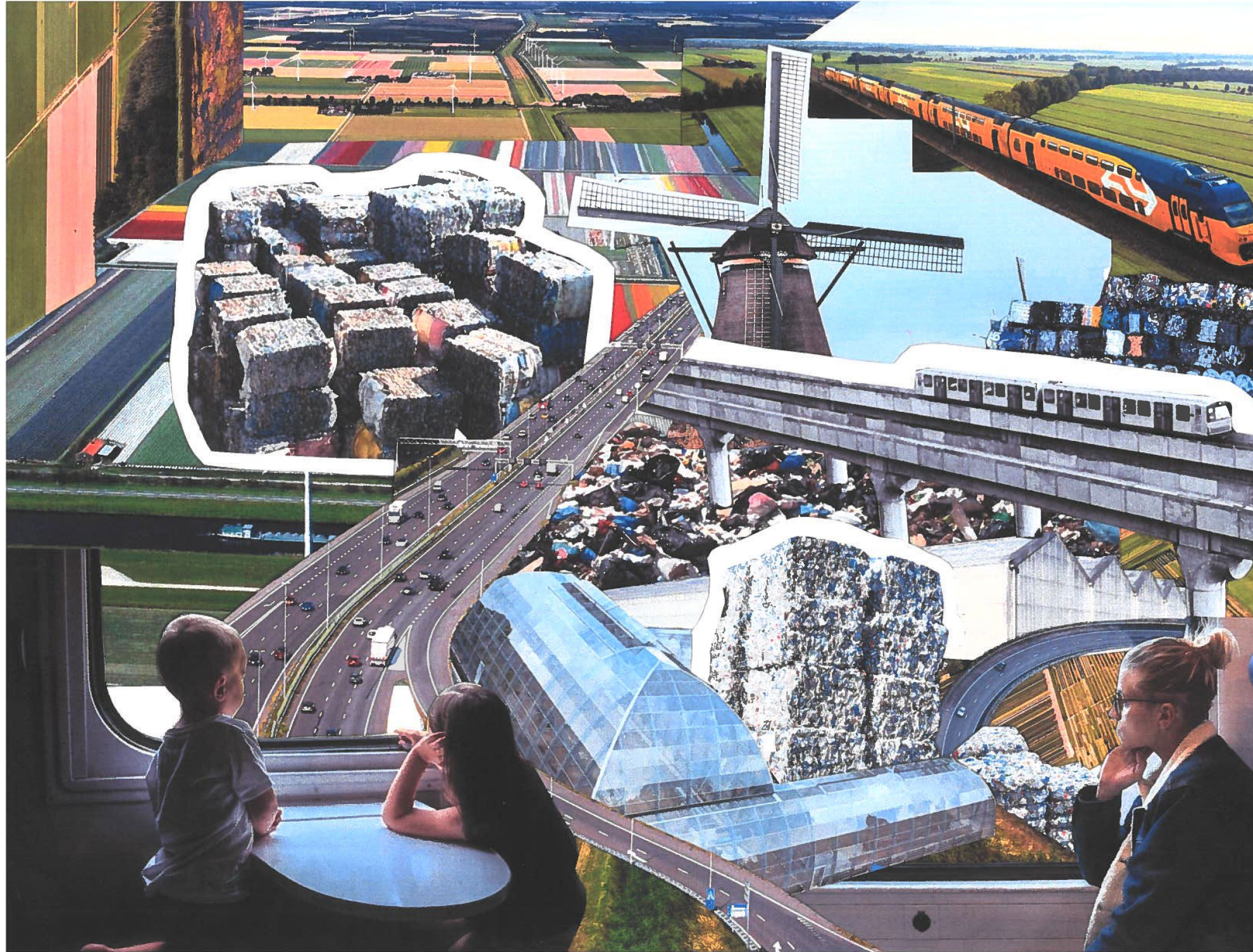# Waste Houses
Messing up The Netherlands

Tutors: Verena Balz & Lukas Höller
Students:

Aleksandra Kurkierewicz (6084362)
Isabella Jaramillo Diaz (6035353)
Julia Schasfoort (5093759)
Yiling Yang (5991250)
Madelief van der Kraan (5226627)

'Spatial strategies for the global
metropolis' Research & Design
studio

MSc3 TU Delft Urbanism

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Abstract

The Netherlands has the ambition to transition to a fully circular economy before 2050. Between this future and where we stand now, there is still a large gap. The Netherlands produces 60 million tonnes of waste per year. This fact contains two problems that this project aims to deal with: 1) the heigh of this number in the first place, and 2) that approximately 20% of the waste does not find its way back into the system. In 2020, 7.6 million tonnes of waste was incinerated and 32.7 million tonnes of waste was exported to non-EU countries, where waste often ends up in landfill or is send for incineration with adverse health effects.

This project takes the radical stance to stop incineration and export, which means the Netherlands must take responsibility for the waste it produces. For much of the waste that currently follows one of these trajectories, there are no adequate solutions for reuse or recycling. Hence, we designed a system of waste collection, sorting, and storage where materials can be stored in waste houses until they find their way back into the system (problem 1). The piling up of the waste will create awareness of the consequences of unresponsible consumption, affecting the behaviour of people through confrontation (problem 2).

The system we design aims to create a disruption of the existing linear system at different levels. The large-scale societal perception of production-consumption-waste generation will slowly change, while the waste houses will create a sense of urgency at the small scale. This will stimulate niche innovations to find innovative solutions to deal with waste that is stored. Our project is thus both an instigator of change and part of the change itself in the transition to the circular economy.

If the project is successful, the waste houses will gradually become obsolete as consumption and waste production go down. In the far future, the former waste houses can house different functions, or they can be demolished in a circular way, returning the materials into the resource loop.

Contents

WASTE HISTORY
Messing up the Netherlands!

How did they plan?

100 years ago

80 years ago

50 years ago

Crazy Faith

IT'S ONLY CRAZY UNTIL IT HAPPENS

15¢

DEAD END

CAUTION
HAZARDOUS AREA
AUTHORIZED
PERSONNEL ONLY

CAUTION
HAZARDOUS AREA
AUTHORIZED
PERSONNEL ONLY

CAUTION
HAZARDOUS AREA
AUTHORIZED
PERSONNEL ONLY

CAUTION
HAZARDOUS AREA
AUTHORIZED
PERSONNEL ONLY

Chapter 1

Context

Urgency

"Dear friends of planet Earth,

Thank you for coming to the UN Headquarters today.

I have asked you here to sound the alarm.

Climate change is the defining issue of our time – and we are at a defining moment.

We face a direct existential threat.

…

What we still lack – even after the Paris Agreement – is the leadership and the ambition to do what is needed.

Scientists have been telling us for decades. Over and over again.

Far too many leaders have refused to listen.

Far too few have acted with the vision the science demands.

We see the results.

…

We need to embrace the circular economy and resource efficiency.

Our cities and transport sectors will need to be overhauled.

…

Enormous benefits await humankind if we can rise to the climate challenge.

A great many of these benefits are economic.

…

There is another reason to act – moral duty.

The world's richest nations are the most responsible for the climate crisis, yet the effects are being felt first and worst by the poorest nations and the most vulnerable peoples and communities.

…

There is nothing to lose from acting; there is everything to gain."

- António Guterres, Secretary-General of the United Nations, in a speech at the UN Headquarters for the Global Climate Action Summit in San Francisco and the annual gathering of world leaders for the General Assembly

Introduction

Today, circularity is the number-one thought on young urban designers' minds. Within urban planning and design, circularity poses a wicked problem with countless complexities, conflicts of interests and spatial tensions to be dealt with. Most urbanists have already understood the importance of accelerating the world's shift towards more sustainable behaviours and circularity within material flows and the built environment. Out of this sense of urgency also comes a desire for radical change in the short term. The worsening of our planet's health won't stop whilst people take their time to take action. Taking the necessity of immediate radical action as our premise, our project picks a focus on waste production and processing and the aim of obtaining a fully circular economy from an activistic angle. We have an abstract vision for the ideal future, but our project focuses on the strategy, necessity of momentary chaos according to transition theory and immediate actions needed to get closer to this unclear ideal future.

For years, the scientific community, experts, activists and also members of civil society have urged world leaders and economic powers to take action and prevent further depletion of resources, polluting activities and worsening of the global warming process. In addition to this, in more recent years especially, the importance of addressing socio-spatial justice within this required action has come to more attention. The goal is to solve climate and social issues together (Rocco, 2024). This is necessary since they are intricately related in countless synergies. The health of the planet and health of societies go hand in hand.

The Netherlands circular economy ambition

Circular economy ambition explained

In 2016, the Netherlands formulated the ambition to transition to the circular economy before 2050 ((PBL, 2023 (PBL, 2023; Rijksoverheid, 2016). In this circular economy we will handle resources and products with care and intelligence. The aim is to use less primary materials by using products for a longer time. Focus lies on reducing, reusing and repairing. Used resources will be used again in new products through recycling. Additionally, focus will shift to using resources that are renewable (CE Delft, 2022; PBL, 2023; Rijksoverheid, 2024).

Necessity

Rather than a desired trajectory, the transition to the circular economy is a necessity. We are using more materials than the Earth can give or restore. Hence, we need to bring back the resource use to the carrying capacity of the Earth. The Netherlands, being the 18th economy of the world, can have a large impact in this transition (CE Delft, 2022; CBS, 2024). This does mean, however, that we need to work, produce, build, and consume in different ways.

Multiple contributions

The circular economy is an important tool to address various issues surrounding the climate. Amongst others, it helps combat climate change, contributes to the recovery of biodiversity, leads to a cleaner environment and healthier living conditions, and increases the security of the resource supply (Rijksoverheid, 2024). Apart from the benefits formulated by the national government, the circular economy contributes to several Sustainable Development Goals, especially SDG12, which concerns responsible consumption and production. At the same time, it influences other SDGs as well. The most significant ones for our project are seen in figure 1.

Rethinking the system

While the ambition is great, the pathway towards the goal is less clear-cut. To transition to a circular economy the whole system needs to function differently. This requires a lot of innovative thinkers, and a lot of people willing to move against the current. Even if we could reach agreement on the necessity of the transition, short-term financial goals, or the way of least resistance will favour the linear model. Both institutions, private actors, and civil society need to work together to make this change happen and maintain a liveable earth, for us and the generations after us (PBL, 2023; Sileryte, 2023).

Figure 1: Sustainable Development Goals particularly relevant for the circular economy ambition of the Netherlands

Figure 2: Media interpretation
Captions and titles from media articles about sustainability, floating above the Dutch landscape

Contradiction

Sustainability, circularity, biodiversity etc. They are the buzzwords of this moment in almost all goals, developments, plans and marketing campaigns. By looking into the media on sustainability, a large amount of ambition becomes visible (see figure 2). However, having ambition and actually being ambitious are two different things. For example, the 2015 Paris Agreement was a landmark international agreement to tackle climate change globally. However, according to a 2023 IMF report "global ambition needs to be more than quadrupled: emissions cuts of 50 percent below 2019 levels by 2030 are needed for staying under 1.5 degrees Celsius warming, but current targets would only achieve 11 percent" (Black, 2023)

Important sources

These are documents used as springboards in exploratory research. A large amount of research has already been conducted on which steps are needed for The Netherlands to reach its goal of a circular economy in 2050 how well the country is underway to achieve this in reality.The following documents are a few of those research papers, government reports and statistical reports with data on waste which will serve as a backbone and references in our research project on waste in The Netherlands.

'Integral Circular Economy Report 2023' - PBL (Dutch agency for planning of the (built) environment)

This aim of this report is to monitor the Dutch progress towards its goal of having a circular economy in 2050. The central conclusion from the report is that governance, legislation and policy change are currently the largest hurdle for reaching the goal, and that rapid changes in this management is necessary to let changes in production and consumption systems really take off. Essentially, the report says that the government has a very large responsibility in leading the way through policy. Besides this, the report includes a lot of very detailed data about the use and flow of materials, import, export, consumption, frameworks through which to view and implement the circular economy. It also has a comprehensive summary of the current state of governance of circularity. This emphasises the need for physical conditions and changes in economic incentives to truly inspire corporate and consumer behavioural change.

'Waste processing in the Netherlands, data 2021' - Ministry of infrastructure and water management

The report shows an overview of the amounts of waste processed by landfills, incineration plants, composting installations, soil treatment facilities and the treatment of dredge materials in the Netherlands during 2021. The report provides data on amounts and also on how this has changed over time. The report also lists the facilities that were operating in 2021 and their location. There is detailed information about the composition of waste at each type of processing facility and also about the amounts and types of waste processed in each individual facility.

'Early warning assessment related to the 2025 targets for municipal waste and packaging waste' - European Environment Agency

This document is an assessment of The Netherlands' statistics on waste packaging, production and processing in relation to EU legislation concerning sustainability goals set by EU directives for 2025 and 2035. It includes targets on proportion of waste being recycled, proportion of waste ending in landfill and assesses the Dutch waste and circularity legislation in relation to EU legislation. It also includes detailed information on the current Dutch waste collection system, taxes on waste incineration and assessment of whether The Netherlands will be likely to meet the targets the government has set for itself.

'Ruimtelijke effecten van de circulaire economie' - CE Delft

This report summarises research conducted so far in the 2022 Spatial Exploration program of the Dutch PBL (planning agency for the built environment). The research focuses on the spatial dimension of transitioning to a circular economy. It explores this through 5 case studies with large potential spatial consequences in a circular economy. The 5 case studies are the plastics industry, the building construction sector, car sharing, local production of biomass and the infrastructure construction sector. For the purposes of this project predominantly the case studies of the plastic industry and building construction sector will be of interest due to their strong spatial connection with material and waste flows.
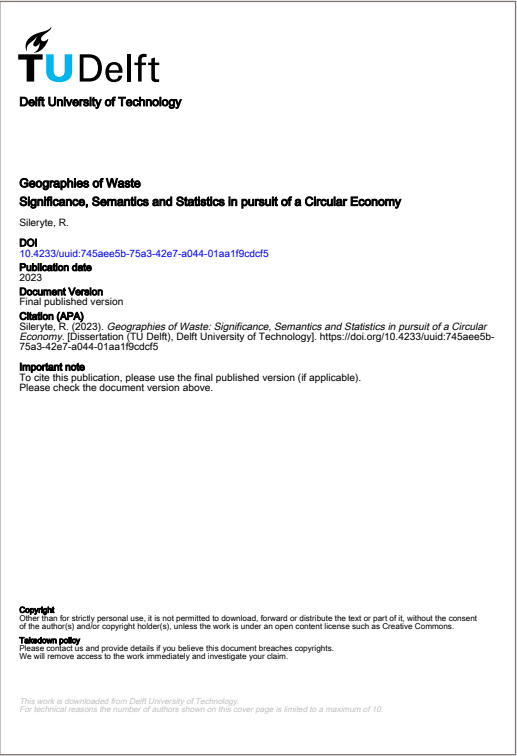
'Geographies of waste, Significance, Semantics and Statistics in pursuit of a Circular Economy' - Rusnė Šilerytė PhD

This is a PhD thesis completed at the TU Delft faculty of the Built Environment. The author did an in-depth research about the connection between circular economy ambitions and the production and distribution of waste. The thesis researches the use and collection of waste flow data, specifically for the Amsterdam Metropolitan Region. The topics explored in the thesis which are of particular significance for this research are (EU) governance, monitoring circular economy transitions and contexts of transformations.

' Composition of household residual waste, sorting analysis 2022' - Ministry of infrastructure and water management

This report presents the yearly analysis of the composition of Dutch household waste. The results are calculated by taking a three-year average and focus on the mixed waste produced by household. It therefore does not incorporate the waste which is already sorted for recycling by households. The report splits household waste into the catagories of compostable, paper, incontinence materials, plastics, glass, metals, textiles, chemical waste, electronic waste, wood and other waste. It also includes data about the amount of recyclable waste and which packaging types are found in mixed waste.

Dutch waste production

The Netherlands produces approximately 60 million tonnes of waste per year (Ministry of Infrastructure and Water, 2020). This waste is processed in different ways. Around 80% is recycled, this includes the composting of GFT (vegetables, fruit and garden waste). The largest part of the remaining 20% is incinerated, with recovery of materials and energy. The waste that cannot be recycled nor incinerated is put into landfill in an "environmentally responsible" way (Ministry of I&W, 2020).

Despite relatively high recycling rates, large amounts of waste collected for recycling are still incinerated after not having been sorted correctly. Additionally, recycling is the lowest value re-use of material within the circular economy

Household waste

Current Situation

In the Netherlands, we produce on average 490 kilograms of waste per person per year (Milieucentraal, 2024a; Rijkswaterstaat, 2021). Approximately 60% of this waste is separated by people. Especially paper and glass are recycled a lot (75%), runner up is the green-fruit-garden waste (gft), fo which we recycle approximately 65%. The recycling rate of plastic packaging and drink packages is rising. Still, around 170 kilo's end up in the "rest" wastebins, which adds up to approximately 35 bags of waste per person per year.

Opportunities

As becomes clear from figure 3, there is still a lot of progress to be made. Not only in terms of quantity, but quality as well. Especially amongst textiles, gft, and PMD waste, the waste processing companies still find a lot of waste that does not belong there (Rijkswaterstaat, 2021). If there is too much 'pollution' of the separated waste, it still end up in the incinerator (Milieucentraal, 2024a).

Industrial waste

In 2020, 13.3 million tonnes of waste came from industry. Of the total amount of industrial waste, 62% comes from the food- and stimulant industries. After this, the metal industry and chemical industry are the largest contributors to the industrial waste production (Compendium voor de Leefomgeving, 2022).
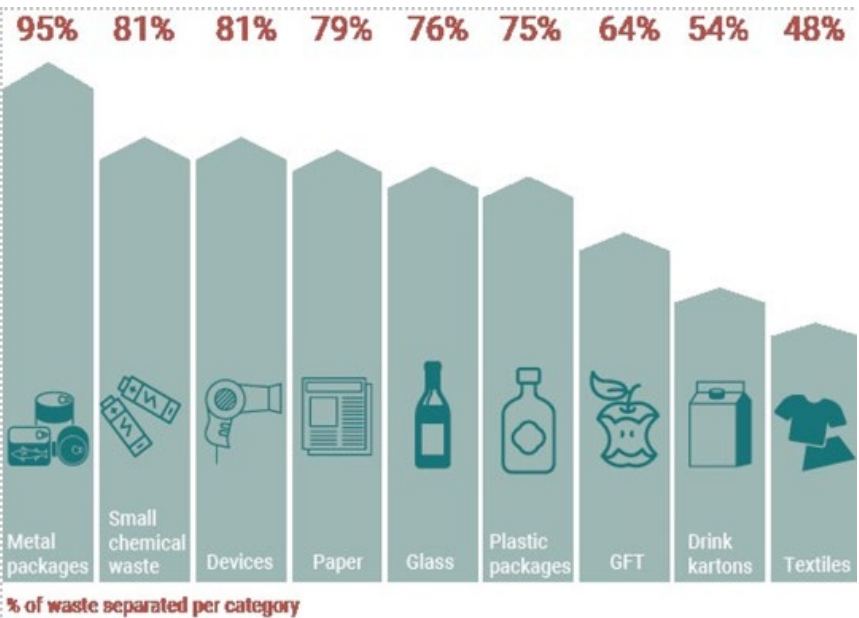

Figure 3: Percentage of household waste separated per category
Based on the diagram published by Milieucentraal (2024a)

Building and demolition waste

In 2018, approximately 25 million tonnes of waste came from building and demolition activities. Building and demolition waste is, on average, 41% of the total amount of waste produced in the Netherlands (60 million tonnes). Of this amount, almost 97% got a useful new application, through recycling, reuse, winning back materials, and other processes meant to obtain secondary resources (CE Delft, 2022). The remaining 3% consist of 25.000 tonnes that is incinerated, 610.000 tonnes that ends in landfill, and 11.000 tonnes that is unloaded (StoneCycling, 2024).

Bulky rubbish

Bulky rubbish consists of waste that is too large for the normal waste bin. One can think of old matrasses, tapestries, furniture, and big pieces of Styrofoam. In many municipalities, there are services in place that collect the waste at people's homes, or there is a central location where people can deliver their waste. Materials and products that can be reused are brought to recycling firms, and the remainder is incinerated with recovery of energy and heat (Milieucentraal, 2024b).

The Netherlands in context

Within the larger European context, the Netherlands produces a little bit less waste per inhabitant than the European average. This can be explained by the fact that the Netherlands is based on a trade- and service economy, which produces less waste than industrial economies. This does not mean however, that we consume less as well. In the diagram with processing methods, we see that compared to other European countries, the Netherlands puts very little waste into landfill. We recycle quite a lot, but also a large part of the waste is incinerated with energy recovery, as seen in figure 4.

Relationship waste and GHG emissions

Solid waste contributes to the generation of greenhouse gasses (GHGs), especially methane (CH4) and carbon dioxide (CO2) (World Bank, 2022). The amount of GHGs that are emitted depends on the amount of waste, the composition, and the way in which it is managed. Both volumes and improper waste management systems cause an increase in emissions.

This is alarming, since the amount of waste that is produced has been increasing steadily over the past decades, while the management of this waste continues to lag behind. It is inadequate in terms of capacity, as well as effectiveness. This means that the emissions from waste will continue to increase if not either one or both of these (quantity & management) are solved.

Data from the World Bank (2022) shows that the quantity and management differ per country and can be categorized based on income levels (see figure 5). A staggering 93% of waste in low income countries is improperly dumped. This number decreases with income level but remains high: 66% of low-middle income countries, 30% of waste in upper-middle income countries, and high-income countries are shown to continue to landfill around a third of their waste.

Important to note here, is that a lot of the waste that is produced in the middle-to-higher income countries is exported to lower income countries, where the waste management practices are of lower quality thus exacerbating the problem.
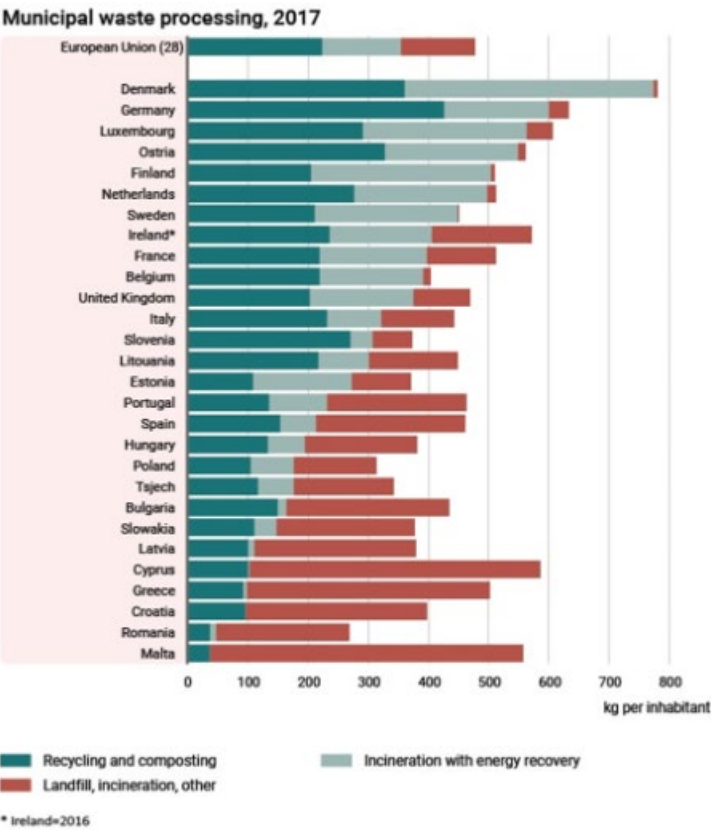
Figure 4: Municipal Waste Processing 2017
Based on the diagram published by CBS (2019)

What's more, the problem is not limited to GHG emissions. The pollution that is caused by improper waste management at the local level, impacts the quality of life through the negative effects on the environment, social, and health of locals (World Bank, 2022).. In this process, marginalised and poor communities are affected disproportionately. This unfair distribution takes place at the international level, exporting waste to lower-income countries, and at the national level, where dumping sites are often located close to vulnerable communities.
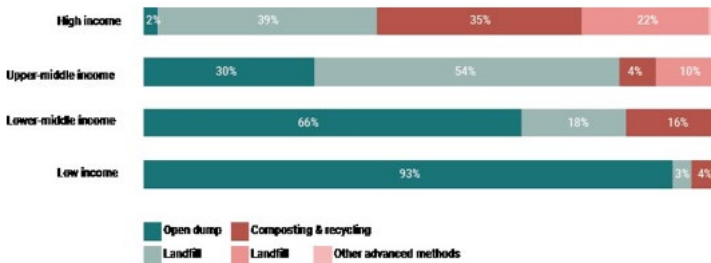
Figure 5: Disposal method by income
Based on a diagram in World Bank (2022)

When we throw it away,

where does it go…

Incineration

In the Netherlands, waste incineration plays a significant role in the management of solid waste. According to data from the Central Bureau of Statistics (CBS, 2020), approximately 10.7 million tons of municipal and industrial waste were incinerated in the country's waste-to-energy plants in 2020. In an early warning report of the European Environment Agency (2022) it was stated that around 41% of the municipal waste that is generated is incinerated (Eurostat, 2022). This represents a substantial proportion of the total waste generated in the Netherlands.

As will become clear from the historic timeline (page 26), incineration has taken a central role in Dutch waste management strategies as it is considered to be a sustainable alternative to landfill. Adverse effects of landfill on the health of people and environment led to negative public opinions and campaigns to reduce landfill sites. Consequently, waste incineration went up and has remained one of the dominant solutions ever since, and is commonly combined with energy generation and resource recovery efforts. The incineration companies in the Netherlands have advanced technologies and stringent emission controls, which aim to minimize environmental impacts and maximize the economic benefit of waste-to-energy systems (EVI, 2024). See figure 6 for an overview of plants and the waste they process.

We argue that within the ambition to the circular economy, incineration does not have a place. The transition to the circular economy requires rethinking traditional waste management practices, including incineration, due to its inherent limitations in resource recovery and environmental impact. Even though incineration helps generate energy, we argue it is unsustainable as valuable materials are lost that could otherwise be reused or recycled.

According to the Ellen MacArthur Foundation (2023), shifting away from linear consumption patterns towards circularity requires prioritizing strategies such as reuse, recycling, and remanufacturing to keep materials and products in use for as long as possible. If we want to minimize waste generation and maximize resource recovery through circular practices, we must therefore reduce reliance on incineration and its associated material loss and emissions.
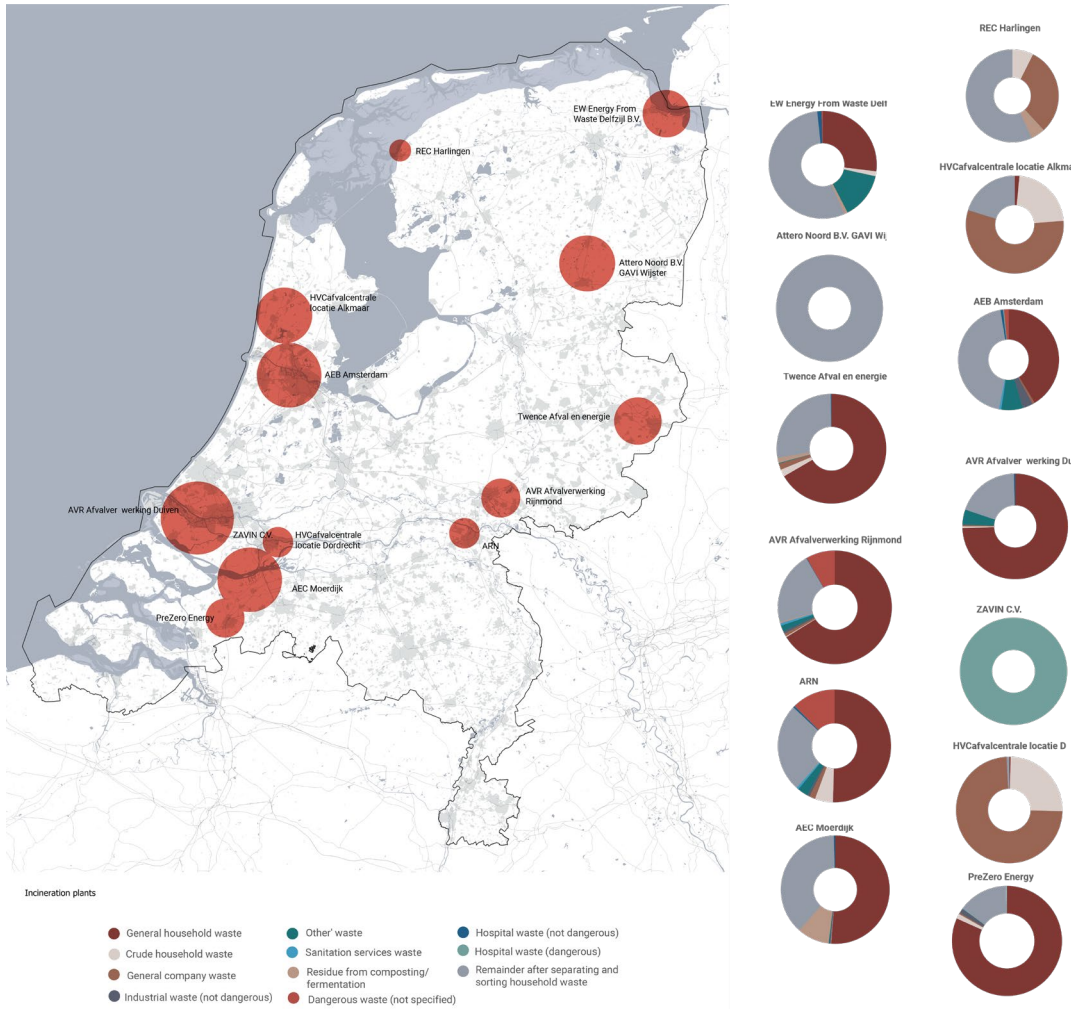

Figure 6: Incineration plants
Dots showing the distribution of waste incineration plants distributed across the Netherlands. Scale of the circles proportional to their relative processing volumes. Based on (Ministry of infrastructure and water management, 2021)

Export

Export within Europe

The Netherlands is a significant exporter of waste to other European countries and is a significant player in the European waste management ecosystem. In 2020, the Netherlands exported over 3 million tons of waste to other European nations (Eurostat, 2022). This exported waste consists of various materials and types of waste, a.o. recyclables, incineration residues, and hazardous waste (Eurostat, 2022). The exportation of waste is justified with the rationale that by using capacities and capabilities of neighboring countries for treatment and disposal, the waste management system is optimized as a whole.

While this is true, it also means that it becomes less clear where responsibility lies for the amount of waste that is produced and how it is handled. To make people aware of the problem and the vast quantities of waste that are produced, we argue that export should stop. When waste piles up we can no longer point to others to blame, and we ourselves have to take responsibility for our actions.

Export outside of Europe

The Netherlands also exports a notable volume of waste to countries outside of Europe, particularly to regions with emerging economies. Precise data on the quantity and types of waste exported beyond Europe is not readily available, but news articles and publications of NGOs show that the Netherlands has exported significant amounts of plastic waste and electronic waste to countries like Malaysia, Indonesia, and Turkey (NRC, 2020; Plastic Soup Foundation, 2022), see figure 7.

In recent years, there has been increasing scrutiny and regulation surrounding such exports, particularly concerning plastic waste, due to environmental and ethical concerns. At the beginning of this year, the European Parliament has announced it wants to forbid the export of plastic waste to non-OECD countries (European Parliament, 2023). The Dutch government is one of the few European countries that opposes this ban (NRC, 2023), which says a lot on the country's dependence on this outlet for plastic waste, as well as the double-standard that is used when talking about circular economy ambitions.

Apart from the export flows that are known, there is the problem of illegal export. Statistics on illegal export are unavailable but some publications indicate that it is substantial (NRC, 2006), especially to countries that have more lenient environmental regulations in Asia and Africa. The illegal export of waste does not only work against global waste management efforts, but it also poses environmental and health risks for the local communities of the receiving countries. There is a strong correlation with questions of social justice, as it is often the poor and marginalised communities that bear the consequences.

In line with our strive for justice and bringing responsibility back home, we therefore aim to stop export. To minimize and eventually stop the illegal export, there is need for global cooperation and strict regulation.
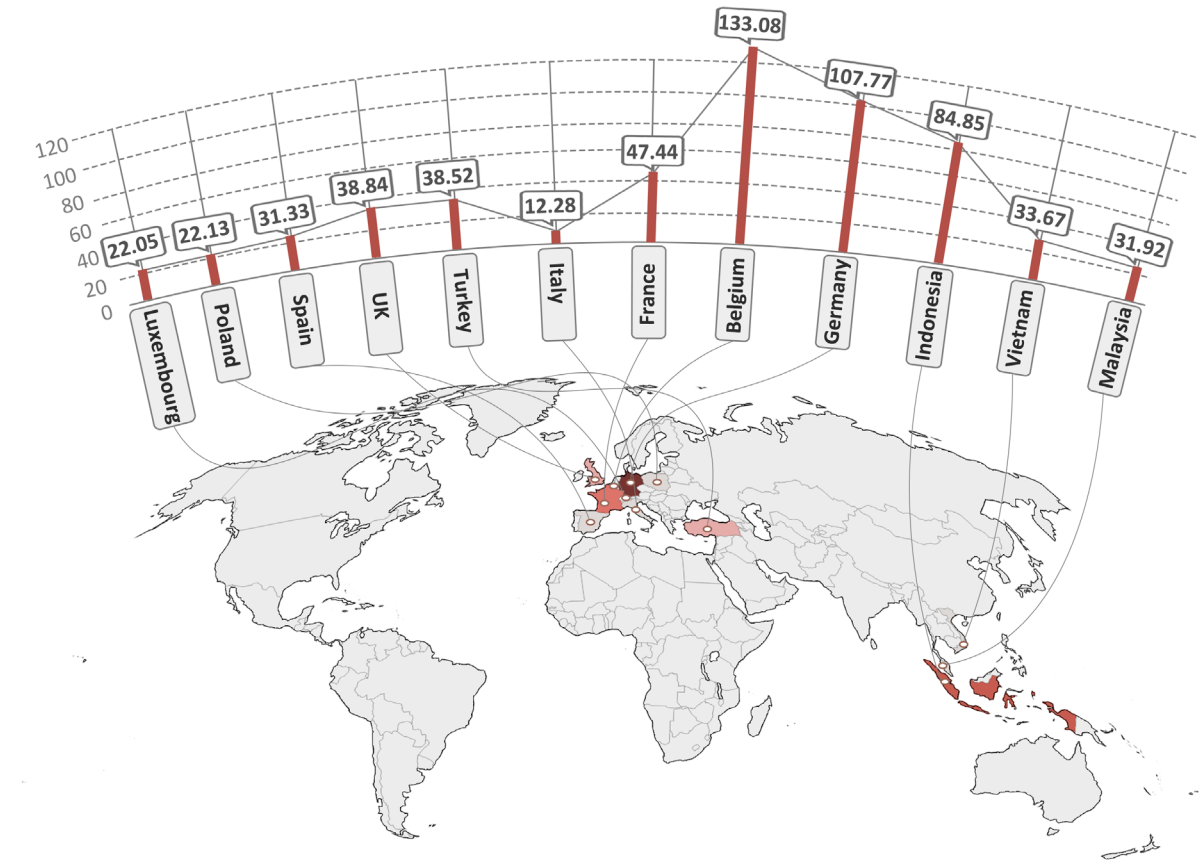
Figure 7: Waste exports from the Netherlands in 2022, by destination
Based on (Statista, 2024)

Global sociospatial justice issues

The export of waste brings up questions about socio-spatial justice. The export of waste from developed countries to developing countries perpetuates issues of social justice in various ways.

First of all, it plays out at the international level by perpetuating global power relations. Wealthier nations (illegally) dump their waste on the grounds of countries with fewer resources and less political power, which continues the cycle of exploitation and inequality (Amnesty International, 2016). The countries at the receiving end of this process often do not have proper waste management facilities at their disposal, thus creating negative effects on the health of people and the environment (Kubanza & Simatele, 2015). Besides the fact that the countries that consume the most do not take responsibility for their behaviour, they worsen the negative effect on the environment by transferring responsibility to countries where techniques are less technologically advanced or absent.

Secondly, it exacerbates social inequalities in the receiving countries themselves, as the dumping sites and waste facilities are often located near disadvantaged communities. These communities – often minority groups or economically disadvantaged communities – are the ones who bear the direct consequences and risks of this waste, which is often mismanaged (e.g. open burning), polluting the environment and creating health risks (Ferronato & Torretta, 2019).

In order to address these social injustices, we need to rethink the waste management system on a global scale, guided by responsible consumption, environmental justice, and fair distribution of resources.

Historic developments of waste management

Trends

Waste as symbol of unsustainability

Political and social resistance to landfills

Fragmented waste system is centralised

2019: waste sector in the Netherlands has stabilised; international context remains dynamic

STOP the STINK

Think Green, Think Clean.

Policy

Waste processing is done locally

Ladder van Lansink (1979). Waste hierarchy

Insitutional reforms (1989-1992)
- Nationale Milieubeleidsplan (NMP1)
- Afval Overleg Orgaan (AOO)
- Vereniging van Afvalverwerkers (VVAV)

Municipalities now work together

European law is increasingly important and influential

2016 Ambition formulated to be have a circular economy by 2050

2050 Netherlands has a circular economy

Prevent
Reuse
Recycle
Incinerate
Landfill

Vereniging van Afvalverwerkers

Economic

First recycling activities & opening of second-hand shops

Increased investments in incineration plants

(illegal) export of waste is increasingly attractive

Landfill taxes are introduced (1995)

Few but big waste processing firms

Import of waste for incineration

CE: prevent waste in the first place

ReFuse
Don't call it waste.
NO

€

Social

Publication Limits to Growth (Club of Rome, 1972)

Growing dissatisfaction on waste and landfills

Pilot: Sustainable closing of landfill sites

114 definitions of circular economy (Copernicus Institute, 2017)

2030 50% reduction in primary raw materials

THE LIMITS TO Growth

Research RIVM (1989) waste incineration scandal

Circular (noun)

Waste

Landfill as the dominant solution

Increased separation of waste by households

Waste seen as resource

Increased focus on prevent and reduce

Gradual decrease in the amount of landfill sites

Export: relocate instead of solve

Increase in incineration capacity

Refuse
Recycle

1960	1970 Oil Crisis (1973)	1980	1990	2000	2010	2020	2050
	1600 landfills	450 landfills	200 landfills	80 landfills	19 landfills		

Historic developments of waste management

With the timeline, we can show how transitions in the waste sector have taken place in the past. This analysis is useful for our project as it can help us to accelerate and steer a new transition. In the text below, we describe historic developments with terminology taken from transition theory, specifically the multi-phase and the multi-level approach (niche, regime, landscape). The text is understandable on its own, but for a better understanding of the terminology, see page 42 where the conceptual framework is explained.

In the 1960s, we can see economic growth at the landscape level, which goes hand in hand with an increase in production, consumption and waste generation. In the regime, waste processing is done locally, and landfill is the dominant solution.

In the 1970s, the landscape exhibits a change towards environmental awareness, climate change and widespread discourse on sustainability. Waste becomes a symbol of unsustainable practices. The publication of Limits to Growth (Club of Rome, 1972), is an important catalyst. At the niche level, we see that the first recycling activities emerge, and the first second-hand shops open. At the regime level, the Ladder of Lansink (1979) is introduced in politics, which caused a shift in how waste ought to be handled (prevention, reuse, recycle, incinerate, landfill). Consequently many landfill sites are closed (from 1600 to 450), and focus shifts to incineration.

In the 80s, we see that the political and social resistance against landfills continues at the landscape level. In the regime, investments are made in incineration plants in line with previous regime developments. At the same time, the RIVM published research results on the emissions from incineration plants, causing a scandal that influenced public opinion at the niche level. This led to increasing pressure not only on landfills but also on incineration plants, which made (illegal) export increasingly attractive. The waste problem is thus relocated, not solved.

In the 90s, the regime displays numerous reforms. The governments is taking action against contaminated sites, municipalities start working together, influenced by institutional reforms between 1989-1992. Landfill taxes are introduced and incineration capacity is increasing. The fragmented and decentralised waste sector turns into a centralised system of recycling, incineration, and landfill. Responsibility shifts to the producer to make separation of waste possible. At the niche level, households are increasingly separating their waste.

In the 2000s we see that European law becomes increasingly important and influential. Overcapacity of Dutch incineration plants has led to the import of waste from other countries, including the UK. The waste market can be considered highly professional, as few large companies operate internationally and are nationally governed. The niche developments of recycling and separation by consumers are taken up in the regime, they are now new behaviour patterns that are part of the status quo.

In 2010, we see at the landscape level that the international waste sector remains very dynamic. At the European level, a pilot is introduced to sustainably close landfill sites. 3 of these pilots are located in the Netherlands. In 2016 the ambition is formulated at the regime level to transition to a fully circular economy in 2050. In 2017 the goals to reduce waste production are made quantitative. Due to these ambitions, the focus lies on prevention of waste generation. In terms of perception and framing, waste is increasingly seen as a resource.

In 2020, the challenge becomes more apparent: the current systems is focused on optimizing waste processing (incineration and landfill), while the circular economy focuses on reorganising production and consumption to prevent generation of waste in the first place. Alongside this, there is a problem of interpretation and definition, as there are 114 different definitions of the circular economy. Overall, there is still a huge gap between today and the ambition for 2050.

Taken together, the historical developments show that changes start with individuals, with ideas that spread and are shared between many actors. It starts with institutions, and it starts with market forces. It starts in multiple places at once and each are mutually reinforcing. This shows both the complexity as well as the potential of change.

Image (Marcilhacy, 2018)

Chapter 2
Analytical & Conceptual Framework

Chapter content:

Problem Statement

The Netherlands produces 60 million tonnes of waste per year (Rijkswaterstaat, 2020). In line with the ambition to transition to a circular economy by 2050 (Rijksoverheid, 2016), approximately 80% of waste is currently recycled (Rijkswaterstaat, 2020).

However, for the remaining 20%, the Netherlands currently seems to turn a blind eye. Through methods of incineration (7.6 tonnes/year (Rijkswaterstaat, 2020)) and export (In 2020 the EU exported 32,7 million tonnes to non-EU countries (European Parliament, 2023)), we are not confronted with our waste but instead, we make it disappear. As a consequence, public awareness of the problem is low, as waste simply disappears from our daily lives after it has been thrown in the trash. This relates to questions of responsibility and justice, across the entire chain from production to consumption and discarding the product as waste.

When considering the circular economy ladder of responsible consumption, the first step is refusal (Ellen McArthur Foundation, 2023). In order to tackle the problem at the source, the question becomes how consumption can be reduced. First step in this process is making the waste we produce visible again.

Figure 8: Collage of two extremes
It symbolises the two directions society can now take with regard to waste management.

Research Questions

Contextual questions

How can waste be integrated in the Dutch 'landscape' if it is no longer exported or incinerated?

How can people's behaviour of consumption be influenced through spatial interventions on waste accumulation?

(What governance structures are relevant, where lies interest and power, and how should costs and benefits be distributed?)

Design question

In what way can physical waste hubs/storage spaces be designed to influence public opinion and contribute to reducing consumption?

Transition theory

A transition is a process of change in which society or a subset of it fundamentally changes due to different interconnected transitions taking place at different levels (Loorbach, 2002). This includes culture, behaviour, economy, institutions, belief systems, technology, ecology etc. It is necessary that change happens at different levels simultaneously such that the whole system starts to turn.

Main Concepts

The transition framework consists of two transition concepts: multi-phase and multi-level (Loorbach & Rotmans, 2006).

The multi-level concept

This consists of three levels, the niche, regime and landscape level (Loorbach & Rotmans, 2006). Each of the levels interact as seen in figure 9

The regime – meso level - Consists of social norms, rules, and beliefs that shape the way in which companies and institutions function. In the pre-development phase this level is mostly hampering change (Loorbach, 2002). Due to the boundaries of the regime, it will first optimize the system. Due to persisting problems, however, perceptions at the landscape level will start to change.

The landscape – macro - Level consists of international trends, geopolitics, and slow societal changes. Meanwhile at the niche level, innovators will start to experiment with alternatives to the existing regime (Loorbach, 2002).

The niche – micro - This is thus formed by individuals, activists or entrepreneurs, and local initiatives that challenge the status quo.

The multi-phase concept

This consists of 4 main phases as seen in figure 10:

1) Pre-development phase where change is not yet visible but experimentation is happening
2) Take-off stage where the process of change starts building up
3) Acceleration phase where structural changes start to happen and become visible at the larger scale
4) Stabilization phase where the speed of change is decreasing and a new equilibrium is found.

"A transition is the shift from an initial dynamic equilibrium to a new dynamic equilibrium."

Loorbach & Rotmans, 2006

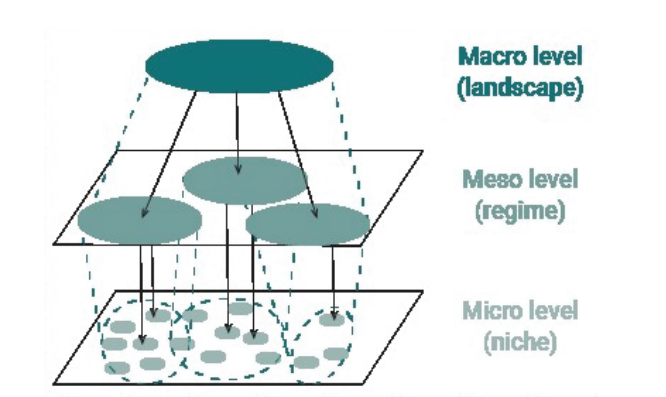How do you turn transition theory into action?

Figure 9: Multi-level interplay in transitions
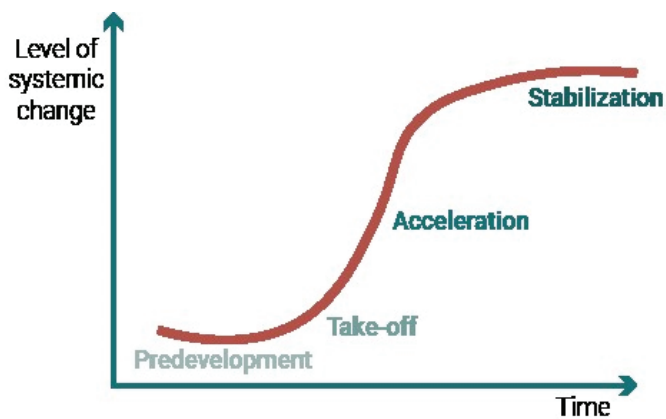Based on a diagram in Loorbach, 2002

Figure 10: Four phases of transitions
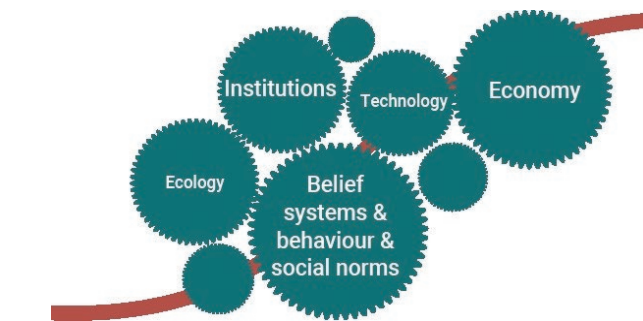Based on a diagram in Loorbach, 2002

Figure 11: Reinforcing Cogweels
Based on a diagram in Loorbach, 2002

Transition management

How can transitions be managed? There is no way in which we can have full control over transitions, but we can influence and steer them, such that the direction and speed of transitions moves in a desirable and sustainable direction (Loorbach 2002; Loorbach & Rotmans, 2006).

Transition management is based on 2 strategies (Loorbach & Rotmans, 2006):

1) System improvement (improvement of the existing circular economy trajectory)
2) System innovation (a new trajectory: waste storage instead of incineration)

In the management of transitions, the multi-phase and multi-actor concepts are important to see how developments in different domains, levels, and amongst different actors influence one another. It is based on long-term thinking and back-casting. It is a cyclical process, consisting of the following steps, as also shown in figure 12 (Loorbach, 2002; Loorbach & Rotmans, 2006):

1) Develop a transition arena
2) Develop a long-term vision and a transition agenda
3) Execution of transition experiments
4) Monitoring and evaluation

Transition Arena

The actors in the arena need to reflect the complexity of the problem. It consist of different actors from different sectors, and should include companies, NGOs, governmental bodies and knowledge institutes. It should consist of groups that are willing to take an active role in the transition (e.g. be forerunners, visionaries, be open-minded) (Loorbach 2002; Loorbach & Rotmans, 2006).

First, the transition arena exists separate from the existing arena. Over time, both arena's will converge as seen in figure 13
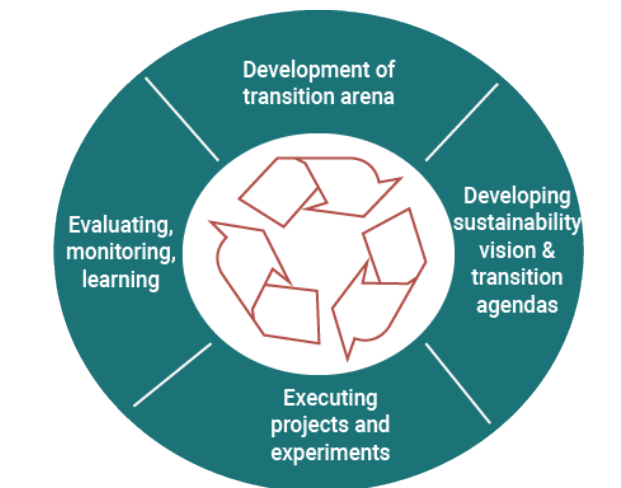

Figure 12: Transition management
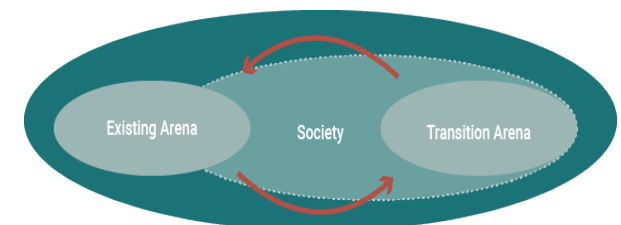Based on a diagram in Loorbach, 2002

Figure 13: Communicating Arenas
Based on a diagram in Loorbach, 2002

Transition vision and agenda

The long-term vision can be a guiding light to help shape actions both on the short- and long-term.

At the same time, inspiring visions can be communicated through transition images. Transition images will help to envision the transition pathway, but do not set the future into stone.

The transition images can change over time as learning and evaluation processes take place.

The agenda forms the compass that the participants in the transition arena can follow. Here back-casting is used to translate the future vision into concrete actions on the short term (figure 14).

Transition experiments

Transition experiments result from the transition vision and images. They are potential pathways that contribute to realising the vision. To shape the experiments, it is important to look at which niches can be used to locate the experiments and to be aware of the way in which the regime looks at these niche experiments. The main goal is to have different experiments that reinforce one another.

Monitoring and evaluation

The transition arena, the agenda, and the experiments should be monitored to see whether the transition is moving in the desired direction and if adjustments need to made.
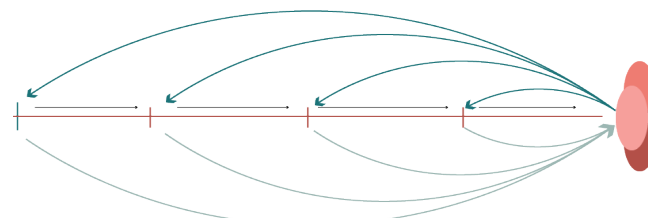
Figure 14: Backcasting and plurifocul long-term sustainability goals
Based on a diagram in Loorbach, 2002

Transition theory linked to our project

How can this theory be put to use in our project?
The steps described in transition management are used as strategy to shape our project.

1) Develop a transition arena

Within the waste management system, several important actors can be identified. They are shown in figure 17. These are either forerunners and innovators, or actors with a lot of power and interest for innovation.

Companies: The Royal Dutch Association for Waste and Cleaning Services (NVRD) is included here, as they state on their website that they want to help the transition towards a fully circular economy. It is a branche-organisation, thus having the potential to influence the existing climate.

NGOs: WISE is an important action group in the waste sector, who published an article where they state that investments in incineration should stop, and that incineration plants should not be part of the future economy (WISE, 2024). Rebel Group is located between NGOs and knowledge institutions, as it is an independent research group that offers consultancy. They were asked to research the effects of different waste management strategies on export and incineration (RebelGroup, 2024). They say that phasing out incineration should be an important point on the agenda.

Knowledge Institutes: DRIFT is a research institute for transitions. In 2019, they published a report on the development of incineration, landfill, and reuse and recycling practices in the Netherlands (DRIFT, 2019). In general, they are strong proponents of sustainable transitions.

Governmental bodies: The ministry of Infrastructure and Water is the most important actor in the waste management system. Even though they are part of the established system, they display interest in innovative practices and can be an important actor in accelerating the transition. VANG is located in between the government and companies. It is an initiative to help municipalities make the transition to the circular economy through waste management (VANG, 2024). Both the Ministry of I&W and the NVRD are partners in this programme.

2) Develop a long-term vision and a transition agenda

This is done with the manifesto and visually through the transition images shown in figures 15 and 16

3) Execution of transition experiments

Our experiment focuses on waste houses – storage facilities – as an intermediate solution to reach the envisioned fully circular economy.

The experimental storage spaces offer a solution for the waste that has currently no place in the circular economy. Instead of incinerating the waste, exporting it, or putting it in landfill, the waste is stored until solutions for processing are found.

The aim of the experiment is to change people's behaviour by designing these storage facilities in such a way that they have high visibility and interaction. Apart from the practical goal to keep materials in the loop, the goal is to reduce consumption and the generation of waste in the first place. After all, according to the Waste Hierarchy system, refuse, reduce, reuse are prioritised, and recycling is the last option (Ellen McArthur Foundation, 2024).

4) Monitoring and evaluation

While the project is rolled out, it is important to constantly evaluate response. To see whether the campaigning and shocking effect indeed helps to change people's behaviour. This can be done by external parties through questionnaires as well as carefully monitoring the type and amount of waste that ends up in the storage facilities.

Figure 15: Transition images
Included on page 116

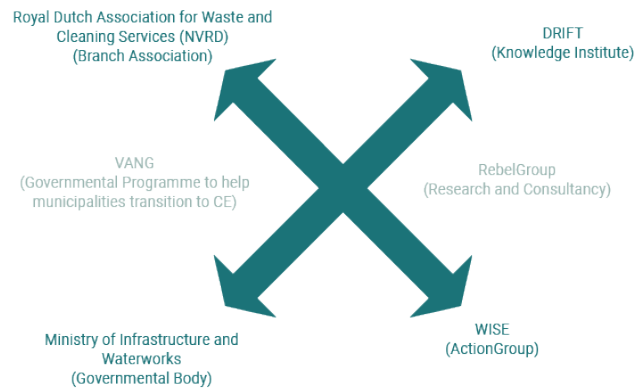**Figure 16: Manifesto**
Included on page 38

Figure 17: Key societal actors that are a part of our transition arena
Based on a diagram in Loorbach, 2002

Acknowledging

Invisible worlds.

What happens to the milk package or the plastic wrapping that most supermarket vegetables and fruits are wrapped in? If we throw the paper into the right container, will it make the world a better place? When shopping, do buyers ask themselves

what will happen to the item they are purchasing after it is no longer useful to them?

All these questions are related to a system that mostly goes unnoticed but is inextricably linked to our current way of living: the early morning's garbage trucks that collect the waste we create from our doorstep after which it is transported to

to places that rarely or never cross our minds.

Mountains made of dirty secrets.

We have all seen images from distant countries, where garbage is piling up to create new landscape formations.

In the pictures that circulate in the media we see local people sifting through these piles, trying to somehow cope with this reality over which they have no control.

What goes up in smoke.

Closer to home, we see great chimneys with clouds of smoke coming out. Although the clouds are snow-white, the view is accompanied by an ominous feeling. Who knows what kind of particles these clouds contain. The incineration plants on the city outskirts offer promises of sustainability, where waste is turned into smoke, heat and energy.

The promise of a clean world: unwanted waste into clean energy.

However, something is also lost.

How do our stories touch?

What is interesting, is that the images from distant lands, and the smoke around our corner are often not connected to the trucks that silently drive our streets in the morning. Let alone to the small waste bins in our kitchens and homes, or the choices we make in the stores and supermarkets.

The Manifesto

Looking the beast in the eye.

Before stories can be rewritten, they have to be told.

Let us make our waste visible again, so that we know the shape and size of the beast that we are dealing with. Let us find out how the beast came into existence, how it is fed, and how it grows.
Let us find out how to stop it, and how we can turn the beast into something beautiful.

Redefining

Rewriting our stories.

The dominant story that is currently told goes like this: we collectively define waste as

"unwanted matter"

or material of any type, especially what is left after useful substances or parts have been removed" (1).

Taking responsibility.

Before we can put on such new glasses, there is work to do. If we want to redefine the beast, we must fully embrace it. We must invite it into our lives. We have to see that our throwing of products in the waste bin at home, is directly linked to the

dirty mountains on the news and the smoking pipes along the highway.

What if we changed this story and regarded waste as something precious? What if every waste bin and bag was full of diamonds? What if we find out that these gems were always there, but we just did not have the capacity to see?

Invite the beast back into our lives.

We have to bring our waste back home and stop incineration and export.

Let new eyes conceive of new

Once this first step is accomplished, we can start to learn together. We can teach ourselves and one another to see, look, and think with different mindset.

Recall the beauty inside the beast.

Together we can call upon our collective creativity to turn the dirt, the daunting, and the unjust, in something that sustains life.

Behavioural change & case studies

The Theory of Reasoned Action (Fishbein & Azjen, 1975) describes how intention, subjective norms, and perceived behavioural control influence whether or not someone will engage in a particular behaviour (LaCaille, 2013). The theory is shown abstractly in figure 18.

Intention of the person is the best predictor of behaviour (e.g. I separate waste because in that way I contribute to a more healthy planet). Intention is shaped by how the actor thinks that people around her value that particular action (e.g. my friends think that waste separation is important). Additionally, factors that facilitate or prevent the engaging in the action influence the likelihood of the action being performed (e.g. I have knowledge to separate waste appropriately).
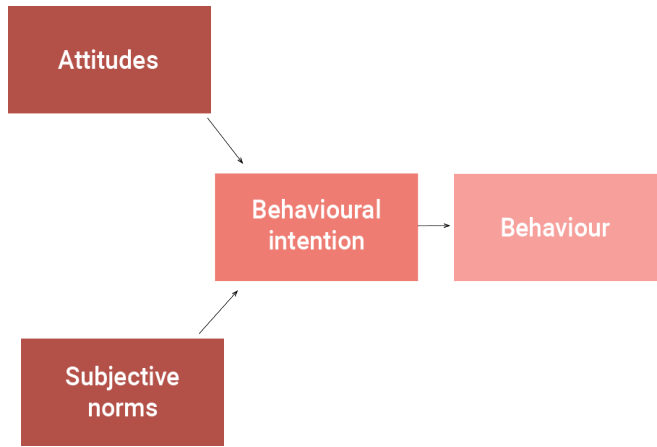
Figure 18: Theory of Reasoned Action
Based on the works of Fishbein & Azjen, 1975

Case studies of behavioural change

In the past, impactful events, monuments or periods have already proven to be able to change the behaviour of society or to inspire proper action by those in charge. In particular, events which cause chaos and discomfort prove to catch attention and really open up discussions. The following case studies illustrate examples of small or large changes in societal behaviour.

The Great Stink - London Thames 1858

The Great Stink affected public health through bad smell regardless of social classes. The British Parliament was unable to work due to the stench. This extreme level of discomfort, disgust and health threat was the push needed for the construction of proper sewers.

Paris 2023 waste collection strike

This example from Paris is the closest to our scenario of confronting society with the waste it produces. As the quote illustrates, the piling up of waste during only 8 days already had its psychological impact on the people of Paris. Whether this even changed behaviour on a large scale can be doubted. However, the quote proves the confrontational shock effect of events like these.

Statue of a 'normal' woman - Rotterdam

The placement of this statue sparked a lot of discussion on institutional racism in The Netherlands and made people question why some groups were so strongly opposed to this representation of a normal black woman. The result of this event is to some extent more consciousness and awareness of discrimination.
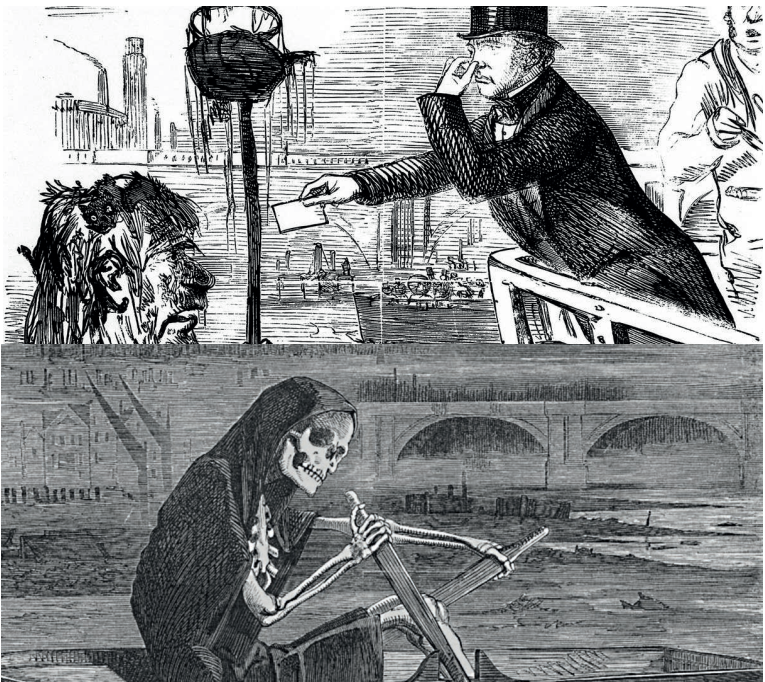
Figure 19: The Great Stink - London Thames 1858
Image: Historic UK

Figure 21: Paris 2023 waste collection strike
Image: Bloomberg, 2018

Figure 22: Statue of a 'normal' woman - Rotterdam
Image: NRC, 2023

Figure 20: Construction of London sewage system
Image: Herschan, 2016

"Anne-Marie, 68, a singer and former dancer, said it was sobering to see the sheer scale of rubbish produced by the city: "I've been trying to create as little rubbish as I can, but I've got no choice but to bring my bin bag down and add it to the pile."

Shock, disgust & confrontation with waste production
From an article from the Guardian (Chrisafis, 2023)

Figure 23: Empowerment & visibility of 'normal' black women in Rotterdam. Image: Akbarzadehpoladi 2023

Conceptual framework

Our conceptual framework connects the theories and strategies of our project into a combined system, illustrating how they work together to accelerate the transition to a circular economy. The 4 key topics of transition theory, people, flows, space and their associated concepts are explained in more depth below.

Transition Theory

The project aims for a transition: from a linear economy to a circular economy, and from unethical consumption behaviour towards a more sustainable pattern that does not inhibit people and planet from thriving. Transition theory is therefore the most important element in our conceptual framework, as it explains and facilitates the shift that we aim for.

As mentioned before, three concepts are leading: the multi-level concept, the multi-phase concept, and transition management (see page 34)

Windows of opportunities should be used such that the existing system will transition into a new socio-technical paradigm: the Circular Economy.

Circular Economy

The circular economy has many different definitions, but a commonly accepted definition is to keep materials and products at their highest level of application for as long as possible (Tsui, Derumigny, Peck, Timmeren & Wandl, 2022). How products and materials can find their way back into the system is made explicit in the circular economy butterfly diagram of the Ellen McArthur Foundation (2023). This system of loops aims at turning waste into a resource. To reduce waste production, the Ladder van Lansink (Motion in the Second House in 1979) offers a hierarchy of most desirable and least harmful actions, with prevention and reuse at the top, and incineration and landfill at the bottom. This is now reformulated into the R-ladder (RVO, 2023).

The way in which our strategy (storage) contributes to reaching the circular economy vision is visualised along these hierarchies in butterfly diagrams. They are explained in more detail in the next chapter (see page 52).
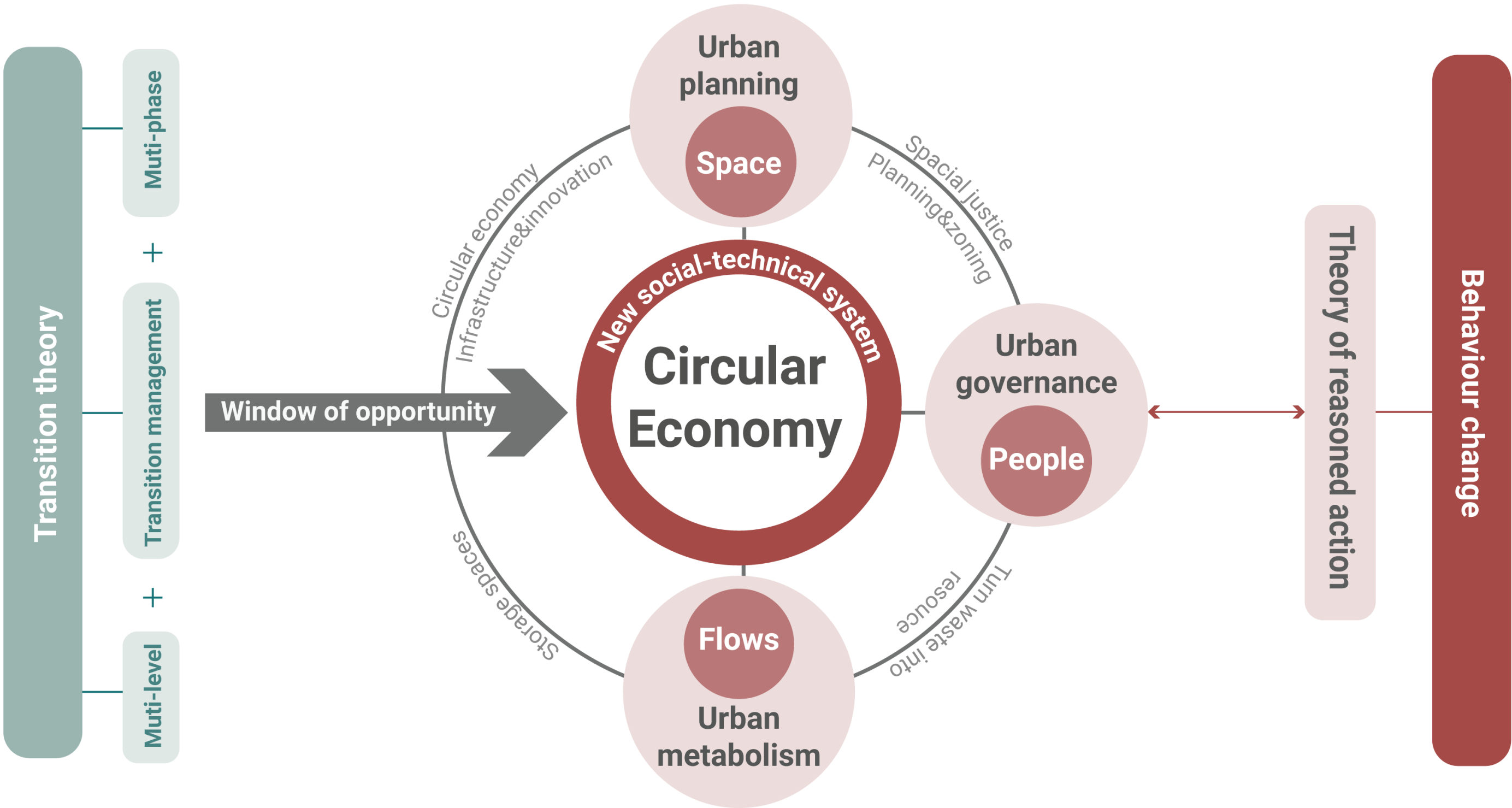
Circular Economy – Space, People, Flows

The circular economy was initially primarily focused on the circularity of materials, products and companies. Currently, this view has expanded to larger geographical scales, moving from the product, to the level of the neighbourhood, and from there to the city, country, region, and global scale (Tsui et al., 2022). The application of the circular economy at the larger scale often follows the framework of Tjallingii (1996), who divides environmental planning into people, space, and flows.

Space is especially relevant for the current project, as urban planning intervenes at this level. At the same time, the other aspects are necessary to get a complete understanding of the problem and potential solutions. The spatial aspect is of especial importance since Tsui et al., have indicated that the spatial perspective is often lacking in literature on circular cities (2022). Focus in existing literature lies mainly on urban governance (people) and urban metabolism (flows).

At the same time, the circular economy is fundamentally spatial: physical spaces like storage and recycling facilities and activities for reuse of products have spatial translations as well. For the design project, it is important to define where these storage facilities can be located, in which quantity and at what scale, and how this affects flows and people.

Urban Governance

Urban governance focuses on the interaction between the public sector, private sector, and civil society (Song, Chen, Duan, & Zheng, 2023). The concept of urban governance itself is something that is constantly in transition, as it changed from traditional governance models to governance network models, and has, from the 21st century onwards, steered towards multi-subject participation (Song et al., 2023).

Urban Governance - actors

In the diagram that maps the new waste system we are proposing (see page 63), most relevant actors have been identified.

Conceptual framework

International Agreements influence and shape enforceable laws at the supranational and national level. The United Nations Environment Programme is an important actor in the management of waste, and specifically the Framework Legislation for Integrated Waste Management (UNEP, 2016). Such frameworks and conventions help shape international trends and opinions (landscape) which influences the existing system (regime) (Rotmans & Loorbach, 2009).

European legislation has an even greater impact on local waste management, as these laws can be enforced at the national level. Specifically relevant are the Waste Framework, the Circular Economy Action Plan, the EU Green Deal, and the EN-norms that contribute to sustainable production methods (European Comission, 2023abc).

At the national level, there is an ambition to transition to the circular economy before 2050 (Rijksoverheid, 2016). Responsibility is shared between industry, consumers and government to reduce material consumption. The polluter pays principle (European Commission, 2023d) can be used as a guiding principle in finding appropriate locations for storage (e.g. make industry responsible for its own waste collection), as well as the behavioural aspect described in the section below. The behaviour of industry can be changed through such EN- and NEN-norms at the European and national level respectively.

Municipalities are responsible for the municipal waste collection, while waste processing is increasingly centralised as few large companies dominate (see development over time as depicted in the timeline on page 26) (Raak, Spork, & Graaff, 2019).

Urban Governance – behaviour change

Consumers are found both at the end and the beginning of the waste cycle. People produce waste, which environmentally responsible consumers separate and sort at the end of its life cycle. At the beginning of the cycle they influence supply and product designs through their consumption patterns and choices.

Change can be initiated at the niche level, where entrepreneurs or activists come up with innovative ideas that can change the status quo. To change the existing waste system towards a more sustainable alternative, we are aiming for an awareness campaign that can influence people's consumption behaviour. The Theory of Reasoned Action is of particular importance in our framework, as was explained in the previous section (page 40).

Ethics is of general importance, not only for individuals but for actors in urban governance and planning (Silva, 2007). Decisions of the private sector and the public sector should, ideally, be shaped by ethical considerations. In our case, this should concern the shared idea that action is necessary to move towards a more equitable, just, and sustainable paradigm. Ethics plays a role in our own team as well, as we base design decisions on what we as a group consider to be just and/or necessary actions for a desirable future.

Urban metabolism

Urban metabolism studies "the sum total of the technical and socio-economic processes that occur in cities, resulting in growth, production of energy and elimination of waste" (Kennedy, Cuddihy & Engel-Yan, 2007). It studies different flows in a city or region, and generally looks at the input of resources, and output as waste. This is shaped by linear thinking, since reclassifying waste as resource would lead it to loop back into the material flow.

We will see how waste flows through a city or region. Waste moves between the municipal and national level, from consumers that separate the waste, waste collection and transportation by the municipality, separating and sorting by industry, and processing at either recycling facilities or incineration plants and landfills. The latter two have left the conceptual framework as they are no longer relevant in our future scenario.

Apart from reclassification of waste as resource, it includes strategies for reducing material use. Behaviour of industry can be changed through norms at the European and national level, and by changing legislation around waste categorization which prevents waste from being used and perceived as resource. At the same time, behaviour of consumers can also influence the flows of production, material use, and waste production. This again suits the Transition Theory described before (Rotmans & Loorbach, 2009).

Urban Planning

The spatial aspect of circular cities is often overlooked (Tsui et al., 2022). This is the place where all that has been discussed before comes together, and gets translated to physical space. This influence is also exerted the other way around, as spatial planning attempts to plan processes of social, economic, and environmental change to achieve certain goals (Huxley & Inch, 2020).

In our project, we place specific emphasis on spatial justice. The decision to stop export stems from the fact that waste from large producers (such as the Netherlands) is exported to countries in the Global South, which has a negative effect on the health of the local environment and its people. From our own ethical perspective, we aim to take distributive and procedural justice into account (Rocco, 2022).

Another important aspect related to spatial justice, is the decision of where activities should take place. Relating to the polluter pays principle, waste storage could be located next to the biggest producer, or in the case of behavioural studies, it could be placed such that most people are confronted with it. Spatial clustering forms the bridge between planning and metabolism, as clustering of waste production/reuse/recycling could shorten material cycles, contribute to collaborations between industries, and reduce emissions of ancillary activities.

Integral approach

An attempt is made to categorise all the relevant theories and concepts in the three subcategories of people, flows, and space. While this serves the discussion of the individual elements, they should be approached as a holistic whole, where each element influences the other, therefore making boundaries less clear than now visualised.

Methodology

Description of research & problem field

This research addresses the problem of excessive waste generation in the Netherlands. It looks at the large amount of waste that is generated in general, and more specifically at the waste for which currently no methods exist for reuse or recycling: the waste that is incinerated or exported. The problem is that through these methods, waste is made to disappear. This brings us to two different lenses through which this problem is addressed:

1) a technical-economic perspective
2) a social perspective.

Firstly, the disappearance of materials is not in line with the ambition of the Netherlands to transition to a circular economy before 2050. Hence there is a technical, procedural, and strategic challenge to turn this waste into a resource.

Secondly, as people are not confronted with their waste production, public awareness of the problem is low. This relates to responsibility and justice. Moreover, the first step on the CE ladder is "refuse" showing that consumption should be reduced to tackle the problem at the source.

The first step in the transition to the circular economy is thus to make waste visible again and store it until adequate solutions are found for reusing and recycling the materials.

Our research question is thus as follows:

In what way can physical waste hubs/storage spaces be designed to influence public opinion and contribute to reducing consumption?

In order to answer the main research question, the following sub-questions were formulated:

How can waste be integrated in the Dutch landscape if it is no longer exported or incinerated?

How can people's behaviour of consumption be influenced through spatial interventions around waste accumulation?
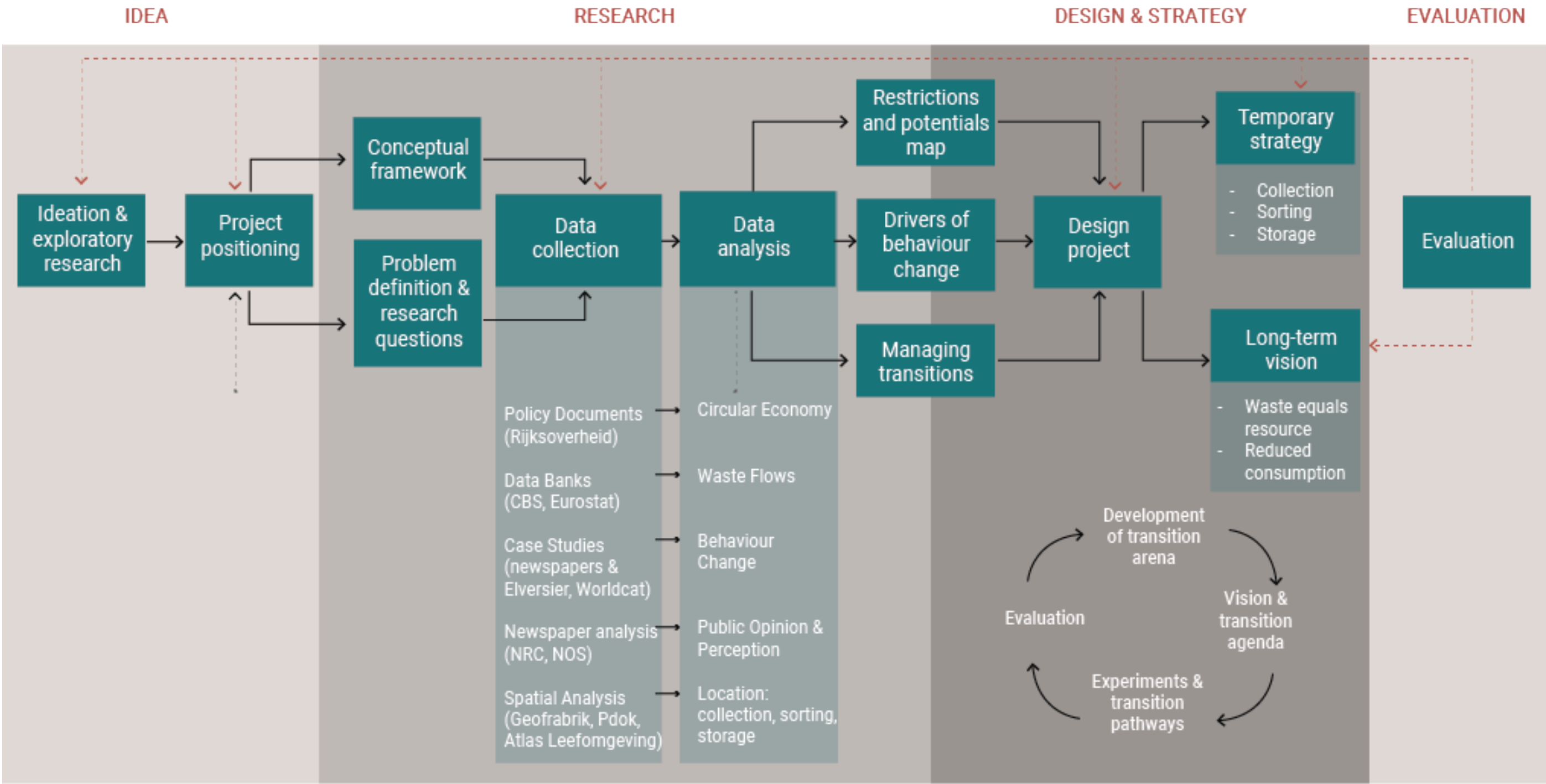
What governance structures are relevant, where lies interest and power, and how should costs and benefits be distributed?

Keywords: circular economy, waste storage, behaviour change, transition

Methods used

In order to answer the sub questions, the following methods were used:

1) Web research and scans of the relevant policy documents to map the current state of the circular economy.

2) Research in data banks to map existing waste streams, flows from production to consumption to waste generation, different types of waste and how they are processed, landscapes of the actors involved across the chain.

3) Case study analyses of how behaviour can be changed through confrontation or spatial changes. These aim to proof the assumptions made in the theoretical and conceptual framework that our strategy can influence people's behaviour.

4) Newspaper analyses to get an insight in the existing attitude towards waste, and what the general public knows about the waste system.

5) Spatial analyses to identify suitable locations for storage spaces

6) Research by design to test integral solutions: working from vision to strategy by means of spatial interventions and designs

IDEA — RESEARCH — DESIGN & STRATEGY — EVALUATION

Ideation & exploratory research → Project positioning → Conceptual framework / Problem definition & research questions → Data collection → Data analysis → Restrictions and potentials map / Drivers of behaviour change / Managing transitions → Design project → Temporary strategy (Collection, Sorting, Storage) / Long-term vision (Waste equals resource, Reduced consumption) → Evaluation

Policy Documents (Rijksoverheid) — Circular Economy
Data Banks (CBS, Eurostat) — Waste Flows
Case Studies (newspapers & Elversier, Worldcat) — Behaviour Change
Newspaper analysis (NRC, NOS) — Public Opinion & Perception
Spatial Analysis (Geofrabrik, Pdok, Atlas Leefomgeving) — Location: collection, sorting, storage

Development of transition arena → Vision & transition agenda → Experiments & transition pathways → Evaluation

Methodology

Data collection

In this research we make use of secondary data.

1) Data from PDOK, Atlas Leefomgeving, and Geofabrik was used to do spatial analyses in QGIS.

2) Data from the World Bank, CBS, and Eurostat was used to justify and find the rationale behind the design project, and was sometimes used as input data for QGIS as well.

3) Academic articles from Worldcat, Springer, and Elsevier were used to draw the conceptual framework, and find case studies to test our assumptions.

Data analysis

For the spatial analysis we defined criteria for areas in which waste can and cannot be stored. These criteria were based on the literature, personal and group values, and the data that was found during data collection. Taken together this resulted in a "potential map" showing all the potential locations in which a given storage space with specific characteristics can be located.

The rationale behind the project, and the effect on behaviour change was first shaped mostly by intuition and personal experience. To add strength, case studies were analysed to search for overlaps to decide whether it is applicable to our design solution.

In depth reading of the literature on transition management resulted in a 4-step process that was used to frame the design project:

1) define transition arena, 2) develop long-term vision and transition agenda, 3) execute transition experiments, 4) monitoring and evaluation.

Conceptual Framework

Transition theory provides methods to accelerate and steer transitions in a sustainable direction. The new sociotechnical system is shaped by people, flows, and space, where each concept is linked to a dominant theory. Numerous crosslinks exist between the concepts as they form an integral whole and should thus not be considered in isolation. The new system causes and is causes by changes in behaviour

Design outcomes

The outcome of the project is twofold:
1) Long-term and idealistic vision for the future, and 2) a (temporary) strategy for transitioning towards this future.

1) Future vision

The project envisions a fully circular economy for the future of the Netherlands, in which responsibility is taken for the waste that is produced. This means that consumption has reduced to reduce the generation of waste in the first place, and that all materials find their way back into the economy and resource loop.

All the processes and material flows which occur in this future are not completely clear to us either. However, we have chosen to use an idealistic and vague future vision as our starting point in order to gear our strategy, using a strategic vision, towards achieving such ideals in the far and not clearly defined ideal future.

2) Strategic vision

Our project consists of a strategy which acts as an intermediate step in the process of achieving the future vision in the long term. Our strategic vision contains short-term actions which build up towards this more vaguely envisioned future.

In order to achieve this future, waste that is currently incinerated and exported should be locally stored. Through the confrontation with the waste that piles up in these spaces without adequate solutions, we create chaos that disrupts the existing linear system.

This will stimulate changes in the social perception of the problem at the larger scale, and stimulate innovations at the local scale, to find alternatives for dealing with this waste.

Over time, the waste that is stored will find a place back in the system, and a substantial part of the storage spaces will become obsolete. Several will remain in place for temporary storage of materials, while others will find a new function as start-ups, research facilities,

or monuments for the old waste economy. Alternatively, they can be demolished in a circular way if no adequate use is found.

Discussion and evaluation of the tools and methods

The project is simplified in multiple ways. This should be taken into account when judging the results. To better align with reality this could be improved upon for a future project.

Waste is a complex and technical topic. The project does not make statements on the technical aspects of the type of waste and how they ought to be stored exactly. Interactions between materials, chemical reactions, or decomposition over time could play a role in possibilities for storage.

The data on export is limited. It is difficult to find data on the quality and quantity of the materials exported, which companies are responsible for the export, and the aspect of illegal export makes it difficult to get a clear view of waste flows.

Phasing out incineration and export does not only influence the Netherlands, but has a great impact on the waste system in other countries as well. Both the receiving countries as well as the countries that exported their waste to the Netherlands for incineration are affected. The impact and potential effects abroad could be mapped in the future to get a better insight into the overall circular impact of the design project. Behaviour change, in general, is hard to predict and prove.

A critical note should be made on the case studies. They depict situations that are different from the one that we deal with in the current project. One can therefore not directly say that the desired effect will happen. For future projects, it could therefore be interesting to broaden this search, and see how behaviour change happened in different situations.

The inclusion of transition studies in the conceptual framework helps, but this management theory concerns itself mostly with larger trends, and once it zooms in on the individual scale it focuses on fore-runners and innovators, rather than explaining how broad spread behaviour can change.

Image (Dutch News, 2022)

Chapter 3

Transition analysis and vision
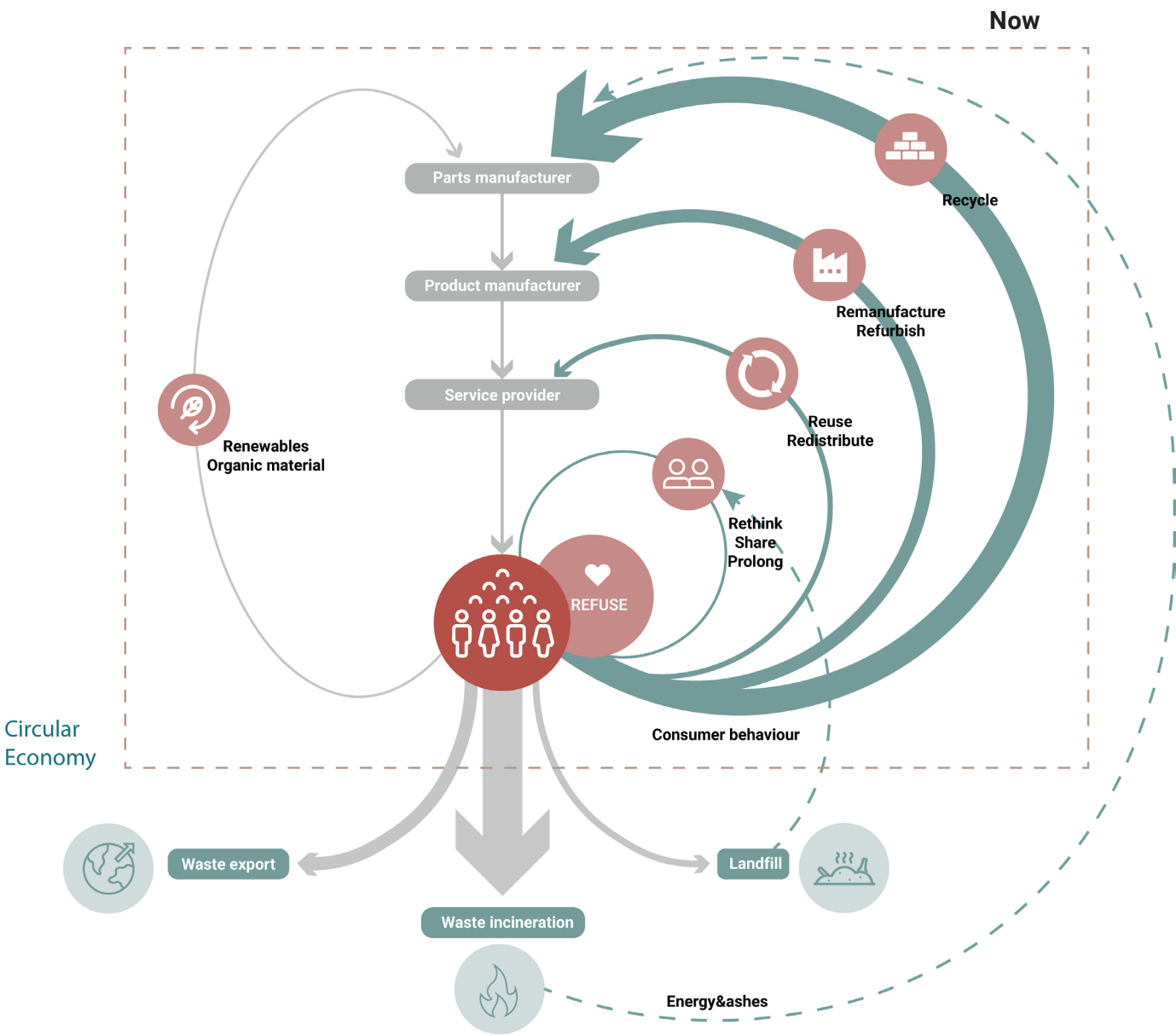
Chapter content:

Achieving a circular economy

The current cycle of materials within the economy is far from circular. The diagrams below illustrate the flows of waste materials within the economy now, during the transition phase we propose, and in the ideal future. They show the components of the circular system from the most desirable high-value loops of refusing and reusing down to the lower-value loop of recycling. The diagrams illustrate the differences between the current and desired economic system and illustrate the importance of our project in bridging these gaps.
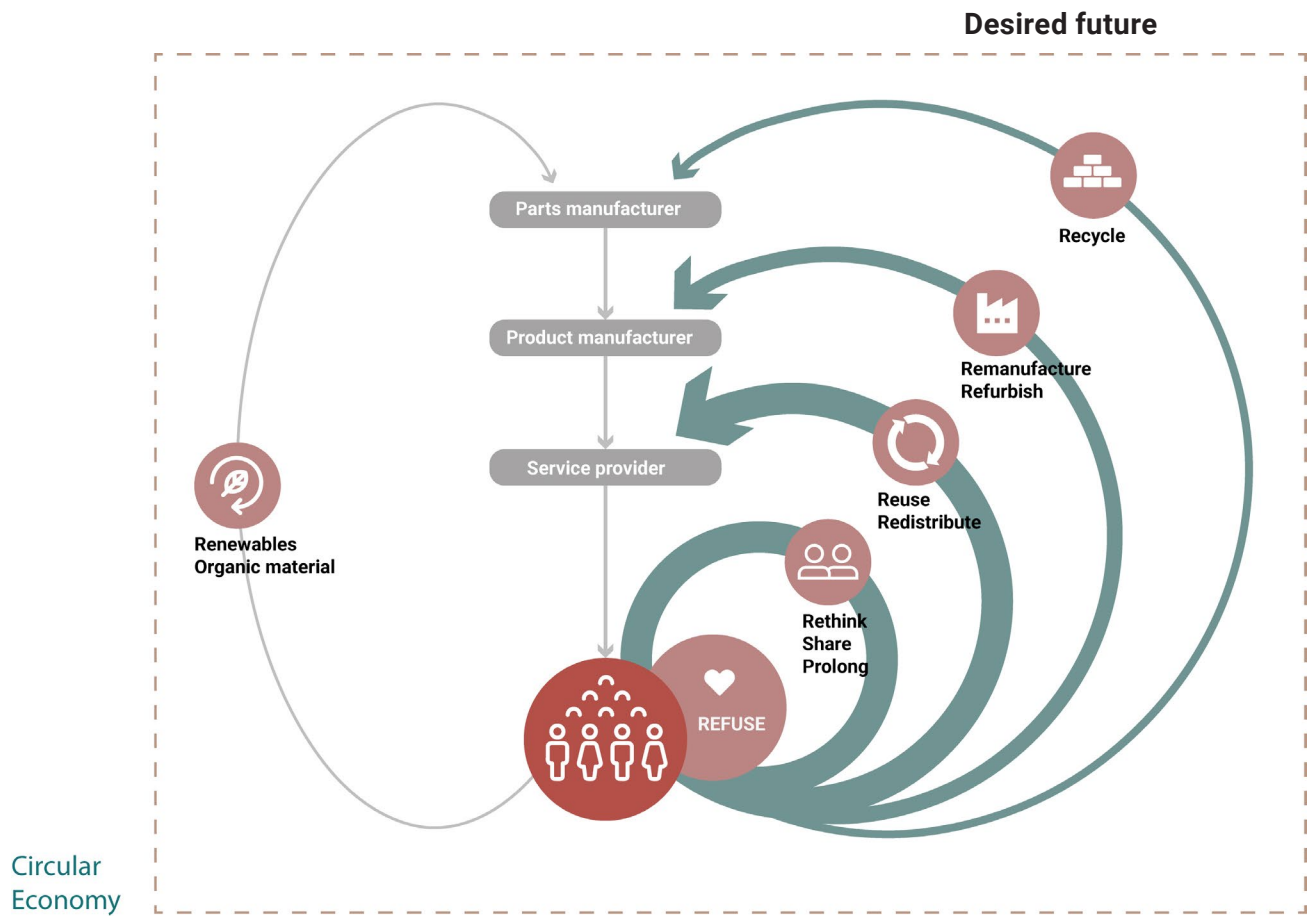

Figure 24: Stages of transition towards a fully circular economy
Based on the 'Butterfly diagram' by the Ellen MacArthur Foundation

The current economy

The Netherlands is currently already making some attempts at obtaining a circular economy. Quite a large amount of waste is sorted for recycling. However, the largest proportion of waste in The Netherlands today still leaves the circular economy system through exports, landfill and predominantly incineration. These flows out of the system are lost material resources which can not be recovered.
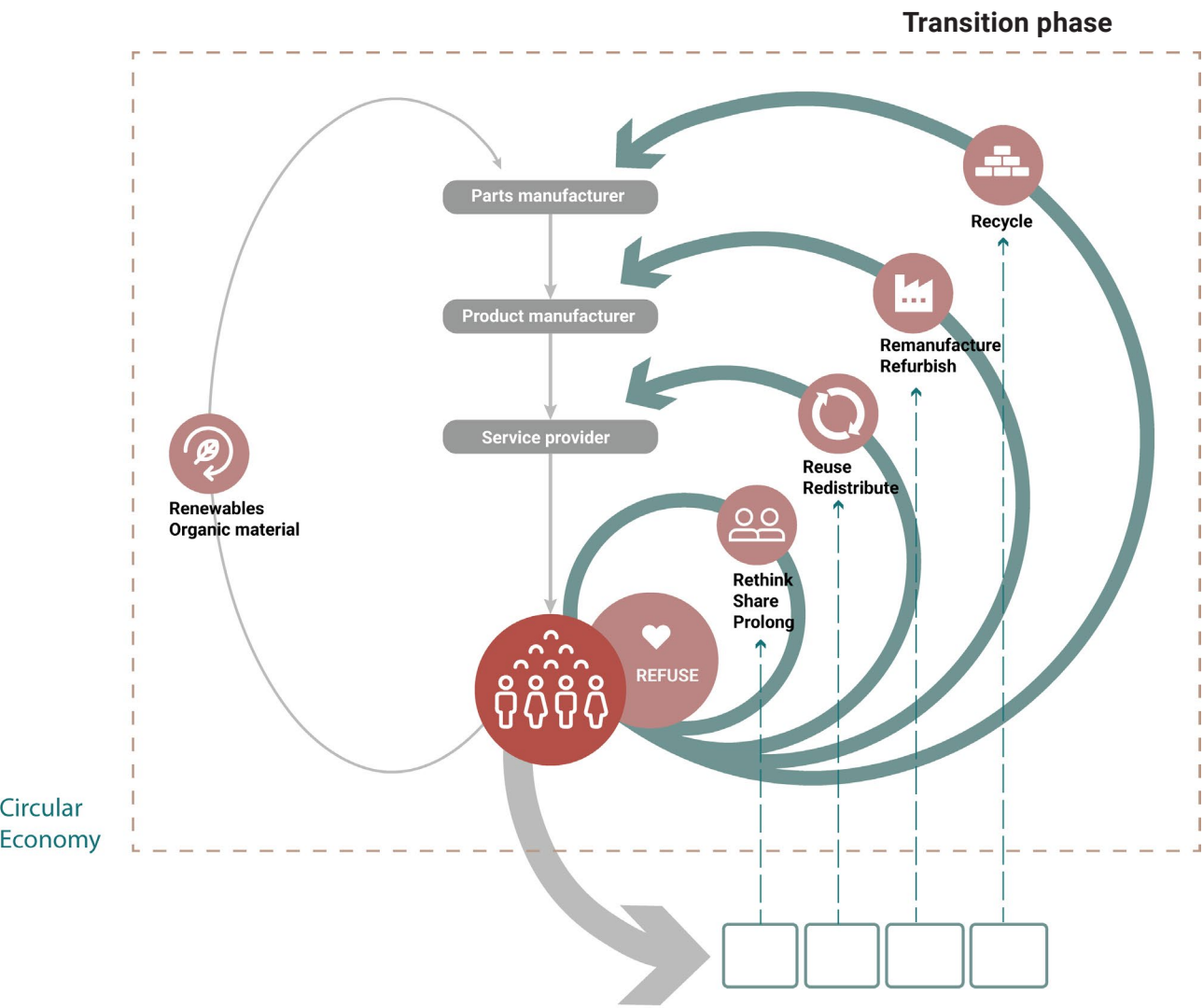
The transition economy - Waste House system

In order to stop the loss of resources, all export, incineration & landfilling of waste needs to be stopped. Ideally they all have a place to be fed back into the circular economy system. However, in transition from the current system there are no processing techniques & capacities yet to deal with all waste. Therefore storage spaces are needed where this waste is held until a more developed circular economy is able to take the materials back into the system. In this transition phase, a growth of high-value loops in the circular economy occurs and less waste is produced is produced in the first place as a result.

Fully circular economy

In the ideal economy there is little waste production in the first place since products are designed to be long-lasting, easy to integrate back into the circular economy and consumers consume less. The waste streams that still occur all have a place within the circular economy and particularly within the high-value loops of sharing and reusing, since the materials retain their value without barely any processing in these loops. All waste that was stored during the transition phase in waste houses has been re-integrated.

Vision map

In the vision map we give a first overview of what the new system will look like after export and incineration are phased out.
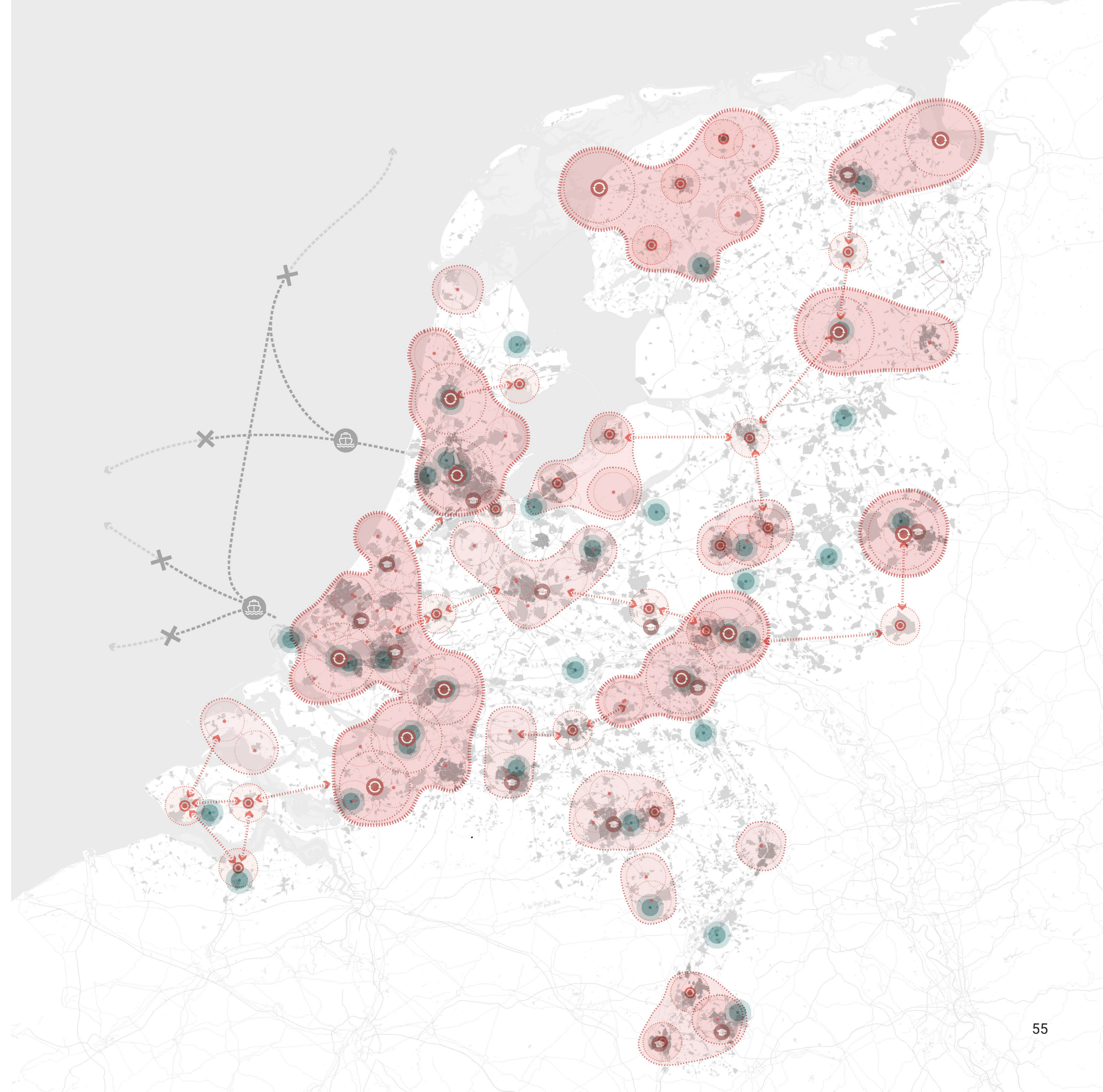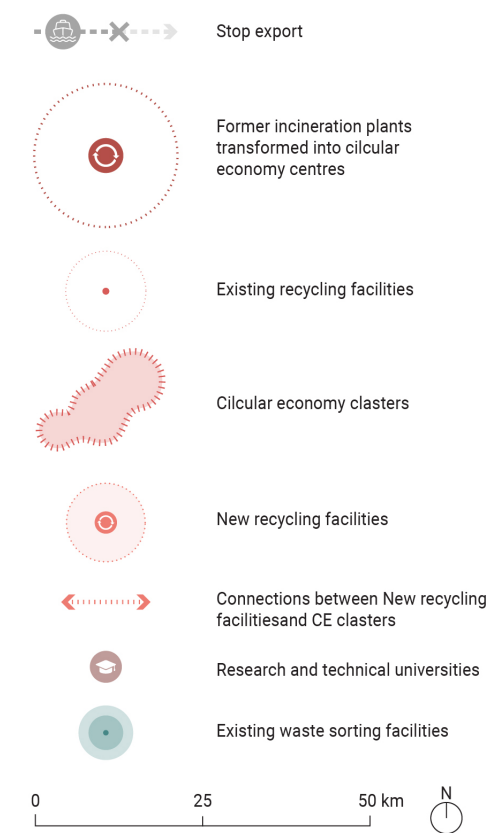
On the map of the Netherlands, we can see both old infrastructures finding a place in the new system as well as new infrastructures being added.

The old infrastructure includes spaces that have become obsolete – such as incineration plants – and can now be reused for circular economy related activities, as well as spaces that were already part of the circular economy system.

The new infrastructure takes the existing circular economy infrastructure as a base and builds and expands from there. On the map, the red blobs indicate big Circular Economy (CE) clusters. These can be seen as centres of innovation for the new economy. They include existing and new CE infrastructure, knowledge institutions, and large processing companies. By clustering them together we aim to increase cooperation and support the development of new technologies and innovative practices.

Outside of the big clusters, we have identified small cities that now lack CE infrastructure. We mapped the cities for which we expect there will be a need for such facilities in the future. The yellow arrows show that these smaller hubs are connected to the big CE clusters.

Across the whole map we show storage spaces. After all, in the circular economy diagram development shown before, storage will be an essential part of the pathway towards a fully circular economy. Additionally, the map shows various sorting locations, as these are essential to support the network of storage spaces.

Stop export

Former incineration plants transformed into cilcular economy centres

Existing recycling facilities

Cilcular economy clasters

New recycling facilities

Connections between New recycling facilitiesand CE clasters

Research and technical universities

Existing waste sorting facilities

0   25   50 km

N

Creating Chaos

Fundamentally changing people's relation to their waste and creating discomfort through shock and confrontation is something that won't be liked by most. However, we see the urgency of changing our behaviours regarding material cycles as a rightful justification of creating chaos. Within our frame of intervention we intentionally create chaos for the best of everyone. We do this out of necessity and believe that the Dutch government should take its responsibility by embracing our plan.

Frame of intervention

Our waste houses project is the facilitator of transition, and not the final goal we foresee for The Netherlands. It is a way to break the current waste system down and to accelerate the adoption of the circular economy. We do not want to continue consuming and storing it in waste houses that grow larger and larger. There must be a tipping point amidst the chaos where our project has changed the regime enough to become less necessary again. At the end of the window of transition, waste houses are repurposed and the economy is fully circular. The start date of this frame of our intervention is today. The end date is not clear, as we do not know what the future will look like in detail.

Material waste flows

The X diagram in figure 25 shows the emergence of the circular economy at the same time as the breakdown of the current waste system and irresponsible consumption. Key phasing milestones are labeled and linked with the implications they have for the transition. The frame of intervention is the key transition moment where chaos causes the behavioural changes and alterations of the system necessary as visualised in figure 26.
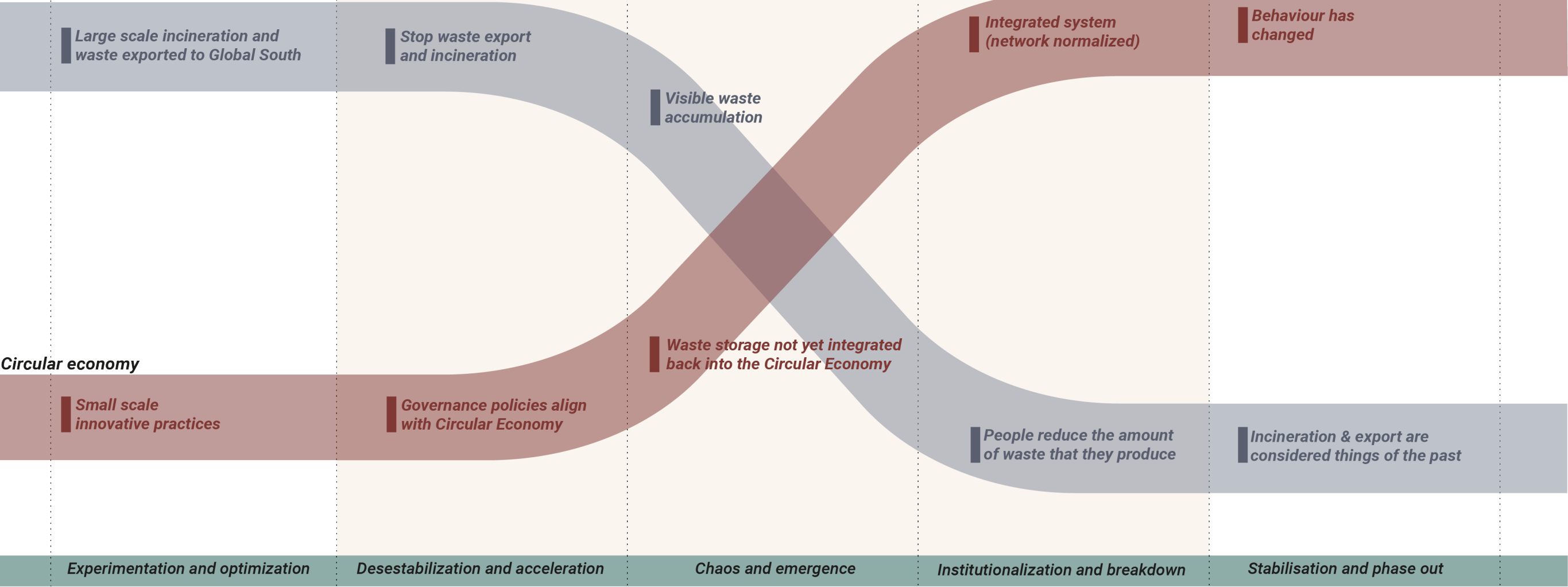

Figure 25: X-curve with our frame of intervention in time
The window of transition created through the Waste House project shows the breakdown of the current waste system and the establishment of the circular economy in relation to chaos.
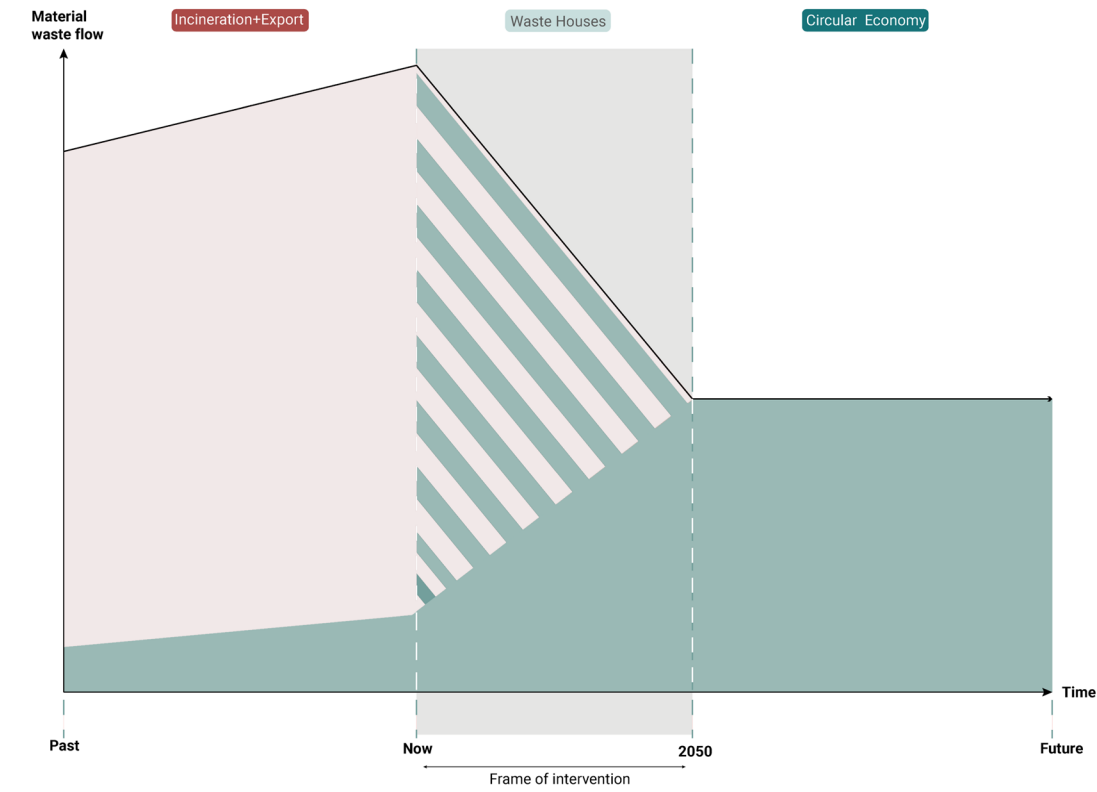
Figure 26: Visualisation of the vision
The frame of intervention with the waste house system.

Chapter 4
Strategy

Looking back to the manifesto (page 38):

'And thus we take responsibility for all our waste, and keep all of it here. Our project will from now on strategise the sorting, storage and growth of the circular economy uses for waste materials to accomodate this choice.'

Chapter content:

New waste system

Actors of the waste system

Systemic sections

Spaces in the new waste system

Space types in depth

> Collection spaces

> Sorting spaces

> Storage spaces

- *Circular economy storage*

- *Dangerous waste*

- *Bulky waste*

- *Smelly & small waste*

- *Small waste*

Space types overview

Strategic vision

New waste system

Our strategy consists of a radical new waste system without export and incineration, creating chaos and incentives for transitioning towards a fully circular economy. The system builds on the existing waste system but in many ways also changes society's relation to waste drastically.

3 stages of waste system

The system consists of three main steps: Collection, Sorting and Storage, as shown in figure 27.

Collection - In the collection stage waste produced by all actors in society is accumulated at centralised places of varying scales. This accumulation is society's first visual confrontation with the necessity to reduce its waste production.

Sorting - At the sorting stage all the waste from the collection points is sorted thoroughly and directly re-integrated back into the circular economy if that is currently possible. All other waste is sent to storage spaces.

Storage - These storage spaces are our so-called waste houses and replace all previous incineration, export and landfilling of waste. It is stored, thoroughly sorted, with the knowledge that, if not today, there will be a place for it in the circular economy of the future.

Of these three, the storage stage is the most radically different to today's waste system. However, all three steps contribute to the faster adoption of a circular economy through both practical measures and influence on society's behaviour.

Explanation of waste system

We look at the waste flow system starting from the user. Through consumption and production the user is the origin of waste. They include households and companies. Users are currently already encouraged to re-use, recycle and compost their waste. Under our waste system they will be incentivised more strongly

to do this as much as possible.
In the collection spaces visibility and personal interaction with waste is key to engage society with the waste issue. The collection points in neighborhoods and iconic public places are where actors are confronted by the quantity of waste produced and their personal contribution to this, incentivising behaviour change.

At the sorting locations waste that can currently be re-used, recycled or composted is once again separated if not done correctly by whoever threw it away. All other waste is sorted into specific categories and stored in waste houses. The whole flow system is shown in figure 28.

The waste houses are visible, shocking and confronting to society in a similar way as the collection points. However, they are at a much larger scale and illustrate the scale of the waste produced by society as a whole. They cause behavioural change through a shock effect. Additionally, they also display potentials of all those piled up materials left un-used. Over time, the potential causes the creation of start-ups, innovation and new ways of waste re-use which grow the circular economy.

With time, behaviour change causes a drastic reduction in consumer consumption and also more sustainable practices in companies such as designing products using re-used materials, designing for repair and designing for a lifetime use.

Behavioural change

Through the waste house system, society is incentivised towards the following actions. The components of possible behaviour changes are based on the circular economy diagram in chapter 1, referencing the Ellen MacArthur Foundation's Butterfly Diagram.

In order of priority:

- **Refuse**

- **Rethink**
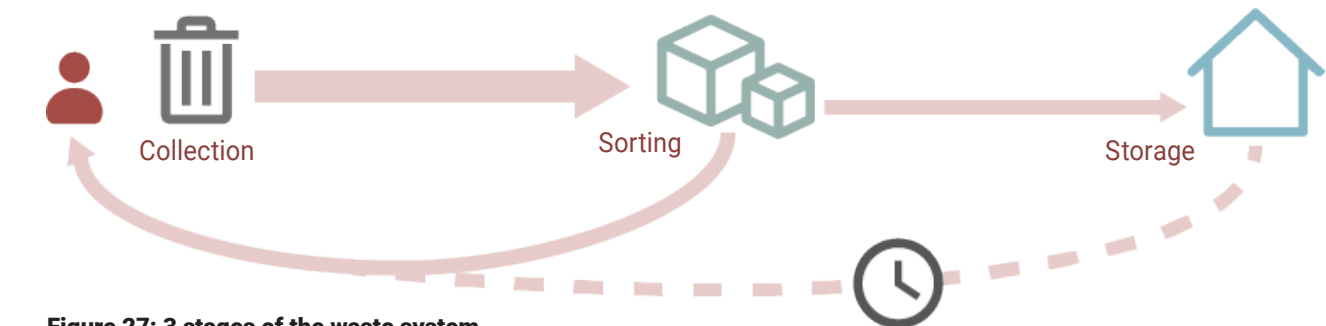
- **Re-use**

- **Remanufacture**

- **Recycle**

Figure 27: 3 stages of the waste system
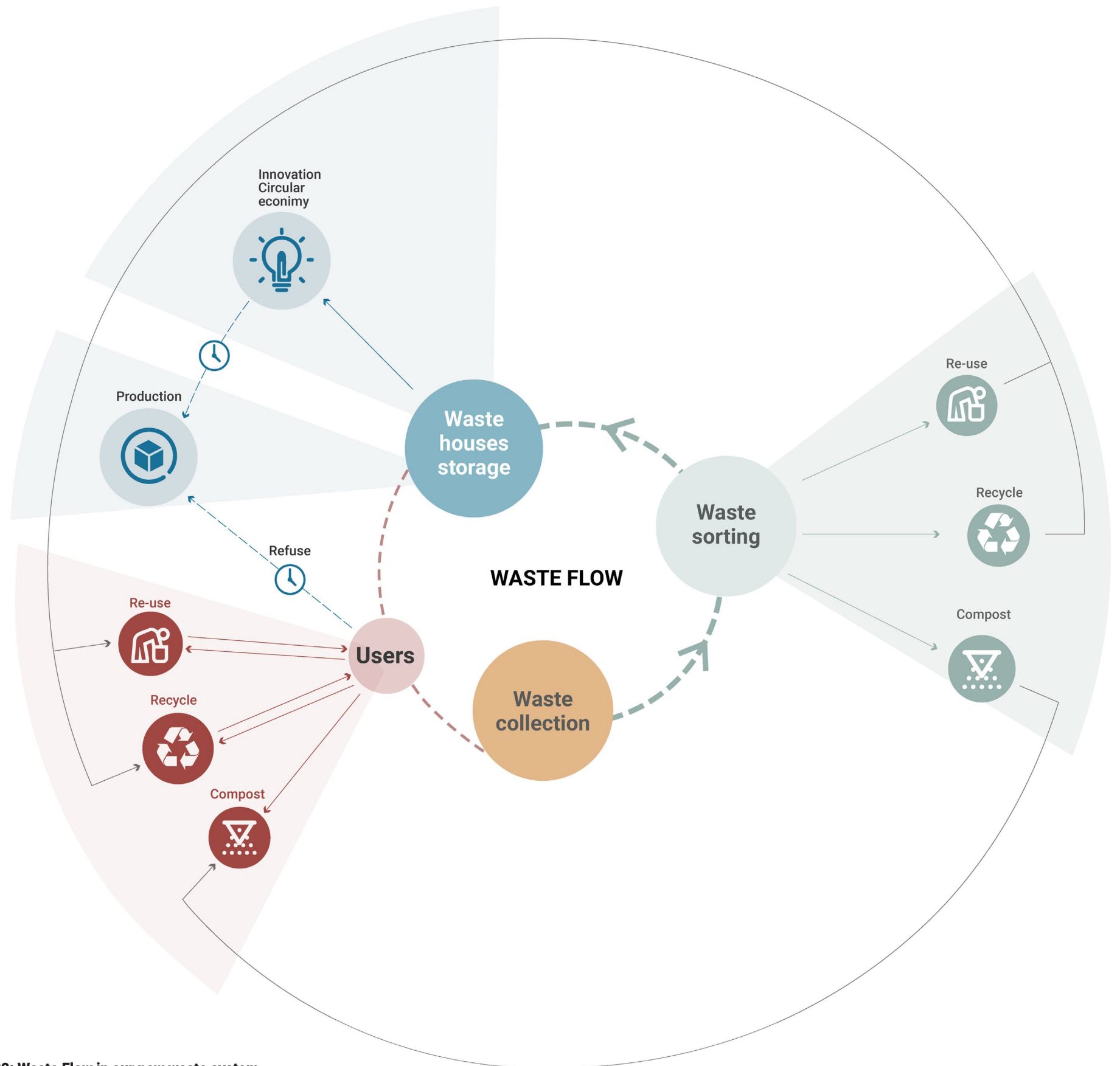A simple illustration of the flow of waste

Figure 28: Waste Flow in our new waste system
Showing the 3 steps and also where the material flows back into the circular economy

Actors of the waste system

We plotted the main actors involved in our waste house project on a Power-Interest matrix (figure 29). The actors are categorised according to whether they are private, civic or public sector actors. This reveals interesting trends about which types of actors are most interested and most powerful.

The matrix shows that very interested civic sector groups such as environmental advocate groups, Global South citizens and community initiatives often also do not have a lot of power.

Another interesting trend can be seen for the private actors. They are generally interested in short-term financial gain and most therefore do not benefit from the new waste system.

The public sector is generally powerful and often interested in the plan. However, the lower the level of government (for example, municipalities as opposed to national government), the less interested they are due to greater concerns about the practical implications of the new waste system on a local scale. High-level governance bodies such as the EU are very interested as their level of ambition is also generally higher.

From this we can conclude the following:

1) Civic society has a high interest but low power in this project

2) The private sector has varying levels of power but generally a low interest

3) Public sector actors are both powerful and generally interested

Figure 29: Matrix of actors plotted against power and interest in the waste house system
The graph is subjective, since it was plotted based on our group discussions.
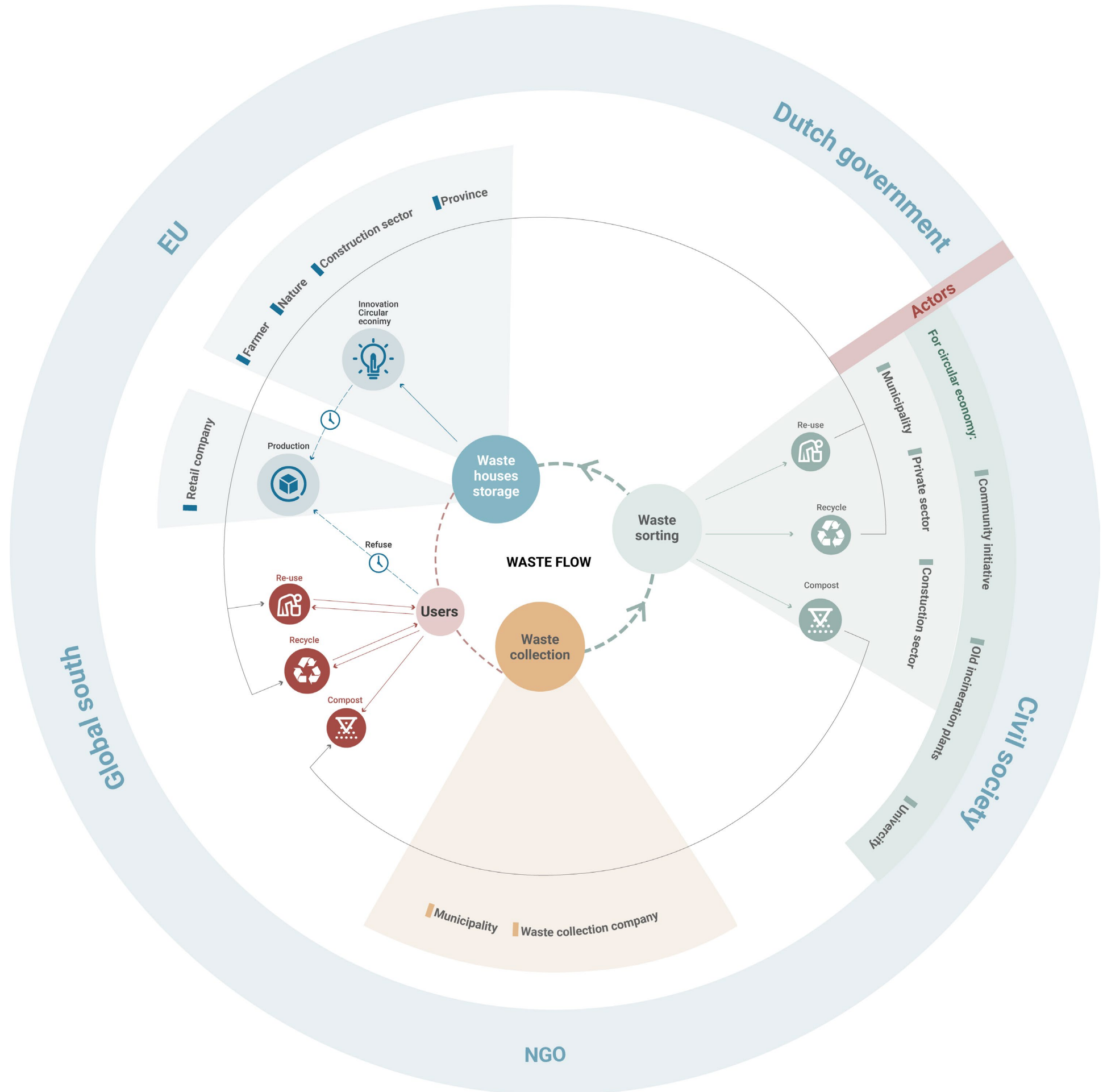
Figure 30: Relating actors to the 3 stages of the waste system
An estimation of, where in the process, the actors are operating, impacted and exerting their power mostly

Systemic sections

These sections illustrate the current waste system in the Netherlands next to the new waste management process we are proposing through storage in waste houses.

Current system

The current system shows that waste and materials are imported and through production and consumption contribute to the waste from users in the Netherlands. All the waste currently not used in the circular economy already, which would mostly mean being recycled, leaves the system through incineration and export.
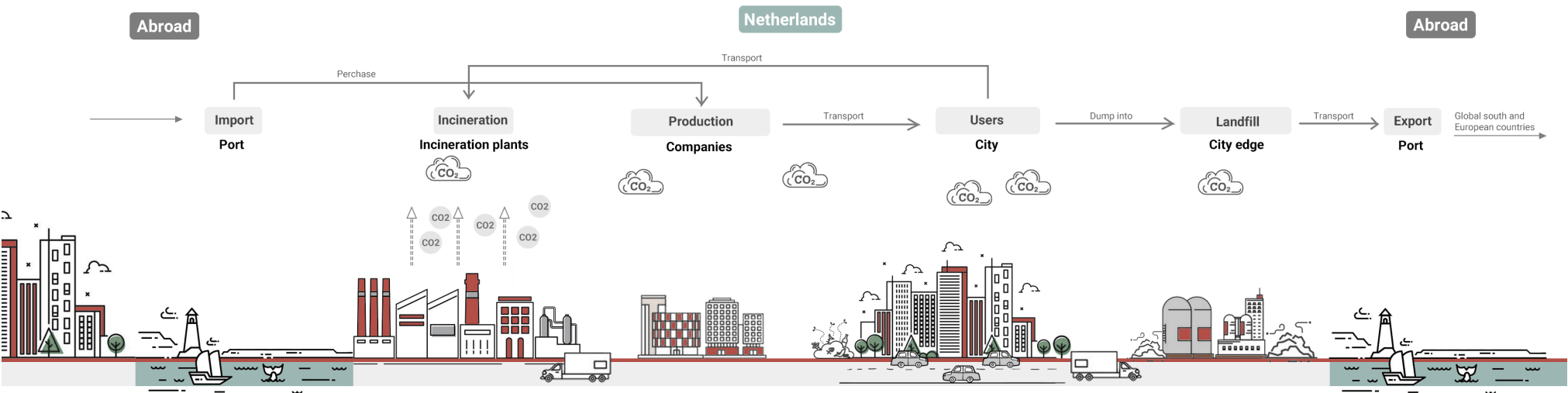
Waste house system

In our system there is no export and incineration. All waste produced is collected, sorted, integrated back into the circular economy or otherwise stored for the future. An important loop of increased innovation and searching for uses of waste links the waste back towards production and users.
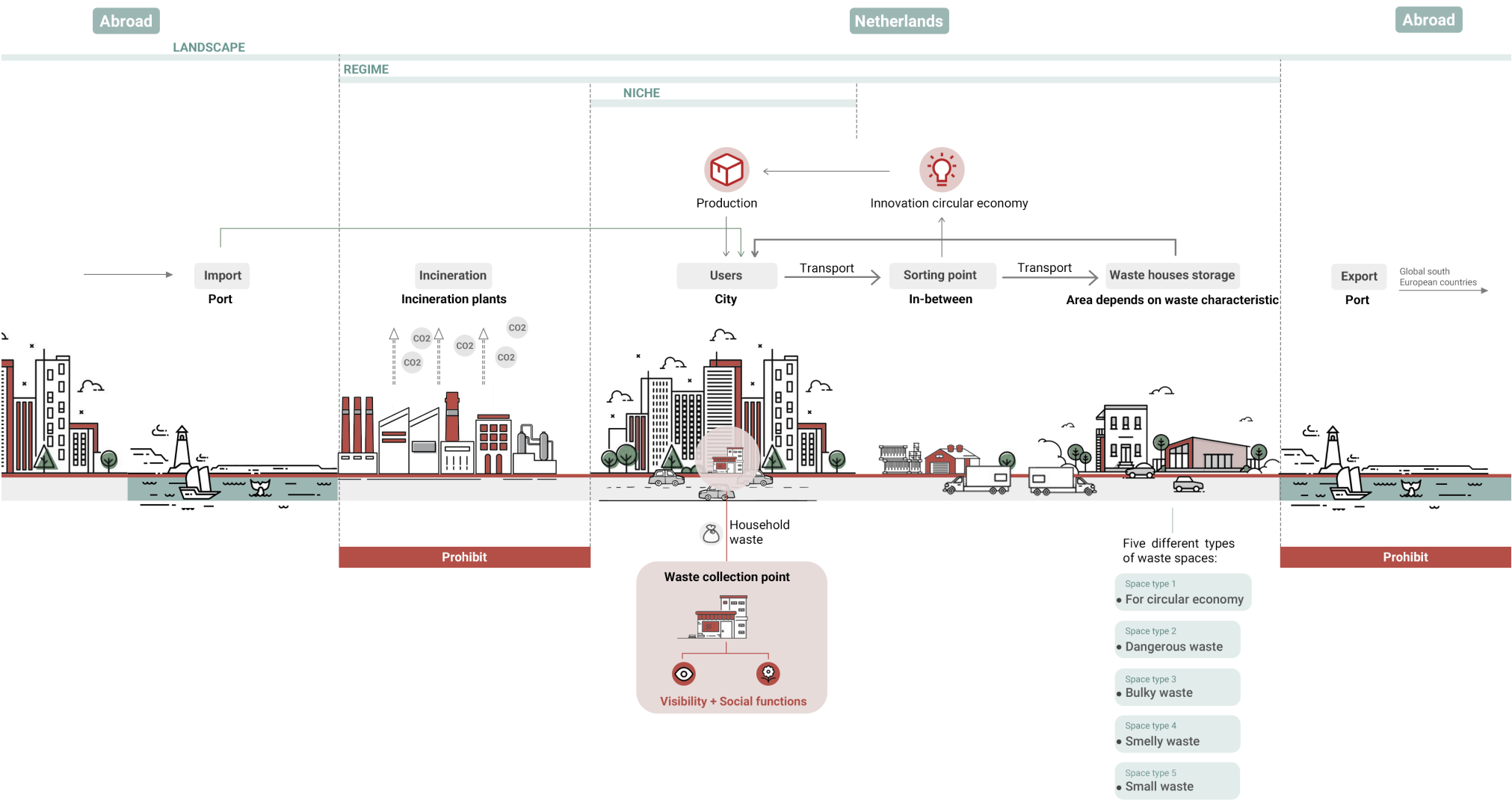
Spaces in the new waste system

This decision tree illustrates which spaces waste flows through in the new waste system, starting from the user and ending in waste houses

The 3 steps of collection, sorting and storage are shown, as well as the specific characteristics of stored waste which define the differences between the different waste houses we design.

WASTE FROM USERS	COLLECTION POINT	SORTING	STORAGE WASTE HOUSES

Join to circular economy? — Yes → **Waste house 1** circular economy — Immediately utilized and entered into the waste circular economy.

No ↓

Is it dangerous? — Yes → **Waste house 2** Dangerous waste — Dangerous waste that people can barely aproach.

No ↓

Is it bulky? — Yes → **Waste house 3** Bulky waste — Large waste, such as large furniture, which is super visible and need large space to put it in.

No ↓

Is it smelly? — Yes → **Waste house 4** Smelly waste — The waste that is super smelly and harmful to people's health.

No → **Waste house 5** Small waste — The small and not smelly waste will go to this type 5 storage space.

Space types in depth

Collection spaces

The first step in the waste system consists of collection. Collection facilities are the smallest scale in our system, and it takes place at the neighbourhood level. These spaces are practical and abundant, but will also start to serve a campaigning purpose. Their locations become more public and intertwined with daily life. People and companies have the responsibility to bring their waste to these points as waste is not collected elsewhere.

Spatial & design

1) Spread across country everywhere according to waste production level there

2) Reuse locations of current underground waste bins and add more in public locations within neighbourhoods and central city spaces

3) Waste is visible and users have to interact with it to leave it there. This creates more relatability to waste footprint

Base maps used to locate collection points:

Map that shows the growth of the 38 largest cities of the Netherlands over the past centuries. This allows us to identify the city cores, to see where collection points are essential.

Neighbourhood map, as we want to make sure that each neighbourhood has at least 1 collection point.

Base maps: City growth, neighbourhoods and population per municipality
Full maps: see appendix page 134

□ Areas where waste is collected locally

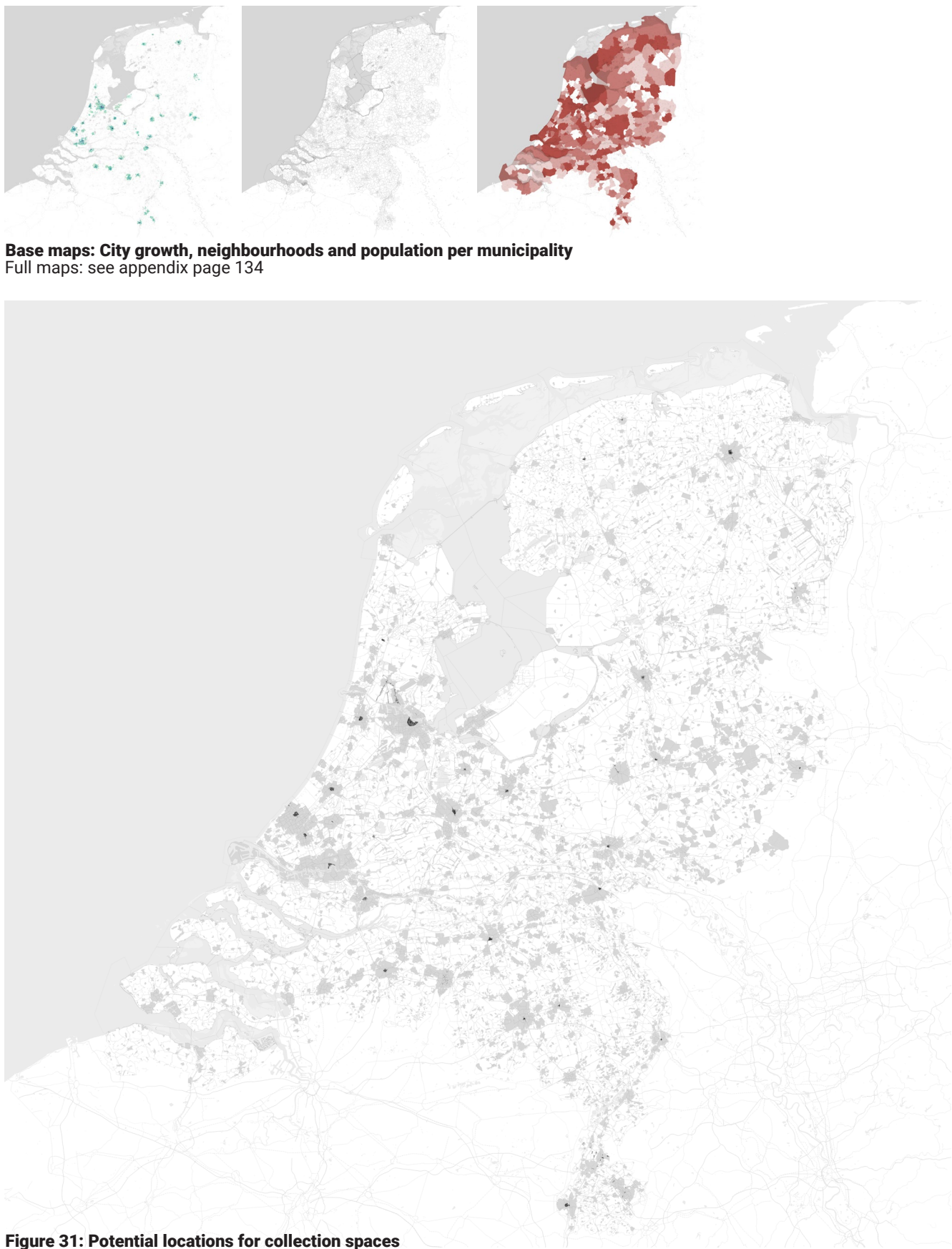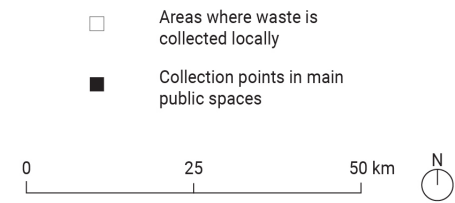■ Collection points in main public spaces

0 ———— 25 ———— 50 km
N

Figure 31: Potential locations for collection spaces

Social & strategic

1) Accessible from households by foot or bike

2) Campaign function through shock with visible waste and personal interaction, causing behavioural change

Figure 32: Impression of collection spaces & their design characteristics

Sorting spaces

The second step in the waste system consists of the sorting spaces. These are of varying sizes and locations but combine the waste from collection points and decide the destination of the waste afterwards: already into the circular economy or otherwise storage? And if storage, which type is suitable? The sorting spaces also have an important social function.

Waste is brought to the sorting facilities to be separated according to different categories. These categories are described in depth in the next section.

Spatial & design

1) On the edge of the peri-urban and cities

2) Reuse of old industrial buildings, waste management facilities or incineration infrastructure

3) Practical for sorting function but also social and transparent spaces.

Base maps used to locate sorting spaces:

Map with the existing disposal and recovery sites. This has two rationales behind it:

There is a lot of mixed waste stored in these disposal sites. Over time we can perhaps find ways to reuse the waste in there.

When we overlapped these locations with waste management infrastructure, we saw that these sites are often located close to incineration plants. In our strategy, the closed incineration plants will be re-used as innovation hubs for the circular economy. It is useful to link our new infrastructure to such hubs to stimulate innovation in reuse, remanufacturing, and recycling practices
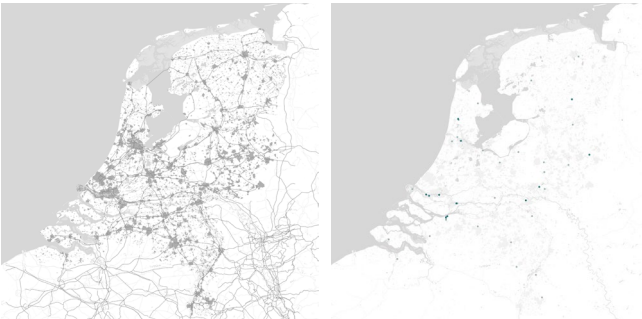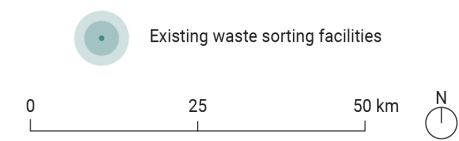
Base maps: Cities and infrastructure, and existing recycling & waste sorting locations
Full maps: see appendix page 136

● Existing waste sorting facilities

0   25   50 km   N
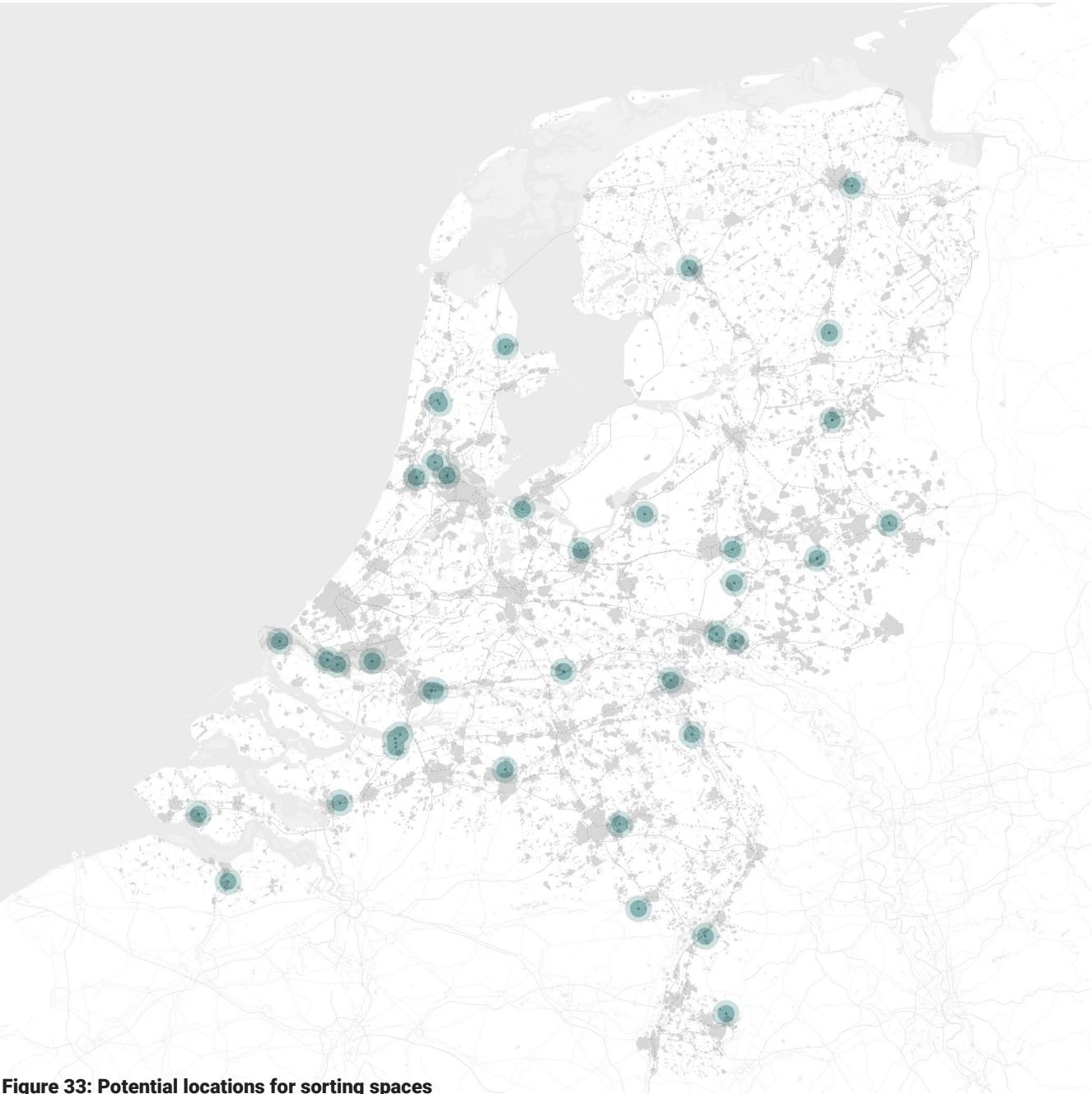
Figure 33: Potential locations for sorting spaces

Social & strategic

1) Accessible from neighbourhoods for employees and visitors

2) Social and community functions which connect people more with the circular economy by combining them with repair cafe's, research institutes, educational centres, workshop spaces, community centres etc.

Figure 34: Impression of sorting spaces & their design characteristics

Storage spaces

After sorting, the waste will be stored in different waste houses. The waste houses are categorised according to 6 categories (see decision tree, page 66).

To find appropriate locations we made a restrictions map, which includes different layers that contain spaces we do not want to touch:

Base maps used to create restriction map:

1) Layer with the Natura2000 areas. These are protected natural areas and should not be interfered with.

2) Layer with the flood prediction. Given the fact that the Netherlands lies below sea-level there is risk of flooding, both from the sea and the rivers. Waste should not be stored in places with high flood risk to prevent spreading of toxic materials or waste materials that have an adverse effect on the health of people and nature.

3) Layer with cities. Due to the big scale of the storage spaces and their visual impact, it will be more suitable and meaningful in the peri-urban area. Moreover, it is very common in the Netherlands to commute a lot between cities, increasing visibility of the storage spaces compared to when they would be located in one neighbourhood of the city where not many people venture. Additionally, it is an opportunity for smalles cities to be involved in the circular economy transition, both in terms of logistics and job opportunities.

Base maps: Natura2000 areas, flood risk and city areas
Full maps: see appendix page 137

- ▪ Natura 2000
- ▪ Cities
- ▪ Flood predictions

0   25   50 km   N
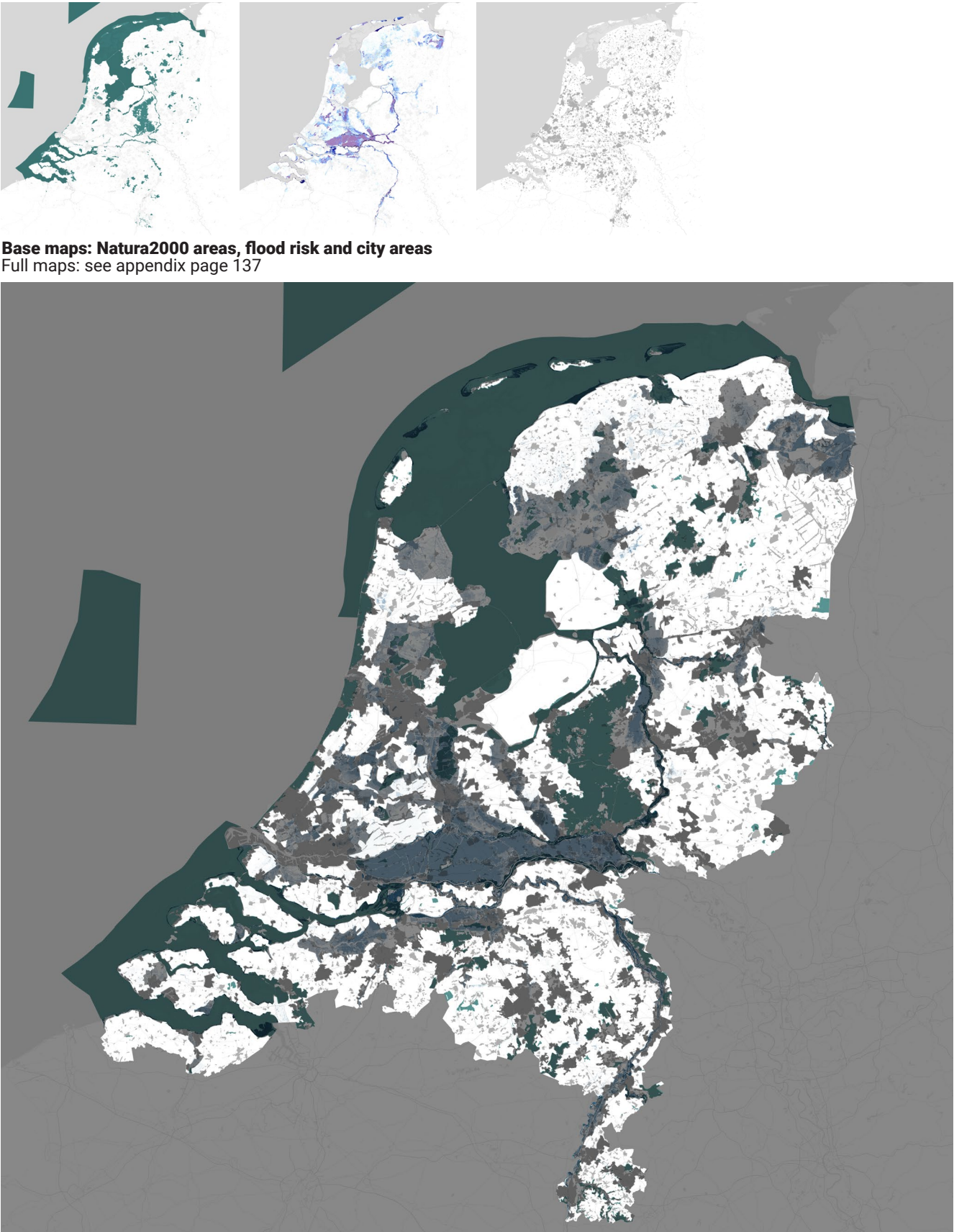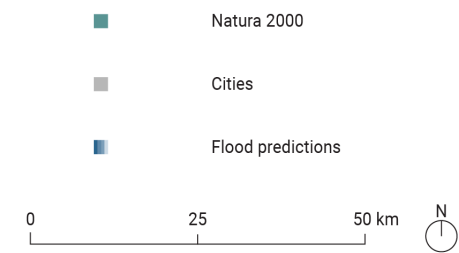
Figure 35: Restriction map, leaving blank the potential locations for sorting spaces

Waste houses in depth

The waste houses are the storage spaces at the core of our project. The piling up of waste for a circular future is the direct result of stopping all incineration and exports of waste. This storage is of a huge scale and therefore also has significant spatial impacts. Additionally, the behavioural change needed for the transition our project accelerates, is most strongly linked to the campaign power of some of the waste houses. The following pages explain the significance and details of the waste houses.

Circular economy storage

Waste House type 1

The first waste house type is storage for the circular economy in the short term. This means that there are technologies and practices already available currently for the circular processing and re-integration of this waste. However, due to a time lag or logistical issue it is not yet possible to transport the sorted waste directly to its processing or reuse location.

Base maps used to locate circ econ storage

Incineration plants. They will be used as innovation hubs for the circular economy. Given that these plants are part of the historic system, they can take a symbolic stance in our new proposition. They can be symbols for a positive, green and sustainable future, building upon the remnants of the old.

Existing recycling facilities. We chose to limit ourselves to Renewi's existing recycling locations. This is the biggest waste processing firm in the Netherlands and is active all across the country. This list of spaces could be elaborated on in the future, to include other waste firms as well.

Base maps: Existing recycling & waste processing and incineration plants
Full maps: see appendix page 138

Former incineration plants transformed into cilcular economy centres

Existing recycling facilities

New recycling facilities

0   25   50 km   N
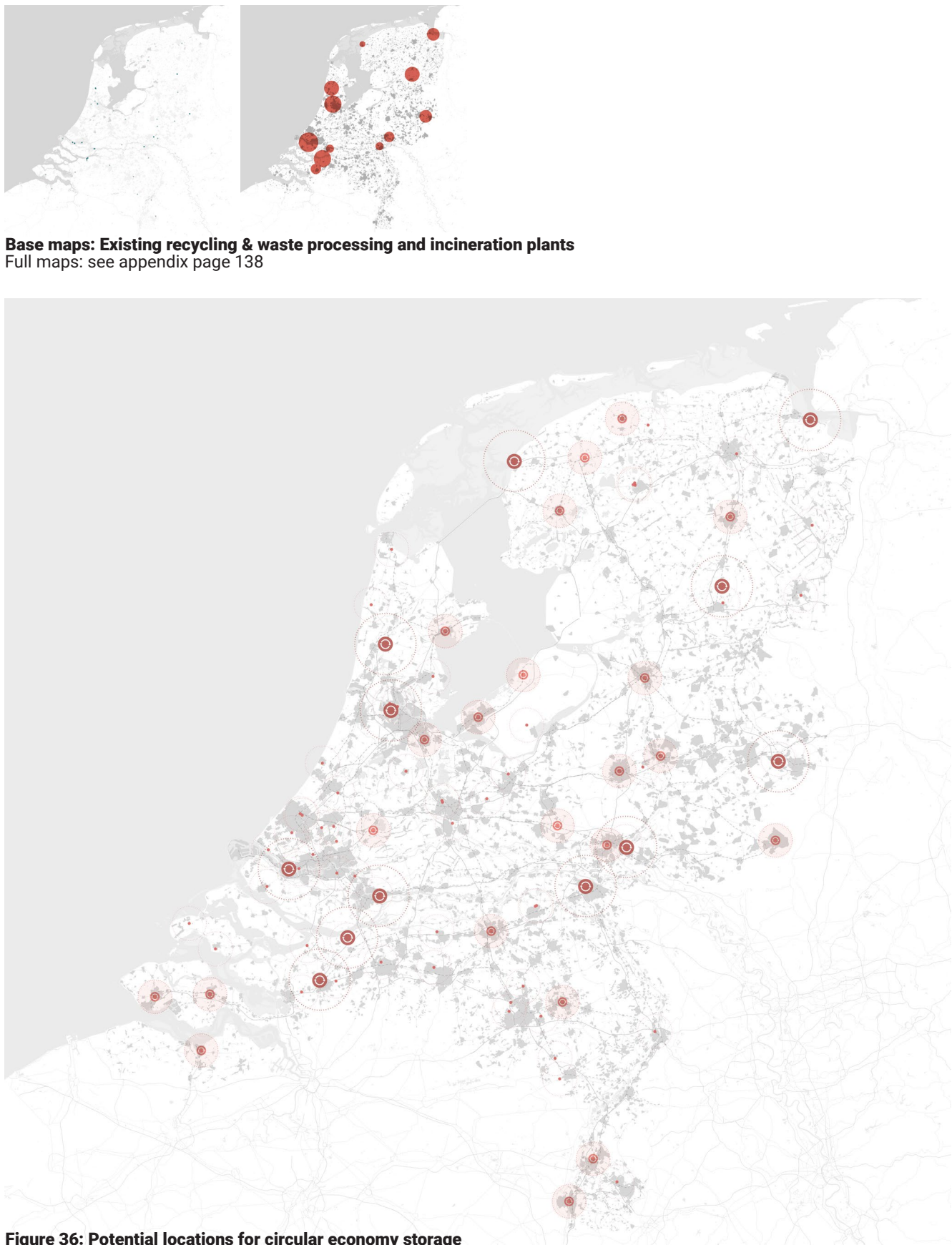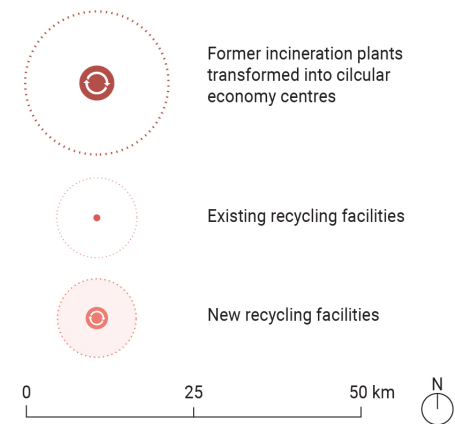
Figure 36: Potential locations for circular economy storage

Spatial & design

1) Existing recycling hubs

2) Reuse closed incineration plants to serve as iconic symbols where the old and new system meet

3) These spaces occur at three scales: the neighbourhood, the city, and at large industrial sites in the peri-urban

Social & strategic

1) Where possible add research function, link to universities

2) Where possible add local opportunities for jobs, learning or social interactions

Figure 37: Impression of circular economy storages & their design characteristics

Dangerous waste

Waste House type 2

The second waste house type is the storage of dangerous waste. Due to qualities such as toxicity, radioactivity, being a biohazard or other extreme condition, people and nature need to be protected from contact with the waste. However, dangerous waste also needs to be stored for re-integration in the circular economy of the future.

Spatial & design

1) Store far away from people and nature to prevent contact with the material: unreachable, closed, and safe

2) Impermeable soil and low flood risk

Base maps used to locate dangerous waste

Existing infrastructure that can be used for storing dangerous waste is mapped and includes the following elements: forts; landfills, old mines. Criteria are that these spaces can be closed off to their surroundings such that no risk is posed for people and nature.

Potential places for new storage spaces include places where subsidence is low, and places that are located nearby roads that currently transport hazardous waste. New storage spaces for hazardous waste should be outside of the nature network, and not on top of groundwater protection areas.
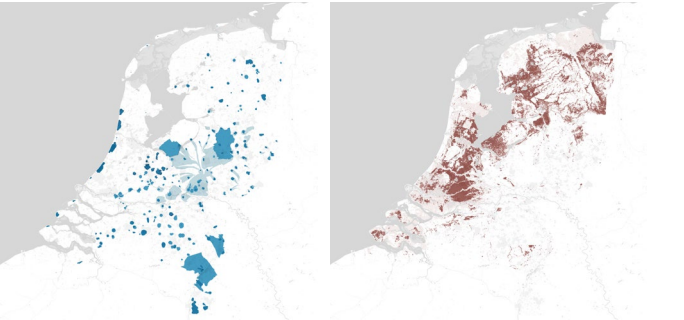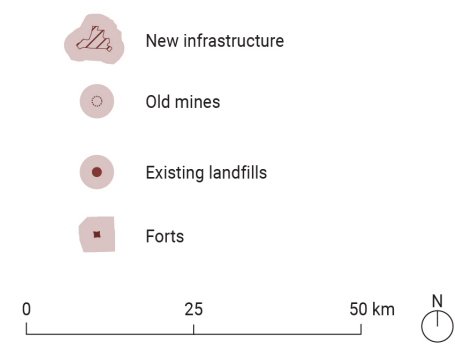
Base maps: Groundwater protection areas and soil subsidence.
Full maps: see appendix page 139

New infrastructure

Old mines

Existing landfills

Forts

0   25   50 km   N
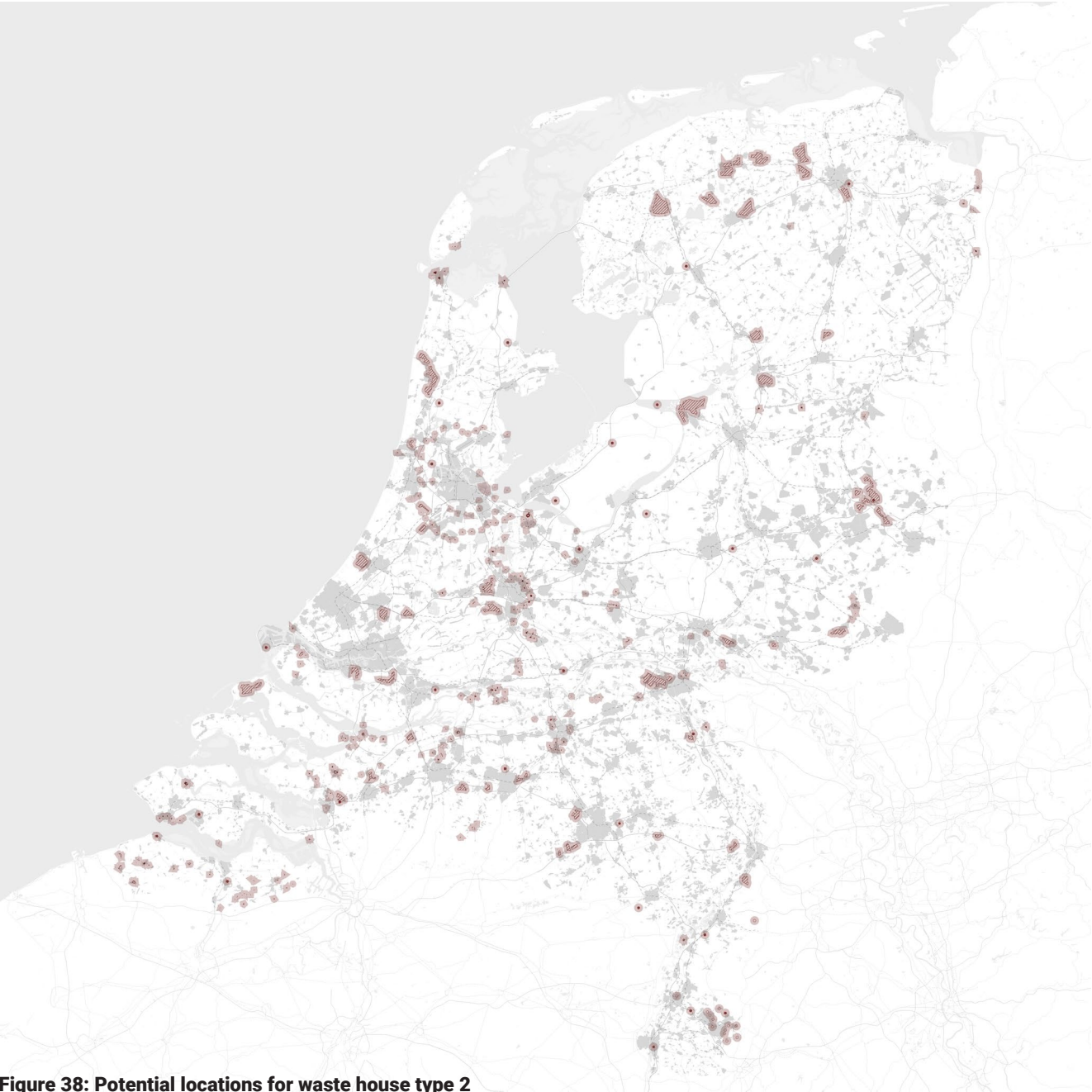
Figure 38: Potential locations for waste house type 2

Social & strategic

1) In specific cases (e.g. historic bunkers) they can be integrated with used spaces for awareness strategies

2) Take account of national security and provincial responsibilities

Figure 39: Impression of type 2 waste houses & their design characteristics

Bulky waste

Waste House type 3

The third waste house type contains waste that consists of large components after being sorted. For example, this could include car parts, machines, building materials, furniture etc.

Spatial & Design

1) Clearly visible from a distance, large in size

2) Visible confrontation with waste

3) Located near infrastructure or iconic, loved and heritage locations

Social & Strategic

1) Campaign function and shock effect through size and contrast with (loved) surroundings

Base maps used to locate bulky waste

Popular tourist destinations are suitable to place the bulky waste to increase exposure and create a large contrast between the storage space and its surroundings.

Experienced value of the landscape is used to find places where people rank the value of the landscape as being high. The assumption is that the higher value is assigned, the more people visit this space thus increasing exposure and visibility.

Tree height map, to pick flat areas with little trees, such that the storage spaces are visible from a large distance and where visibility is highest.

Bulky waste storage

0   25   50 km   N
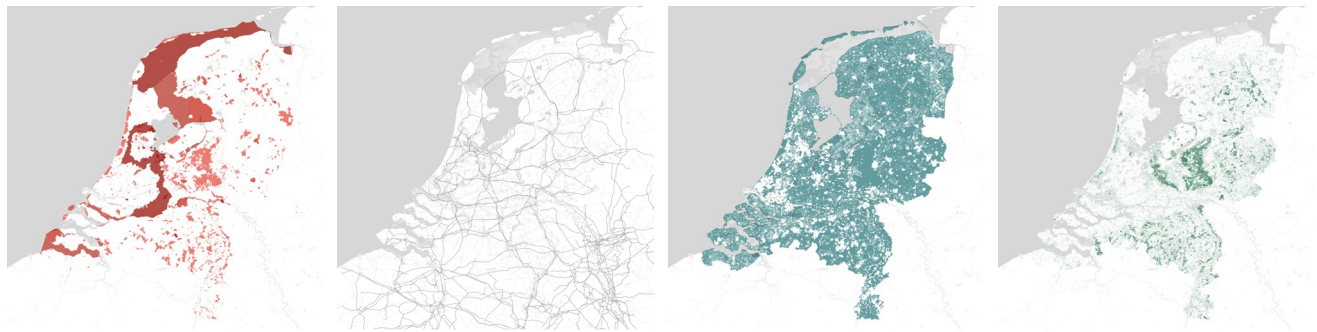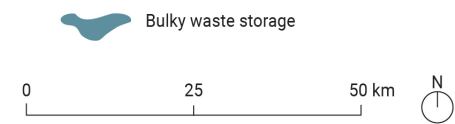
Base maps: Protected heritage, transport infrastructure, experiential value of the landscape and tree height
Full maps: see appendix page 140
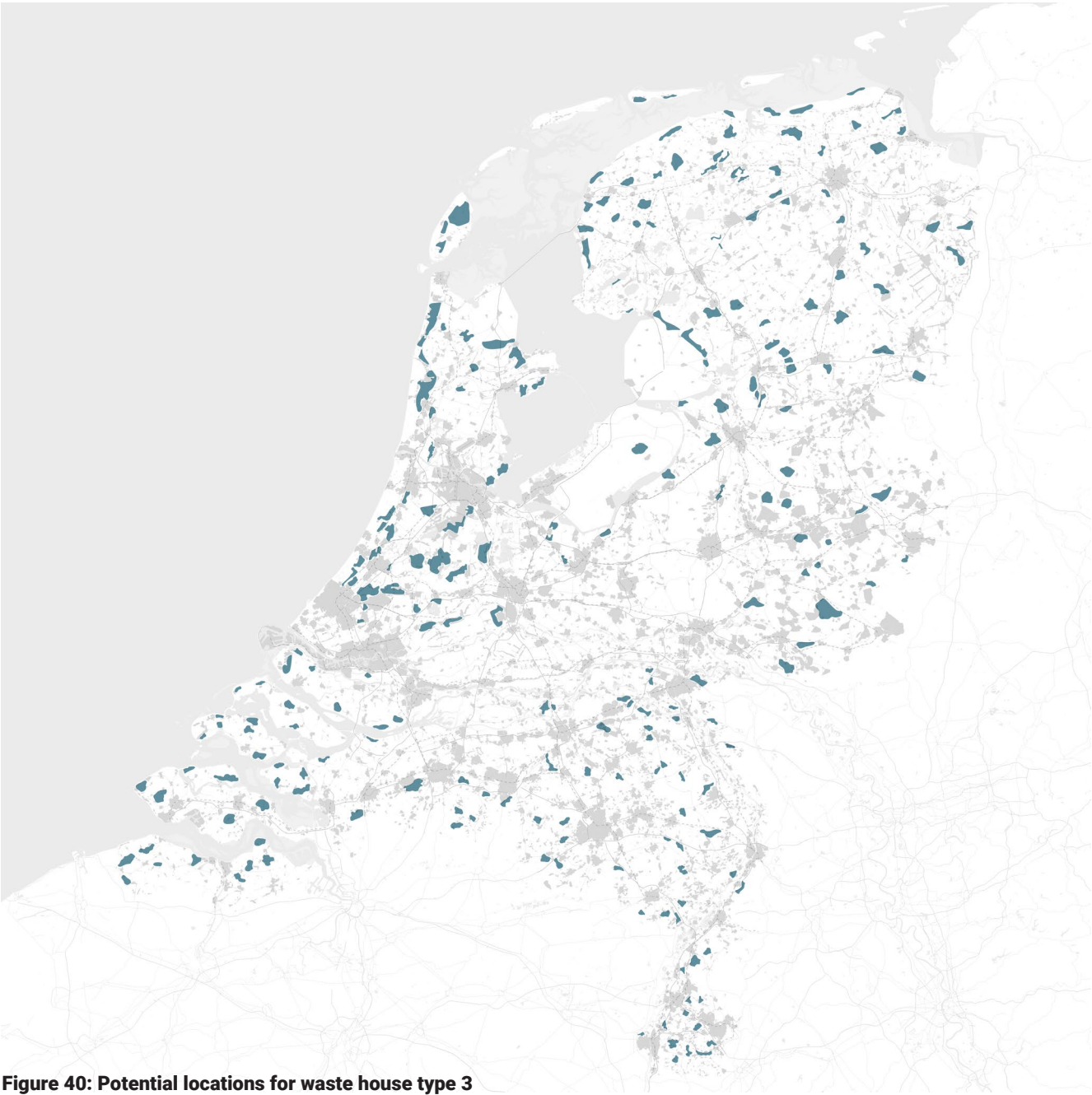
Figure 40: Potential locations for waste house type 3

Figure 41: Impression of type 3 waste houses & their design characteristics

Smelly & small waste

Waste House type 4

The fourth waste house type is smelly waste. The spatial element of this waste house is quite complex since bad smell can be bad for public health and also affect people closer to the waste house more than others. However, they can still have a campaigning shock and discomfort function if placed correctly according to the points summarised below.

Spatial & Design:

1) Close to highways and trains (temporary exposure) where air quality is already low

2) Choose busy routes or intersections

3) Can vary in size

4) Placed according to dominant wind direction

Base maps used to locate smelly waste

Wind speed and wind direction are mapped to see where and how far the smell travels. This to include a just component and make sure that some people are not affected by the smell more than others.

Highways are mapped to ensure equal exposure (not permanent or long term)

Air quality map, which shows that the air quality around the roads is already low

Base maps: Nitrogen dioxide air quality, cities and infrastructure and wind speed
Full maps: see appendix page 142

Smelly & small waste storage

0   25   50 km   N
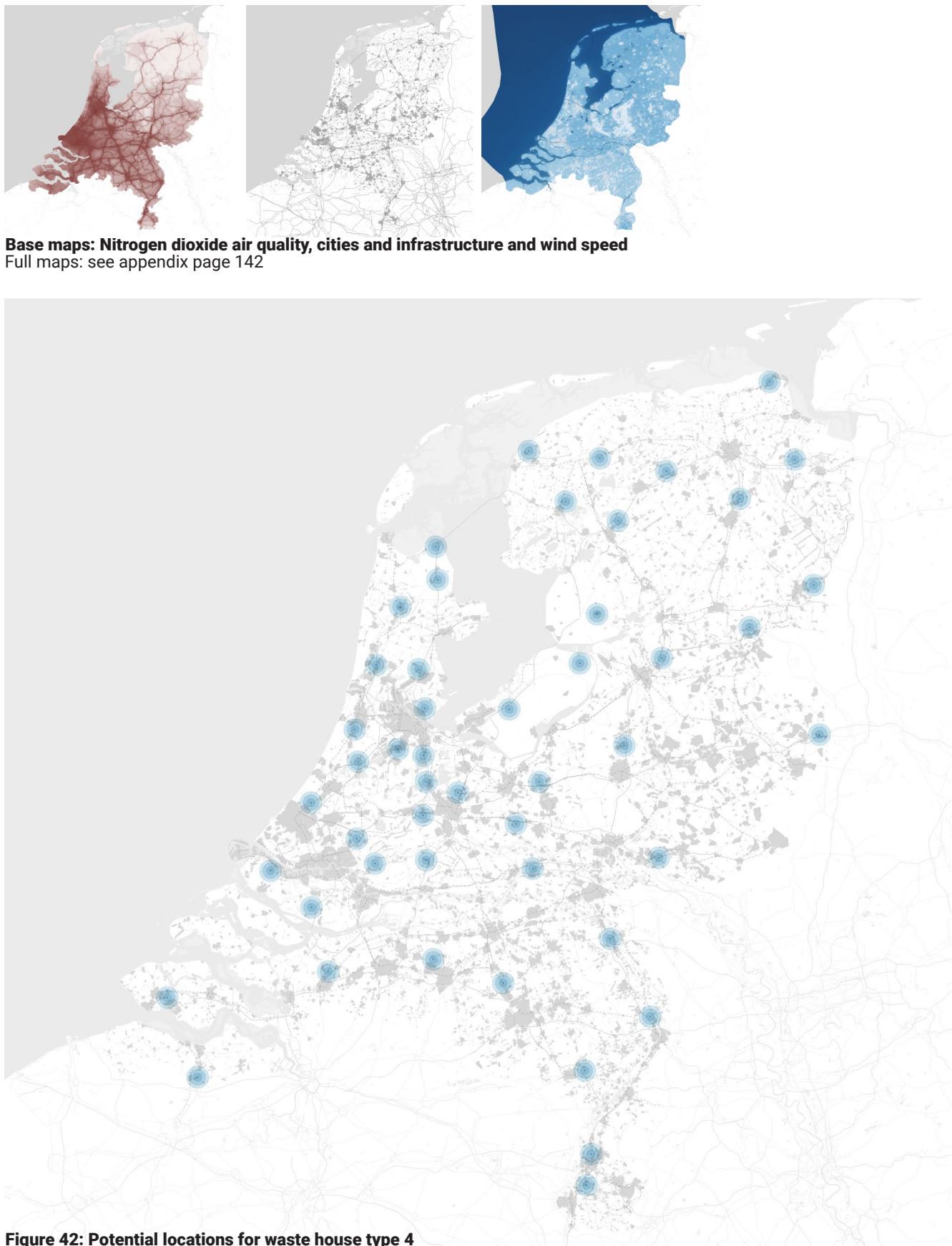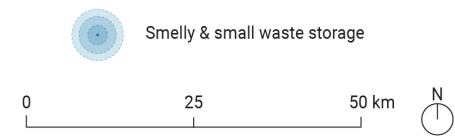
Figure 42: Potential locations for waste house type 4

Social & Strategic

1) Shock through signs and discomfort of smell

2) Smell along highways and train lines ensure everyone is affected equally, as opposed to some neighbourhoods more than others.

Figure 43: Impression of type 4 waste houses & their design characteristics

Small waste

Waste House type 5

The fourth waste house type is smelly waste. The spatial element of this waste house is quite complex since bad smell can be bad for public health and also affect people closer to the waste house more than others. However, they can still have a campaigning shock and discomfort function if placed correctly according to the points summarised below.

Spatial & Design:

1) Waste should be recognizable from a short distance for personal association with stored waste

2) Large buildings following the side of the road and railways in long lines

3) Located along busy routes and congested places to increase visibility and exposure time

Base maps used to locate small waste

Along main infrastructure. The busiest streets are most interesting, as there is a lot of congestion. In relation to the timeframe: first build along the roads where there is most congestion, to increase exposure time such that people can recognize the small pieces of waste that lies in storage.

Big warehouses. This infrastructure can be reused as waste house, as they are often located in strategic places along highways.

Small waste storage

0   25   50 km

N
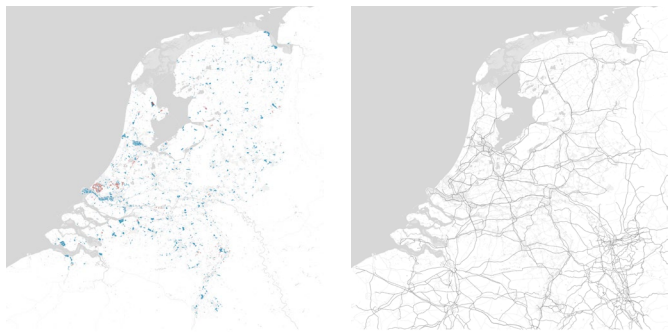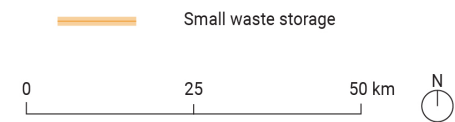
Base maps: Large scale infrastructure along roads and transport infrastructure
Full map: see appendix page 144
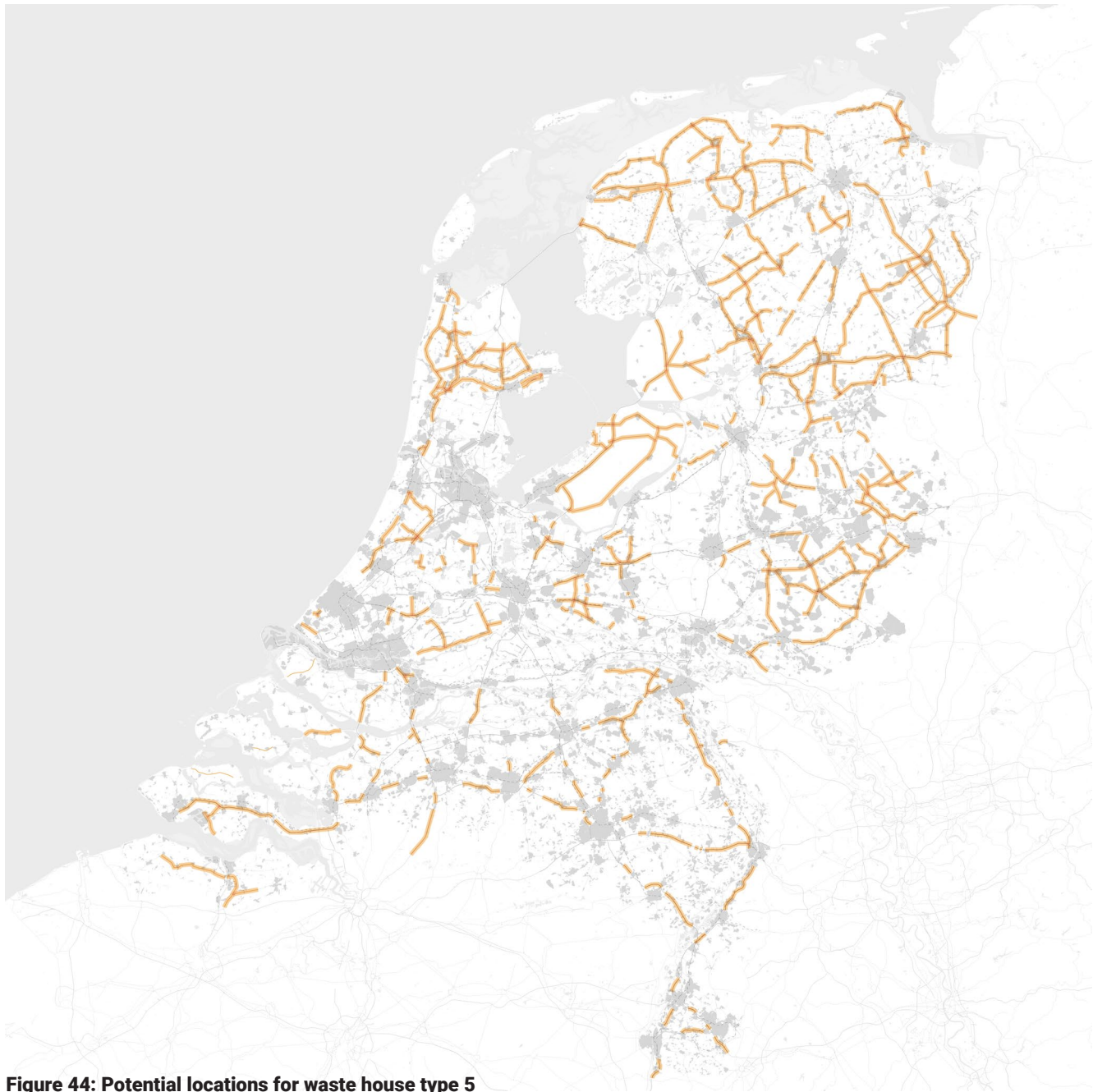
Figure 44: Potential locations for waste house type 5

Social & Strategic

1) Billboard method to highlight shared responsibility

2) Shock effect through size and relatability of visible waste
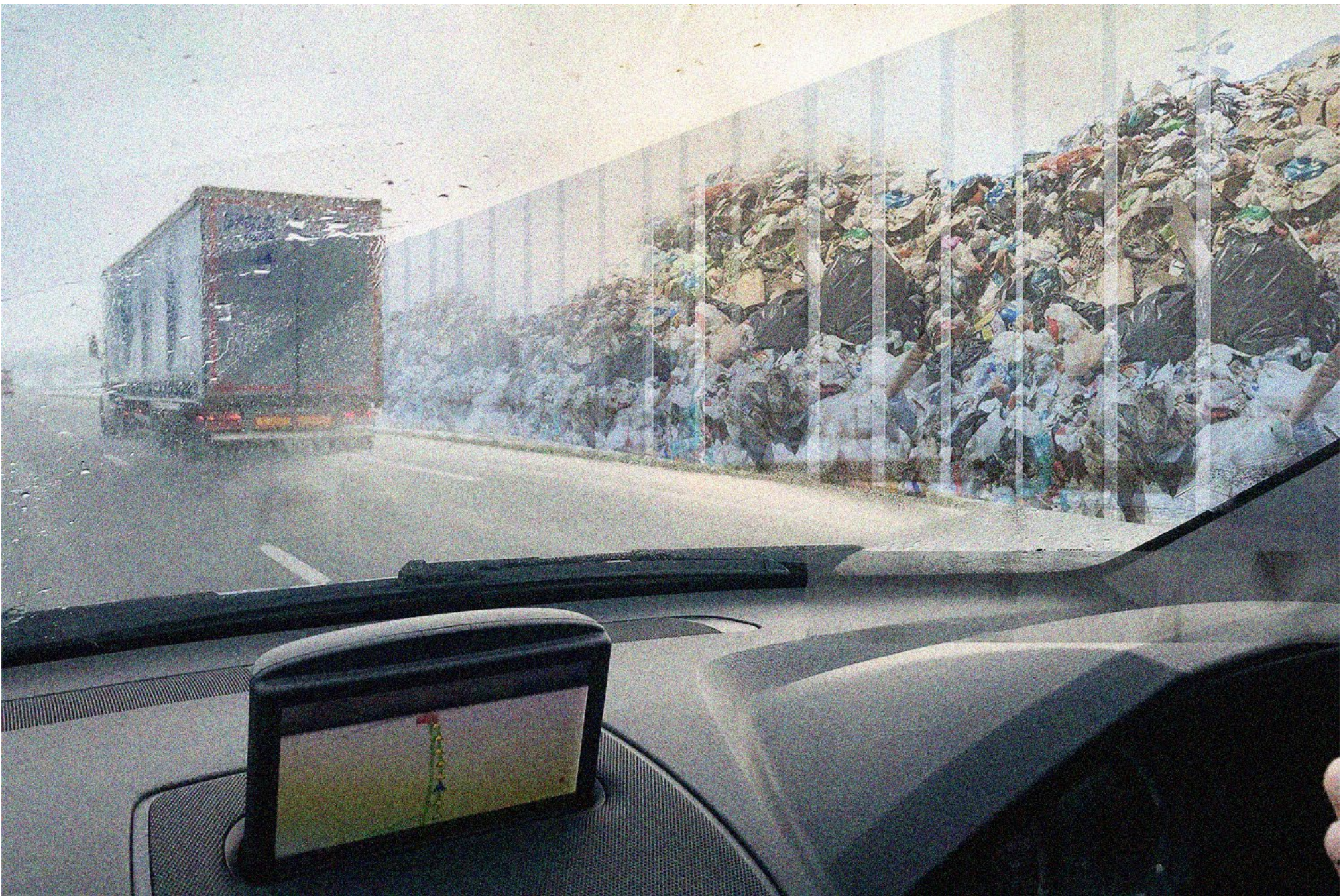
Figure 45: Impression of type 5 waste houses & their design characteristics

Space Types Overview

Our new waste system consists of three main steps with correlating space types. These are collection, sorting and storage. In the sorting stage, all waste is chategorised into 5 distinct categories. As a result, we need 5 different waste house types for storage of all the waste. Each waste house has its own stakeholder, spatial and design logics

| Space types	Sub-categories	Stakeholders	Behaviour Change	Spatial Characteristics	Strategic Places	Size	Design Characteristics
1) Collection		1) Citizens & municipalities 2) Specifically in neighbourhoods: households 3) Companies that produce waste 4) Future collection companies 5) Land owners/people close to collection	1) Shock effect 2) Confrontational through interaction 3) Personally relatable through visibility 4) Because of it being a burden for companies	1) Scattered across all urban areas 2) Neighbourhoods for households 3) Central city locations for the public realm 4) Not hidden away, but a part of daily life	1) Loved local places such as playgrounds, parks, fields, shopping centres, in front of schools, community centres, ponds etc. 2) Loved & iconic city squares, monuments, promenades, shopping centres etc.	1) Varies according to context 2) Larger in more public/iconic spaces	1) Transparency 2) Waste visibility very important 3) Personal interaction with waste 4) Temporary smell 5) Shocking
2) Sorting		1) Sorting companies 2) Municipalities & provinces 3) Start-ups 4) Social/community initiatives	1) Seeing opportunities in waste 2) Integration into social system through work and community initiatives	1) Peri-urban, urban edges 2) Easily accessible from urban communities for work and engagement 3) Old industrial infrastructure 4) Old waste management infrastructure	1) Old waste/industry hubs 2) Close to road, water and rail for logistics 3) Old incineration plants 4) Intertwined with urban development projects	1) Size will vary	1) Practical 2) Transparency showing waste process
3) Storage	Waste House types	Stakeholders	Behaviour Change	Spatial Characteristics	Strategic Places	Size	Design Characteristics
	1) Circular Economy	1) People with future jobs in circular economy 2) Municipalities 3) Research institutes & universities 4) Recycling companies	1) Working in the circular economy 2) Seeing opportunities in waste	1) Separated according to specific material and level of decomposition 2) Existing recycling hubs 3) Accesible for workers & social functions 4) Accesible for logistics 5) Close to research institutes	1) Old incineration plants to make them monuments of the past system 2) Visible and well know places 3) Old industrial sites	1) Entire industrial site 2) To cater for entire city 3) To cater for specific neighbourhoods 4) Size will vary	1) Symbols of old industry/waste system 2) Transparency
	2) Dangerous	1) The state, provinces, national security agencies 2) People living and working closeby 3) Hospitals 4) Ports	Not very significant/relevant	1) Separated according to specific material and level of decomposition 2) Safely away from significant concentrations of people, water or nature 3) Preferably impermeable soil	1) Old mines 2) Bunkers 3) Low flood danger	1) Size will vary	1) Not reachable 2) Closed 3) Safe
	3) Bulky	1) National government - concern for image 2) Locals and land owners 3) Tourists 4) Everyone who passes it! 5) The provinces 6) Manufacturing companies	1) Shock effect 2) Companies inspired and confronted to change 3) Large informative signs explaining it	1) Separated according to specific material and level of decomposition 2) Visible from distance 3) In the view of iconic/loved places 4) Visible from infrastructure like roads and trains	1) Campaign places (loved & iconic) 2) Possibly even seen from the plane 3) Important for tourists 4) Local importance	1) Huge	1) Huge 2) Very transparent 3) Waste visibility most important characteristic
	4) Smelly & Small	1) National government 2) Provinces 3) All people closeby and passing it	1) Shock effect 2) Confrontational through discomfort 3) Large informative signs explaining it	1) Separated according to specific material and level of decomposition 2) Peri-urban - safe enough distance from cities 3) Close to highways and trains 4) Preferably congested areas	1) Busy routes between cities 2) Areas with existing poor air quality 3) Congested areas	1) Probably large but size will vary according to location. Most importantly, smell is created	1) Chimneys/smell exhaust pipes 2) Strategic choice of smell radius and taking into account wind directions
	5) Small	1) National government 2) Provinces 3) All people closeby and passing it	1) Shock effect 2) Personally relatable through visibility 3) Large informative signs explaining it	1) Separated according to specific material and level of decomposition 2) Visible from closeby from car or train 3) Preferably in congested areas	1) Busy routes between cities 2) Congested areas	1) Large 2) Long	1) Very large 2) Linear along infrastructure routes 3) Very transparent 4) Waste visibility most important characteristic

Strategic Vision

The strategic vision map is an elaboration of the vision map shown before (page 54). It now includes more specific information on all the space categories that have been discussed above – collection, sorting, and all the different storage waste houses.

Important to note is that this is a potentials map, which shows all the potential locations for each space type. We will not build everything, but this is the maximum number of spaces that we can use for each purpose.

To better clarify all the information that this strategic vision map contains, we will zoom into four focus areas. We picked these areas because 1) each location displays all the different space types, and 2) they are each very different in character which allows us to show how our system can be put to use in different situations and scenarios.

We will zoom into Rotterdam Port City, Loved Places, the City Gate, and the Autonomous City.

Preview of zoom-in areas
Detailed explanation and maps are in the next chapter

Collection points in main public spaces

Existing waste sorting facilities

Former incineration plants transformed into cilcular economy centres

Existing recycling facilities

New recycling facilities

Dangerous waste storage

Bulky waste storage

Smelly & small waste storage

Small waste storage

0   25   50 km

N
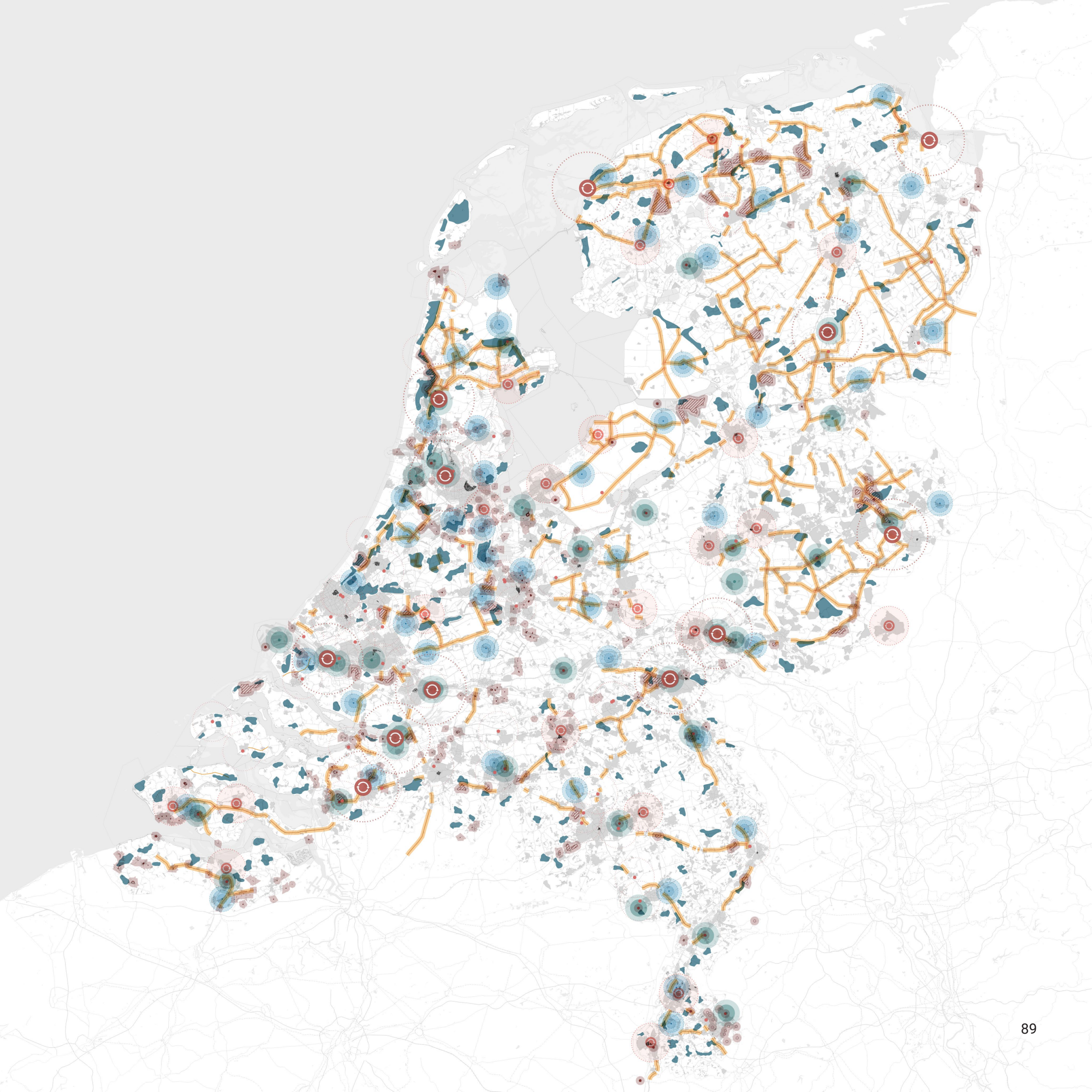
Chapter 5

Focus areas

Chapter content:

Zoom-ins introduction

Each of the zoom-ins can be complex and overwhelming to understand. Here we will explain the basic system that is at the base of each of them to increase legibility.

Inside the cities, the small dots indicate local collection points. From there, waste is transported to the sorting facilities located at the edge of the city or in the peri-urban. In line with the principle of industrial responsibility and the polluter pays, industry itself is responsible for its own waste collection and will bring the waste directly to the sorting facilities. Waste can travel either by road or by water. After sorting, it is stored in the different storage spaces.

Collection points in main public spaces

Local waste collection

Sorting spaces
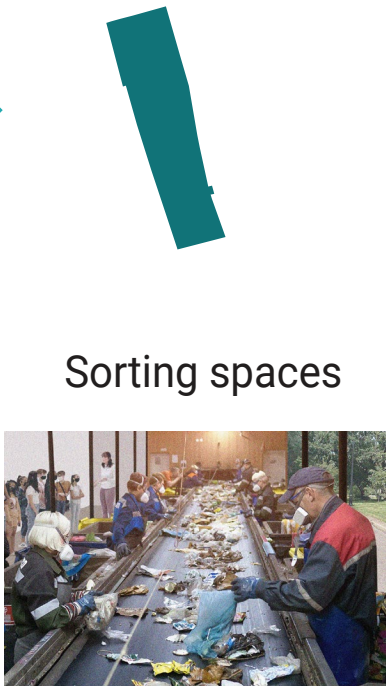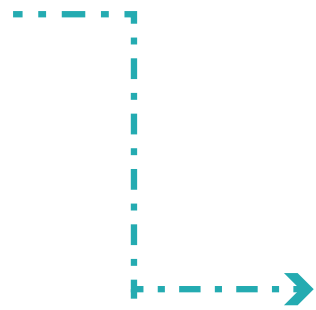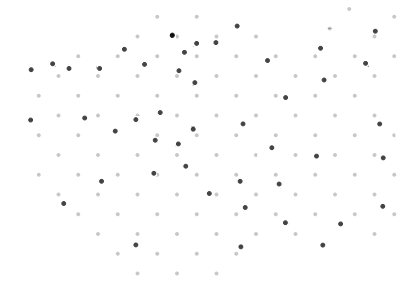
Circular economy facilities
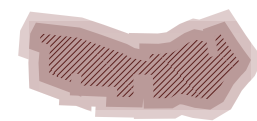
Dangerous waste storage

Bulky waste storage

Smelly and small waste storage
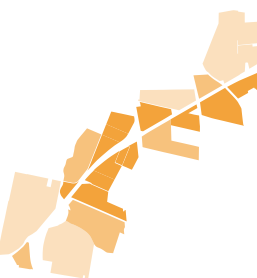
Small waste storage

Figure 46: Explanation of map attributes for zoom-ins

Rotterdam port city

The port of Rotterdam is one of the biggest ports in Europe. It is a place where several big cities, industries, universities, productive agricultural lands, and both waterbodies and big infrastructure comes together. This makes it an interesting example of showing how all the elements of the system work together to form a functioning whole.

The map shows an old incineration plant that is now used as circular economy hub. This hub is closely connected to knowledge institutes, which include the Technical University in Delft and the Erasmus University in Rotterdam. Some of the companies in the port that used to be responsible for exporting waste are now repurposed to serve in the circular economy network. This change brings along new job opportunities for the people living in the surrounding villages and cities.

In the cities, there are collection facilities, sorting is located at the city edge and close to industries. Waste is transported by road and water.

Actors

	Power get on board	Interest: proponent involve	Interest: opponent convince	Who's behaviour is changed target
Province of South-Holland	top-down control and influence	circular economy ambitions	complex mediating process	
Municipalities	responsibility for local waste management	circular economy ambitions	complex mediating process	
National Government	top-down decisionmaking power	circular economy ambitions	complex mediating process	changing long-term vision and goals
Incineration plant	centralised industry, few big companies		their industry will be phased out	
Export companies	big companies, little transparency		their industry will be phased out	
Industries in port	landowners			should take responsibility for waste production and collection
Greenhouse companies	landowners		some need to give up space for storage	
Landowners new locations	landowners	depends on the reward/compensation	depends on the reward/compensation	
Knowledge Institutes		innovation and research		
Residents	voting duty and right	a world that is cleaner and more just	not in my backyard	change consumption patterns

Weight
1.
2.
3.

Collaboration CE with universities

Job opportunities

Collection

Waste distribution

Railway and roads

Major and minor traffic congestion

View

Collection points in main public spaces

Local waste collection

Industries and possible CE

Sorting facilities

Close connection between CE and sorting facilitites

Former incineration plants transformed into cilcular economy centres

Recyclable facilites

Dangerous waste storage

Bulky waste storage

Smelly and small waste storage

Small waste storage

0   2.5   5 km
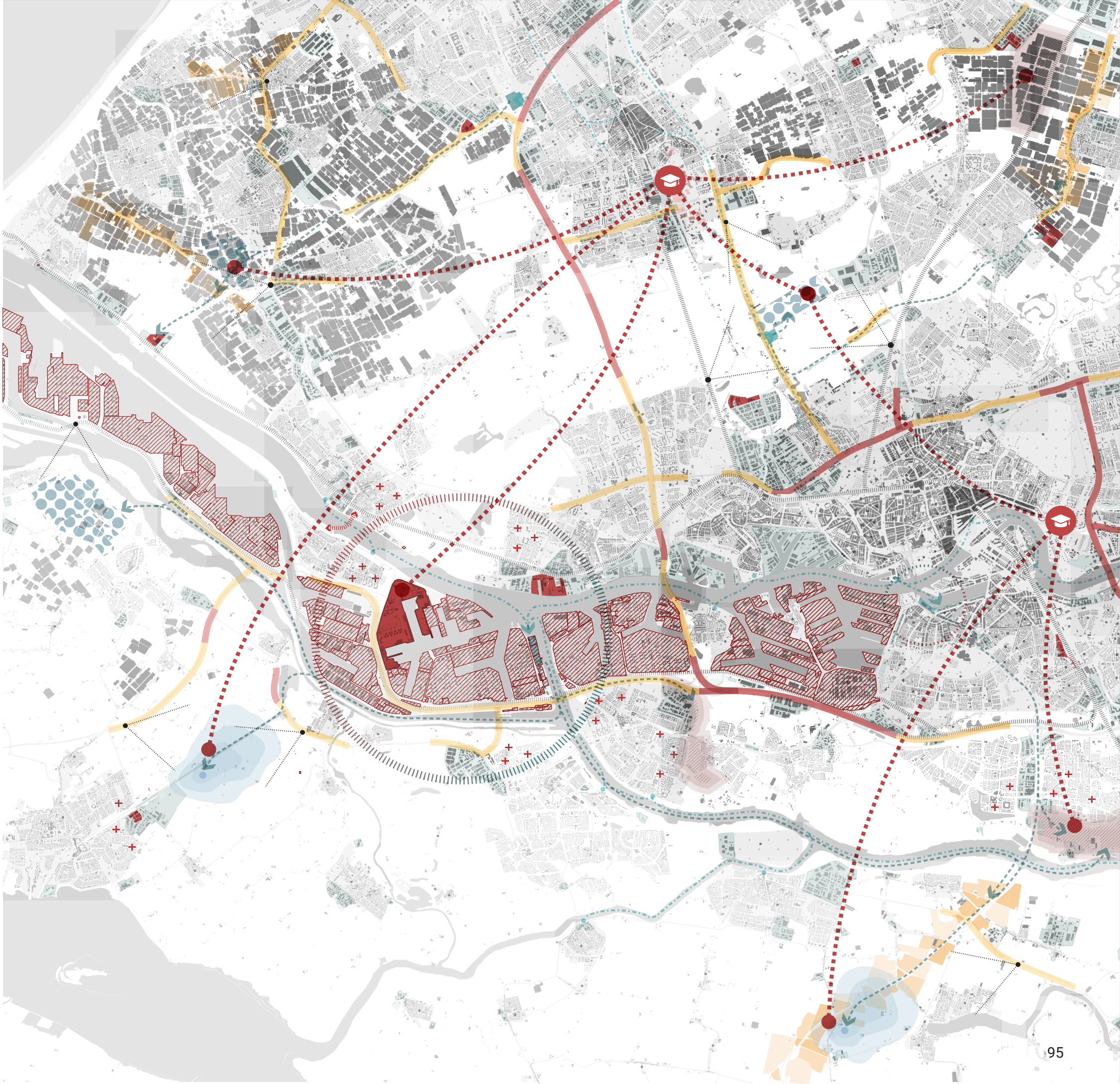
Loved places

The Netherlands is famous for its dune area that stretches across nearly the entire west coast of the country. The beaches are protected and are often connected to natural parks, both of which are often visited by locals. These areas serve well to house Space Type 3 (Bulky waste houses).

Perhaps even more iconic are the Dutch Tulip fields, part of the Dutch national identity, pride, trade, and one of the main tourist attractions. This again establishes a confrontational contrast with Storages of Type 3. All the other space types are present in the map as well.

Again, we see the system plays out at different scales, with collection at the neighbourhood scale in the cities and larger sorting spaces at the city edge or peri-urban. Waste is transported by road.

Actors

	Power get on board	Interest: proponent involve	Interest: opponent convince	Who's behaviour is changed target
Province of NorthHolland	top-down control and influence	circular economy ambitions	complex mediating process	
Municipalities	responsibility for local waste management	circular economy ambitions	complex mediating process	
Tulip farmers	landowners		need to give up space & income compromised	
Tourist infrastructure	landowners			
Landowners new locations	landowners	depends on the reward/ compensation	depends on the reward/ compensation	
Nature protection	Natura2000 dune area legally binding	long term benefits for the climate	nfrastructure on edge of protected dunes	
Residents	voting duty and right	a world that is cleaner and more just	not in my backyard	change consumption patterns
Tourists			'polluted' attractions	bring awareness back home
Schiphol	powerful economic actor			storage houses visible from plane

Weight

1.
2.
3.

Legend:

- Contrast between 'loved' places and wastehouses
- Nature and tulips fields
- Tourist attractions
- Schiphol flight path
- Job opportunities
- Collection
- Waste distribiution
- Railway and roads
- Major and minor traffic congestion
- View
- Collection points in main public spaces
- Local waste collection
- Industries
- Sorting facilities
- Close connection between CE and sorting facililities
- Recyclable facilites
- Dangerous waste storage
- Bulky waste storage
- Smelly and small waste storage
- Small waste storage

0 1 2 3 4 5 km N

City Gate

The city gate displays a busy knot of roads next to the historic city of Gouda. From this infrastructural node, traffic can reach the city of Rotterdam, as well as the cities of Delft and The Hague. Due to the large amounts of traffic and traffic jams, this City Gate is suitable for all the different space types, due to the possibilities for long-term exposure and visibility.

Just like in the previous example, there are sorting facilities and collection points at the local scale. Transport happens here by road.

Actors

	Power	Interest: proponent	Interest: opponent	Who's behaviour is changed
	get on board	involve	convince	target
Province of South-Holland	top-down control and influence	circular economy ambitions	complex mediating process	
Municipality Gouda	responsibility for local waste management	circular economy ambitions	complex mediating process	
Existing industries	landowners		need to give up space for CE infrastructure	should take responsibility for waste production and collection
Landowners new locations	landowners	depends on the reward/compensation	depends on the reward/compensation	
Ministry of I&W	top-down control and influence	interest in CE & part of the transition arena	mediating conflicting interests	
Nature protection	Important though not always legally binding	long term benefits for the climate	new infrastructure on natural edge	
Residents	voting duty and right	a world that is cleaner and more just	not in my backyard	change consumption patterns

Weight
1.
2.
3.

Connections with main cities
Job opportunities
Collection
Waste distribiution
Railway and roads
Major and minor traffic congestion
View
Collection points in main public spaces
Local waste collection
Industries
Sorting facilities
Close connection between CE and sorting facilitities
Recyclable facilites
Dangerous waste storage
Bulky waste storage
Smelly and small waste storage
Small waste storage

0   1   2   3   4   5 km   N
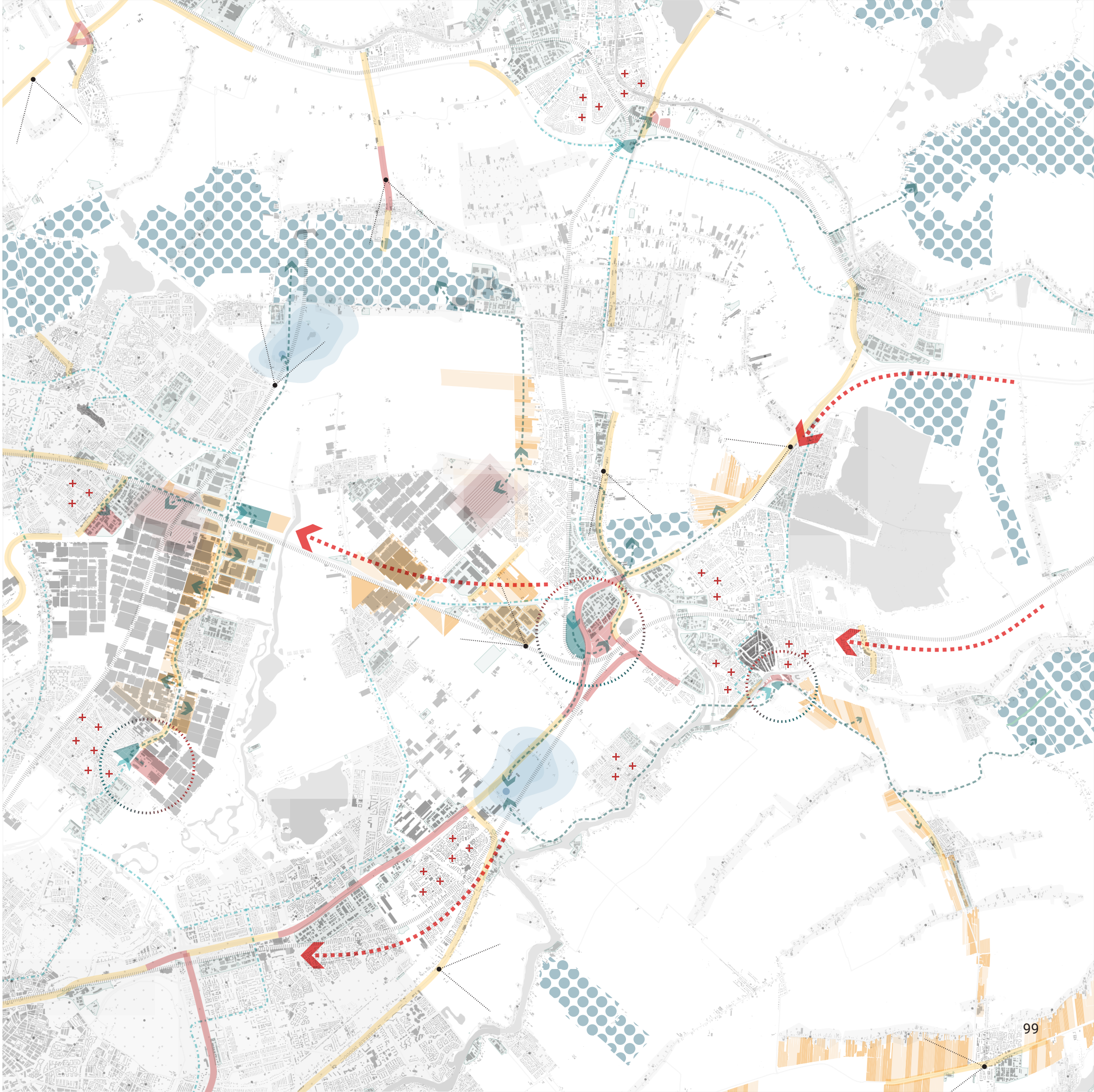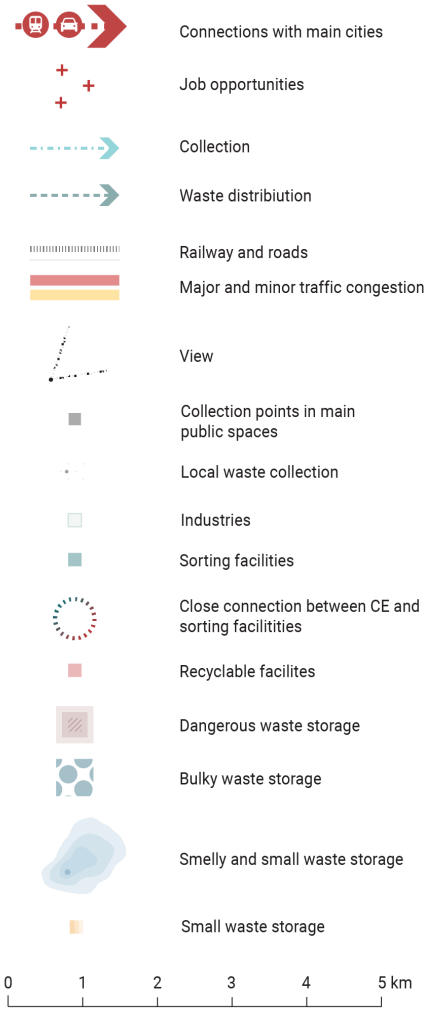
Autonomous city

This location gives an example of where a group of small cities operates on a self-sustaining waste system. Local solutions are found for collection, sorting and storage. In this specific cluster of smaller cities, there is suitable room for each space type. In the long term, this can be an interesting strategy since a local system can stimulate clustering and thereby foster collaboration.

Additionally, operating at a smaller scale can stimulate behaviour change in a different way, as it is very clear where responsibility lies. Locals know exactly that they themselves are responsible for the quantity of the waste accumulated, as well as the quantity and quality of the waste that is reused or recycled.

Actors

	Power	Interest: proponent	Interest: opponent	Who's behaviour is changed
	get on board	involve	convince	target
Province of Utrecht	top-down control and influence	circular economy ambitions	complex mediating process	
Municipality De Ronde Venen	responsibility for local waste management	CE ambitions; self-sufficiency; forerunner		
Local industries	landowners		need to give up space for CE infrastructure	should take responsibility for waste production and collection
Landowners new locations	landowners	depends on the reward/ compensation	depends on the reward/ compensation	
Heritage protection	heritage protection legally binding		waste stored in protected places	
Nature protection	Important though not always legally binding	long term benefits for the climate	new infrastructure on natural edge	
Residents Mijdrecht &Vinkeveen	voting duty and right	a world that is cleaner and more just	not in my backyard	change consumption patterns

Weight
1.
2.
3.

Self-sufficient cities

Job opportunities

Nature

Collection

Waste distribiution

Railway and roads

Major and minor traffic congestion

View

Collection points in main public spaces

Local waste collection

Industries

Sorting facilities

Close connection between CE and sorting facilitities

Recyclable facilites

Dangerous waste storage

Bulky waste storage

Smelly and small waste storage

Small waste storage

0 1 2 3 4 5 km   N
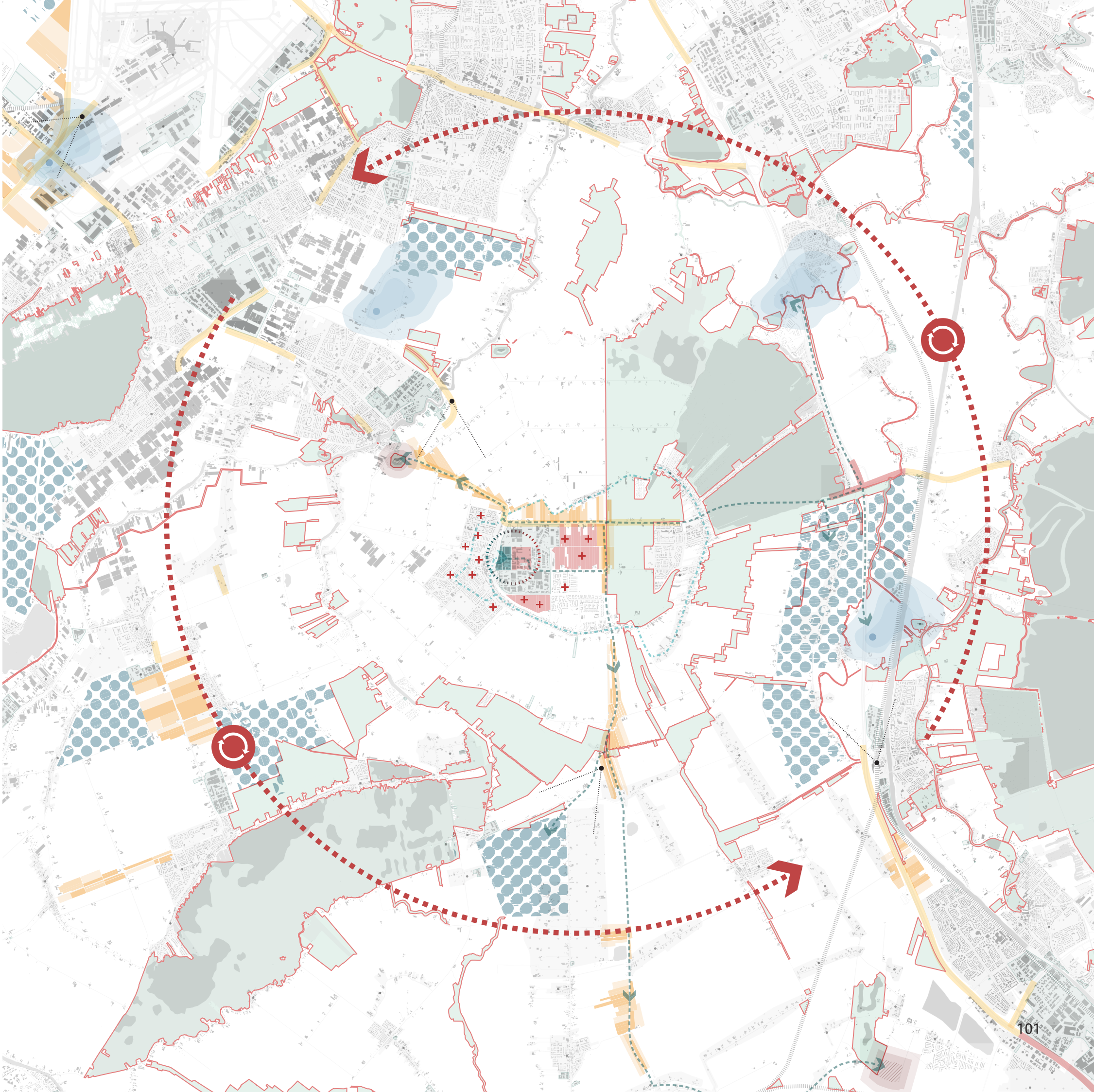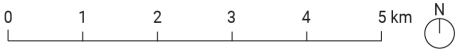
Chapter 6

Phasing and evaluation

Phasing

This diagram illustrates the implementation of our plan over time and in relation to processes on policy, social, spatial and economic levels. The actions further in time have a less definitive start and end year. However, this diagram shows the flow and logic behind how our plan will be enacted and which effects we expect to set in motion. As clearly visible from the amount of action taken straightaway, starting in 2024, the sense of urgency in our interpretation of the phasing is great. The waste houses cannot wait.

2020   2025   2030   2035   2040   2045   2050

European regional development fund & the Cohesion fund aim to strengthen economic, social, and territorial cohesion in the EU as well as promote sustainable development, more specifically promote the transition to a circular and resource efficient economy. The Just Transition Fund sets the roadmap for climate neutrality in 2050 in a just and fair manner.

Campaigns by NGOs to stop export of plastic

Taxonomy Regulation - Incineration and discposal of waste are unsustainable.

DNSH - New incineration plants are considered as non-compliance

Gradual phase-out of import of waste for incineration as overcapacity is shrinking

Ban on exports of non-hazardous plastic waste to non-OECD countries

European Investment Bank stops investments in incineration plants

Netherlands Enterprise Agency (RVO) stimulates innovation and entrepreneurs on circular economy

Incineration taxes are introduced

Green Deals are made between companies and the national government to use the stored waste as resource
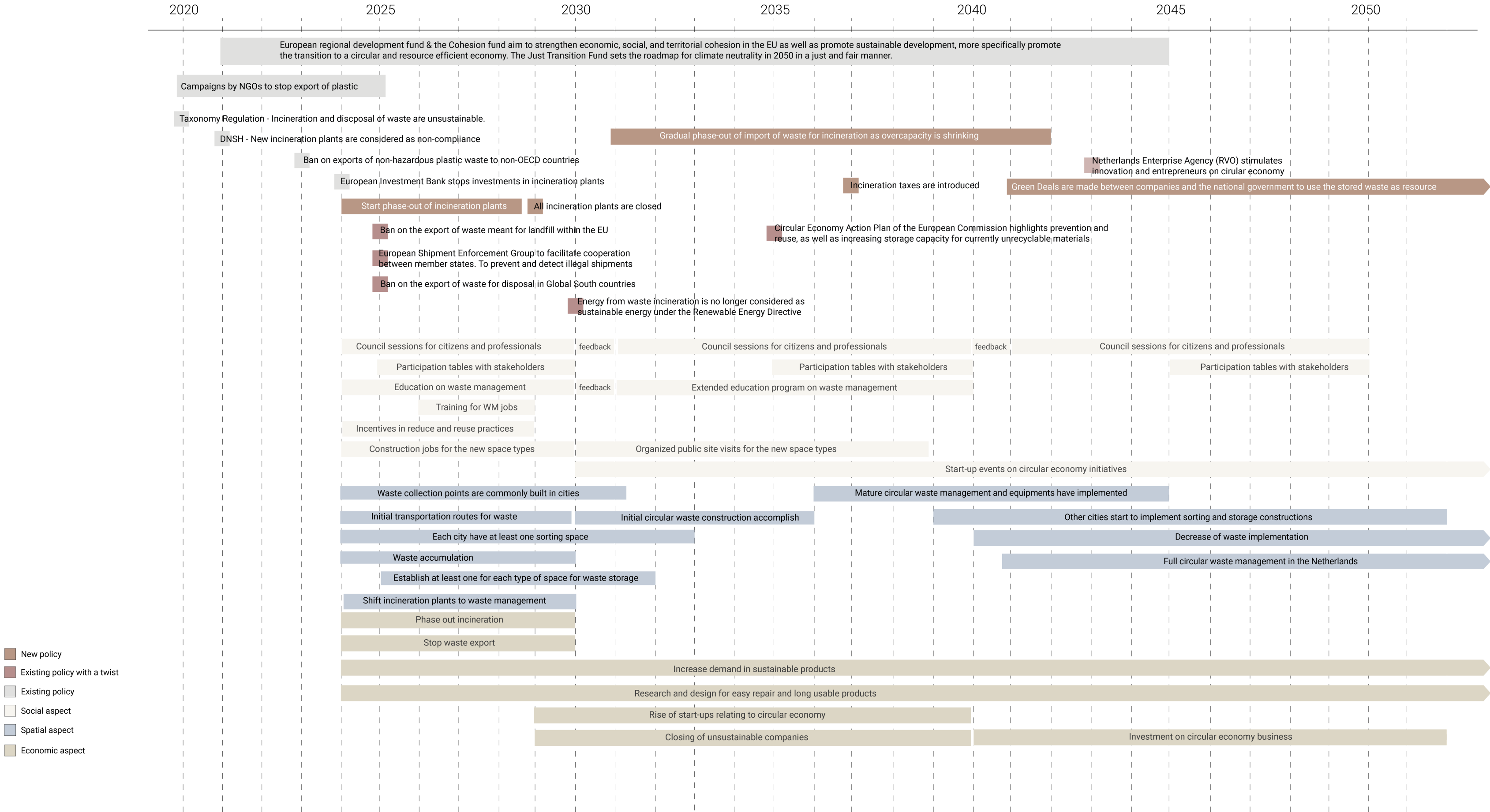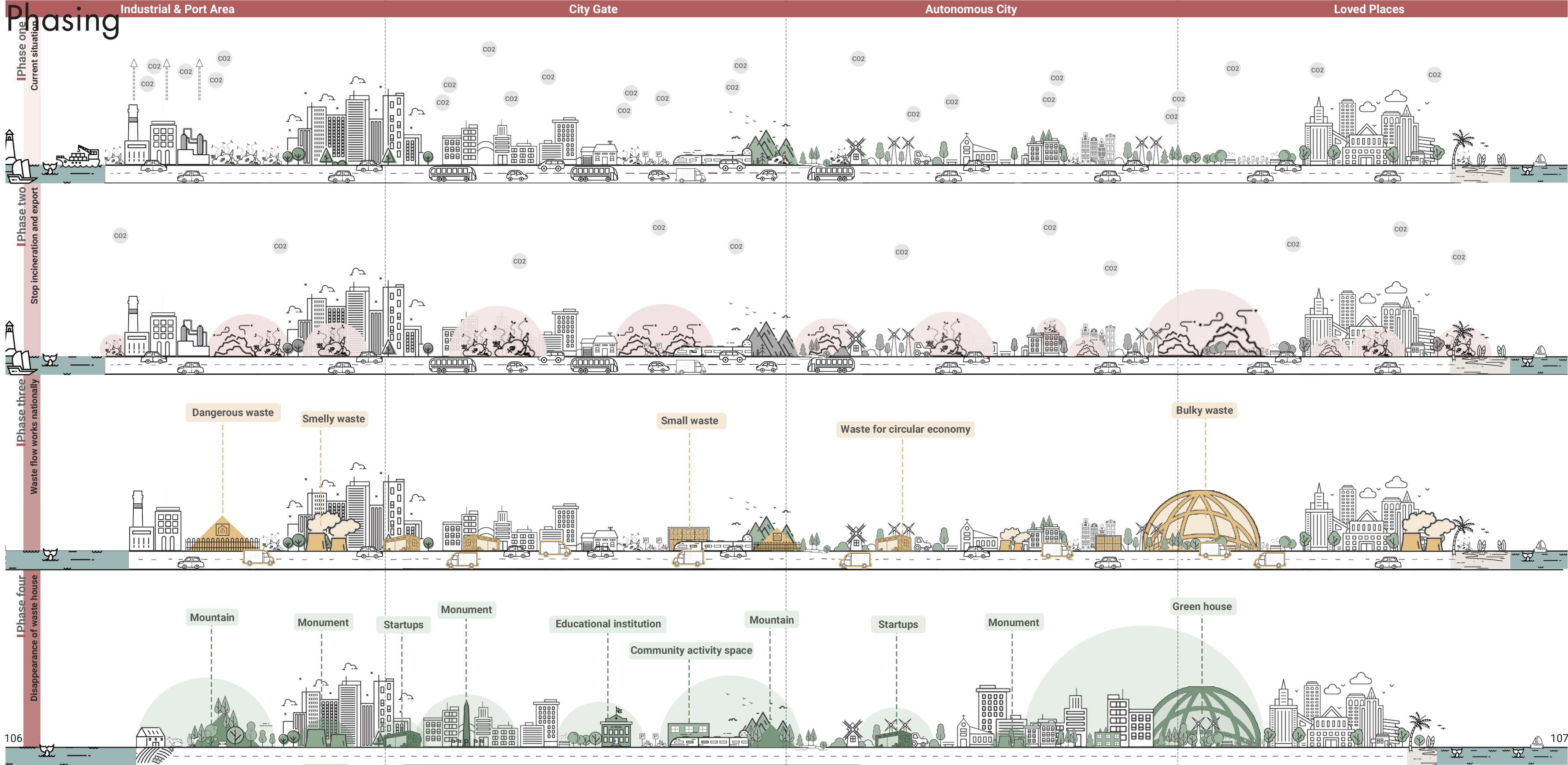
Start phase-out of incineration plants

All incineration plants are closed

Ban on the export of waste meant for landfill within the EU

Circular Economy Action Plan of the European Commission highlights prevention and reuse, as well as increasing storage capacity for currently unrecyclable materials

European Shipment Enforcement Group to facilitate cooperation between member states. To prevent and detect illegal shipments

Ban on the export of waste for disposal in Global South countries

Energy from waste incineration is no longer considered as sustainable energy under the Renewable Energy Directive

Council sessions for citizens and professionals — feedback — Council sessions for citizens and professionals — feedback — Council sessions for citizens and professionals

Participation tables with stakeholders   Participation tables with stakeholders   Participation tables with stakeholders

Education on waste management — feedback — Extended education program on waste management

Training for WM jobs

Incentives in reduce and reuse practices

Construction jobs for the new space types   Organized public site visits for the new space types

Start-up events on circular economy initiatives

Waste collection points are commonly built in cities   Mature circular waste management and equipments have implemented

Initial transportation routes for waste   Initial circular waste construction accomplish   Other cities start to implement sorting and storage constructions

Each city have at least one sorting space   Decrease of waste implementation

Waste accumulation   Full circular waste management in the Netherlands

Establish at least one for each type of space for waste storage

Shift incineration plants to waste management

Phase out incineration

Stop waste export

Increase demand in sustainable products

Research and design for easy repair and long usable products

Rise of start-ups relating to circular economy

Closing of unsustainable companies   Investment on circular economy business

Legend:
- New policy
- Existing policy with a twist
- Existing policy
- Social aspect
- Spatial aspect
- Economic aspect

Phasing

Phase one — Current situation

Phase two — Stop incineration and export

Phase three — Waste flow works nationally

Dangerous waste

Smelly waste

Small waste

Waste for circular economy

Bulky waste

Phase four — Disappearance of waste house

Mountain

Monument

Startups

Monument

Educational institution

Community activity space

Mountain

Startups

Monument

Green house

Sustainable development goals

The circular economy is an important tool to address various issues surrounding the climate. Amongst others, it helps combat climate change, contributes to the recovery of biodiversity, leads to a cleaner environment and healthier living conditions, and increases the security of the resource supply (Rijksoverheid, 2024). Apart from the benefits formulated by the national government, the circular economy contributes to several Sustainable Development Goals, especially SDG12, which concerns responsible consumption and production.

At the same time, it influences other SDGs as well. For our project specifically, SDG 3 as the overarching goal to lead the specific strategies that guide the achievement of the other SDG goals. During the process of realising people's social behaviour change, all aspects that we have mentioned below will work together in a way and adjust their importance from time to time.
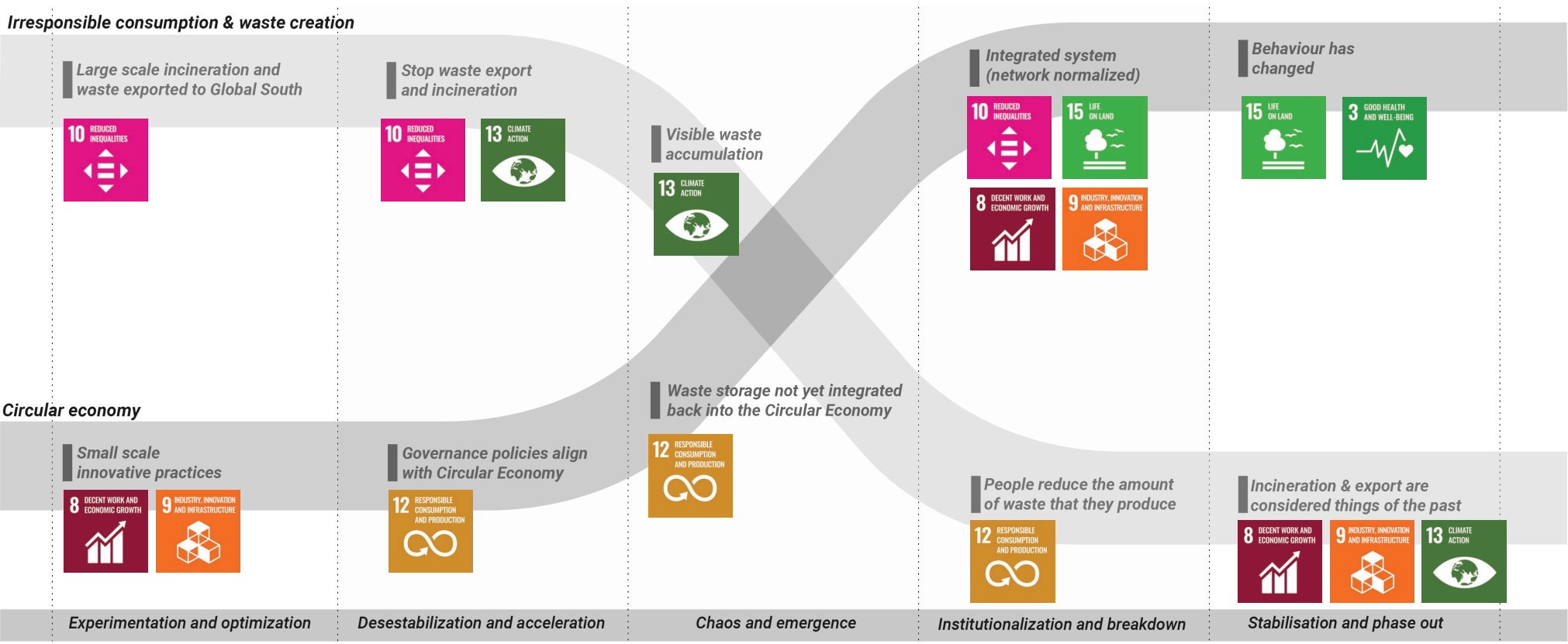
STG 3. Good health and well-being

- By stopping exports, the health of people living in countries where waste is shipped can improve.
- Emissions of CO2 and other air pollutants from incinerators can contribute to various health and environmental problems. By stopping this process, the health of the planet can improve.
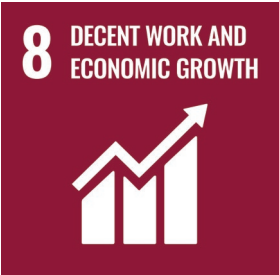
STG 8. Decent work and economic growth and STG9. Industries, innovations and infrastructure

- Transformation of current incinerators to become part of the circular economy in the future.
- Creation of chaos and the sudden need to deal with the problem, recyclable companies and startups become an important part of the strategy and contribute to economic growth.
- Building new infrastructure, waste houses and transformations of them, contributes to the growth of new jobs

STG 10. Reduced inequalities

- By stopping exports we can give voice to the more vulnerable communities that are influenced by the current system.
- In our interventions are influencing people's behaviour equally. Both urban and peri-urban places are areas of our strategy. We want not only to change the behaviour of urban residents in the Netherlands, but also of tourists who are only temporarily there.

STG 12. Responsible consumption and production

- Changing behaviour from consumption to more a more responsible and environmentally friendly is an important part of our vision and strategy.
- By treating current waste as a future resource, can contribute to an increase in respect from currently existing materials, which are limited and increasingly valuable.

STG 13. Climate action

- The introduction of sudden chaos, will cause people to face the problem of waste production.
- Stopping incineration and waste exports in the Netherlands, other European countries will be affected. In this way, we can introduce a globally trend towards a circular economy, and the Netherlands can be a forerunner of this trend.

STG 15. Life on land

- When performing analysis and determining the values we want to protect in our strategy, natural areas have always been given priority.
- By creating a contrast between the attractive qualities of national parks and nature preserves and the proposed waste house, we wanted to create a shock effect. Through it, we wanted to raise awareness of the fact that waste always ends up somewhere and by its presence can affect the natural environment.

Chapter 7

Future

Chapter content:

Waste Houses life cycle

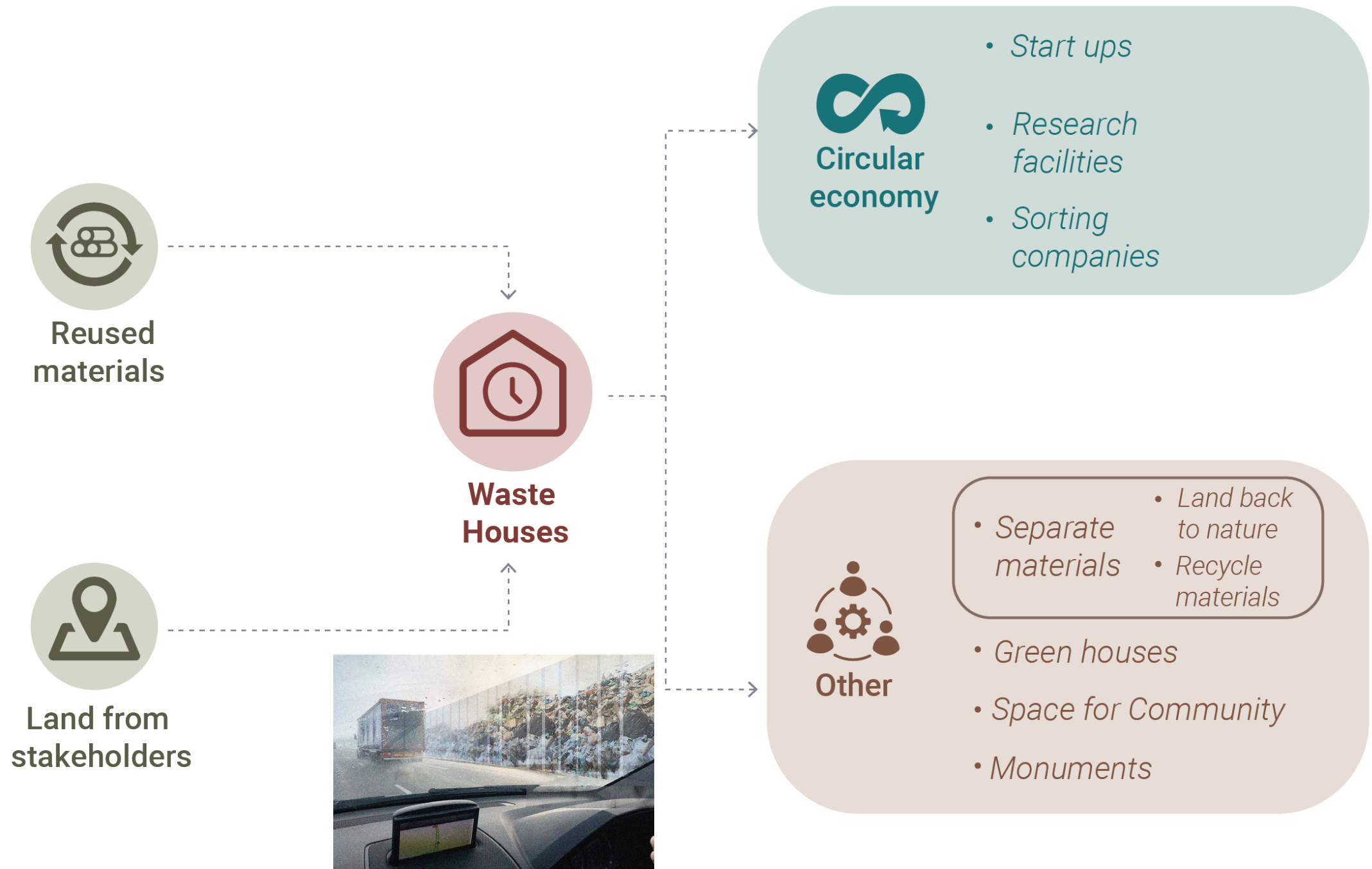Vision and strategy together

Transition images

Waste House life cycle

The construction of waste houses is a huge infrastructural undertaking. The construction process and materials required for the new system have been accused of hypocrisy due to requiring the 'consumption' of a lot of material, with assumed material externalities. However, the construction of waste houses is also possible using reused materials from previous demolitions. In addition, after society has transitioned towards a circular economy in the future, there are opportunities for the structures and materials of waste houses after they have completed their use as storage facility. They are designed with this life cycle in mind and are therefore also deconstructable into valuable building blocks or easy to repurpose for new uses in the future.

If the system we designed is successful, a large part of the waste houses will become obsolete. Some will remain in use for temporary storage as they cannot always be processed immediately.

The waste houses that remain part of the circular economy system can either be linked to start-ups that turn the waste materials again into resources, or to universities or independent research institutions to devise efficient and healthy ways of reusing and recycling the materials. Some storage spaces can turn into sorting spaces, as those will continue to be important in our envisioned future.

The ones that become obsolete can serve different functions. By this point, the circular economy is a given, which means the building should either be reused or demolished in such a way that materials can be harvested for new purposes (circular demolition). When considering reusing the existing space, one can think of greenhouses as there is ample use of glass, community spaces, as they are located in strategic, visible, and accessible locations, and they can serve as monuments to remember the waste economy that once was.

Reused materials

Land from stakeholders

Waste Houses

Circular economy
- *Start ups*
- *Research facilities*
- *Sorting companies*

Other
- *Separate materials*
- *Land back to nature*
- *Recycle materials*
- *Green houses*
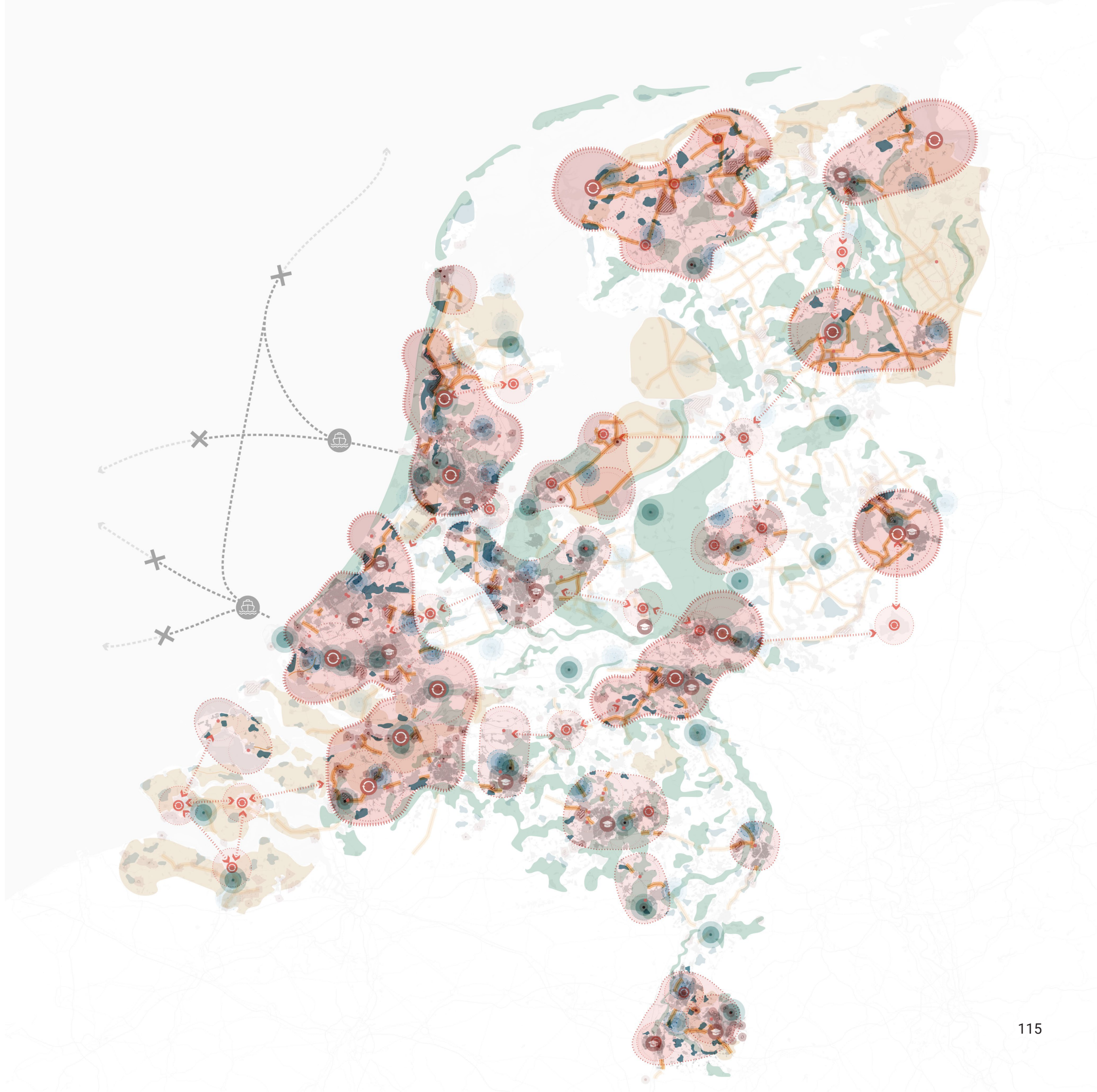- *Space for Community*
- *Monuments*

Vision and strategy together

This map combines the vision map with our strategy and phasing. As explained before, our project consists of two phases: 1) a strategic vision for temporary storage of materials, and 2) a vision for a circular economy future where people consume less and produce less waste. This means that a part of the system that we have created in phase 1 will become obsolete once we reach phase 2. We therefore need to think of ways in which these spaces can be reused that is in line with our circular economy vision.

The map shows various circular economy clusters. These clusters will continue to exist in phase 2. All the spaces that were added as new infrastructure in the cluster can be repurposed for CE goals. Potential uses were discussed on page 112 and include links with start-ups, research institutes and universities, or turning the storage space into sorting spaces.

Outside of the CE clusters, the storage spaces will either be demolished in a circular way or be reused for purposes that are unrelated to the circular economy. Here, one can think of greenhouses or community spaces. Areas that fall outside of the clusters include for example the tulip fields, the coastline, and areas close to nature. These spaces are given back to nature and people once less waste is generated, and more ways of reuse and recycling are found.

Stop export

Former incineration plants transformed into cilicular economy centres

Existing recycling facilities

Circular economy coasters with new infrastructure

New recycling facilities

Connections between New recycling facilitiesand CE clasters

Research and technical universities

Existing waste sorting facilities

Deconstructed waste houses

Nature

Agriculture

0   25   50 km   N

Transition images

1) Export and incineration rule the world

2) Waste accumulation chaos

3) Confrontation with waste

4) Waste houses in full swing

5) Reuse and recycling finally normal

6) What even is waste?

Chapter 8

Reflections

Group reflection

Answering our research questions

How can people's behaviour of consumption be influenced through spatial interventions on waste accumulation?

In this project we sought for ways to change people's consumption patterns and to change the way society views the value of materials and what constitutes 'waste'. With an exploration of transition theories and behaviour change theories prior to our strategy, we came to a few elements which would help us answer our main research question about behavioural change. The aspects which come to the foreground in our project are the importance of the shock effect and showing where the responsibilities lay. We have tried to do this through the design choices and spatialisation choices of our waste houses, collection and sorting spaces. By making the waste visible and also personally relatable through, for example, interaction at the collection stage or proximity with the waste house type 5. These shock effects are important parts of the chaos we have identified as necessary for a thorough transition to occur. However, since the mid-term we have also worked more on influencing people's behaviour through positive incentives at the same time as the negative shock effects. These included the showing of good practices as inspiration for how waste can be re-integrated into the circular economy, informing people through signs and social/educational functions linked to waste sorting locations. This will empower people to feel that they are in control and able to change their ways through the new knowledge they gained. We are also framing our intervention as an opportunity for start-ups and people with ideas for the new circular economy, rather than simply a punishment for irresponsible consumer behaviour.

How can waste be integrated in the Dutch 'landscape' if it is no longer exported or incinerated?

Storage spaces seem to be the most adequate solution for the waste that is piling up. After all, there are no solutions yet for reusing and recycling all the waste we produce. The expectation is that solutions will be found over time, which means waste must be stored for the techniques to be applied. We feel that our answer to this question is quite radical but necessary in order to stop the current patterns of mass consumption and discarding of materials out of the economy system. In addition, we believe that keeping the waste physically within the Dutch borders contains an important symbol of justice. The status quo of exporting waste and incineration does harm to other countries and to the climate, whilst The Netherlands no longer has to deal with it or be confronted by its scale of consumption. By keeping everything here, The Netherlands takes responsibility.

What governance structures are relevant, where lies interest and power, and how should costs and benefits be distributed?

Our project will have many opponents since it creates discomfort for nearly everyone. The chaos is not pleasant, and many actors will be against the idea of waste houses due to the hindrance it will give them in the short term. However, as we have already explained, the creation of chaos within our strategy is necessary in order to achieve true behavioural change and obtain a circular environment. Turning ambitions into actions is sometimes confronting and uncomfortable, and therefore top-down responsibility of governing actors is core to our plan. This means that the national government, provinces, municipalities and the EU will play an important role in enforcing the plan, despite opposition from companies and citizens.

However, there is also an important bottom-up element to our plan. That is the trust in the creativity and innovation of grassroots movements, start-up entrepreneurs, big companies and society in general to find ways to best adjust and change their behaviours to fit the new circular system.

Currently, stakeholders with very little power and with a great interest are the communities in the global south who receive exported waste and have to manage this. They will benefit greatly from the waste houses since The Netherlands will no longer be exploiting them and their environment. The negative externalities created by our project are distributed fairly through the way we have spatialised our project. Socio-spatial justice is something we have been quite sensitive to throughout the project and given a lot of thought. The waste houses are placed so that no inhabitants of particular areas will be negatively affected more than others. We have identified public goods such as sites of heritage, public transport, roads, infrastructure and horizons as spaces we can relate our shock effects to due to their non-discriminatory nature.

Design question: In what way can physical waste hubs/storage spaces be designed to influence public opinion and contribute to reducing consumption?

In the design of the collection, sorting, and storage facilities we tried to work with different methods to engage people. By broadening the range of methods used, we aim to enlarge the group that is personally addressed or affected by the project.

We engage different senses (smell and sight). For example large storage houses visible from a large distance or smelly houses next to the highway.

We play with contrasts (beauty and disgust). For example, glass waste houses in the touristic tulip fields

We try to evoke conflicting feelings (disgust and care; shame and pride). People want to take care of their homes and the landscape that surrounds them, which conflicts with feelings of disgust. Similarly, pride of cultural heritage mixes with shame for the amount of waste we produce (both linked to a colonial and extractive past).
Important to note: there can also be pride in the chaotic period of the project. The piling up of waste can trigger a sense of pride because we take responsibility. There is pride in ethical integrity.

Scientific relevance

The project aims to create chaos. It is an example of the step before arriving at the envisioned future. In this regard, it adds to the scientific body of knowledge by offering a thought experiment on how transition theory can be applied to the waste management system. It tries to look at how chaos can lead to desirable results, and, perhaps most important, how windows of opportunity can be created through spatial interventions.

Through the project, both the spatial infrastructure as well as the provocative nature, we set up a frame. It is a framework as well as a windowsill. It sheds light on what is happening. From there, people themselves can judge the information they get and judge for themselves what is the right action to take. As such, the project takes the shape of open-source knowledge. From there, change will happen at different levels and in ways that cannot be foreseen.

Due to the unpredictability of future development, we work a lot with uncertainties. The positioning of the project is based on an elaborate theoretical framework, but how this plays out is a question. The project can help add to the scientific field by trying to create a project that embraced this uncertainty and turn it into a strength rather than something to fear.

Societal & ethical relevance

Justice is where ethics and action come together, which becomes especially evident in our efforts to turn the tide in the global waste chain. This initiative marks not just the start of a larger transformation but also underscores the power of leading by example. At its core, justice serves as the guiding principle, propelling us towards a world that is fairer and more equitable for all. However, achieving this vision requires more than just words – it demands a fundamental shift in how we behave and make choices. It's about each of us playing our part in creating meaningful change, one decision at a time.

In the broader context of transitioning towards a fairer world, there are numerous aspects that need to be addressed. From economic structures to social norms, these transitions are interconnected and pivotal in shaping our collective future. Our project aims to expedite and steer these transitions in a positive direction. By sparking conversations, raising awareness, and mobilizing communities, we can drive systemic change that not only addresses environmental concerns but also tackles underlying social injustices. Together, we can forge a path towards a more sustainable, fair, and just future where everyone can thrive.

Individual reflections

Madelief van der Kraan

5226627

In my individual reflection I would like to discuss the importance of governance in the face of the climate crisis and the urgency of action, as well as the need to drastically change the world's economic system and our project's implications for socio-spatial justice. The power-interest matrix illustrates that the actors with the greatest power to implement changes and to undertake action are large governmental bodies such as the EU, national governments and municipalities. The disparity between ambitions, speeches and agreements such as the Paris Agreement and the actual climate actions undertaken by governments is far from hopeful (Black, 2023). The truth appears to be that it is easy and desirable to sketch ambitious visions with beautiful words and images, but that the breakdown of late capitalism and chaotic steps necessary to work towards such visions are too radical for influential actors to take.

Therefore, I also think that one of the strengths of our project is its acceptance of uncertainty about the eventual future. Rather, it focuses on the strategy needed to move in the direction of such a future and proposes short-term steps as opposed to shaping detailed visions for the future. I feel that this approach is currently necessary in urban design and planning practice everywhere, since there is no time for inaction whilst climate change continues to worsen. We focus on creating chaos, and are not scared to create disruption. We sketch the necessary scenario that powerful actors take their responsibilities and that governance inaction no longer causes stagnation in climate action.

I believe that disruptive interventions in the status quo are necessary to become sustainable sufficiently as soon as possible. This is not only about spatial and physical structures, but also about the economic system the world operates under. Our group started off the quarter with a shared feeling of frustration when we were considering the far-reaching impacts of current capitalism on every aspect of society, social injustice and unsustainable systems. Today, capitalism has made companies, products and individual people act with full attention to their competitiveness and individual prosperity rather than their collective wellbeing. This comes at the cost of Global South citizens, animals, plant-life, natural resources and our planet's climate (Rocco, 2024). We decided that we wanted to create a project that would tackle the amount of CO2 emissions and depletion of resources through one of its main causes; consumption, which is rooted in capitalism. How do we make people change their behaviour? How can we collectively consume less, need less and most of all want less too? The circular economy is one of the main solutions to these questions, and by focussing on strategy rather than an idealistic vision we have attempted to attain this new economic system.

We discussed how our project could affect different groups of people and how we can plan for socio-spatial justice by dividing the benefits, shocks and negative externalities our project introduces well. Therefore we have paid a lot of attention to the division of the public goods and spatialisation of our space types. We want to create shocks which are felt just as much by everyone, and do not affect citizens in cities more than people in the countryside.

Aleksandra Kurkierewicz

6084362

At the start of this quarter's project, we set out some initial questions that would stimulate our thinking and guide us throughout the work. What strategies should we implement to address the uncertainty of the future? How should we put theory into practice? Could visioning local development scenarios for the Netherlands contribute to making a difference in the global world?

In developing our vision, we placed a strong emphasis on the circular economy, as this is one of the Netherlands' main ambition for 2050. In order to achieve this, decisive steps must be taken to streamline this transition. That is why our project is not focusing on the circular economy vision itself, but rather on how to start and manage it. While addressing those issues, the Transition Theory has served as a backbone of our thinking. Transition x-cure shows that to shift from an old system to a new one, chaos is necessary. The proposed chaos of confronting people with the problem of waste not only creates an emotional response, but in our case also becomes a planning tool.

Later on, as we began establishing the strategy for implementing our vision, we came to conclusion that our ideas cannot be a single guideline for reaching the goal. In regional planning it is important to look beyond visions, strategies or polices. It is crucial to distinguish the role of the people who should participate in these processes. In this project we highlight that without their involvement and without their behavioral changes, the vision cannot be reached. We believe that our interventions are necessary to make people aware of the invisible system that they are a part of. It is important to acknowledge how much waste we produce and think about it more often than only while throwing away a bag full of our waste.

What I believe is unique and strong in our project is the statement we followed: stop incineration and export of waste. It was interesting to see, as the project developed, that those words affect multiple scales all at once: Global South, where waste is exported, European countries that export their waste to Netherlands and peri urban landscape of the Netherlands. All of them are linked to the regional planning, which is limited by national borders only spatially. The impact of policy decisions goes far beyond them.

Presented multiscale intervention is driven by our groups' deep care for our planet, not equally distributed justice and an uncertain future. Our initial ethical discussions led us through the whole process of defining the research questions. Those questions served as a starting point for creating a strategy, which led us to our vision. Later, we would juxtapose our vision back again with the initial discussions. By looping the design process, we always had a chance of taking a few steps back and create many iterations, which finally led to a stronger and more impactful project.

Isabella Jaramillo Diaz

6035353

During the work of this quarter, I had the opportunity to link my principles, concerns, and hopes as a citizen of the world, into a project. We began with an idea rooted in our own experience in the world, and the anxiety generated by the little control and power we have over the world and how it functions. This frustration turned into an urge to delve deeper in the topic, and to understand more about the waste system that concerns us all, and these questions led us to research on the subject, and from here, the need to propose a solution. Design was the contribution, from our expertise to this major issue that involves us all, but the process doesn't end here, since we constantly evaluated our design ideas with research, which led us back and forth between these two moments. Our hypothesis is based on personal experiences, but the arguments of our design and proposal are based on the research we conducted this quarter.

This project starts as a top-down proposal, understanding that the decision to halt waste exports and waste incineration involves different countries around the world, facing environmental and social responsibility to utilize and transform the waste produced in the country. However, subsequently, the way we position and present our project spatially gives power and control to all citizens. Control and power, because by formulating a transparent waste system project, everyone has the knowledge and can thus utilize it. Governance as a regulatory and transparency element to lead us to the democratization of waste and greater ownership of what we consume is key for it.

Our project is based on the hypothesis that behaviour change due to the chaos of waste accumulation can trigger a systematic change in consumption. And to make this happen, the project bases the design in two visions. One vision applies a proposal aimed at stopping the waste system for materials that cannot enter the circular economy and storing them, while the other is hopeful, envisioning a successful waste storage project, fruitful innovation, and a circular economy system in the country. This peculiar way of interpreting time and presenting a vision beyond our control (because we are not certain that all stored materials will actually find a function within the circular economy) helped us think about closure and how to integrate not only the spaces that we were creating, but also the different actors in the world, both in our strategic vision and in our final vision. With this, all human beings have an indispensable role in the outcome, and if consumption habits and our relationship with waste change positively, we can achieve the hopeful vision, but it's not entirely certain.

To conclude, I take away a profound learning from this period. Understanding the global context, the need to achieve justice for countries bearing a disproportionate burden in the current process, and the pursuit of structural change so that future generations may have a better future, has been enlightening and of great importance to me. The endeavour to recognize socio-spatial injustices in the face of issues where the most powerful not only consume resources from the less powerful but also, ultimately, dispose of their waste on their lands, is something I pledge to always work towards. Seeking social and environmental responsibility is the driving force of this project, and it has become one of my greatest ambitions.

Yiling Yang

5991250

This project is exciting for me, as I have never done anything similarly bold and very provocative regional design projects. Through this quarter's exploration of waste in the Netherlands, I have gained a more systematic understanding of waste management situation in the Netherlands and both national and global flow of waste, which is a precious learning opportunity for me who is not super familiar with the relevant policies and planning in the Netherlands.

Our project began with a common goal for our group: social justice. It served as a backbone throughout our project. However, when we tried to build the logic of the project with social justice and changing citizens' social behavior as the ultimate goal, we found it difficult. In my opinion, it takes a lot of time and needs different external factors to change a person's mindset through regional planning and intervention, which is why we divided the project into three phases, adapting the project to the characteristics of the different time periods, in order to influence people's social behavior as much as possible, and at the same time to make public space in the Netherlands more green and sustainable under the waste circular economy.

With the general framework in mind, we decided, with inspiration from our mentors, to make this project bold in terms of visualization and the way of telling the strategy. First messing up people's daily lives with a slightly ironic attitude, and then bringing the chaos to the social public spaces in and out of cities before the intervention of different types of waste houses. This chaos approach, which I think is inevitable in the development of most social issues, seems to be out of line with the conventional logic of thinking as an urban planner, but is also very reasonable from my perspective. As mothers always tell their children, only when they fall do they realize they have to watch out for steps while walking. The same for global warming, when the ozone hole becomes bigger and the sea level continues to rise, people can realize that if we don't make changes, we won't be able to survive on this planet. The same is true for our project. It is only when someone's benefits are threatened (front yards and neighborhoods are piling with waste) and there is no immediate solution to this situation, then that one will be shocked and start to change social behavior, and ultimately, form a sustainable state of development (circular economy).

In addition to that, different stakeholders play different roles in different segments to support the sustainability of the waste management cycle. I also found that multi-stakeholder collaboration in large-scale regional planning is a very complex and large topic that needs to be researched, and I am super looking forward to more opportunities in the following study to learn more about how urbanists and different stakeholders communicate and collaborate in the decision-making process of planning.

Julia Schasfoort

5093759

The group project started out very inspirational and ambitious. The lectures on global socio-spatial justice, combined with the large scale of the project, the topics, and the personalities within our group turned the first weeks into a buzz of activist ideas and a desire to change the world for the better. Inevitably, this is sometimes paired with feeling the weight of the world on your shoulders, making you feel small and insignificant in the face of such dauntingly large questions. The type of questions we asked ourselves and the scope of the answer were fed by the Methodology lectures, and added a lot to the ideation and project-shaping phase. Thanks to the assignments in class, we started thinking about the complexity of the project from the start: including governance networks, actors, theories and methods.

Personally, I have a tendency to first focus on theory, feeling safe to move only after collecting evidence and arguments. When doing individual projects, this means the design is sometimes postponed. By working in a group, it was possible to immediately translate research into design, which meant we could 'test' whether the theory worked out in space, and redirect or shift direction if needed. From each design outcome and spatial translation, new questions arose which meant research and design could continuously be done side-by-side. As a result, I feel the project became very coherent and 'round' – that is, fully embodied rather than consisting of separate bits that are glued together by a pretty story.

The combination of research and design proved to be very useful in the translation of our vision into strategy. Inspiring lectures and conversations with tutors and amongst ourselves really helped to formulate a beautiful vision for a desired future. However, how to get there is a whole different story. This is where theory came in handy since our project envisions a transition and luckily, research abounds in this field. What is more, transition research is already highly practical as it talks about the management of transitions, and has been adopted as a strategy by several ministries in the Netherlands. Both the fact that there is theory on which we can base our strategy, as well as that this theory is already translated into practice helped a lot to guide the project. It is sometimes difficult to get a grip on strategies and to judge whether or not the pathways are realistic. In-depth reading of transition studies gave us several steps (method) to start with. From there we could build our strategy such that it became both grounded in theory as well as carefully tailored to our spatial context and design project.

Overall, I learned a lot from this quarter. Especially how working together enriches both the process and the result and how complex and wide different topics and issues stretch. In the course of a quarter we crossed the entire globe, linking practices in the Netherlands to social justice abroad. The multitude of voices – group members, tutors, guest lecturers, researchers, journalists, stakeholders – reminded me once again how valuable different voices and listening are in understanding, positioning, visioning, and actioning.

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Maps and analysis

Map in report	Layer	Source
Base map for all maps	Water	https://download.geofabrik.de/europe/netherlands.html
	Roads	https://download.geofabrik.de/europe/netherlands.html
	Railway	https://download.geofabrik.de/europe/netherlands.html
	Cities	https://app.pdok.nl/brt/top10nl/download-viewer/
Vision map and after strategy	Incineration	Ministry of Infrastructure and Water. (2020). Afvalwerking in Nederland, gegevens 2020.
	Recycling facilities	https://www.eea.europa.eu/en/datahub/datahubitem-view/9405f714-8015-4b5b-a63c-280b82861b3d
	Sorting facilites	https://www.eea.europa.eu/en/datahub/datahubitem-view/9405f714-8015-4b5b-a63c-280b82861b3d
	Universities	https://en.wikipedia.org/wiki/List_of_universities_in_the_Netherlands and Qgis
	Natura 2000	https://app.pdok.nl/viewer/#x=189606.32&y=472687.18&z=3.3123&background=BRT-A%20 standaard&layers=a7aeddf2-3b37-4668-9c75-de93d9326276;PS.ProtectedSitesNatureConservation
Restriction map	Cities	https://app.pdok.nl/brt/top10nl/download-viewer/
	Flood prediction	https://www.atlasleefomgeving.nl/kaarten
	Natura 2000	https://app.pdok.nl/viewer/#x=189606.32&y=472687.18&z=3.3123&background=BRT-A%2 standaard&layers=a7aeddf2-3b37-4668-9c75-de93d9326276;PS.ProtectedSitesNatureConservation

Strategic vision

Collection	Growth of 38 largest cities 1200-2010	https://rce.webgispublisher.nl/Viewer.aspx?map=VerstedelijkingNL#
	Neighbourhoods	https://www.atlasleefomgeving.nl/kaarten
Sorting	Sorting facilities	https://www.eea.europa.eu/en/datahub/datahubitem-view/9405f714-8015-4b5b-a63c-280b82861b3d
Circular economy storage	Incineration	Ministry of Infrastructure and Water. (2020). Afvalwerking in Nederland, gegevens 2020.
	Recycling facilities	https://www.google.com/maps/
Dangerous waste storage	Groundwater protection map around drinking water sources	https://www.atlasleefomgeving.nl/kaarten
	Basic network - transport of hazardous substances	https://www.atlasleefomgeving.nl/kaarten
	Soil subsidence	https://www.klimaateffectatlas.nl/en/
	Mines	https://www.demijnen.nl/mijnen/opdekaart
	Existing landfills	https://www.eea.europa.eu/en/datahub/datahubitem-view/9405f714-8015-4b5b-a63c-280b82861b3d
	Forts	https://rce.webgis.nl/nl/map/erfgoedatlas
Bulky waste storage	Trees in Netherlands	https://www.atlasnatuurlijkkapitaal.nl/kaarten
	Experiential value of the landscape	https://www.atlasnatuurlijkkapitaal.nl/kaarten
	National and world heritage	https://rce.webgis.nl/nl/map/erfgoedatlas
	Touristic places	https://www.tulipcycling.com/about-holland/bike-tour-themes

Map in report	Layer	Source
Smelly & small waste storage	Industries sites	https://app.pdok.nl/brt/top10nl/download-viewer/
	Roads	https://download.geofabrik.de/europe/netherlands.html
	Nitrogen dioxide 2022 (NO2)	https://www.atlasleefomgeving.nl/kaarten
	Wind	https://globalwindatlas.info/en/area/Netherlands
Small waste storage	Roads	https://download.geofabrik.de/europe/netherlands.html
	Railway	https://download.geofabrik.de/europe/netherlands.html
	Land use	https://app.pdok.nl/brt/top10nl/download-viewer/
	Greenhouses	https://www.nationaalgeoregister.nl/geonetwork/srv/dut/catalog.search#/metadata/0a01b844-d4e1-4f9c-b1a7-f7fc71b2ee5a
Zoom in	Tulips fields	https://tulipfestivalamsterdam.com/check-flower-map-see-blooming-flower-fields-around-keukenhof-gardens/
	Schipol flight path	https://www.schiphol.nl/en/schiphol-as-a-neighbour/page/is-my-house-underneath-a-flight-path/
	Congestion (time Thursday 16 pm)	https://www.google.com/maps/

Image source for report

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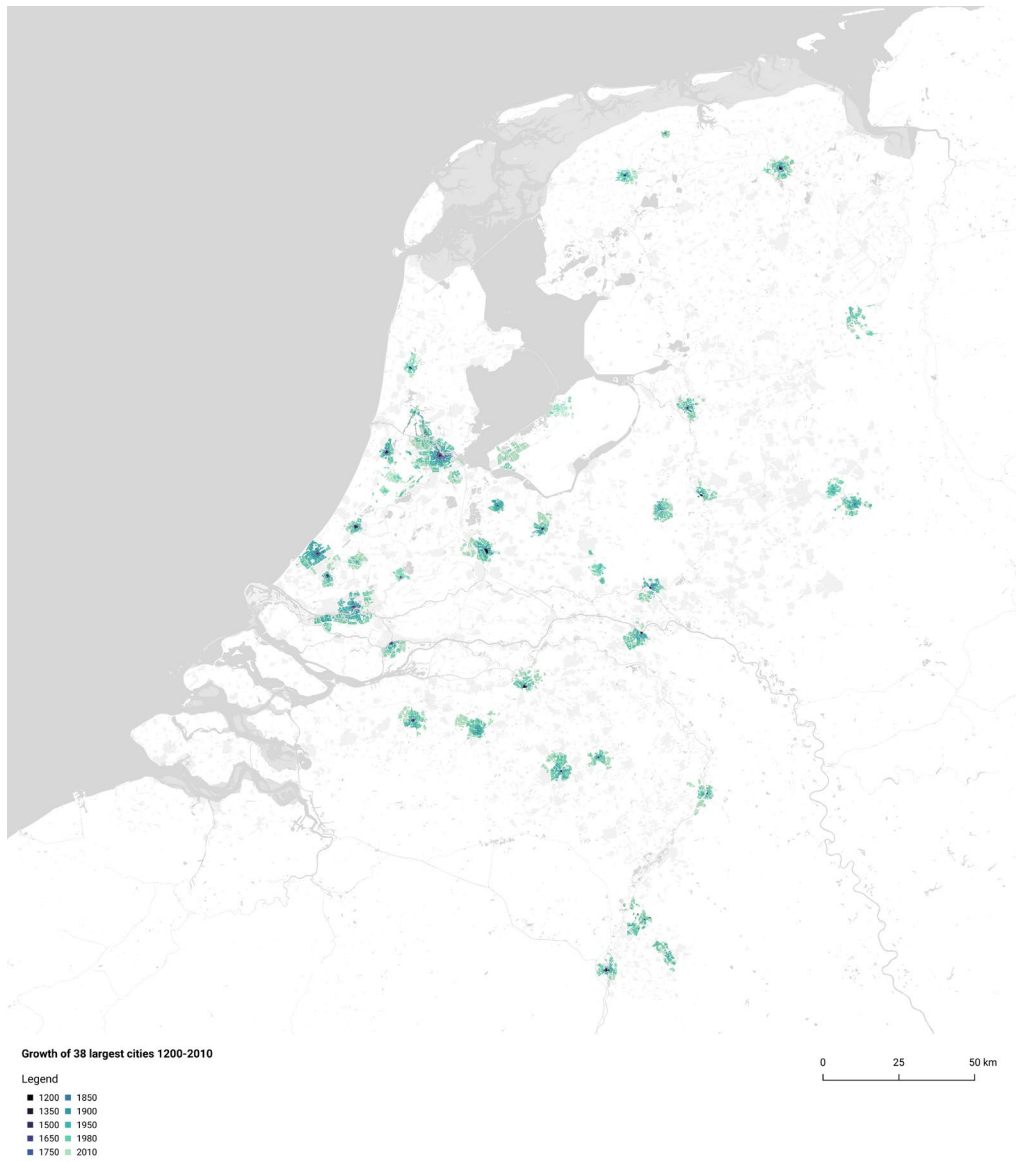Akbarzadehpoladi, P. (2023, June 9). Rotterdam maakt kennis met een nieuwe vrouw. De Havenloods. https://www.dehavenloods.nl/nieuws/algemeen/47853/rotterdam-maakt-kennis-met-een-nieuwe-vrouw-en-heeft-een-mening

Image source for collages

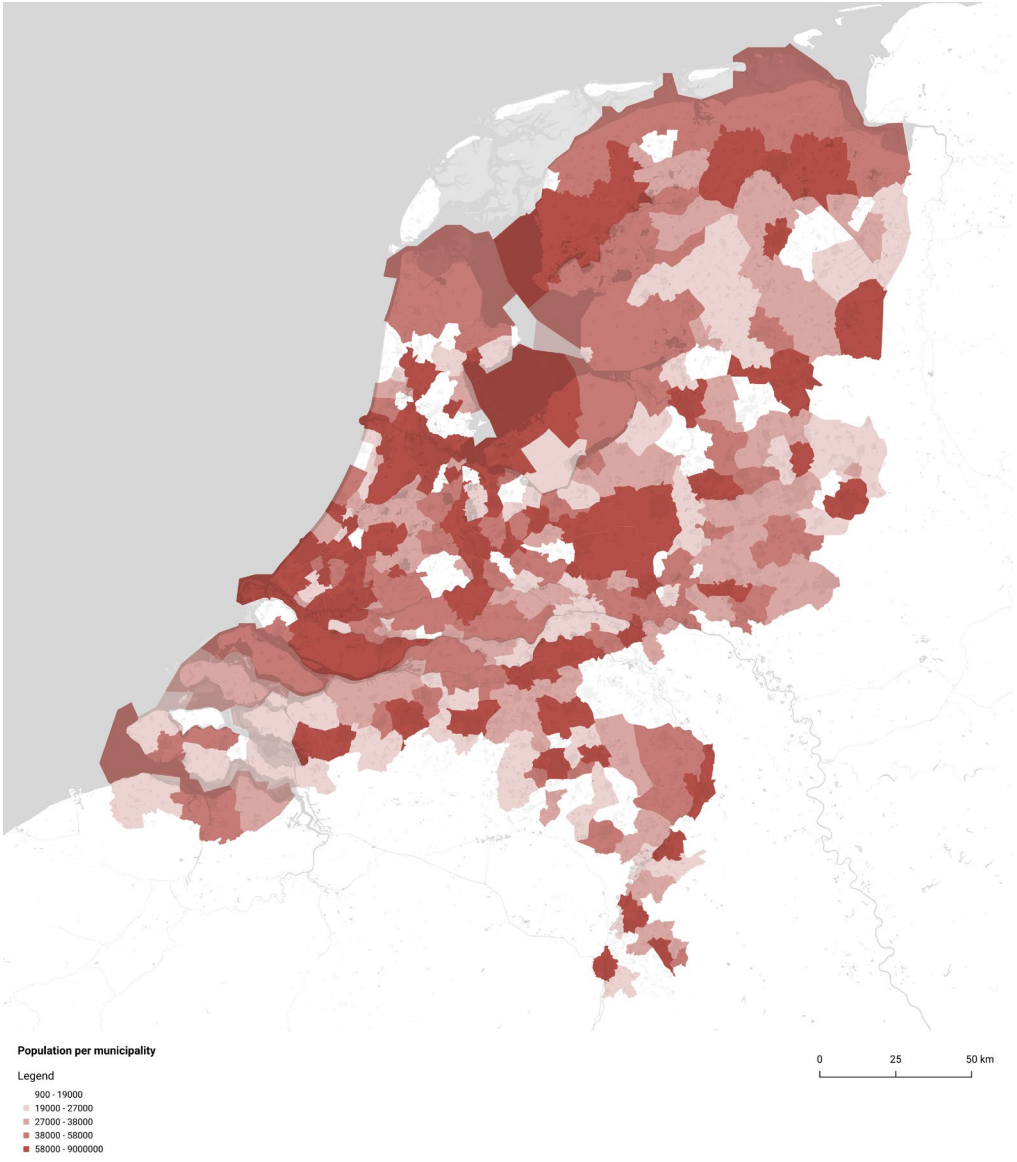| Our graphics	Used image source
Vision scenario	https://hydrogen-central.com/rotterdam-mou-world-hydrogen-2022-summit-exhibition/
Photomontage:	
Collection	https://eu.njherald.com/story/business/2016/06/10/france-strikes-trash-taint-image/2927716007/
	https://www.famsf.org/events/highlights-tour
Sorting	https://lion-companies.com/recycling/waste-sorting-system
	https://www.youtube.com/watch?v=2AlZzZRFjvY
Danger	https://commons.wikimedia.org/wiki/File:Old_people_looking_at_something.jpg
	https://www.flickr.com/photos/by_photo_snaiper/12622630634
Bulky	https://lieschenradieschen-reist.com/ein-ausflug-in-den-spreewald-das-tropical-islands/
	https://www.philandgarth.com/kinderdijk-windmills-a-day-trip-from-rotterdam/
Smelly	https://www.nytimes.com/2019/11/14/world/europe/netherlands-speed-limit.html
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Future	https://www.archdaily.com/927087/lan-handling-technologies-office-building-cepezed
	https://torontolife.com/life/inside-markhams-stunning-new-52-million-community-centre-climbing-wall-teaching-kitchen-glow-dark-playroom/
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	https://www.wsj.com/articles/container-carrier-msc-orders-five-giant-box-ships-for-762-million-11571161325
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Waste accumulation	https://www.utoronto.ca/news/cities-and-countries-aim-slash-plastic-waste-within-decade
	https://www.pinterest.fr/pin/463870830353029802/
	https://www.columbusmagazine.nl/thema/citytrips/artikel/11406/reizen-binnen-nederland-in-eigen-land-mooiste-dorpen-provincies
	https://www.politico.eu/article/circular-economy-jobs-waste-garbage-trash-recycling/
Living with our waste	https://encrypted-tbn3.gstatic.com/images?q=tbn:ANd9GcSdke65D3vc_SRIQVgzt6jFbfGtNhHMg0Q7zQnJdFx8CSIET88p
	https://fire.lacounty.gov/hazardous-waste/
	https://www.metoffice.gov.uk/weather/learn-about/weather/optical-effects/why-is-the-sky-blue
Waste storage	https://www.angrybabyproductions.com/?i=gray-paving-slabs-urban-street-road-floor-stone-tile-zz-08e1vyh7
	https://meye.dk/
	https://www.pexels.com/nl-nl/zoeken/blue%20sky/
	https://www.istockphoto.com/nl/search/2/image-film?phrase=man+carrying+child+on+back
	https://www.istockphoto.com/nl/foto/woman-receiving-delivery-signing-a-clipboard-gm1348183883-425464020?searchscope=image%2Cfilm
	https://www.canada-greenhouse-kits.ca/products/triomphe-12-ft-x-15-ft-orangery-chalet-greenhouse-palram-canopia
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	https://www.rajapack.nl/hygiene-cafetaria/vuilniszakken-toebehoren/vuilniszakken-van-hoogresistente-kwaliteit-110l_skuAFZ10P.html?priceVAT=true&utm_source=google&utm_medium=cpc&utm_campaign=20292132479&utm_campaign=PMAX_Shopping_cash_cows&gad_source=1&gclid=CjwKCAjw8diwBhAbEiwA7i_sJXy-LubjvvL16SGLBmtoOFdvf7wq-oFuX9_NEpt1OnUn02-Aus92rhoC4kIQAvD_BwE
	https://www.vecteezy.com/free-photos/grass-texture
Reusing and recycling waste	https://trends.knack.be/ondernemen/studie-gerecycleerd-plastic-heeft-de-perceptie-tegen/
	https://designwanted.com/precious-plastic-brick/
	https://meye.dk/

	https://edu.rsc.org/feature/plastic-waste/3009361.article
	https://www.toolspecial.com/pressol-trechter-700ml-02-665
	https://depositphotos.com/photo/little-child-girl-open-arms-wide-looking-camera-isolated-yellow-341859882.html
	https://www.pexels.com/nl-nl/zoeken/blue%20sky/
What is waste?	https://www.budgetgift.nl/mini-kliko-390035.html
	https://www.dreamstime.com/stock-photo-little-schoolboy-standing-near-lockers-school-hallway-put-backpack-bench-something-s-looking-image73623154
	https://meye.dk/
	https://www.lotpixel.com/texture/grass-texture-2213
	https://www.123rf.com/photo_39754713_many-white-small-flowers-in-top-view-of-grass-texture.html
	https://www.pexels.com/nl-nl/zoeken/blue%20sky/
	https://www.istockphoto.com/nl/foto/group-of-round-faceted-diamonds-isolated-on-white-gm168338993-17143867
	https://www.freeiconspng.com/images/diamond-png
Zoom in	https://en.wikipedia.org/wiki/Mijdrecht
	https://blog.bungalowspecials.nl/leuke-vakantieparken-nabij-de-keukenhof-in-lisse/
	https://bollenstreek.nl/bereikbaarheid-keukenhof/
	https://www.tln.nl/nieuws/oprit-a12-rotterdam-den-haag-bij-gouda-blijft-behouden/
	https://www.omroepwest.nl/nieuws/3664009/gouda-houdt-oprit-aan-a12-naar-rotterdam-en-den-haag
	https://www.afvalgids.nl/grootste-restafvalkeuken-van-rotterdam-vrijwel-volgeboekt-tijdens-wereldhavendagen/avr-rozenburg-restafvalkeuken/

Appendix

Spatial analysis collection space type

Growth of 38 largest cities 1200-2010

Legend
- ■ 1200 ■ 1850
- ■ 1350 ■ 1900
- ■ 1500 ■ 1950
- ■ 1650 ■ 1980
- ■ 1750 ■ 2010

0   25   50 km

Growth of the largest cities

Neighborhoods

Legend
- neighborhoods

0   25   50 km

Neighbourhoods

Population per municipality

Legend
- 900 - 19000
- 19000 - 27000
- 27000 - 38000
- 38000 - 58000
- 58000 - 9000000

0   25   50 km

Population per municipality

Spatial analysis sorting space type

Cities and infrastructure

Legend
- motorway
- main roads
- railway
- urban fabric

0   25   50 km
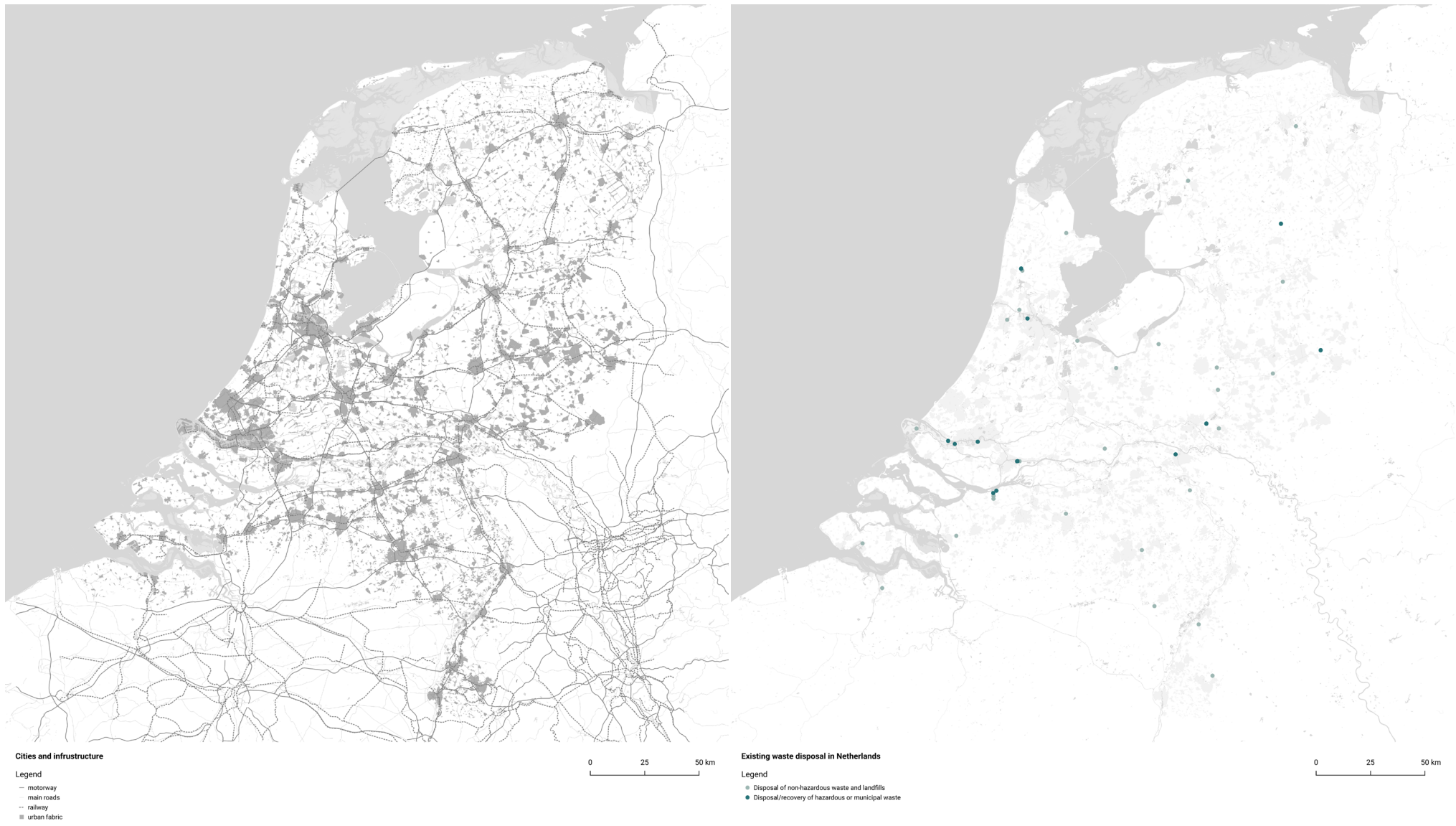
Cities and infrastructure

Existing waste disposal in Netherlands

Legend
- Disposal of non-hazardous waste and landfills
- Disposal/recovery of hazardous or municipal waste

0   25   50 km

Existing recycling & waste sorting locations

Spatial analysis storage space type

Natura 2000

Legend
- natura 2000

0   25   50 km

Natura2000 areas

Flood predictions

Legend
- >0.0 m
- <0.5 m

0   25   50 km
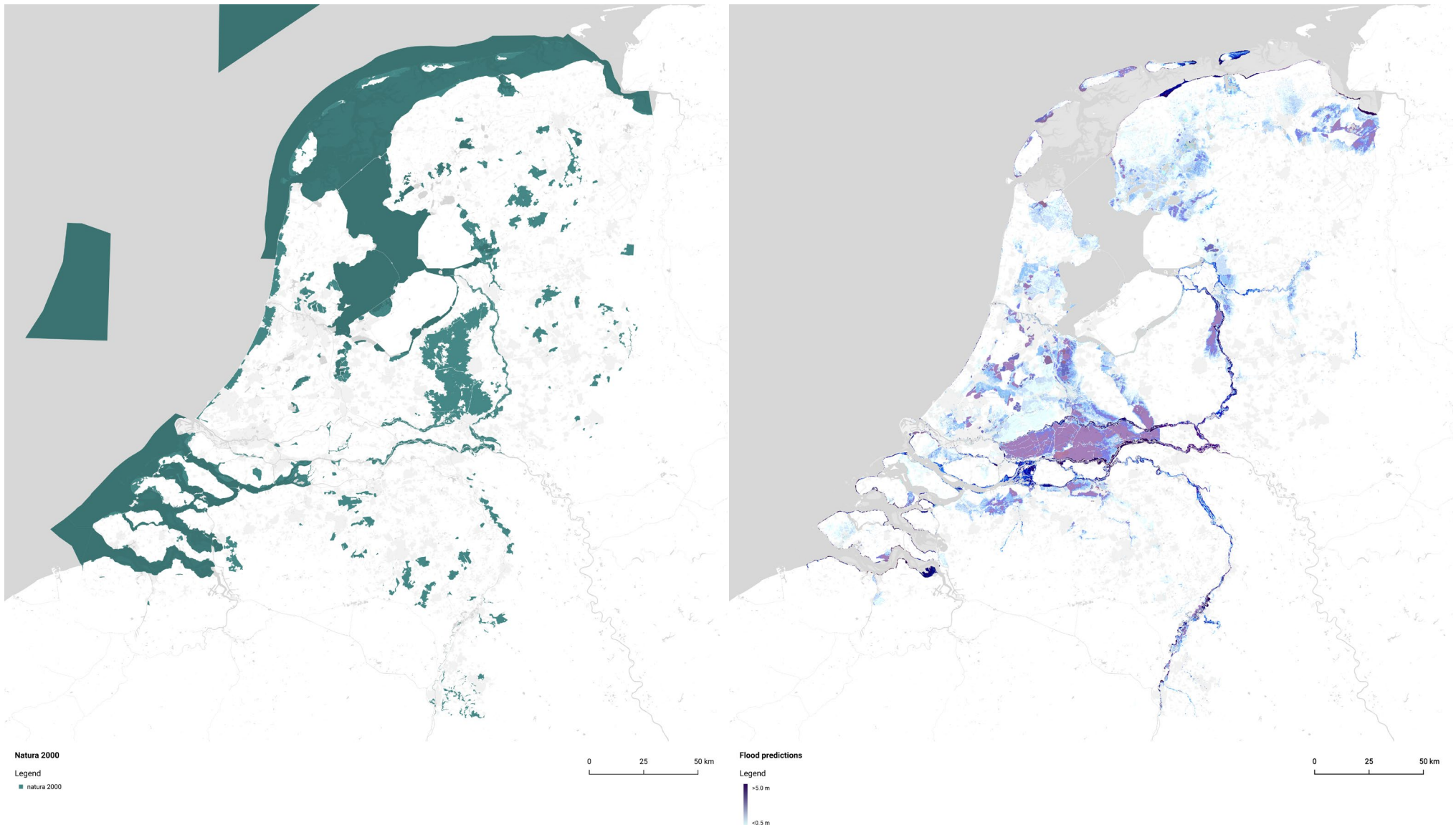
Flood risk areas

Spatial analysis waste house type 1

Existing waste disposal in Netherlands
Legend
• Disposal of non-hazardous waste and landfills
• Disposal/recovery of hazardous or municipal waste

0   25   50 km
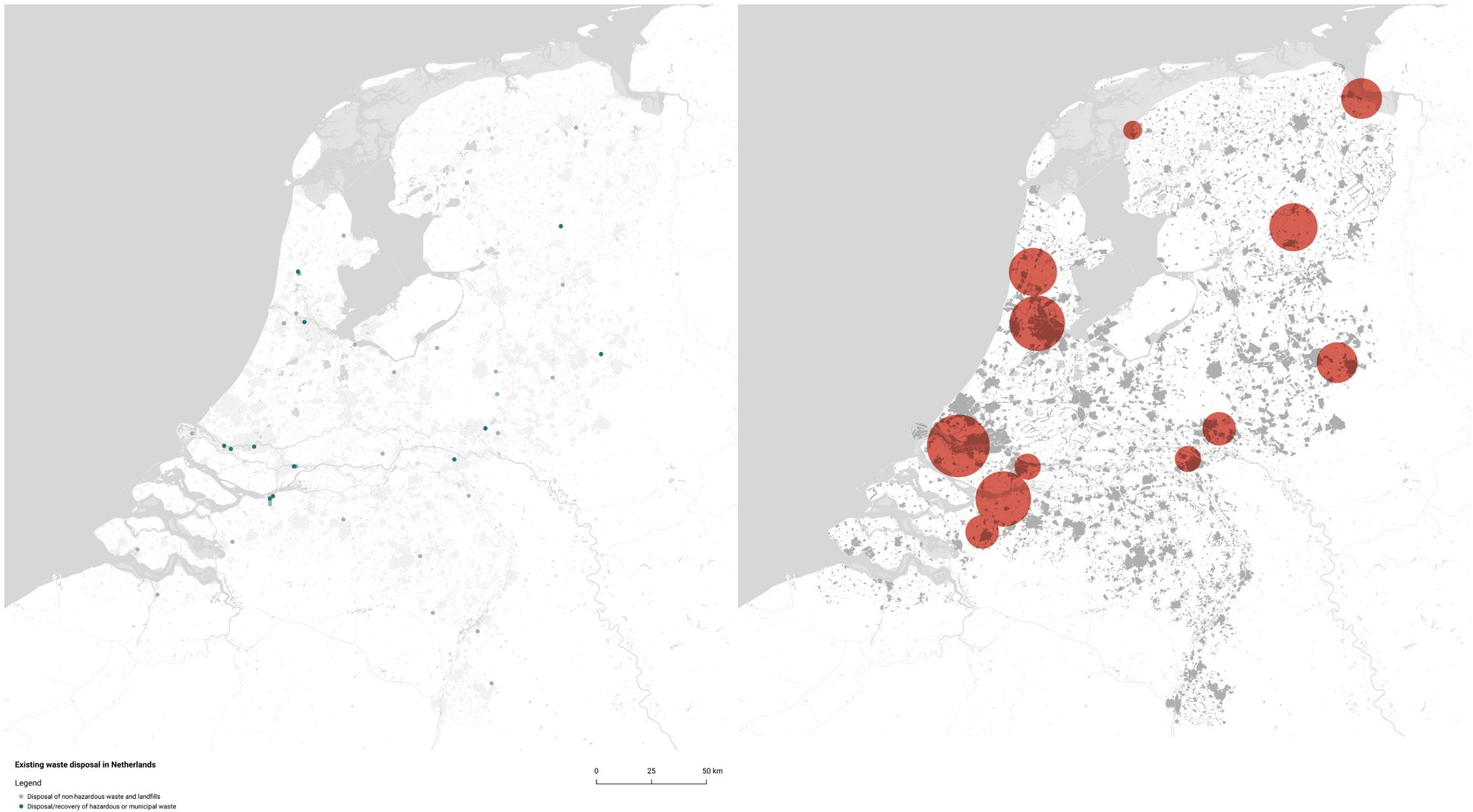
Existing recycling & waste processing facilities

Incineration plants currently in operation, with circle size relative to the amounts incinerated
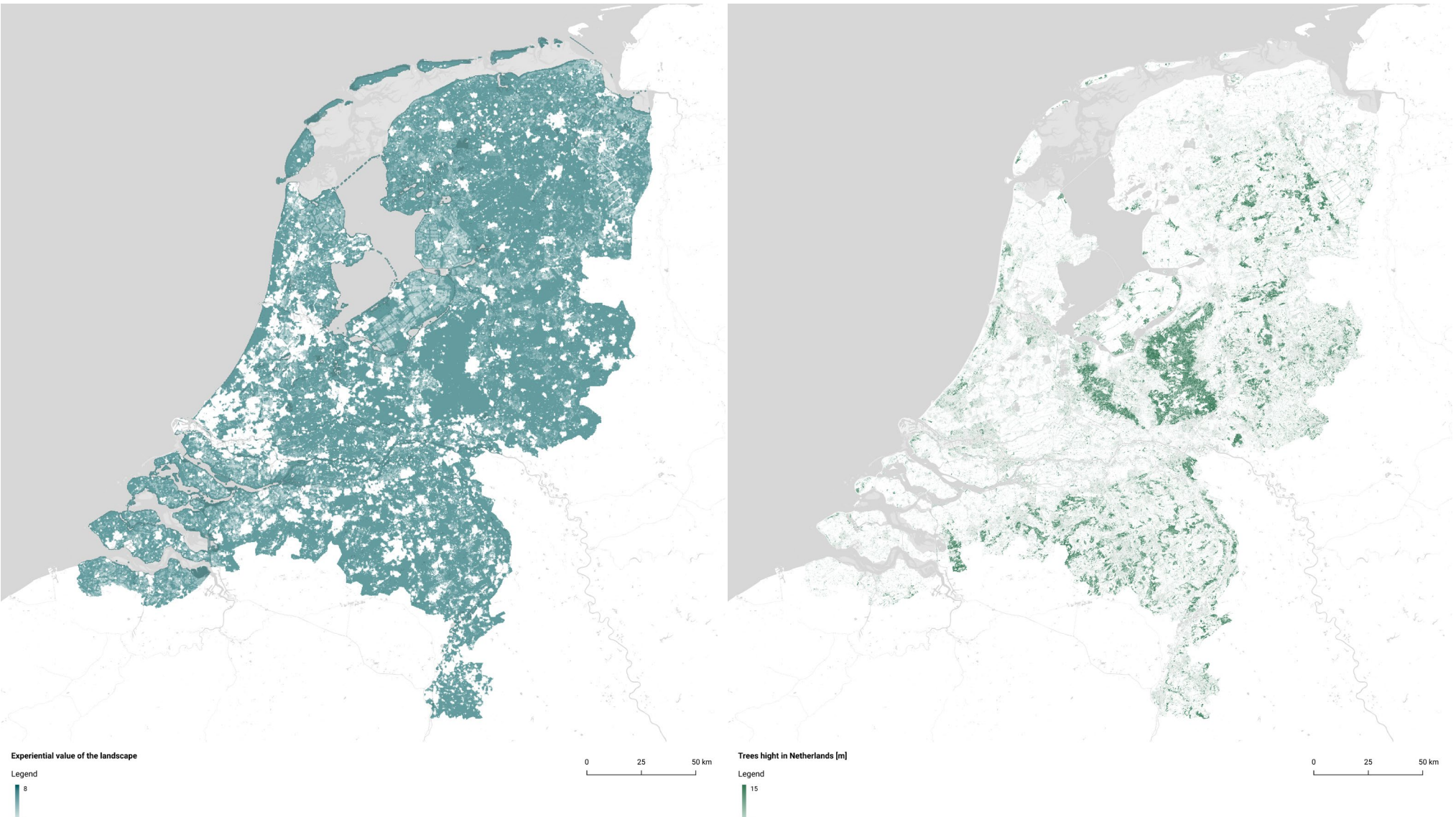
Spatial analysis waste house type 2

Basic network - transport of hazardous substances
Legend
— railway
— water
— roads

0   25   50 km

Soil subsidence
Legend
■ Very extensive (>60 cm)

■ Limited (3-10 cm)

0   25   50 km
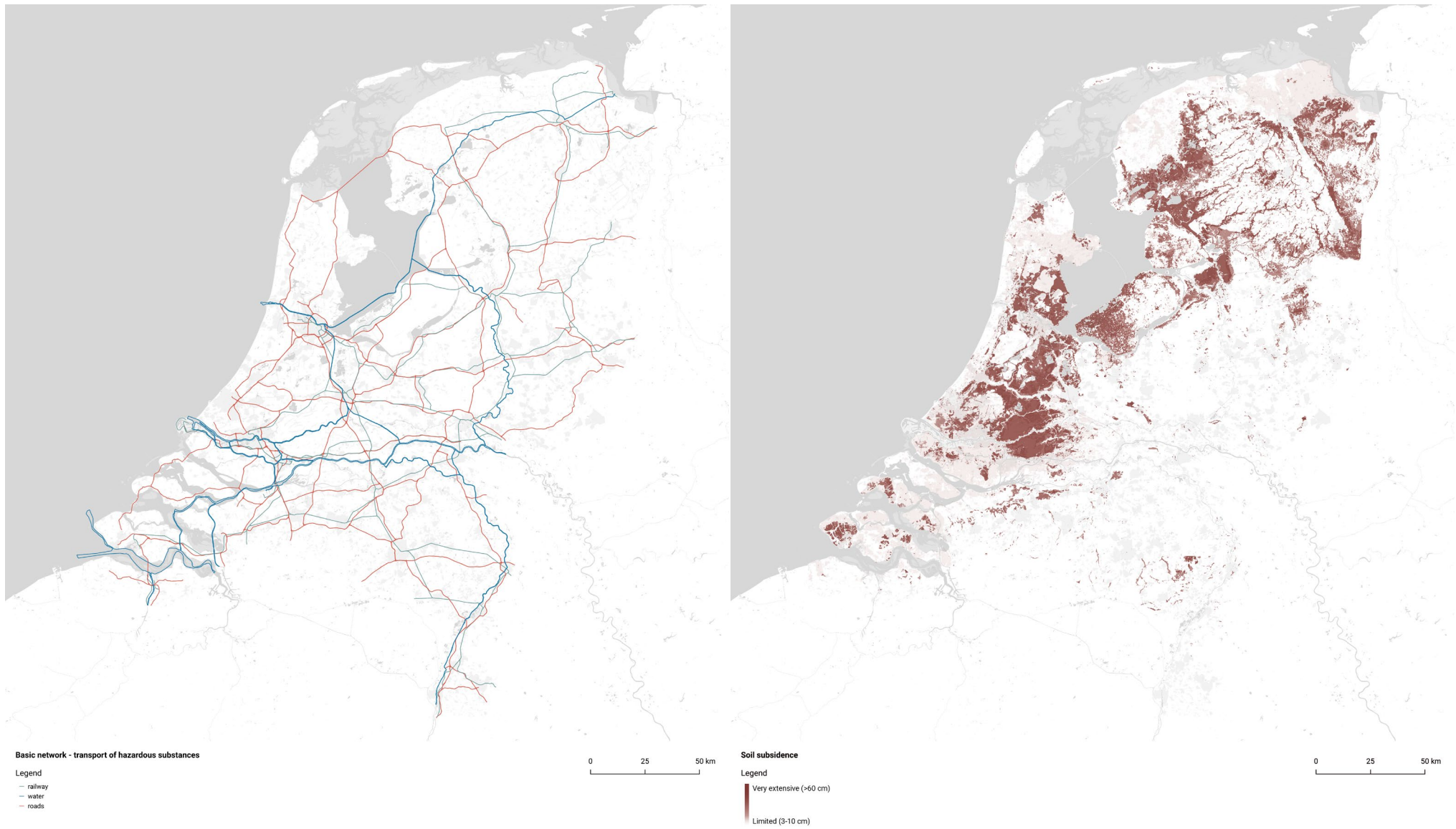
Transport of hazardous substances

Soil subsidence

Spatial analysis waste house type 3
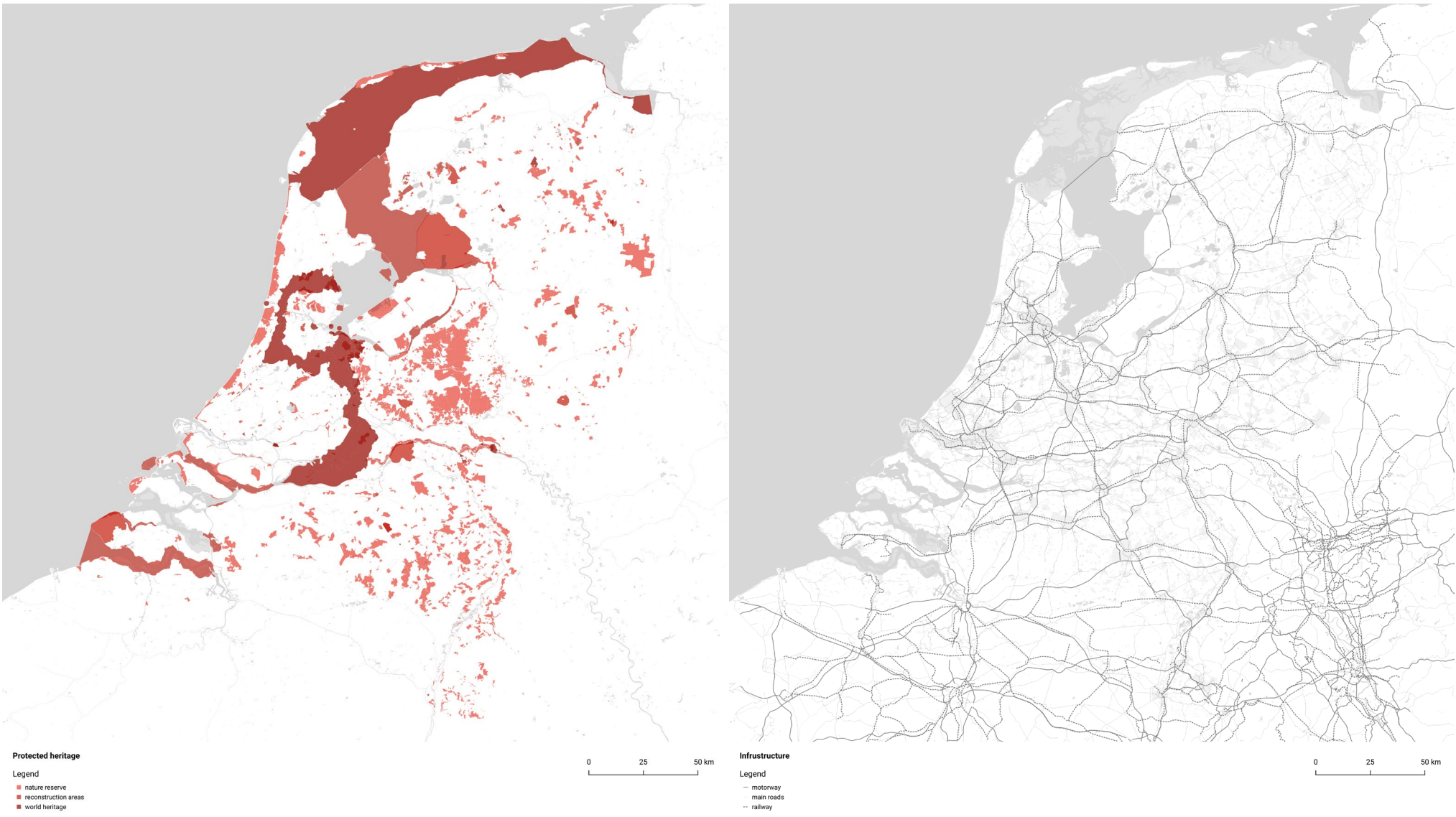
Protected heritage

Transport infrastructure

Experiential value of the landscape
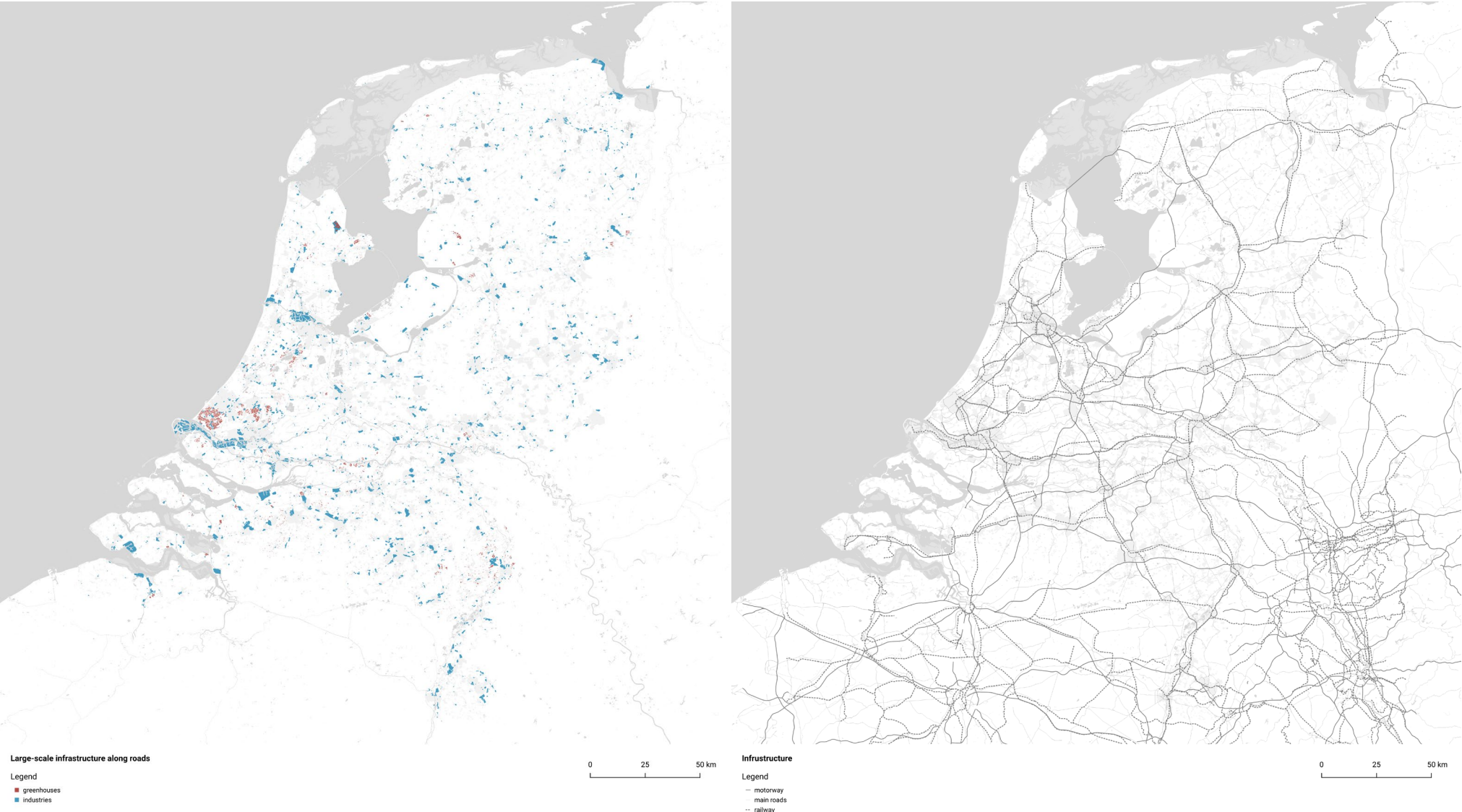
Tree height

Spatial analysis waste house type 4

Cities and infrastructure

Wind speed
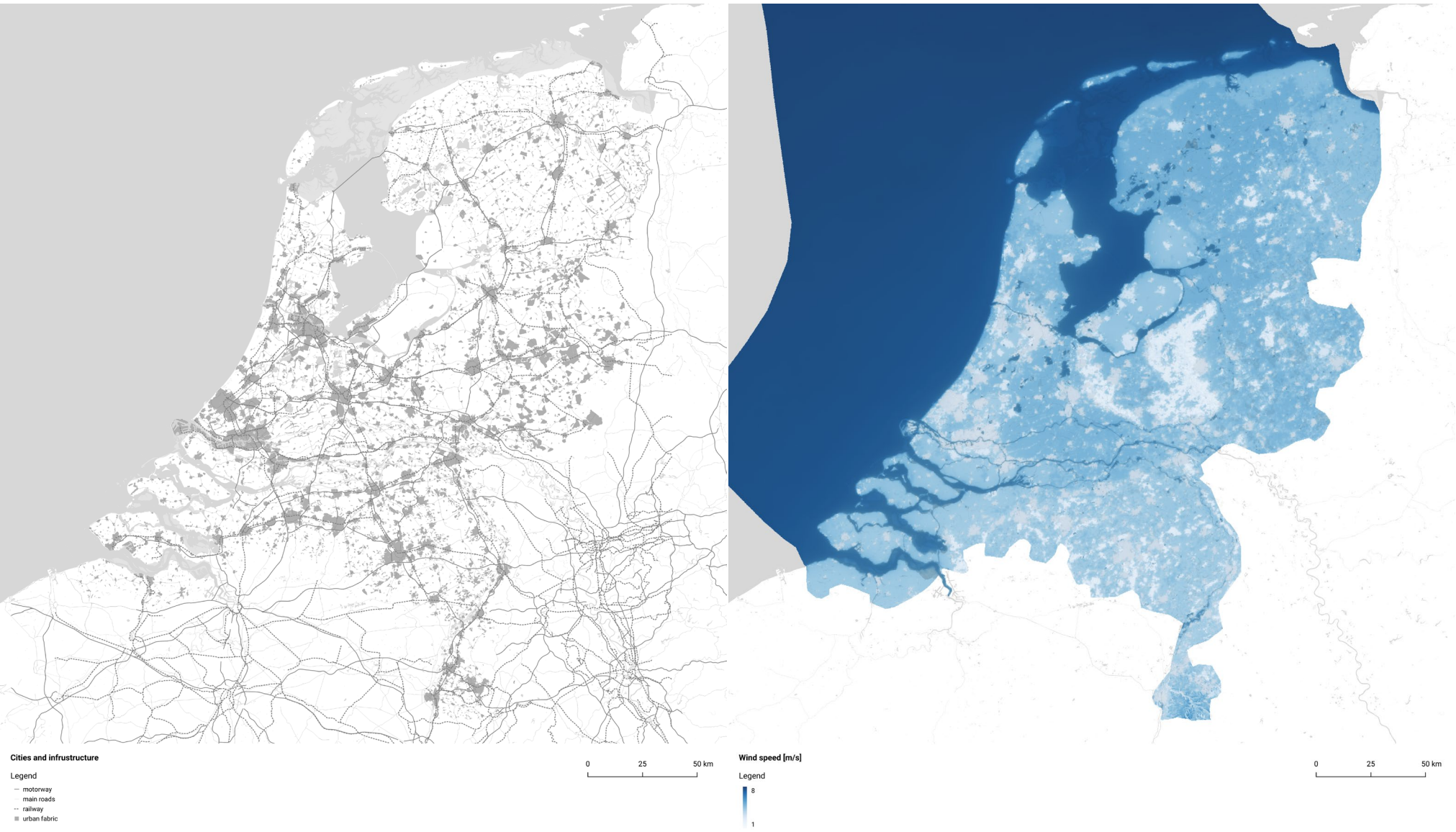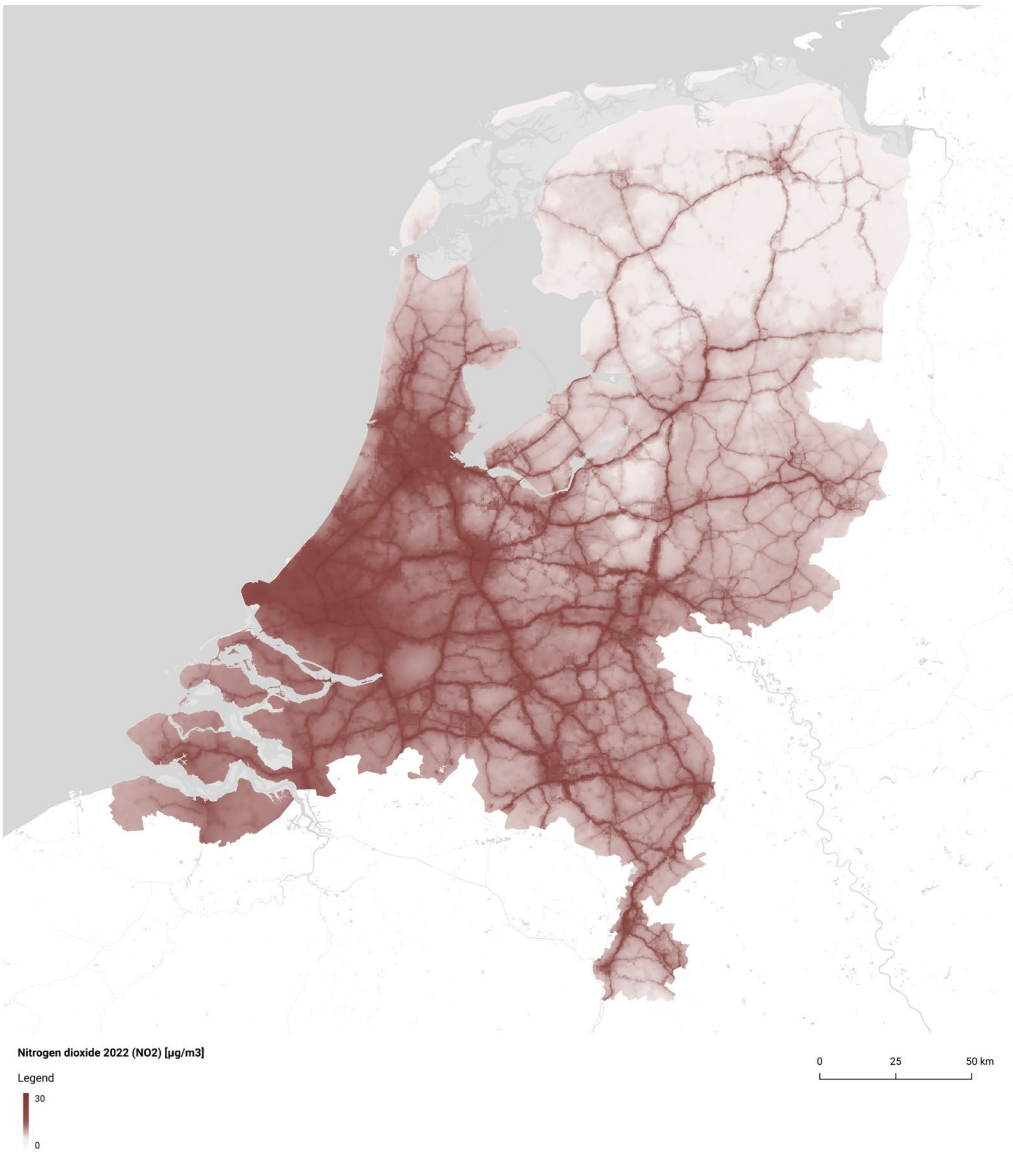

Nitrogen Dioxide

Spatial analysis waste house type 5


Large-scale infrastructure along roads

Legend
■ greenhouses
■ industries

0   25   50 km

Large scale infrastructure along roads

Infrastructure

Legend
— motorway
— main roads
— railway

0   25   50 km

Transport infrastructure

General spatial analysis maps

The following base maps were used to
inform mapping decisions and to obtain
a general understanding of the spatial
dimension of our project.
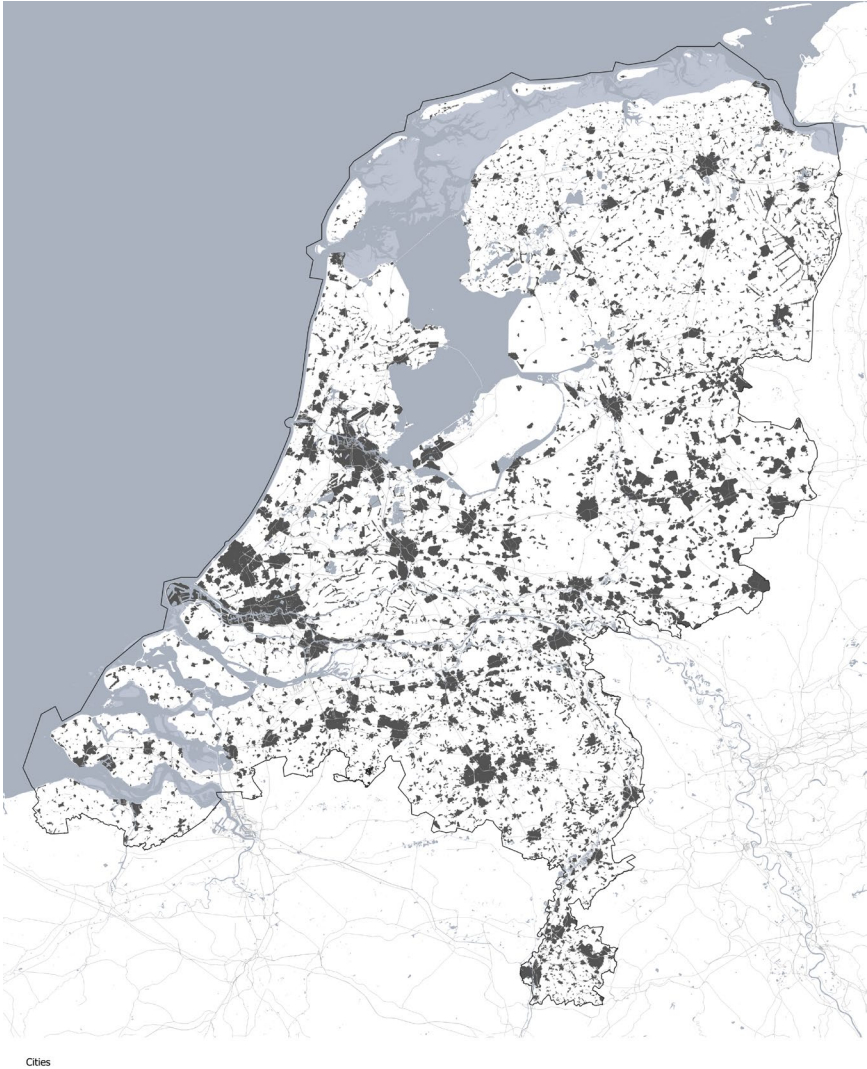
Cities

Cities in the Netherlands
Land cover map of urbanised spaces where people live and work
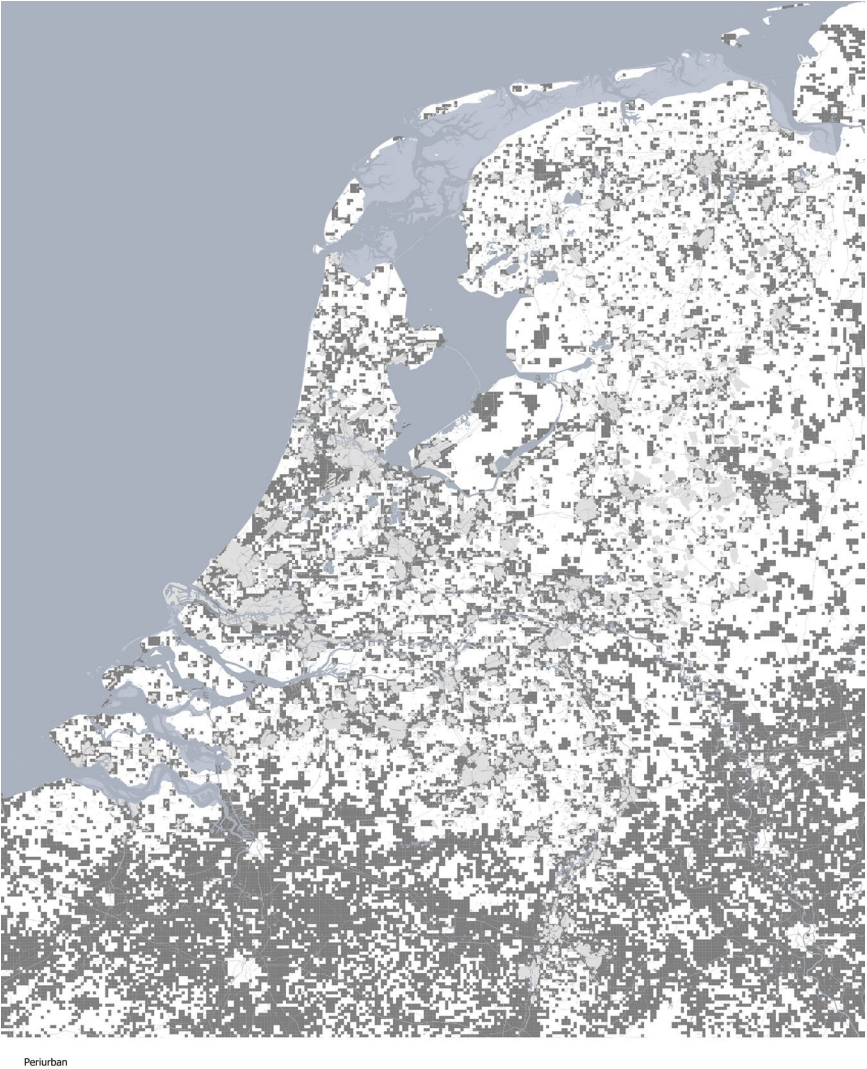
Periurban

Peri-urban areas
Peri-urban land cover in the low lands region calculated using GeoDa and
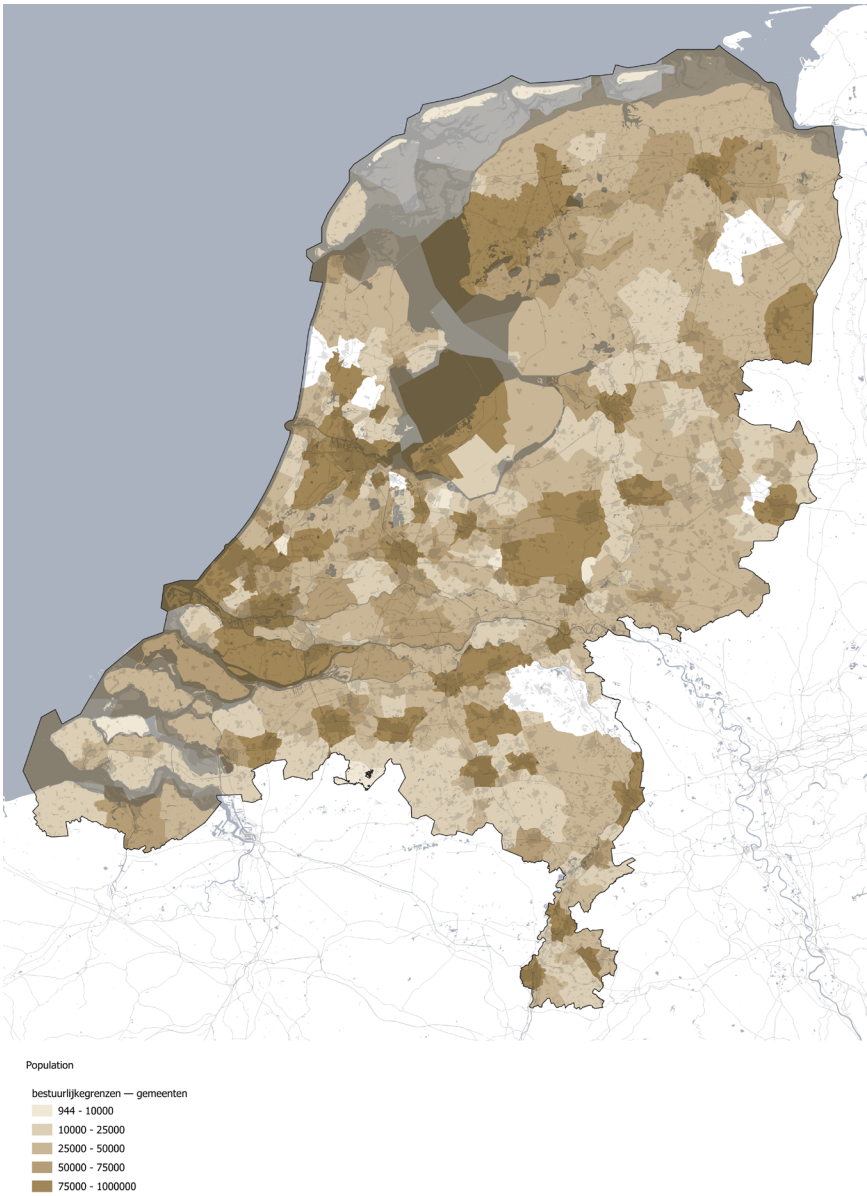variables of XXXXXXX

Nature

Nature in the Netherlands
Land cover map of space described as 'natural'. These include Natura 2000
areas, XXXX
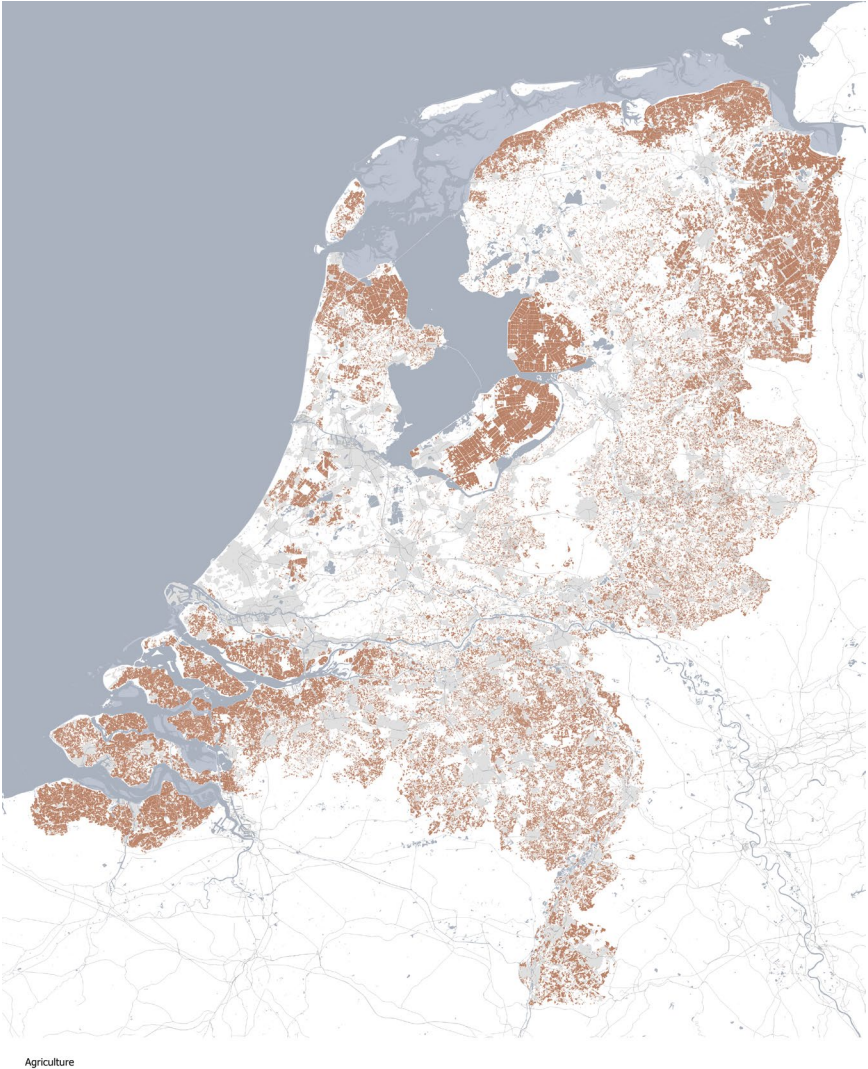
Agriculture

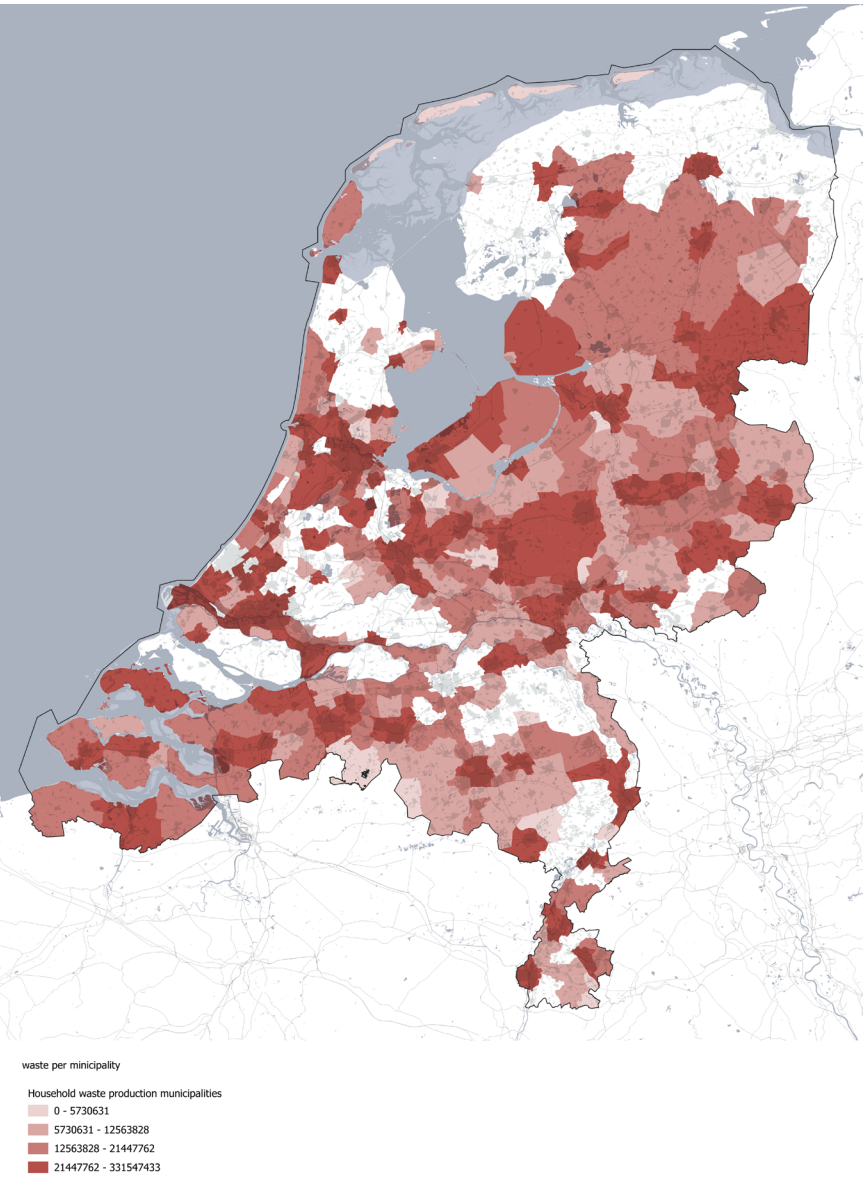**Agriculture in the Netherlands**
Land cover map showing agricultural areas

General spatial analysis maps

Population

bestuurlijkegrenzen — gemeenten

Household waste production municipalities

|	
	944 - 10000
	10000 - 25000
	25000 - 50000
	50000 - 75000
	75000 - 1000000

Population per municipality
The amount of inhabitants per municipality is shown. This is not the same as population density since municipalities differ in size.

waste per minicipality

Household waste production municipalities

	0 - 5730631
	5730631 - 12563828
	12563828 - 21447762
	21447762 - 331547433

Waste per municipality
Tonnes of waste produced per municipality. Interestingly, waste produced and population per municipality do not correlate directly.

Industries CO2
Radius - 10

Concentration of CO2 emissions from industry
CO2 emissions that were produced by industrial complexes in the low lands region

Industries
Radius - 10
Maximum - 50
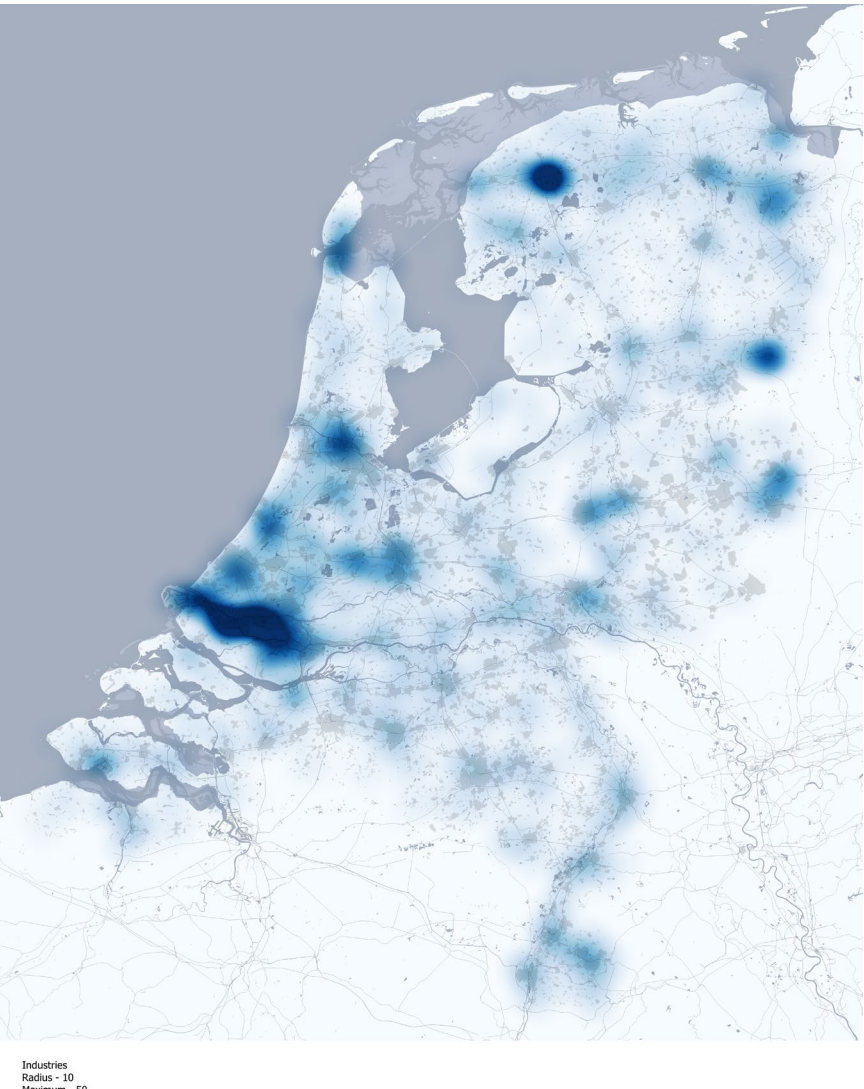
Concentration of industrial sites
The map shows a clear cluster of industrial activity in the Randstad region, specifically in the port of Rotterdam
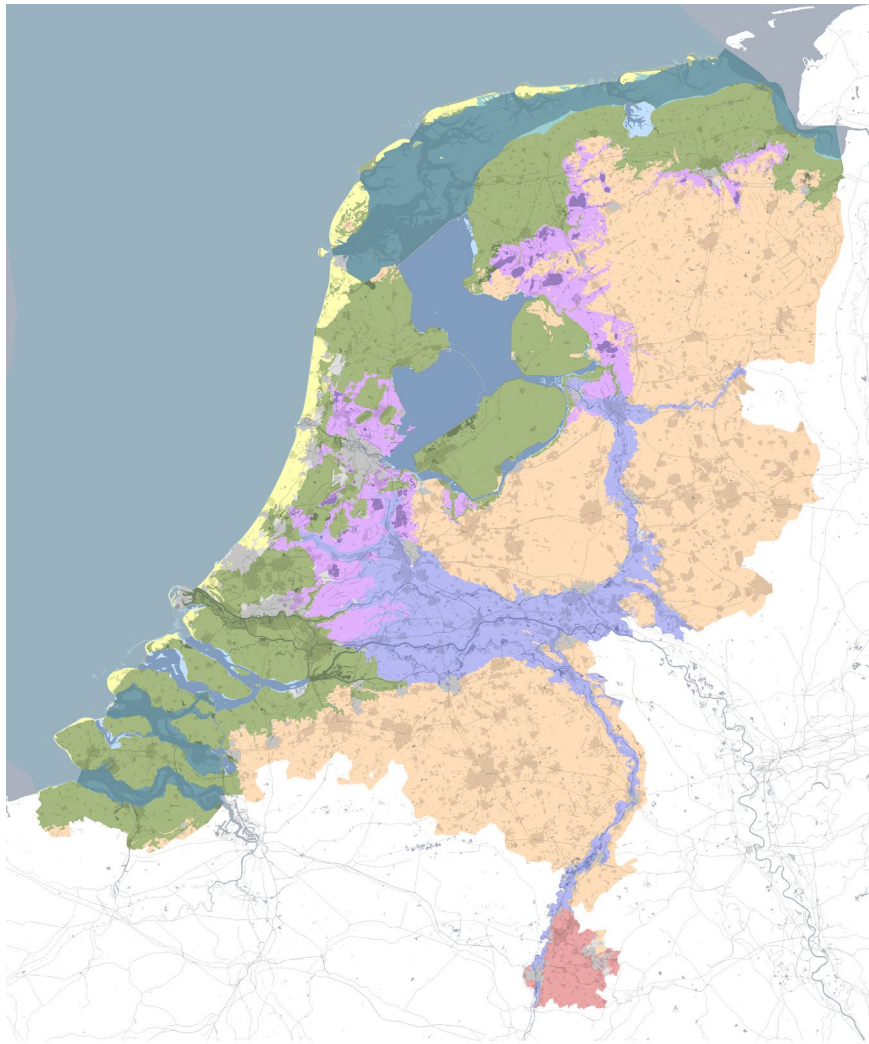
General spatial analysis maps

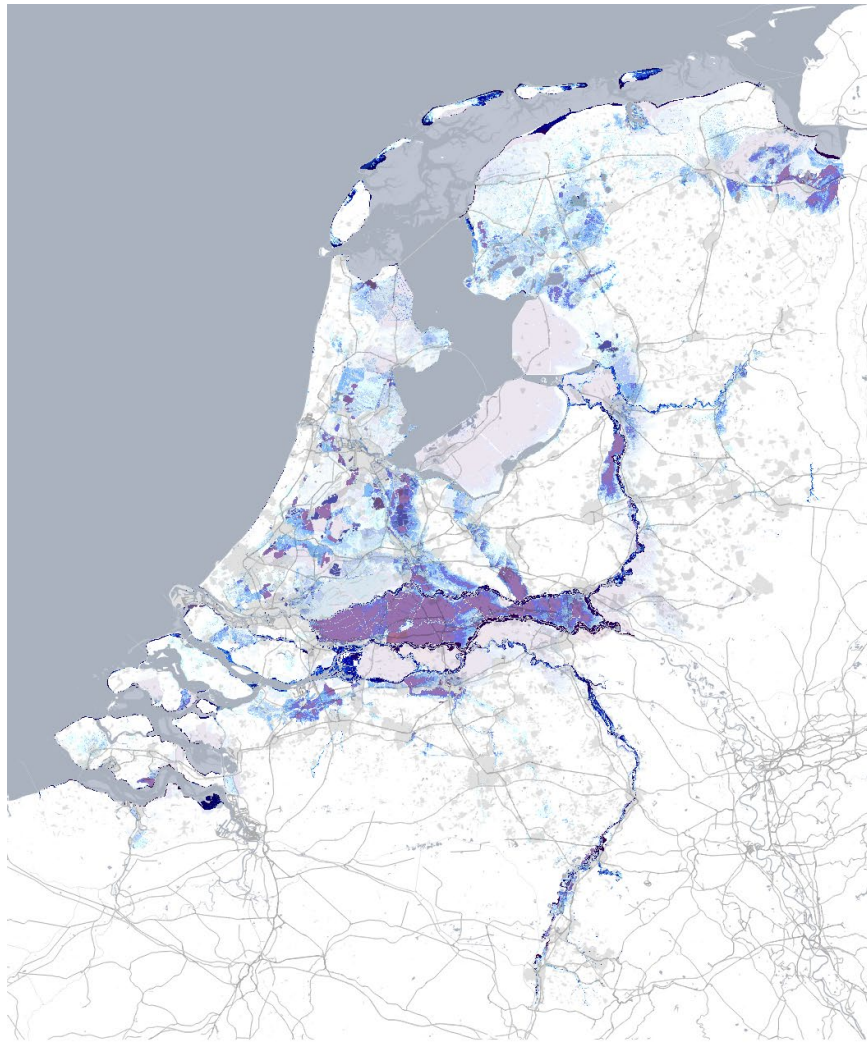Water

Water
Main water structure in the low lands region

Natura 2000

Natura 2000 areas
Dutch Natura 2000 protected natural areas

Natural systems

Fysisch Geografische Regio's

Natural systems
Land cover map of the Netherlands showing general ground/environment
characteristics

Flood predictions

Flood risk in the Netherlands
Land cover map showing areas with high flood risk