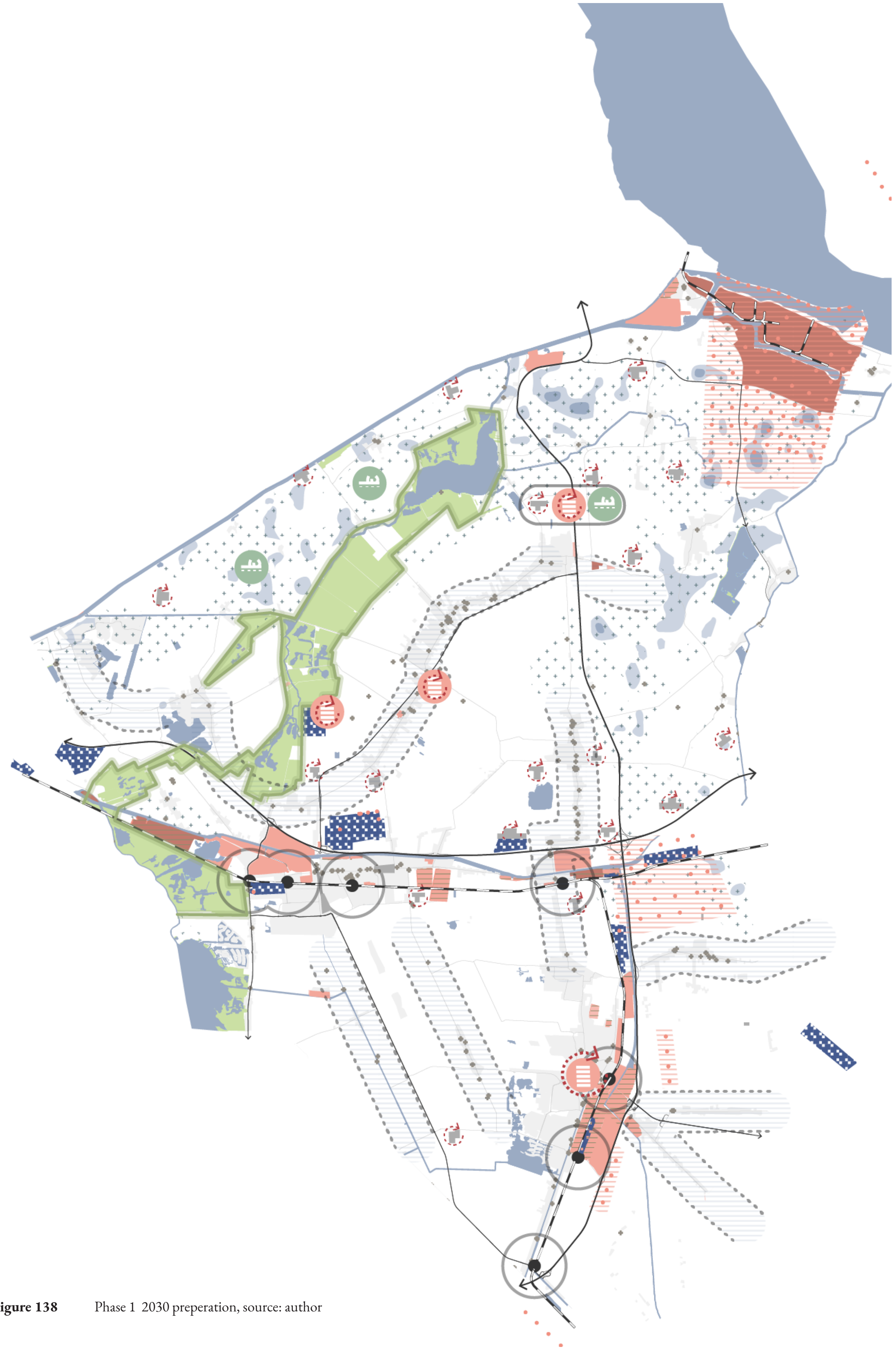


Figure 138 Phase 1 2030 preperation, source: author

5.4 Phasing

Phase 2: 2040 Implementation

Renewable energy production

Groningen now has a new goal from the RES strategy (probably something around the 8,1 TWh). This means about 3000- 4500 ha of new solar fields are needed in the region. This is an opportunity for farmers to diversify their farming.

> Larger windmills can only be placed around the highway.
> Small windmills on the agricultural plots, NAM locations, and edges of villages.
> solar parks are expanding around the NAM locations and areas where the water level is raised.

National Hydrogen network is introduced.
> Storage facilities around Veendam are expanded.
> Nam locations are integrated with the national network.
> Industries in the region get good access to hydrogen, improving the compatibility of the region.

The NAM locations

The NAM locations suitable for energy production are placed with solar panels.

C. Energy production hub (preferable)
C1 energy production only
C2 Remote location with hydrogen conversion
C3 Accessible location with hydrogen for mobility
C4 Green gas production for heating of houses
C5 information point/restaurant/museum

The peat oxidation area's

- Water levels are slowly raised
- Large areas are now transformed for wet agriculture
- The natural area is developed and expanded where needed. The re-naturalization process takes around 50 years.

Urban areas

The station areas are developed according to the urban development plans formultaed in the preparation phase. New housing project are concentrated here.

Industrial areas

Industrial zones surrounding train stations are transitioning into mixed-use areas, while outdated industrial estates are undergoing restructuring to accommodate new sustainable enterprises.

Main actions per time frame
> Placement of renewables arround NAM locations
> establishment of the hydorgen network
> Introduction of wet agriculture
> Further development on the natural corridor
> Redevelopment of regional centers
> New housing developments

Legend

Wet agriculture
Agricultural pilots
Nature corridor
NAM locations
Solar fields
Wind fields
Hydrogen
Information location

Monuments
Protected areas
3/4 ind. class
5/6 ind. class
Mixed-use developement
Urban attention zones
Urban
Main roads
Trainlines
Nature areas

Renewables + hydorgen
Renewables + nature
Renewables + hydrogen (remote)
Renewables + hydrogen (mobility)

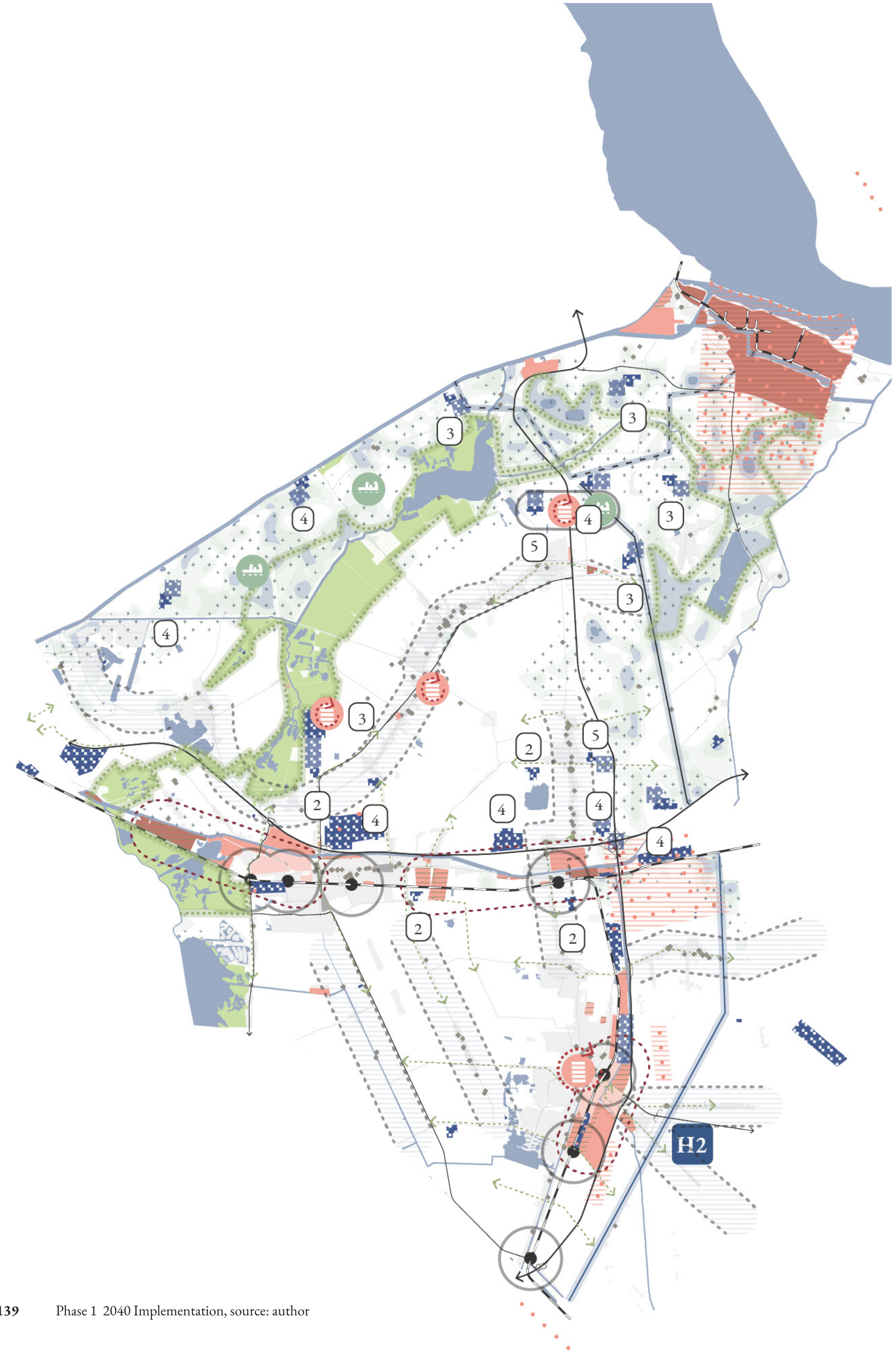


Figure 139 Phase 1 2040 Implementation, source: author

5.4 Phasing

Phase 3: 2050 Establishment

Renewable energy production
The last part of the ambition is built, solar parks and windmills in the region are now producing enough energy to sustain the province and export energy and hydrogen to other regions in the Netherlands.

National hydorgen network is established
> Strorage facilities arround Veendam are again expanded
> Nam locations are intergrated with the national network
> New industries have been attracted and a new ecnomomy arround hydrogen is established in the region.

The NAM locations
The NAM are now fully specialized in both energy production and hydrogen production.

The peat oxidation area's
The natural area has reached it final size and the foucs is now on the renenaturalization process of the corridor.
- touristic routes are established through the area.

Urban areas
The station areas are developed according to the urban development plans formultaed in the preparation phase. New housing project are concentrated here.

New housing development plans are introduced.

green corridors are established.

Industrial areas
Old industrial terrains are used
> some have good potential for mixed use (proximity of a station, housing close by) > these areas attract smaller bussinesses and invest on housing complexes.
Stationszones are optimized, new housing projects are concentrated here.
These ares are developing towards zones that have most of the regional functions.

New bussiness location

Protected zones are made accros the highway area and qualities of the linten are put in a docuement to protect and guarantee these with new development.

Main actions per time frame
> NAM location become multi-functional hubs
> Hydrogen is widely used
> Agriculture optimization
> Nature corridor is complete, guiding the renaturalization process
> Placement of the last renewables
> centers have been renovated and function as regional centers.
> green corridors
> Tourism inlcusion

Legend

Wet agriculture
Agricultural pilots
Nature corridor
NAM locations
Solar fields
Wind fields
Hydrogen
Information location

Monuments
Protected areas
3/4 ind. class
5/6 ind. class
Mixed-use developement
Urban attention zones
Urban
Main roads
Trainlines
Nature areas

2 Renewables + hydorgen
3 Renewables + nature
4 Renewables + hydrogen (remote)
5 Renewables + hydrogen (mobility)

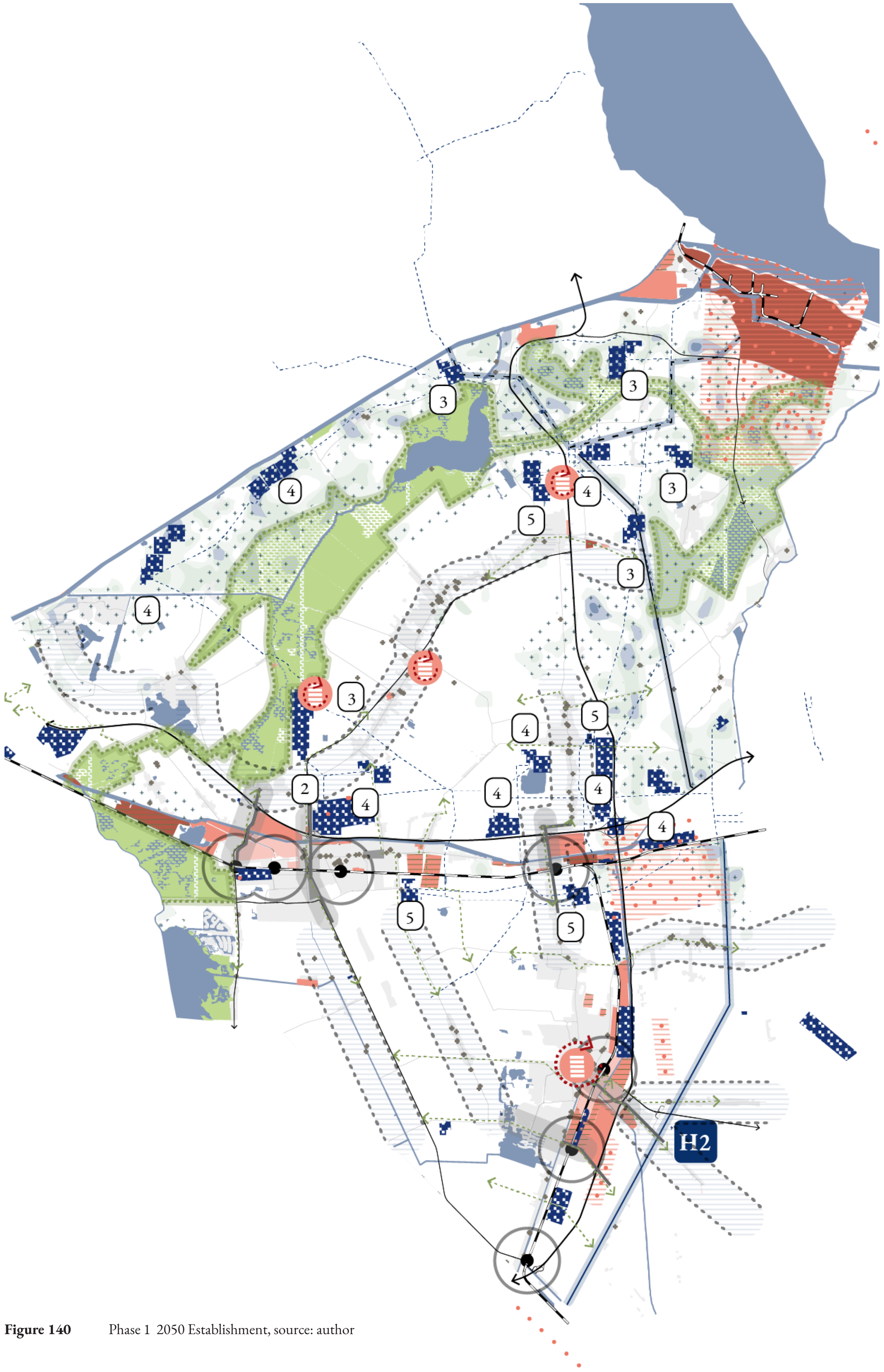


Figure 140 Phase 1 2050 Establishment, source: author

5.4 Phasing

Timeline

The project implementation can be organized into three distinct phases: 2030, 2040, and 2050. These particular years have been selected to align with key policies, such as the European objective of achieving carbon neutrality by 2050.

Phase 1: Preparation (2024-2030)
During this initial phase, emphasis is placed on finalizing the strategic design and establishing the groundwork for the implementation phase. Stakeholders and local communities are actively involved to ensure informed decision-making. Efforts are made to integrate national, regional, and local policies more effectively.

The Nam locations are being prepared to serve as energy production sites. Field trials are being conducted on agricultural land to acquire insights on farming with increased water levels. Plans need to be developed for the regional centers and the redevelopment of industrial areas.

Phase 2: Implementation (2030-2040)
The second phase entails the extensive implementation of renewable energy sources. NAM sites are converted into energy production facilities, while a regional hydrogen network is established. A new natural zone is introduced, linking the natural areas of 't Roegwold, the Schildmeer, and the Hondshalstermeer. Water levels are elevated, and wet agriculture is extensively promoted in the region, contributing to increased water storage capacity. The areas around train stations and the industrial zones are transformed according to the development plans created for these regions.

Phase 3: Establishment (2040-2050)
In the final phase, the focus shifts towards completing the natural corridor, expanding renewable energy placement, and restructuring urban areas to mitigate shrinkage impacts. Agricultural land is further equipped to manage water effectively. Transformation projects for industrial terrains and key urban centers, such as Veendam and Hoogeveen, are finalized to enhance resilience to shrinkage.

One crucial element of the strategy is the annual events, which serve diverse purposes. These events gather people in the region, providing planners with a platform to disseminate crucial information and updates related to the strategy. Furthermore, these gatherings present an opportunity to gather local feedback and insights that can inform the strategy. Every five years, the strategy should be adapted according to changed needs and new input. Important is that there is transparency in the information that was gathered and how it is used.

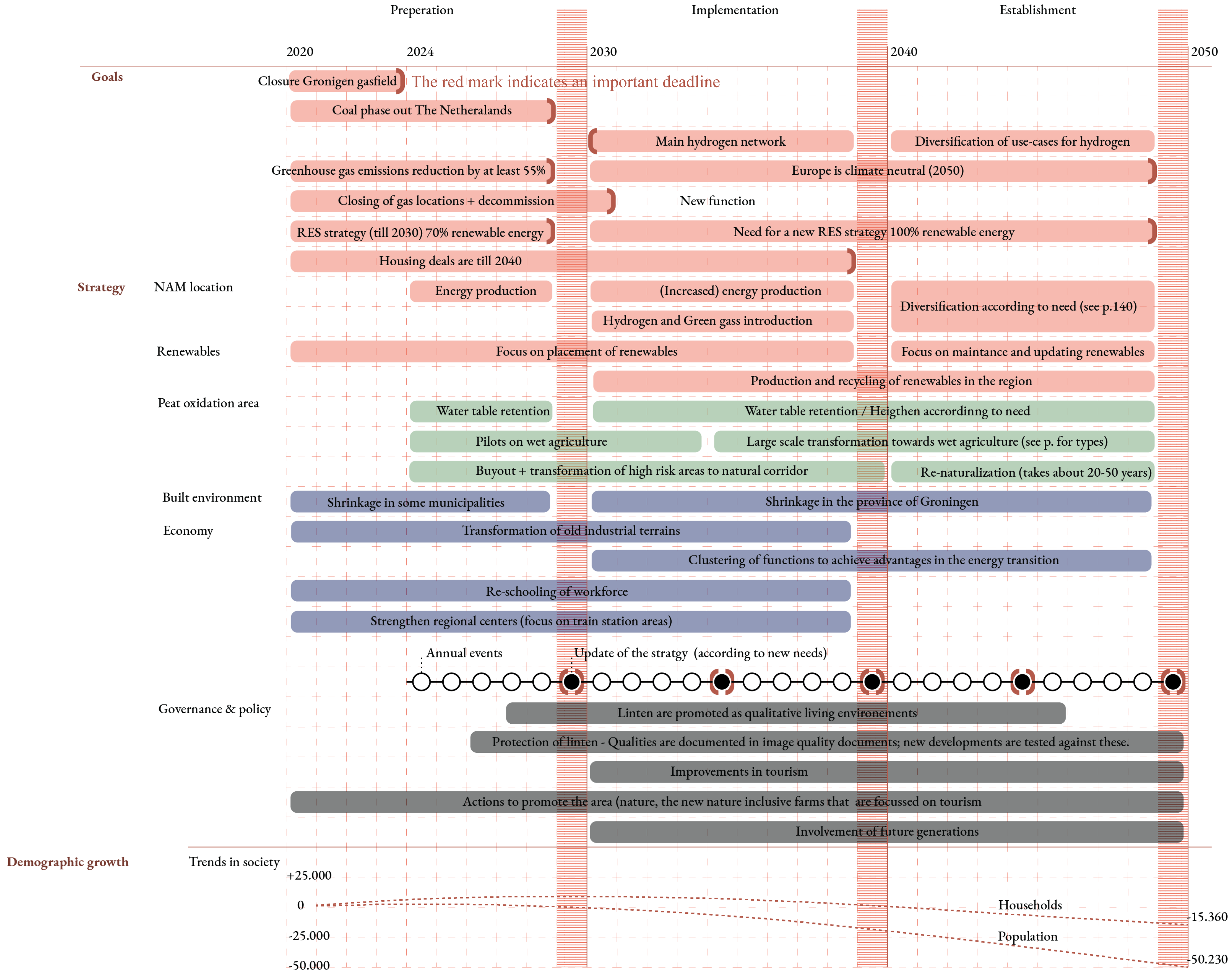


Figure 141 Phasing of the strategy, source: author

5.5 Strategy - social engagement

It's crucial to establish an inclusive transition process, ensuring the protection of vulnerable societal groups. Utilizing different engagement strategies at various stages of the process is vital. Four primary strategies are proposed to foster social engagement across all demographics and facilitate an inclusive transition.

Strengthen participatory processes

Active involvement of local communities is pivotal for inclusive governance, providing insights into local needs and perspectives while aiding in formulating inclusive policies. Due to the impact of gas extraction-induced earthquakes in the Groningen gas field, residents feel marginalized by the Dutch government, leading to diminished trust. Integrating provincial and local stakeholders and fostering collaboration between them and government representatives (at national and provincial levels) is imperative. Special attention should be paid to involving the least engaged, simplifying engagement processes, and ensuring easy access to information.

Raise public awareness

Increasing public awareness is fundamental for achieving social inclusion. Informed individuals are more likely to engage in planning processes impacting their region. Disseminating information about the energy transition and sustainability challenges through various channels is essential. Establishing a dedicated website to inform people about Groningen's developments, conducting online polls to gauge public opinion, and leveraging social media to engage and inform younger generations are essential. Organizing an annual energy festival can raise awareness and attract a broader audience. Additionally, establishing a café or restaurant combining tourism with energy transition information, possibly situated on a former NAM site, could be an effective initiative.

Spread knowledge

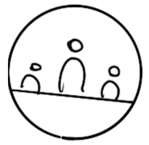
Retraining employees at fossil fuel companies and gas extraction locations is crucial. Open courses should be offered to region residents to actively involve them and provide training or employment opportunities in the sustainable energy sector. Farmers need support to transition their farming practices, ensuring they can continue working in their current fields. Regional knowledge institutions can contribute to broader knowledge dissemination. Designing courses for middle and high schools can enhance awareness among younger locals.

Improve transparency

Enhancing transparency is essential for building trust and fostering engagement. Conducting an annual feedback session, possibly alongside the energy festival, can facilitate stakeholder communication. Providing detailed information and data to young professionals and interested individuals can encourage professional contributions and enrich academic discourse. Establishing an information point or mobile unit to disseminate information and address questions, inspired by successful initiatives like Toukomst, can gather input from the local community.

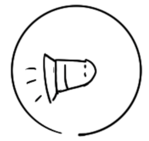
Social engagement

Strengthen Participatory Processes



- Organize local participation moments
- Organize workshops with the local community
- Organize events
> energy festival
- Online discussions

Raise public awareness



- Organize local meetings and public participation moments
- Organize workshops with stakeholders
- Inform via social media
- Create a website
- Courses at local high schools

Spread Knowledge

- Retrain employees
- Offer local training oppertunities and knowledge courses
- Make local knowledge center(s)
- create cources for local highschools
- information point, small van.

Improve transparancy

- Start policy document with why it is important for local residents.
- share knowlegde on the website
- annual feedback session
- provide detailed data for students and young professionals
- information point, small van.

Figure 142 Social engagement strategies, source: author

5.5 Strategy - Governance

Strategy – Governance reform

Promoting cooperation policies

Governance in the Netherlands is generally considered effective compared to many other countries. However, there is a feeling among Groningen residents that they are being overlooked by the central government, while at a regional level there is the impression that the province puts the interests of the city of Groningen first. It is imperative that the national government pays more attention to local needs and enables greater cooperation between all levels of government. Policies tailored to local needs play a crucial role in rebuilding trust between national and provincial/local governments.

Close collaboration with local stakeholders is essential to understand their needs and use their expertise effectively. It is essential to actively involve all stakeholders, including those who may face barriers to participation. Facilitating easy participation and organizing local events can increase engagement. In addition, consideration could be given to offering incentives for participation to attract broader involvement.

Monitoring and evaluation systems

Monitoring and evaluation processes can be facilitated through digital platforms, ideally integrated with a website dedicated to providing information on the energy transition. In addition, social media can also be used. However, in addition to digital approaches, organizing local meetings and publishing regular newspapers can ensure updates are accessible to older residents and provide opportunities for review sessions.

Promoting long-term planning

Harmonization with long-term planning objectives is paramount, especially when it comes to initiatives such as hydrogen implementation and renewable energy deployment. This strategic alignment helps mitigate unexpected challenges and promotes smoother transitions to sustainable development.

Governance reform

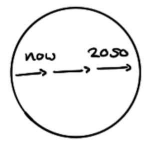
Promoting Collaborative Policies

- Include local stakeholders
- Make more money available for local participation.
- increase the local capacity
- Organize - "design tables" with profesional from all levels

Monitoring and Evaluation Systems

-Publish the progress every year
- social media for polls
- website

Promoting Long-term Planning



- Make policies that are intergrated on multiple scales
- Multi-sectoral planning
- Include EU and national goals

Figure 143 Governance reform strategies, source: author

Local intervention

6.1 Introduction

This concluding section of the strategy focuses on specific location with spatial tension. The types of spatial tension are according to the map on page 147 that shows the spatial tension between the scenarios. The local design interventions aim to provide additional information that adds knowledge to the strategy and shows how elements work on a smaller scale.

The different type of land-uses are listed bellow:

- Energy production
- Wet agriculture
- Nature
- Water storage
- Protection of cultural values
- Protection of natural values
- Living
- Business

The location near Siddeburen deals with the impact of climate change. The NAM location is a large-scale energy production site and serves as a mobility hub. A part of the area is transformed into wet agriculture, and the area has a small part of the natural corridor. In addition to this, the location has a public function as part of the energy and heritage path. At the location, annual events are held, and people can get information about the energy transition and the land transformation to wet agriculture.

Legend

Wet agriculture
Agricultural pilots
Nature corridor
NAM locations
Solar fields
Wind fields
Hydrogen
Information location

Monuments
Protected areas
3/4 ind. class
5/6 ind. class
Mixed-use developement
Urban attention zones
Urban
Main roads
Trainlines
Nature areas

Renewables + hydorgen
Renewables + nature
Renewables + hydrogen (remote)
Renewables + hydrogen (mobility)

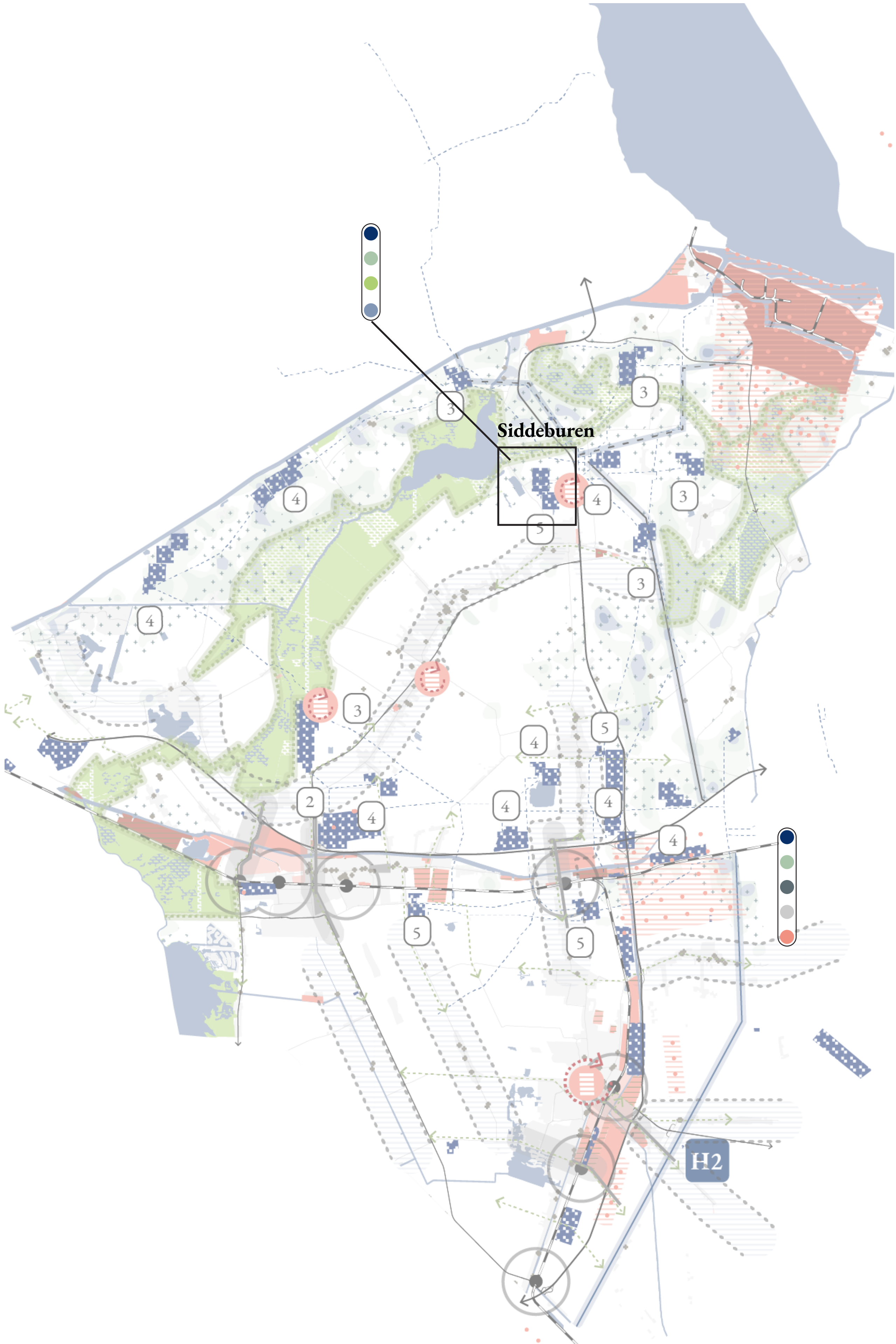


Figure 144 Zoom in locations for the design interventions, source: author

6.2 Siddeburen

The location near Siddeburen, a small village in the countryside of Groningen, features a NAM site that will serve an important role in the strategy. The facility will be transformed to a mibility hub and a major production facility of energy and hydorgen.

The area arround the NAM location is transformed to wet agriculture. The area is used a pilot location for reseach on wet agriculture. The succes of different spicies can be monitored and this information can be used for the large scale transformation towards wet agriculture.

The area is part of the energy heritage path and has an important function in educating and informing people about the eregy transition and the transition of agricultural land. It does also provide an oppertunity for tourism, the renewable cafe has both the purpose of informing the local people about what happenend and the energy transition. In adition to this are there annual events where information is gathered and where people are involved in the decissionmaking process.

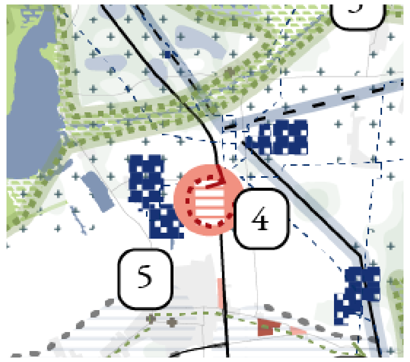


Figure 147 Location on the strategy map, source: author

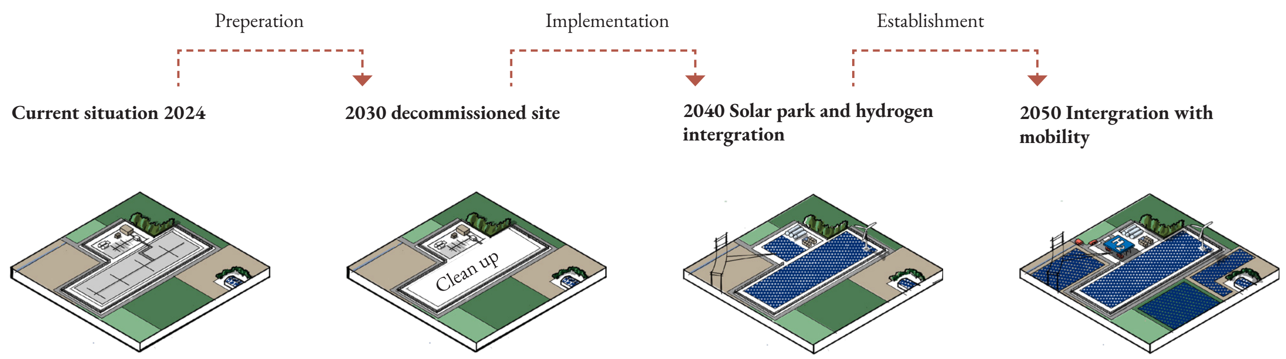


Figure 145 Transoformation process of NAM location, source: author

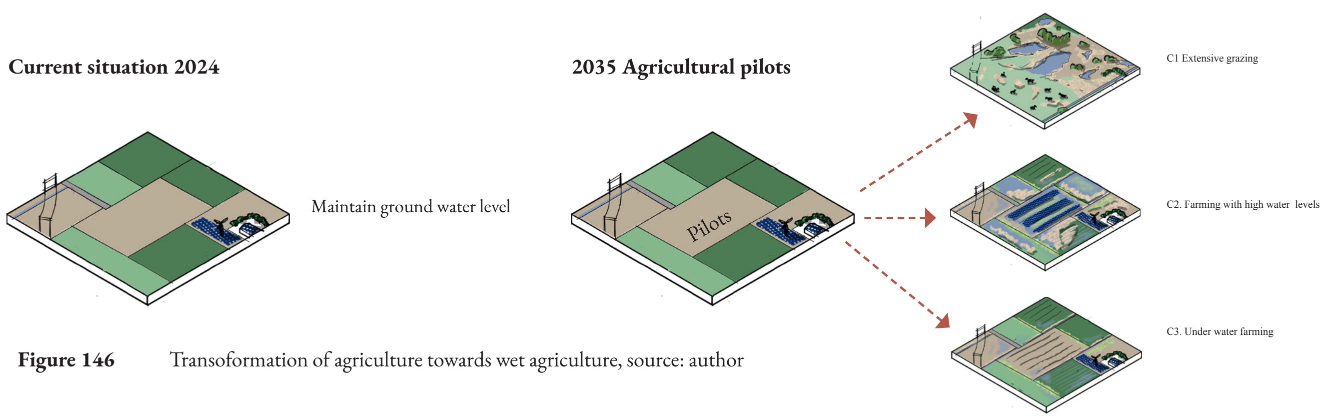


Figure 146 Transoformation of agriculture towards wet agriculture, source: author

Figure 148 1:10.000 location zoom in source: areal photo Qgis

6.2 Siddeburen

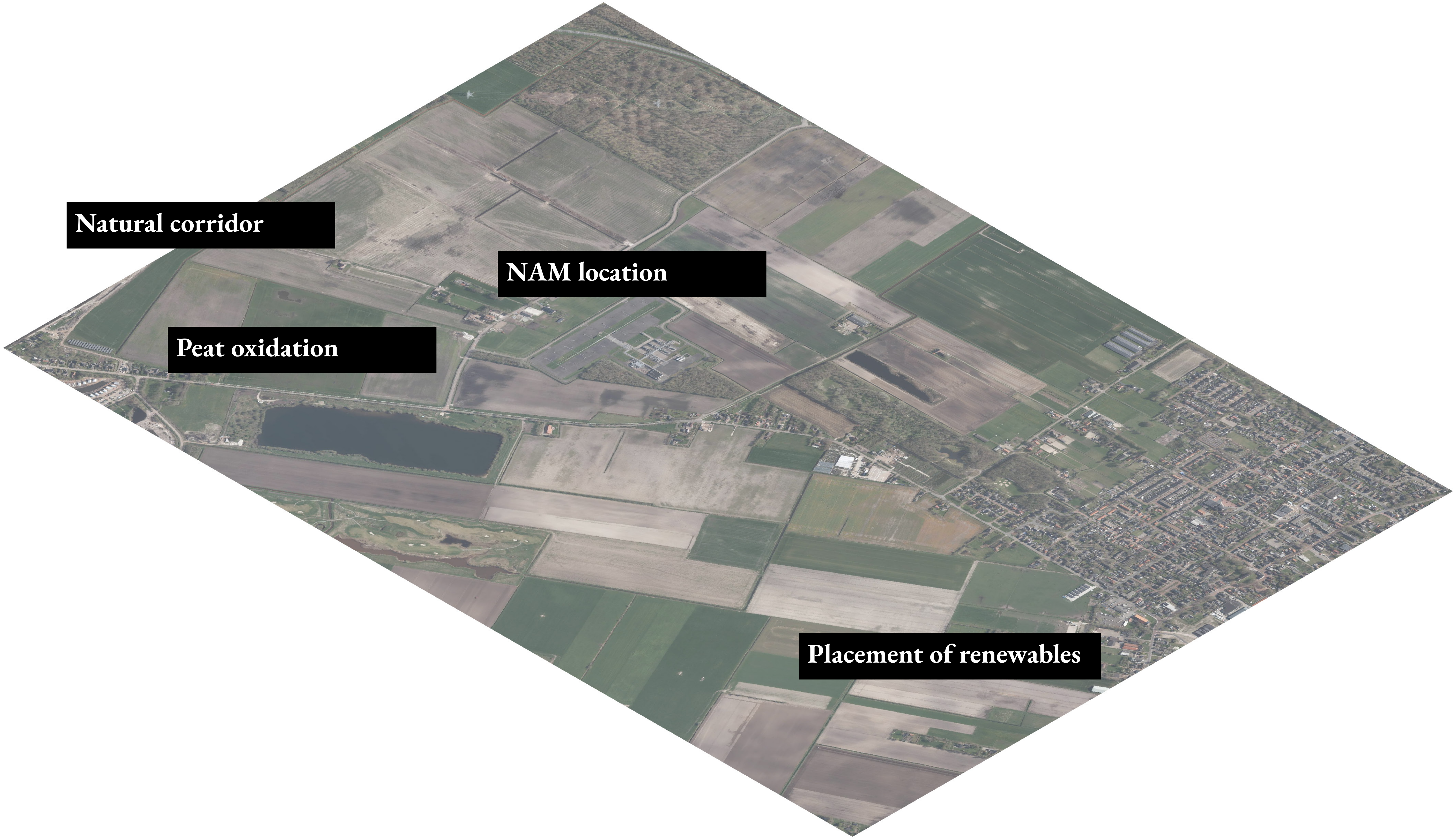


Figure 149 Current situation of Siddeburen, source: author

6.2 Siddeburen

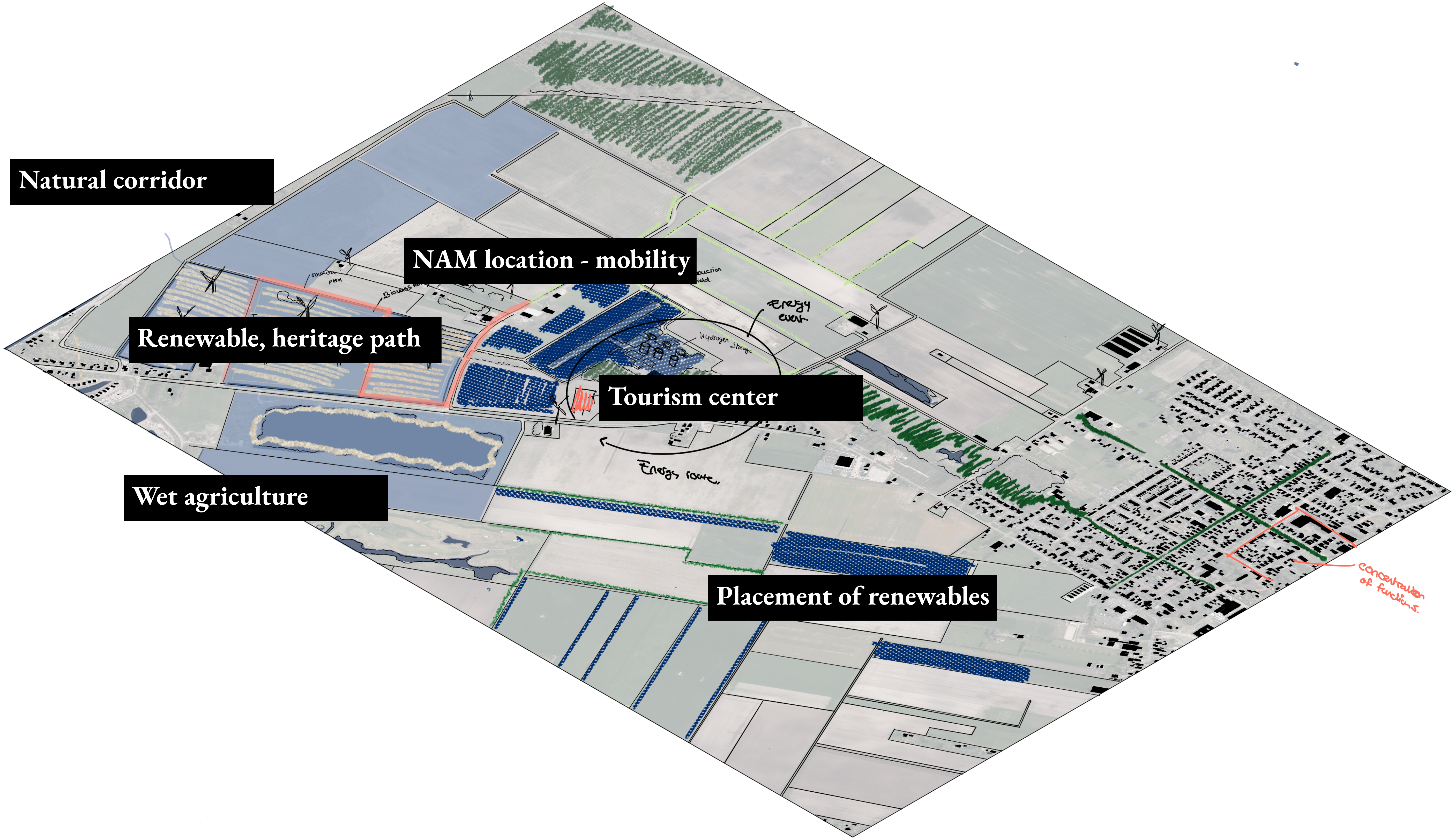


Figure 150 Siddeburen in 2050, source: by author

6.2 Siddeburen

The process of transforming agricultural land towards natural peatlands is shown on this page. There are two methods, putting the area under watter or slow rewetting. The second option is more favourable since, it contributes to making healthy peatlands and has the possibility to heigthen the land instead of the current process of ground subsidence.

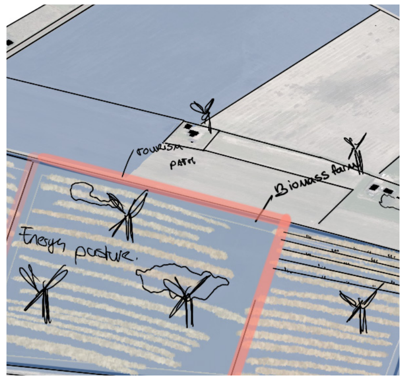


Figure 151 Re-naturalization

Figure 152 Photo of an area that is transformed from agriculture to nature, source: author

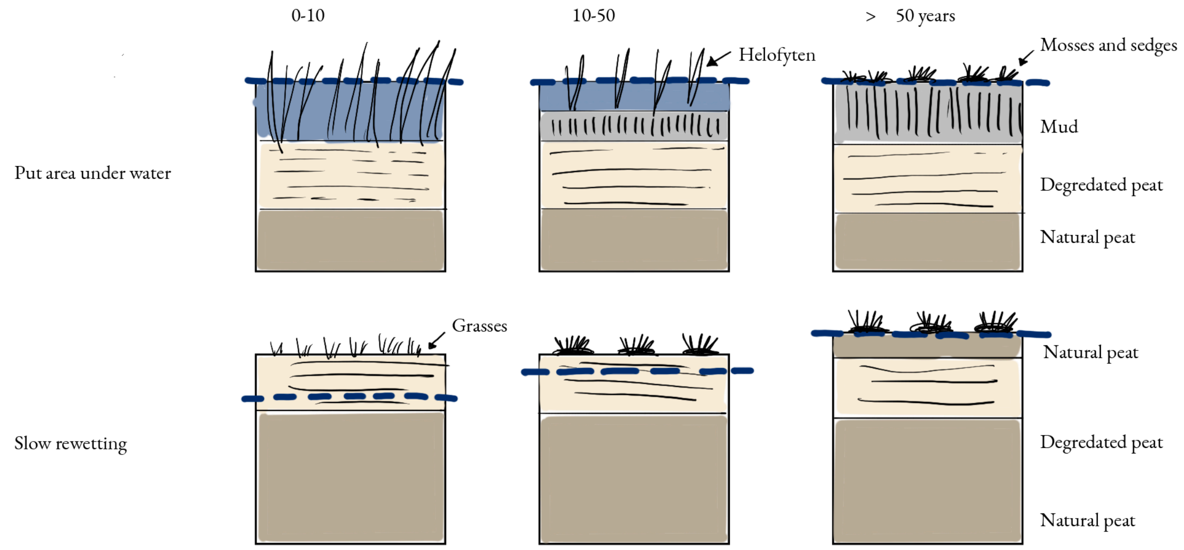


Figure 153 Two types of transformation processes agriculture to peat, by author, source: (Zak & McInnes, 2022)

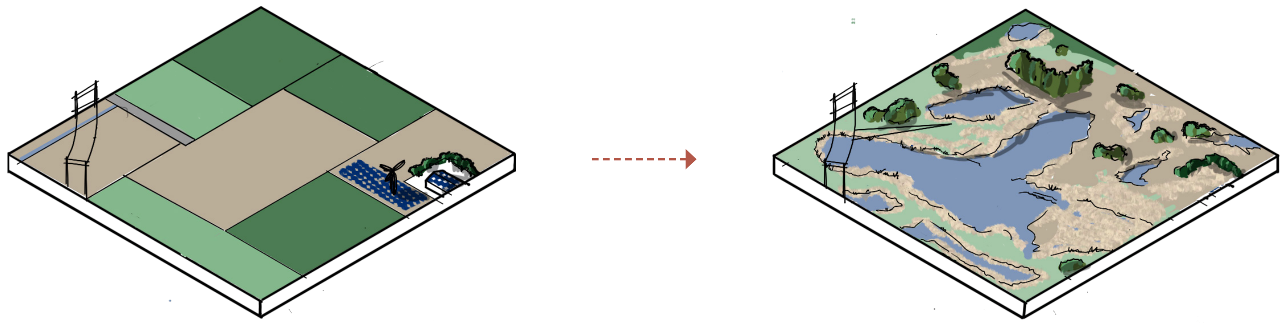
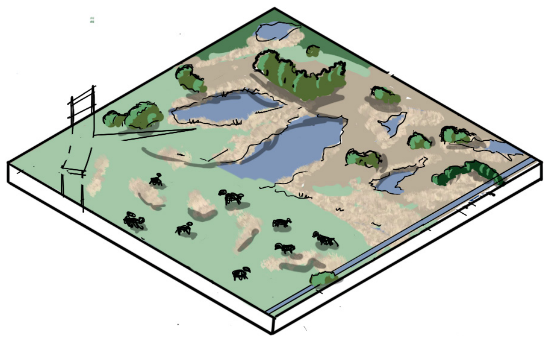
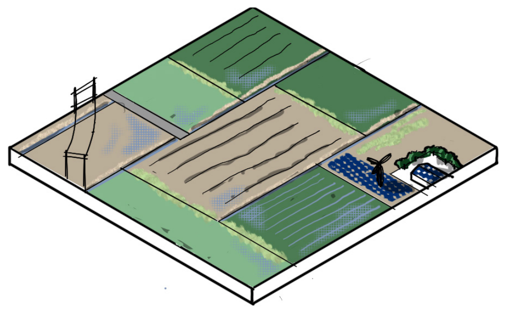
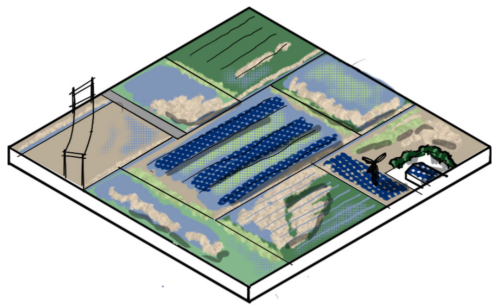
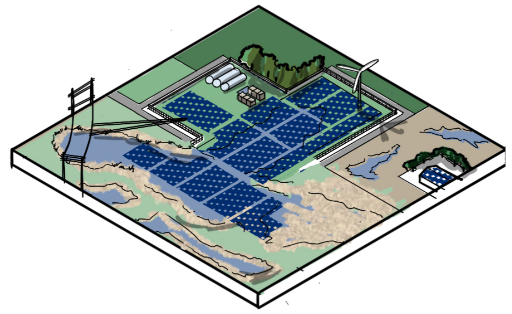


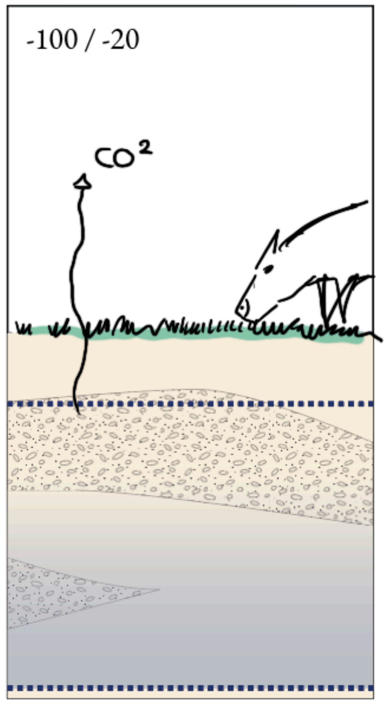
Figure 154 The full transformation of agricultural land towards peatlands takes over 50 years, source: author

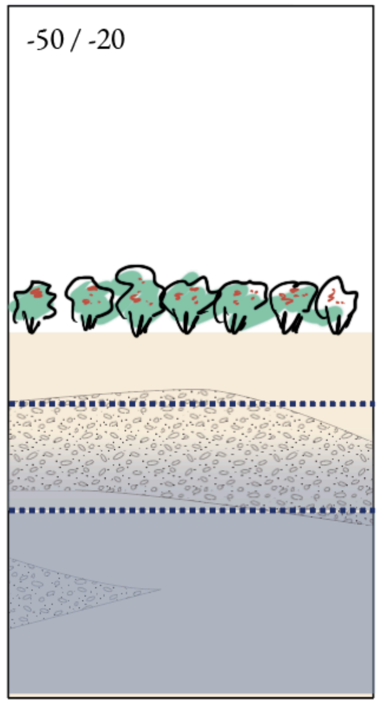
6.2 Siddeburen

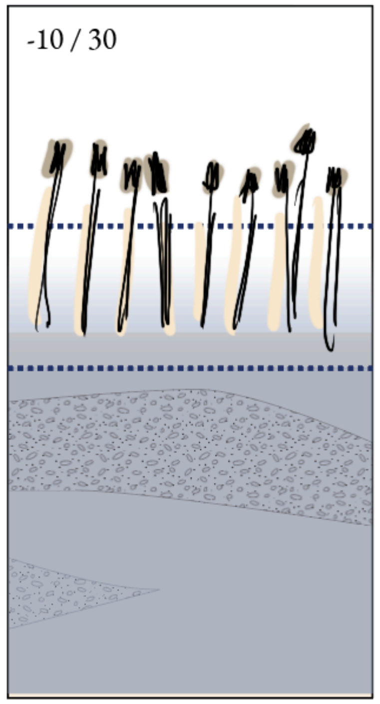
Different types of wet agriculture linked to the typlogies of wet agriculture

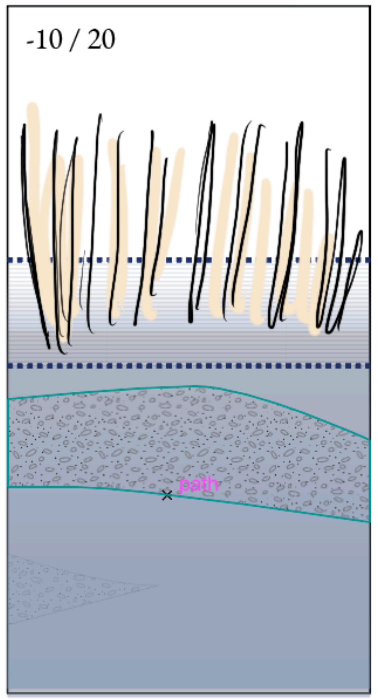





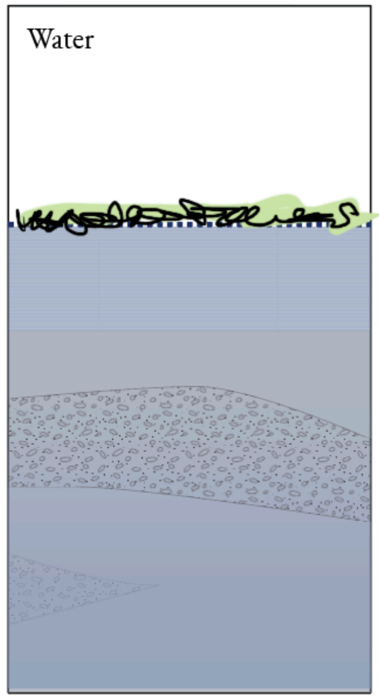
Grassland | Cranberries | Lisdodde | Reed | Kroosvaren | Floating PV panels

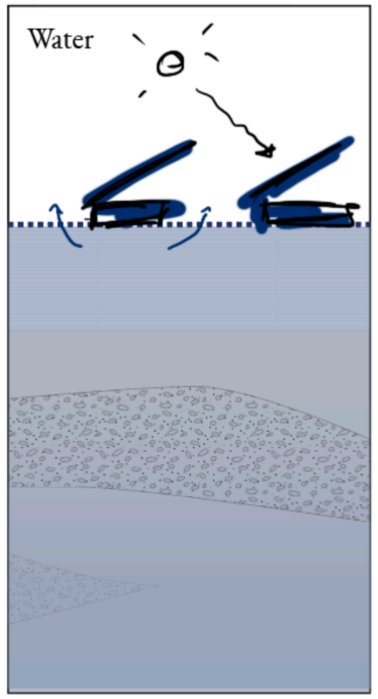












Livestock (food)

Source: author

Cranbarries (food)

Source image: (TheCranberryCom-pany, n.d.)

Lisdodde (building material)

Source image: (Peel 2024, n.d.)

Reed (biomass/ building material)

(Gesneden riet levert prachtige beelden in de Nieuwkoopse Plassen op, 2023)

Kroosvaren (protein rich food for cattle)

(De Grote Kroosvaren | Microscopie van de Natuur, n.d.)

FPV

Source: (Drijvende zonnepanelen | Deltares, n.d.)

Figure 155 possible types of wet agriculture, source: author

6.2 Siddeburen

Figure 156 Photo of the current condition, source: author

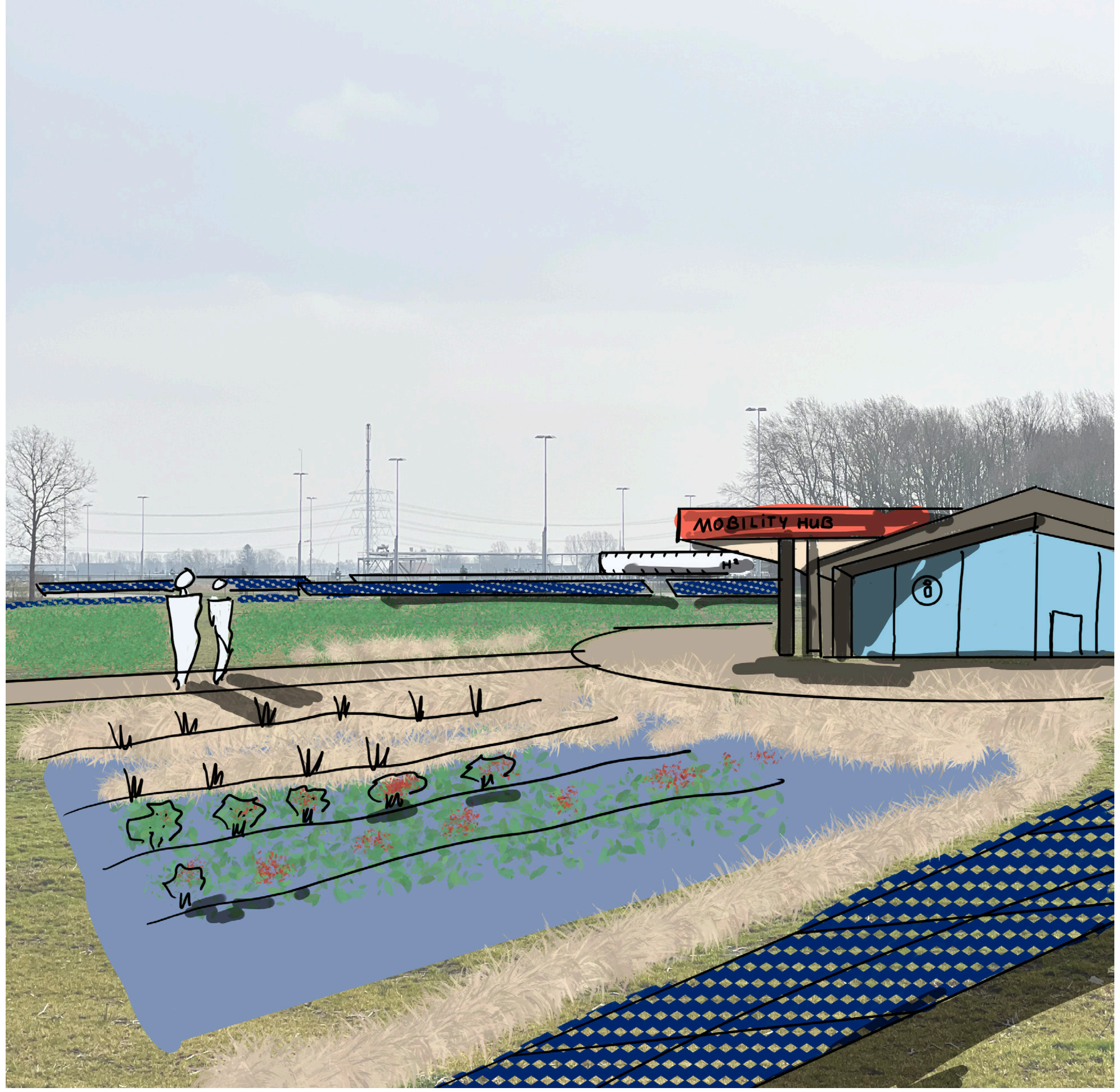


Figure 157 Impression of 2050, source: author

Reflection

7.1 Conclusion

Main-question
How can Groningen, a region vulnerable to the energy transition, facilitate a just energy transition strategy that combines spatial planning, heritage, and the inclusion of the least engaged groups?

Q1: What is the Just Transition Fund, and how can "types of regions (similar to Groningen)" be defined based on social, economic, and spatial elements?

The Just Transition Fund is a European fund that provides economic support to vulnerable regions in the energy transition toward a carbon-neutral economy. Generally, there is a distinction between regions involved in fossil fuel extraction and regions with carbon-intensive industries. Most fossil extraction regions produce coal, which is generally considered the heaviest-hit region in Europe since these jobs and economies will disappear. Carbon-intensive industries will have to transform, but the industries and jobs will remain within the region.

Groningen, the most vulnerable region in the Netherlands, receives over half of the Dutch allocation of the Just Transition Fund resources for the transition of carbon-intensive industries. At the same time, the province must deal with the phase-out of gas extraction from the Groningen gas field, which caused earthquakes and damaged houses in the region. In Europe, Groningen is the only region with a large gas field, making the phase-out of gas extraction and the problems it caused for the region unique. That said, Groningen has socio-economic issues similar to those of other structurally weaker regions, such as an aging population, shrinkage, and a declining economy. Furthermore, renewable energy is often seen as a new economy that can help these regions provide jobs.

In terms of spatial characteristics, Groningen is a semi-urban region. It is a flat area with wide farmlands and problems with water storage and peat in the soil, which caused ground subsidence and CO2 emissions. These problems can help define a region with similar problems while having the same context of vulnerability in the energy transition.

Q2: What are the challenges for the province of Groningen in the energy transition?

Groningen is facing several challenges simultaneously. The gas extraction operation from the Groningen gas field caused earthquakes, damaging over 26.000 houses in the province. "de versterkingsoperatie," a project from the national government to provide money to repair the houses, started late, which created a low trust from the local residents in the government. Furthermore, gas extraction did cause ground subsidence, which is especially problematic in areas with peat in the soil. In these areas, the groundwater level is kept artificially low for agricultural practices. This is causing additional ground subsidence and emits large quantities of CO2. The water level management is at its maximum capacity, and land-use changes are needed to work with the higher water levels, making current agricultural practices impossible.

The placement of renewable energy sources can transition Groningen to a new economy that generates local jobs. However, it is crucial to consider the local population's wishes and respect the landscape qualities and structures when installing renewables. This is particularly important because the Groningen population has had bad experiences with the negative consequences of gas extraction. Additionally, the smart reuse of gas extraction sites and existing infrastructure can offer an advantage for the region when introducing hydrogen. Hydrogen can be used as a medium to store and transport energy. What could reduce the pressure on the current energy grid, which is currently at its maximum capacity.

Moreover, socio-economic challenges, including anticipated population decline, intensify pressures on the local living environment. These challenges disproportionately affect vulnerable groups in society, who often lack representation in governance structures. As a consequence of the poor help from the government with damaged houses, they lack trust in the government. This is illustrated by the last elections, when the PVV, a populist party, almost doubled in votes in the municipalities of Veendam and Midden-Groningen (NOS, n.d.). It's crucial to consider their needs and concerns within decision-making processes.

Q3: What are the current strategies and policies for Groningen, and what opportunities does it already offer?

Groningen has various policies and strategies, some of which have inspired the thesis, such as the documents about the Regional Energy Strategy (RES 1.0 and RES 2.0). These documents helped the region understand the 2030 goals and functioned as a basis for translating the goals to 2050. The goals were then translated to the spatial needs for Groningen in the future. Also, the spatial exploration RES by H+N+S landscape architects provided important insights into how space and energy are connected in the province. The draft strategy for 2050 gives a good overview of Groningen's challenges. The housing deals also give a good overview of building new homes in Groningen. The main gap within these efforts is that Groningen lacks scenarios for the transition on a regional scale.

The scenarios in the thesis provide insights into spatial competition on the regional scale that the transition will entail. They address the increasingly important need for dual use, driven by the energy transition and climate adaptive design, which requires more space for water and nature.

7.1 Conclusion

Q4: How can the least engaged groups and stakeholders get a voice in energy strategy?

The least engaged should become more involved. Several proposed policy measures can achieve this, but an important part is also actively informing them about what is happening in the region and why this is important for these groups. In addition to the importance of the problems, solutions should be provided. The thesis is focused on informing these groups through an in-depth analysis of the problems and the importance of these issues. After this, the scenarios are made to show alternative futures and the strategy with a phasing that shows what decisions are essential in what stage of the strategy to capitalize on the opportunities and avoid the negative problems.

In addition to this, it is crucial to ensure people can get involved. Marginalized groups are willing to participate but cannot because the location is too far away from their homes, or they are not informed about the participation moment. Therefore, it is important for policymakers and designers to actively involve marginalized groups to guarantee that they have a fair opportunity to participate in the energy strategy.

The thesis proposes social engagement strategies, such as annual events around the energy transition, to inform people about what is needed and to contact the local community to find out what their needs are. Furthermore, governance reform actions are proposed, such as better informing the local communities about how their input is used in the planning and design process to create a more transparent process.

Q5: How can local spatial qualities work as a change vector for a new energy economy?

The strategy shows how gas extraction locations and the infrastructure already in place can serve as development locations for the energy transition. The location's function remains the same while switching from fossil fuels to renewable energy sources. However, there are additional uses, such as the introduction of hydrogen, integration with nature, or the location that could serve as a mobility hub.

The agricultural areas have problems with peat oxidation and ground subsidence. By proposing new types of wet agriculture in combination with energy production and tourism, these areas can transform into sustainable areas with new and diverse economic functions. An important addition is that areas with valuable landscape qualities should be protected from large-scale landscape transformations due to the placement of renewables.

The energy production and introduction of a new hydrogen network could be useful in attracting new companies to the area.

Q6: How can these local spatial qualities and local "voices" help to create a strategy and design for Groningen?

Building on the NAM locations, the gas pipelines, and the other elements can create an approach in which Groningen develops into a dynamic landscape with old and new modern elements.

The involvement of local stakeholders is essential in this process. They provide valuable information about the area. However, their needs must also be recognized, and they should benefit from these local changes. For example, the NAM locations can be used to make a strong energy and hydrogen network, which is beneficial for the local community. It will provide a good business climate, and the regional hydrogen network will lower the pressure on the energy grid that is currently overloaded. The mobility hubs can be helpful for the local community.

Also, the strategy proposes different uses of the NAM location and agricultural land, providing the local people with different solutions and qualities. These can be used to get the local community involved in the design-making process.

Q7: How can the Groningen strategy help formulate a strategy for similar European regions?

The project started with the Just Transition Fund, created for vulnerable regions to the energy transition in Europe. To some extent, these regions share similarities, such as having jobs within the fossil energy sectors and often struggling already. However, there are also major differences.

Approaches to creating a new renewable economy and how regions can deal with peatlands producing CO_2 emissions can help other regions facing similar issues adapt to a new economy. In addition, local needs and the inclusion of marginalized groups are essential in all regions. The engagement strategies can be used by all European regions.

However, large parts of the methodology and systematic approach can be re-applied in other European regions. A limitation could be that the same data that is available in the Netherlands is not available in other countries in the EU.

7.2 Reflection

1. The relation between the graduation topic, urbanism and master program

Between Subject and Studio
The thesis presents a strategy for the central part of Groningen, with the energy transition as a focal point. This strategy also addresses other significant challenges, such as socio-economic issues, the necessity for water management, and the transformation of agricultural land in response to climate change.

Given the limited availability of space in the Netherlands, these challenges necessitate a well-structured strategy and equitable governance. It is crucial to inform the local population about these issues, involve them actively in the process, and provide continuous feedback.

The thesis explores various scenarios for Groningen's energy transition and highlights different governance approaches. The studio Complex Cities explores complex planning and design challenges in combination with governance and participation trajectories. Therefore, the studio and the subject intersect in addressing complex spatial problems and engaging local communities to foster inclusive governance.

Between Subject and Urban Planning
The energy transition has profound spatial and social implications. Other challenges related to climate change and socio-economic conditions also demand space, which is scarce in the Netherlands.

Integrating renewable energy sources effectively requires spatial planning that respects landscape qualities. Historically, energy production has been segregated from human environments, but the new energy landscape will integrate more closely with them. As urban planners, it is essential for us to understand the spatial impacts of the energy transition and incorporate these considerations into our projects. Designers can help visualize future choices and their spatial implications by creating scenarios.

Between Subject and Master's Program
The thesis investigates potential development pathways for Groningen in the context of climate change and the energy transition through research by design methods. This contributes to academic knowledge and offers valuable insights for policymakers and the local community.

2. The influence of research on the design and vice versa

Research and design are always closely linked and never linear processes. The analysis, the development of typologies, the scenario construction, and the strategy development are interlinked processes that require going back and forth a lot. New information provides ideas for the scenario and the design, while the scenario and the design point out new problems that require new research and analysis.

The many policy documents provided valuable insights and helped me understand Groningen's challenges and opportunities. At the same time, this made the project more complicated since a lot of information needed to be considered. Distinguishing between primary and secondary issues proved to be essential but also challenging. Conscious choices to include or exclude specific topics earlier in the process would have made the project more manageable. Integration of the topics was achieved by creating typologies that could be used in scenario construction and strategy making.

The idea of spatial competition is the key element connecting the analysis, scenarios, and strategy. Spatial competition provides insight into prioritizing different issues, values, and design principles. These choices will impact the future of Groningen and create different burdens and benefits for the local communities. The strategy is based on the three scenarios, preconditions, and principles adapted from the analysis. The strategy entails phasing and design solutions.

3. Assessment of approach, methods, and methodology

The original plan was to develop two strategies: one for the European regions included in the Just Transition Fund and another specifically for Groningen, the most vulnerable region in the Netherlands. This was quite ambitious, and as I delved deeper into the European context, I discovered that Groningen's situation is unique. Most gas fields in Europe are in the North Sea, while the Groningen gas field is the only large-scale gas field on land.

As the process evolved, the focus shifted to Groningen and the Dutch context. Groningen faces significant challenges related to the energy transition and deals with numerous other concurrent issues. The SWOT analysis, preconditions and principles, and the development of typologies were instrumental in structuring the analysis.

The analysis revealed a competition for space in Groningen, necessitating clear decisions and innovative solutions for dual land use. Developing different scenarios provided insights into possible outcomes. These scenarios consider various factors, such as economic policy and social priorities, and draw inspiration from the PBL (Plan Bureau van Leefomgeving) scenarios. Based on these scenarios, a strategy with design interventions was formulated.

Reflecting on approach and methods
The research laid a strong foundation for the thesis's design aspects. The main challenge was not gathering knowledge but distinguishing primary issues from secondary ones. The SWOT analysis and the creation of typologies were instrumental in structuring the information derived from the analysis, thus providing a solid basis for further design.

7.2 Reflection

The scenarios were created to test various strategies with different values and design approaches, aiming to clarify the diverse uses of space. In this process, typologies offered more profound insights into the concrete spatial impact at a smaller scale. Introducing the preconditions and starting points later in the process was crucial for evaluating and merging the scenarios into a cohesive strategy.

Ultimately, the approach used for the thesis proved effective. A more precise plan of approach and better differentiation of primary and secondary issues could have simplified the process, allowing more time to be dedicated to the final design. However, this also highlights that the design process is inherently non-linear, characterized by steps forward and backward.

Limitations of the methods used

The methodology used in this project required many steps and thinking throughout the scales. In retrospect, initiating research focused on Groningen earlier in the process would have been beneficial, as much of the knowledge acquired at the EU scale proved less directly applicable locally. Limiting the research field earlier in the project would have helped to create more time for the project.

Therefore, another limitation was time. The construction of typologies, scenarios, and a cohesive strategy with phasing is complex and requires a lot of research and design. An interesting addition to this project would have been to create the scenarios in more depth and showcase these scenarios in Groningen among local communities. This approach would have provided valuable new insights while creating awareness and informing local communities.

4. Scientific and societal value

Society widely recognizes the importance of the energy transition. As a result, people have started making more conscious choices, such as installing solar panels on their homes.

However, it has become clear that the benefits and costs of the energy transition are not equally distributed. To address this, funds such as the Just Transition Fund and, on a regional scale, the reinforcement operation for Groningen have been established. The socio-economic consequences and spatial impact of the energy transition require further research. This involves gathering knowledge, but 'research by design' is also crucial for gaining new insights into the energy transition. In the thesis, three scenarios have been made to explore different futures for Groningen. The scenarios can be seen as research for the final strategy, which is the design.

This thesis combines energy transition, social inclusion, and landscape renewal theories to promote more inclusive governance. As Sijmons (2014) showed, the energy transition has a clear spatial component. In this thesis, this idea is applied to the region of Groningen by translating the goals of the regional energy strategy to space. This thesis uses scenarios to provide insight into spatial competition and different development paths for the Groningen region. Using the space differently creates different benefits for the local population. The energy transition does not only have a spatial component, but it is also important to consider local needs and the local landscape.

The thesis also emphasizes the importance of inclusive governance. The energy transition must consider less-engaged groups in society, such as older, less-educated, and young people. These groups are often not politically involved but experience the most adverse consequences of the transition (Verena Balz et al., 2023 p.10-11). Actively informing and involving these groups is crucial. Therefore, the thesis proposes typologies and scenarios to show alternative possibilities and futures. This can help them understand what is possible for the future of Groningen in the long term and what is at stake. By creating a clear design, it becomes easier to be actively engaged and make logical decisions. In addition, potential conflicts between stakeholders can also be identified.

Inclusive governance also means that policymakers must inform the population well, maintain dialogue, and actively provide feedback on what is done with the information that has been collected. The importance of this is illustrated by gas extraction, where the government paid too little attention to the negative consequences for Groningen, which deeply affected confidence in the government and institutions.

5. Transferability of project results

Initially, the project's research focused more on the European scale. The project looked at vulnerable regions in the energy transition that were all part of the Just Transition fund. To some extent, these regions share similarities, such as having a relatively high number of people working in fossil-dependent industries. These regions often deal with increased socio-economic problems due to the energy transition. However, the local conditions and problems are quite different. Categorizing the regions is challenging, but to some extent, it is possible, such as fossil activities or spatial elements such as the degree of urbanization (urban versus non-urban) or coastal versus mountainous regions.

The region of Groningen faces a unique challenge with the closure of the Groningen gas field due to the earthquakes and Ground subsidence it caused. The Groningen gas field is the only large gas field in the EU on land, creating a unique situation. On the other hand, Groningen has carbon-intensive industries and socio-economic challenges like other regions. The placement of renewables with the consideration of the landscape is an approach that can be copied, but the local conditions are most likely different from Groningen.

This means the project is not directly transferable to other regions since

7.2 Reflection

there are differences. However, parts of the knowledge, methodology, and approach can be copied for other regions phasing similar issues. For example, the approach to develop typologies used for scenarios to provide alternative futures is useful and insightful for just governance. An essential condition is that enough data should be available for the other region. The Netherlands has a lot of spatial data available, but this might not be true for other regions.

6. Influence of site visit on project

The site visit proved valuable in helping me better understand the situation in the area and the scale of different elements. The countryside's landscape is very open, and the gas-winning locations are more prominent and far more present than expected. Another element was the windmills and new solar parks, which created a considerable scale distortion in the current landscape. This starkly contrasts with the small-scale road villages; the contrast between the two landscapes is mainly present in the transition from the ribbon toward the landscape.

7. Future recommendations

The project's initial idea was to develop three more detailed scenarios. A further recommendation would be to develop the three scenarios in more depth. The scenarios would provide better insight into spatial competition and conflict of interests between different stakeholders. Additionally, the project's findings and results could be diffused in Groningen to inform local people, ask them for their opinions, and gather feedback. This approach, in the thesis, could reach its full potential by not only proposing strategies to involve the least engaged but also doing it. Preferably, together with policymakers and planners. In this way, future decision-making includes different perspectives and knowledge, leading to just governance and more trust from the local community. Although it could be challenging to get actively involved with these marginalized groups and gain their trust.

References

8.1 Bibliography

Alves, D. P., Kanellopoulos, K., Medarac, H., Kapetaki, Z., Miranda, B. E., Shortall, R., Czako, V., Telsnig, T., Vazquez, H. C., Lacal, A. R., Nijs, W., Gonzalez, A. I., Trombetti, M., Mandras, G., Peteves, E., & Tzimas, E. (2018, July 30). EU coal regions: Opportunities and challenges ahead. JRC Publications Repository. https://doi.org/10.2760/064809

Bouwstenen voor het Deltaplan, Noordelijk Nederland en het stedelijk netwerk Nederland beter verbonden. (2021). chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.sterknoordnederland.nl/sites/sterk/files/2021-04/210415%20Bouwstenen%20voor%20het%20Deltaplan%20(digitaal).pdf

Brown, S., Brown, M., Madlener, R., Thomas, S., Zhou, P., Antunes, C., & Yeh, S. (2019). Recent Developments at Energy Policy. Energy Policy, 133, 110876. https://doi.org/10.1016/j.enpol.2019.110876

Cameron, A., Claeys, D. G., Midões, C., & Tagliapietra, D. S. (n.d.). A Just Transition Fund—How the EU budget can best assist in the necessary transition from fossil fuels to sustainable energy.

Capaciteitskaart invoeding elektriciteitsnet. (2024). https://capaciteitskaart.netbeheernederland.nl

Commissie Bodemdaling door aardgaswinning. (n.d.). Retrieved 17 January 2024, from https://commissiebodemdaling.nl/

De Grote Kroosvaren | Microscopie van de Natuur. (n.d.). Retrieved 14 June 2024, from https://microscopievandenatuur.nl/de-grote-kroosvaren

De grote veenkolonisatie in de Middeleeuwen. (n.d.). De verhalen van Groningen. Retrieved 16 May 2024, from https://www.deverhalenvangroningen.nl/alle-verhalen/de-grote-veenkolonisatie-in-de-middeleeuwen

Delfmann, H. (2024, June 10). Bevolking. Sociaal Planbureau Groningen. https://sociaalplanbureaugroningen.nl/brede-welvaart/bevolking/

Dictionary.com | Meanings & Definitions of English Words. (2024, June 16). Dictionary.Com. https://www.dictionary.com/browse/regeneration

Documenten. (n.d.). Just Transition Fund. Retrieved 18 December 2023, from https://www.stimulus.nl/just-transition-fund/documenten/

Douglas, J. (2006). Building Adaptation (2nd ed.). Routledge. https://doi.org/10.4324/9780080458519

Drijvende zonnepanelen | Deltares. (n.d.). Retrieved 14 June 2024, from https://www.deltares.nl/expertise/onze-expertises/energietransitie/drijvende-zonnepanelen

Dutch national hydrogen network launches in Rotterdam. (2023, June 27). Gasunie. https://www.gasunie.nl/en/news/dutch-national-hydrogen-network-launches-in-rotterdam

Eck, J. R. van, Groot, J., Tennekes, J., & Otto, R. (2020). DAGELIJKSE VERPLAATSINGSPATRONEN: INTENSIVERING VAN STEDELIJKE NETWERKEN?

Electricity grid under further pressure: Cabinet and grid operators take drastic measures. (n.d.). Retrieved 18 June 2024, from https://www.tennet.eu/news/electricity-grid-under-further-pressure-cabinet-and-grid-operators-take-drastic-measures

European Green Deal. (2023, November 10). https://www.consilium.europa.eu/en/policies/green-deal/

Fainstein, S. S. (2014). The just city. International Journal of Urban Sciences, 18(1), 1–18. https://doi.org/10.1080/12265934.2013.834643

Gaswinning in Groningen leverde 428 miljard euro op. (2022, September 6). https://nos.nl/regio/groningen/artikel/303219-gaswinning-in-groningen-leverde-428-miljard-euro-op

gemeente Midden-Groningen, gemeente Veendam, gemeente Oldambt, Provincie Groningen, H+N+S Landschapsarchitecten, Stichting Libau, & Buck Consultants International. (2021). Ruimtelijk-economisch perspectief A7/N33-regio. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.provinciegroningen.nl/fileadmin/user_upload/Documenten/Beleid_en_documenten/Documentenzoeker/Wonen_en_welzijn/211013_Ruimtelijk-economisch_perspectief_A7-N33_klein.pdf

Gesneden riet levert prachtige beelden in de Nieuwkoopse Plassen op. (2023, March 13). Natuurmonumenten. https://www.natuurmonumenten.nl/natuurgebieden/nieuwkoopse-plassen/nieuws/gesneden-riet-levert-prachtige-beelden-in-de-nieuwkoopse

Groningen gasfield | NLOG. (n.d.). Retrieved 17 January 2024, from https://www.nlog.nl/en/groningen-gasfield

IPCC. (2023). Synthesis Report of the IPCC Sixth Assessment Report (AR6). Islam, M. R., Mekhilef, S., & Saidur, R. (2013). Progress and recent trends of wind energy technology. Renewable and Sustainable Energy Reviews, 21, 456–468. Https://doi.org/10.1016/J.RSER.2013.01.007. (n.d.).

Janssen, J., Luiten, E., Renes, H., & Rouwendal, J. (2014). Heritage planning and spatial development in the Netherlands: Changing policies and perspectives. International Journal of Heritage Studies, 20(1), 1–21. https://doi.org/10.1080/13527258.2012.710852

Janssen, J., Luiten, E., Renes, H., & Stegmeijer, E. (2017). Heritage as sector, factor and vector: Conceptualizing the shifting relationship between heritage management and spatial planning. European Planning Studies, 25(9), 1654–1672. https://doi.org/10.1080/09654313.2017.1329410

Just Transition Fund. (n.d.-a). Publieksversie JTF Groningen-Emmen Operationeel Programma en Territoriaal Plan voor een Rechtvaardige Transitie. Retrieved 6 March 2024, from https://www.uitvoeringvanbeleidszw.nl/subsidies-en-regelingen/just-transition-fund-jtf/documenten/publicaties/subsidies/jtf/publicaties-jtf-2023/publieksversie-jtf-groningen-emmen

Just Transition Fund. (n.d.-b). Publieksversie Operationeel Programma JTF Nederland. Retrieved 6 March 2024, from https://www.uitvoeringvanbeleidszw.nl/subsidies-en-regelingen/just-transition-fund-jtf/documenten/publicaties/subsidies/jtf/publicaties-jtf-2023/publieksversie-operationeel-programma-jtf

Just Transition Mechanism allocation. (n.d.). Retrieved 20 December 2023, from chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://ec.europa.eu/commission/presscorner/api/files/attachment/860527/JTM_and_JTF_Allocation_Table.pdf

KAW & Provincie Groningen. (2024). Masterplan regiocentra Groningen-quickscan opgaven en toekomst perspectief. https://www.provinciegroningen.nl/actueel/nieuws/nieuwsartikel/vernieuwing-voor-groningse-steden-en-dorpen/

Kloosterman, R., & van der Werff, M. (2009). Culture: A local anchor in a world of flows? A critical assessment of cultural spatial planning in the Netherlands. WienLit. https://dare.uva.nl/search?identifier=7f0d94b7-d0e0-49f0-b945-a1d2ebd3493f

Kuiper, Rienk, Hamers, David, Nabielek, David, van Dam, Frank, Dammers, Ed, Evenhuis, Emil, van Gaalen, Frank, de Hollander, Guus, van Hoorn, Anton, van Minnen, Jelle, Pols, Leo, Rijken, Bart, Rood, Trudy, Snellen, Danielle, Dirkx, Joep (Wageningen University & Research), & Wolters, Henk (Deltares). (2023). Vier scenario's voor de inrichting van Nederland in 2050-Ruimtelijke Verkenning 2023—Hoofdrapport. Planbureau voor de Leefomgeving. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.pbl.nl/uploads/default/downloads/pbl-2023-vier-scenarios-voor-de-inrichting-van-nederland-in-2050-4832.pdf

Landscape values and perceptions – Environmental Geography. (n.d.). Retrieved 29 January 2024, from https://www.environmentalgeography.nl/site/themes/landscape-values/

Locaties en activiteiten | Nederlandse Aardolie Maatschappij. (n.d.). Retrieved 18 June 2024, from https://www.nam.nl/gas-en-olie/locaties-en-activiteiten.html

Loorbach, D. A. (2022). Designing radical transitions: A plea for a new governance culture to empower deep transformative change. City, Territory and Architecture, 9(1), 30. https://doi.org/10.1186/s40410-022-00176-z

Madanipour, A., Shucksmith, M., & Brooks, E. (2022). The concept of spatial justice and the European Union's territorial cohesion. European Planning Studies, 30(5), 807–824. https://doi.org/10.1080/09654313.2021.1928040

Marty, O. (2020, July 13). What should we make of the Just Transition Mechanism put forward by the European Commission? https://www.robert-schuman.eu/en/european-issues/0567-what-should-we-make-of-the-just-transition-mechanism-put-forward-by-the-european-commission

McDowall, W., Reinauer, T., Fragkos, P., Miedzinski, M., & Cronin, J. (2023). Mapping regional vulnerability in Europe's energy transition: Development and application of an indicator to assess declining employment in four carbon-intensive industries. Climatic Change, 176(2), 7. https://doi.org/10.1007/s10584-022-03478-w

Milieu. (2023, December 20). Sociaal Planbureau Groningen. https://sociaalplanbureaugroningen.nl/brede-welvaart/milieu/

Ministerie van Algemene Zaken. (2023, June 23). Gaswinning Groningen stopt per 1 oktober 2023—Nieuwsbericht—Rijksoverheid.nl [Nieuwsbericht]. Ministerie van Algemene Zaken. https://www.rijksoverheid.nl/actueel/nieuws/2023/06/23/gaswinning-groningen-stopt-per-1-oktober-2023

Ministerie van Onderwijs, C. en W. (2019, January 31). Aardbevingen en erfgoed—Rijksdienst voor het Cultureel Erfgoed [Onderwerp]. Ministerie van Onderwijs, Cultuur en Wetenschap. https://www.cultureelerfgoed.nl/onderwerpen/aardbevingen-en-erfgoed

Monitor Brede Welvaart Groningen 2022. (2023). Sociaal Planbureau Groningen. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://sociaalplanbureaugroningen.nl/wordpress/wp-content/uploads/2023/03/Monitor-Brede-Welvaart-Groningen.pdf

Nationale Omgevingsvisie Duurzaam perspectief voor onze leefomgeving (p. 134). (2020). Ministerie van

8.1 Bibliography

Binnenlandse zaken en Koningsrelaties. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://open.overheid.nl/documenten/ronl-59b3033c-0826-4624-ba7f-41aec10b6d7a/pdf

NOS - Uitslagen Tweede Kamerverkiezingen 2023. (n.d.). Retrieved 16 June 2024, from https://app.nos.nl/nieuws/tk2023/

NU.nl, D. (2020, September 2). Toezichthouder: In huidig tempo duurt versterking Groningen nog twintig jaar. NU. https://www.nu.nl/gaswinning-groningen/6074764/toezichthouder-in-huidig-tempo-duurt-versterking-groningen-nog-twintig-jaar.html

Open Data Portal for the European Structural Investment Funds—European Commission | Data | European Structural and Investment Funds. (n.d.). Tyler Data & Insights. Retrieved 9 January 2024, from https://cohesiondata.ec.europa.eu/funds/jtf/21-27

Opruimen en hergebruik | Nederlandse Aardolie Maatschappij. (n.d.). Retrieved 12 May 2024, from https://www.nam.nl/opruimen-en-hergebruik.html

Osborne, T., Brock, S., Chazdon, R., Chomba, S., Garen, E., Gutierrez, V., Lave, R., Lefevre, M., & Sundberg, J. (2021). The political ecology playbook for ecosystem restoration: Principles for effective, equitable, and transformative landscapes. Global Environmental Change, 70, 102320. https://doi.org/10.1016/j.gloenvcha.2021.102320

Over GZI Next. (n.d.). GZINext. Retrieved 16 May 2024, from https://gzinext.nl/over-gzi-next/

Peel 2024, A. P. de. (n.d.). AgroProeftuin de Peel Pilot natte teelten: Waterbeheer met verdienmodel. agroproeftuin.nl. Retrieved 14 June 2024, from https://www.agroproeftuindepeel.nl/projecten/pilot-natte-teelten

Provincie Groningen. (2021). Kwaliteitsgids provincie Groningen. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://storage.googleapis.com/kwaliteitsgids-image-storage/01/kwaliteitsgids-definitief.pdf

Provincie Groningen. (2022a). Dit is Groningen—Koersdocument Omgevingsvisie. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.provinciegroningen.nl/fileadmin/user_upload/Documenten/Downloads/Downloads_2023/Koersdocument_Omgevingsvisie_Provincie_Groningen.pdf

Provincie Groningen. (2022b). Regionale veenweidestrategie 1.0 Een verkenning voor de toekomst van de Groninger veenweiden. https://provinciegroningen.bestuurlijkeinformatie.nl/Agenda/Document/80c218ca-a219-471b-89fe-3ba18d133155?documentId=c7f04d96-1e83-4b3a-a5d1-68ec9e15f40e&agendaItemId=aeb6e21f-e230-4cdc-91d4-daa08fa53079

Provincie Groningen. (2023a). Dit is Groningen Waardevol Groningen Ruimtelijk voorstel NOVEX. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.provinciegroningen.nl/fileadmin/user_upload/Dit_is_Groningen.pdf

Provincie Groningen. (2023b). Transitie Landelijk Gebied Groningen 'Stand-van-zaken' document. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.provinciegroningen.nl/fileadmin/user_upload/Documenten/Dossiers/Stikstof/Stand-van-zaken-document_Transitie_Landelijk_Gebied_Groningen.pdf

Provincie Groningen, H+N+S Landschapsarchitecten, & Stichting Libau. (2023). Startnotitie Gebiedsplan Groningen—Transitie landelijk gebied. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.provinciegroningen.nl/fileadmin/user_upload/Documenten/Dossiers/Stikstof/Startnotitie_Gebiedsplan_Groningen_Transitie_Landelijk_Gebied.pdf

Provincie Groningen, Minister van Binnenlandse Zaken en Koningsrelaties, & Gemeente Eemsdelta. (2023). Regionale woondeal 2022-2030- Regio Eemsdelta. https://www.volkshuisvestingnederland.nl/onderwerpen/woondeals/documenten/publicaties/2023/04/21/woondeals-groningen

Provincie Groningen, Minister van Binnenlandse Zaken en Koningsrelaties, Gemeente Oldambt, Gemeente Pekela, Gemeente Stadskanaal, Gemeente Veendam, & Gemeente Westerwolde. (2023). Regionale woondeal 2022-2030 Regio oost-Groningen. https://www.volkshuisvestingnederland.nl/onderwerpen/woondeals/documenten/publicaties/2023/04/21/woondeals-groningen

Provincie Groningen, Minister van Binnenlandse Zaken en Koningsrelaties, Provincie Drenthe, Gemeente Assen, Gemeente Groningen, Gemeente Het Hogeland, Gemeente Midden-Groningen, Gemeente Noordenveld, Gemeente Tynaarlo, & Gemeente Westerkwartier. (2023). Interprovinciale woondeal Regio Groningen-Assen. https://www.volkshuisvestingnederland.nl/onderwerpen/woondeals/documenten/publicaties/2023/04/21/woondeals-groningen

Randvoorwaarden—De betekenis volgens Ensie Encyclopedie. (n.d.). Retrieved 15 May 2024, from https://www.ensie.nl/redactie-ensie/randvoorwaarden

Reed, B. (2007). Shifting from 'sustainability' to regeneration. https://doi.org/10.1080/09613210701475753

Regionale Energie Strategie (RES) Groningen. (n.d.). Retrieved 24 April 2024, from https://www.provinciegroningen.nl/actueel/dossiers/energietransitie/regionale-energie-strategie-res-groningen/

RES Groningen. (2021). Regionale energie strategie Groningen—Concept RES. https://resgroningen.nl/over+de+res/achtergrondinformatie/default.aspx

RES Groningen. (2023). RES 2.0 Groningen. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.resgroningen.nl/over+de+res/achtergrondinformatie/handlerdownloadfiles.ashx?idnv=2467068

RES Groningen, H+N+S Landschapsarchitecten, & Stichting Libau. (2020). Werkboek Ruimte RES Groningen. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.libau.nl/wp-content/uploads/200526_Werkboek-RES-Groningen-MAIL-VERSIE_spreads.pdf

Rijksoverheid & Provincie Groningen. (2018). Startdocument Nationaal Programma Groningen. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.nationaalprogrammagroningen.nl/app/uploads/2019/03/startdocument-nationaal-programma-groningen-5-oktober-2018.pdf

Ritchie, H., Rosado, P., & Roser, M. (2024). Energy Production and Consumption. Our World in Data. https://ourworldindata.org/energy-production-consumption

Rodrigues, R., Pietzcker, R., Fragkos, P., Price, J., McDowall, W., Siskos, P., Fotiou, T., Luderer, G., & Capros, P. (2022). Narrative-driven alternative roads to achieve mid-century CO2 net neutrality in Europe. Energy, 239, 121908. https://doi.org/10.1016/j.energy.2021.121908

Scheele, R. (2021, 03). KNMI - Weinig wind- en zonne-energie: Energieflauwte in Nederland. https://www.knmi.nl/over-het-knmi/nieuws/dagen-met-weinig-wind-en-zon

Scholte, S. S. K., van Teeffelen, A. J. A., & Verburg, P. H. (2015). Integrating socio-cultural perspectives into ecosystem service valuation: A review of concepts and methods. Ecological Economics, 114, 67–78. https://doi.org/10.1016/j.ecolecon.2015.03.007

Schouten, D. E. (2021, December 5). Dertig jaar na eerste beving in Groningen is 1,2 miljard euro schade vergoed. NU. https://www.nu.nl/economie/6170967/dertig-jaar-na-eerste-beving-in-groningen-is-12-miljard-euro-schade-vergoed.html

Sijmons, D. (2014). Landscape and Energy, Designing Transition.

Spisto, A., Gerbelova, H., Masera, M., & Barboni, M. (2020, June 8). The socio-economic impacts of the closure of the Groningen gas field. JRC Publications Repository. https://doi.org/10.2760/039540

Statistics | Eurostat. (n.d.). Retrieved 20 December 2023, from https://ec.europa.eu/eurostat/databrowser/view/DEMO_GIND__custom_7127262/default/table

The Paris Agreement | UNFCCC. (2024, June 12). https://unfccc.int/process-and-meetings/the-paris-agreement

TheCranberryCompany. (n.d.). Retrieved 14 June 2024, from http://www.thecranberrycompany.nl/

Uitgangspunt—De betekenis volgens Ensie Encyclopedie. (n.d.). Retrieved 15 May 2024, from https://www.ensie.nl/redactie-ensie/uitgangspunt

Ven, D. J. van der. (1941). De Heemliefde van het Nederlandsche volk. N.V.Uitgevers mij A. Rutgers Naarden.

Verena Balz, Thomas Verbeek, Lei Qu, Rebecca Baugh, Marcin Dąbrowski, Leneisja Jungsberg, Martin Ferry, Neli Georgieva, Uwe Serdült, Mariya Trifonova, Samir Amin, & Yoann Clouet. (2023). DUST Deliverable 1.1: Theoretical and conceptual framework. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.dustproject.eu/_files/ugd/fedab5_46fcdd72ced14b77b8d0ab9fb4358dc6.pdf

Waldheim, C. (2006). The Landscape Urbanism Reader. Princeton Architectural Press.

Waterbeheerprogramma 2022—2027. (2022). Waterschap Hunze en Aa's.

What is hydrogen? (n.d.). Gasunie. Retrieved 1 May 2024, from https://www.gasunie.nl/en/expertise/hydrogen/what-is-hydrogen

Williams, J. (2023). Circular cities: Planning for circular development in European cities. European Planning Studies, 31(1), 14–35. https://doi.org/10.1080/09654313.2022.2060707

Zak, D., & McInnes, R. J. (2022). A call for refining the peatland restoration strategy in Europe. Journal of Applied Ecology, 59(11), 2698–2704. https://doi.org/10.1111/1365-2664.14261

8.2 Datasets

Energy

https://globalenergymonitor.org/projects/global-wind-power-tracker/
https://globalenergymonitor.org/projects/global-solar-power-tracker/
https://globalenergymonitor.org/projects/global-oil-gas-extraction-tracker/
https://globalenergymonitor.org/projects/global-coal-terminals-tracker/
https://globalenergymonitor.org/projects/global-oil-infrastructure-tracker/
https://globalenergymonitor.org/projects/global-gas-plant-tracker/
https://globalenergymonitor.org/projects/global-bioenergy-power-tracker/

Industries

https://www.eea.europa.eu/en/datahub/datahubitem-view/9405f714-8015-4b5b-a63c-280b82861b3d

https://s-eenergies-open-data-euf.hub.arcgis.com/datasets/a6a1e8e95514413a90bbb2e40515fdb2

Land use

https://data.overheid.nl/en/dataset/ibis-bedrijventerreinen

European Environment Agency [EEA]. (2018). Corine Land Cover 2018 [Dataset]. EEA. https://land.copernicus.eu/pan-european/corine-land-cover/clc2018?tab=metadata

https://download.geofabrik.de/europe/netherlands/groningen.html

https://nationaalgeoregister.nl/geonetwork/srv/dut/catalog.search#/metadata/a9a3fb99-4d67-4df4-a815-b4bc617af3a0

https://data.overheid.nl/community/organization/groningen_provincie
Statistics

https://www.arcgis.com/home/item

Social data

NUTS3 Europe:
https://www.arcgis.com/home/item.html?id=5eb88decbff54520b49c785241c07bf4

Municipalities in the Netherlands
https://www.pdok.nl/ogc-webservices/-/article/cbs-wijken-en-buurten

8.3 List of figures

List of figures

8.3 List of figures

Apendix

Table for energy production RES		Wind		Solar			
Municipality	Ambition RES 2030	Planned	Placed	Planned2	Placed3	Total	Realization compared to ambition
Eemsdelta	1,19		1,19	0,02	0,07	1,28	0,09
Groningen	0,5			0,3	0,09	0,39	-0,11
Midden-Groningen	0,95		0,31	0,21	0,25	0,77	-0,18
Oldabmt	0,16		0,06	0,14	0,01	0,21	0,05
Veendam	0,15		0,11		0,03	0,14	-0,01

When only solar fields are used on land to provide the energy needed to Provide the energy that is needed for 2030 and 2050

Kolom1	Ambition RES 2050*	TWh to realize	1100 ha 2030	1100 ha 2050	1500 ha 2030	1500 ha 2050
Eemsdetla	1,70	0,42	-99	462	-135	630
Gorningen	0,71	0,32	121	357	165	486
Midden Gronigen	1,36	0,59	198	646	270	881
Oldambt	0,23	0,02	-55	20	-75	28
Veendam	0,21	0,07	11	82	15	111

*Ambition for 2030 is 70% of what is needed so 2030 ambition/ 0,7 = amount needed in 2050