FROM BIODESTRUCTIVE **TO BIODYNAMIC**

Towards a resilient food system with healthy, regional and energy-efficient food production.

From Biodestructive to Biodynamic

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ABSTRACT

Amid the rapid climate change and resource depletion, there is a dire need for energy transition in all sectors for resilience. In the Netherlands, agriculture dominates land use and the economy but remains fossil-fuel dependent, contributing to environmental degradation. The industry must incorporate eco-sensitive practices while facilitating the energy transition, placing farmers at the core of this systemic transition. Furthermore, globalisation has created a distance between producer and consumer, spatially and mentally (Bock & Wiskerke, 2024), creating tensions between the farmers in the countryside and consumers in the cities, which the systemic change needs to factor in.

With its fertile landscapes and high solar and wind potential, Flevoland presents a unique opportunity for synergising health, agriculture and renewable energy in the Netherlands (Staps et al., 2015). A few biodynamic farms already demonstrate eco-sensitive practices, integrating hydrogen, solar, and wind. However, these initiatives are marginalised by globalisation, market pressures, consumer demands, and policy frameworks. Therefore, this project attempts to conceptualise HOW biodynamic farming principles in Flevoland can be upscaled and combined with the sustainable energy transition to strengthen the (regional) food supply chain.

Through spatial mapping and critical analysis of the supply chain and consumer behaviour, the identified opportunities and challenges are translated into a spatial vision for our transition community, i.e. the biodynamic farmers, through three zones: urban, transition, and agricultural, each supporting varying producer-consumer dynamics and shortening the chain while integrating farming, biodiversity, innovation, and renewable energy for a multifunctional and interconnected landscape. The project further delves into the existing policies and identifies synergies, conflicts, and internal dilemmas within the proposed spatial vision. The project developed scenarios to understand the exemplary measures to address the internal dilemmas and upscale the biodynamic farms in Flevoland. These measures are further translated into interconnected strategic actions predominantly as physical spatial interventions and policies to regulate market dynamics and facilitate the energy transition. All of these are supported by collaborations between stakeholders with varying vested interests and raising their awareness through educational reforms. The different zones and types of transition zones are key to implementing this vision. They are reflected at multiple scales, ranging from Flevoland at a regional level to a neighbourhood-scale pioneering pilot project in Oosterwold.

The multiscalar approach, thus, accounts for an adaptive cycle that first creates a demand that enables the agricultural transition comprising spatial and legislative reorganisations, altogether reforming the environmental system. All these aspects together form a resilient food system, focusing on healthy, regional, and energy-efficient food production while giving room to nature and water.

KEYWORDS
Biodynamic farming, energy transition, regional design, Flevoland, producer-consumer relationship, short supply chain

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1.

FRAMING OF THE PROBLEM

THE DUTCH FOOD SYSTEM

FOOD SYSTEM IN GENERAL

Currently, there are significant societal challenges that require immediate action. Climate change can be seen as the most pressing, and energy generation and usage play an instrumental role in tackling this issue. Thus, the UN and EU have set goals (PBL, 2024) concerning the share of renewable energy in our system and reducing overall consumption. However, as it stands, it is likely that we will not reach these goals.

In the Netherlands, the agricultural system accounts for over half of the land use, as seen in Figure 1.3, and **it is responsible for 9% of the total energy usage in the Netherlands** (Eurostat, 2024). This is notably higher than the average of 3% of the European Union. Considering this expanse and the agriculture sector is the primary source of the country's GDP, there is a potential for institutional changes within this sector to achieve the UN and EU goals.

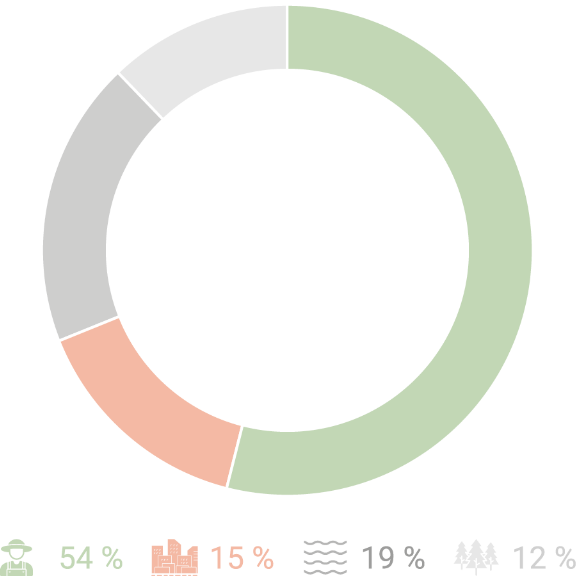


Fig. 1.1 | Land use the Netherlands pie chart
Data from: CBS Statline (2023)

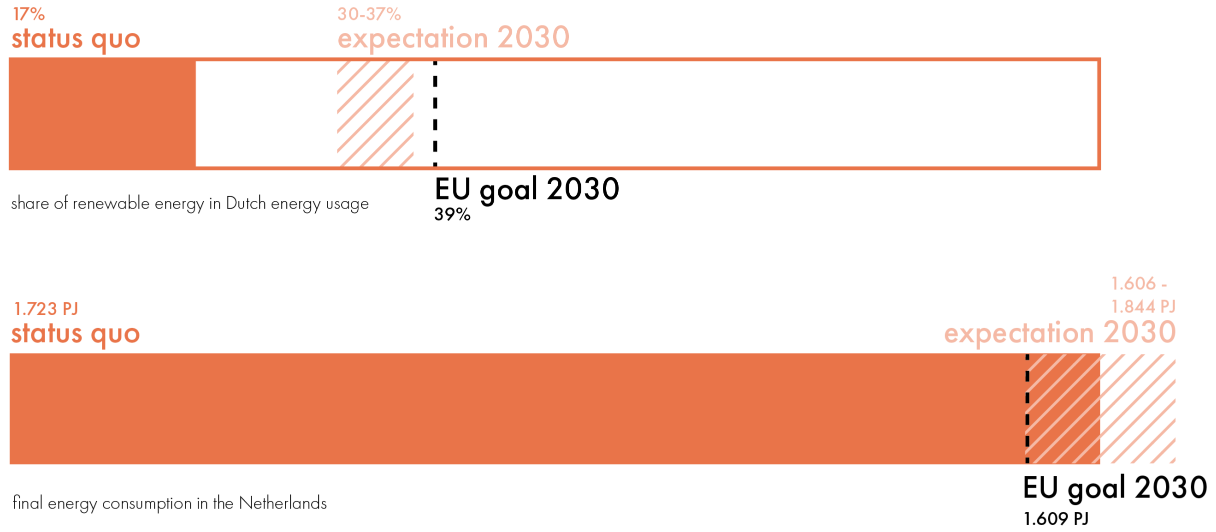


Fig. 1.2 | Paris Agreement status quo
Data from: PBL (2024)

Fig. 1.3 | The Netherlands overview
Data from: Copernicus EU (2018); CBS Statline (2023)

ENERGY

As evident in the systemic diagram, conventional farming methodologies rely intensively on artificial fertiliser, pesticides and heavy machinery, and the **direct and indirect energy usage behind this is responsible for 90% of the total energy consumption within the current agricultural system**, much of it is from natural gas usage, a non-renewable resource (Ferraro, 2007). The long distances travelled, the mediums of transportation for input into the food production, the travel till processors and distributors, and the export rely on delivery by trucks and ferries, both heavily reliant on natural gas. In the production area, the greenhouses utilise high amounts of energy for heating during the winter. In 2023, the agriculture sector emitted 24.9 million tonnes of CO_2 equivalents, accounting for approximately 18% of the Netherlands' total annual greenhouse gas emissions (Burgering, 2024). Subsequently, an immensely high amount of energy and water goes into processing agricultural produce and cooling in storage, distributor centres, and supermarkets. All these phases within the agricultural system generate significant waste, especially in the production phase, due to unrealistic expectations for the looks of vegetables and other produce.

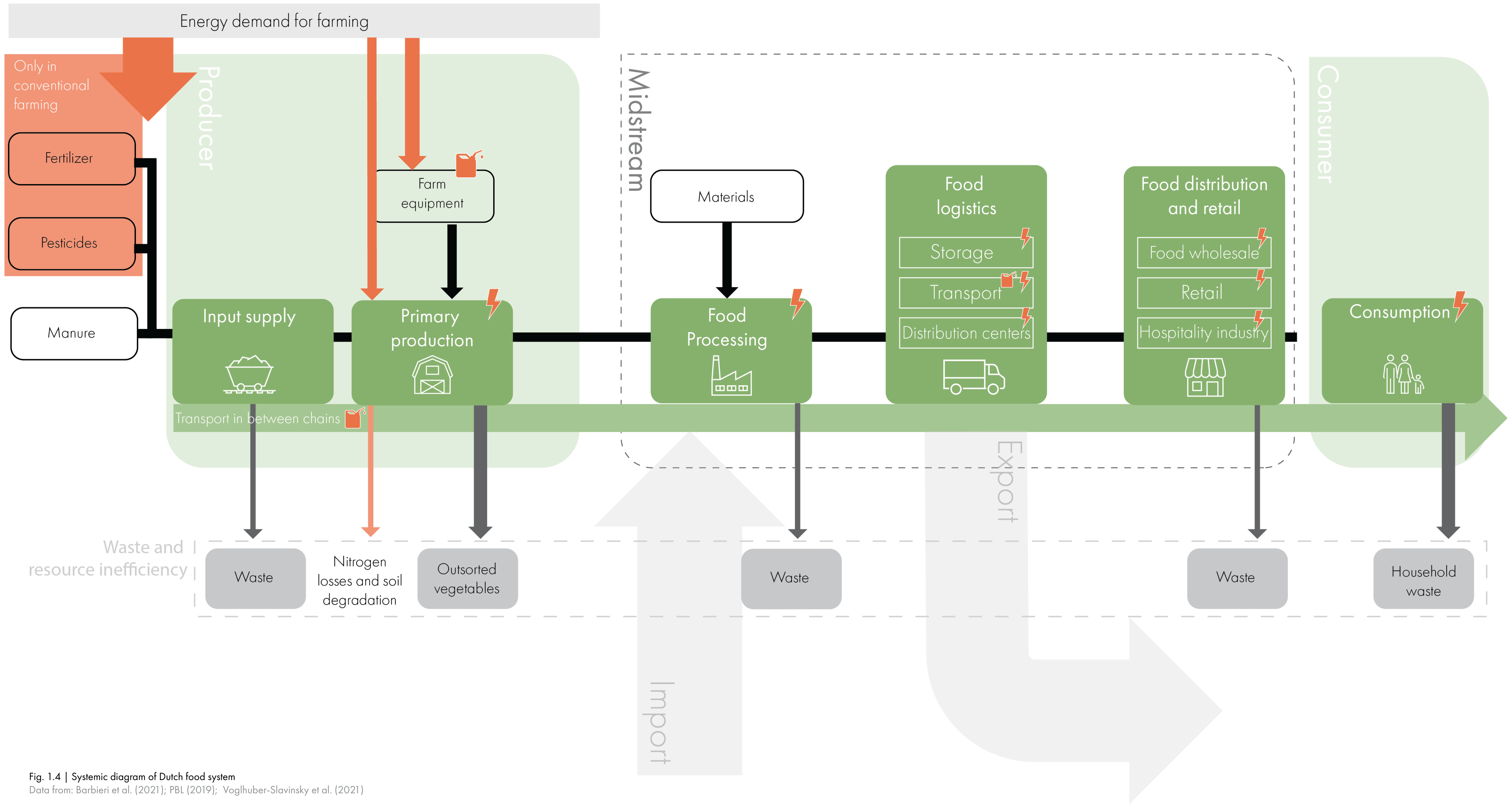


Fig. 1.4 | Systemic diagram of Dutch food system
Data from: Barbieri et al. (2021); PBL (2019); Voglhuber-Slavinsky et al. (2021)

Energy demand for fossil fuel
Energy demand for electricity

Furthermore, **the resource and energy input areas span across the world**. The industries that prepare the input resources, storage, processing, and distribution centres consume a lot of natural gas. These industries require much space and are one of the major contributors to air pollution, too. In 2019, the Dutch chemical sector, excluding refineries, used over 805 petajoules of energy and feedstock, resulting in more than 19 million tonnes of CO_2-equivalent direct greenhouse gas emissions (Eerens & Van Dam, 2022). Steam crackers, such as those operated by Dow Terneuzen, are responsible for over 25% of these emissions.

Dutch agricultural production poses complex environmental challenges impacting rural and peri-urban ecosystems. Excessive use of fertiliser results in nitrogen and phosphorus runoff, triggering eutrophication in water bodies—many of which still exceed EU Nitrates Directive limits (Rijksinstituut voor Volksgezondheid en Milieu, 2024). Pesticide use compounds the issue, introducing persistent pollutants into shared ecological and urban catchment areas. Conventional farming practices also deprive the soil of necessary nutrients in many ways. The overapplication of manure degrades the soil and contaminates groundwater, while ammonia emissions from livestock farming diminish air quality and biodiversity.

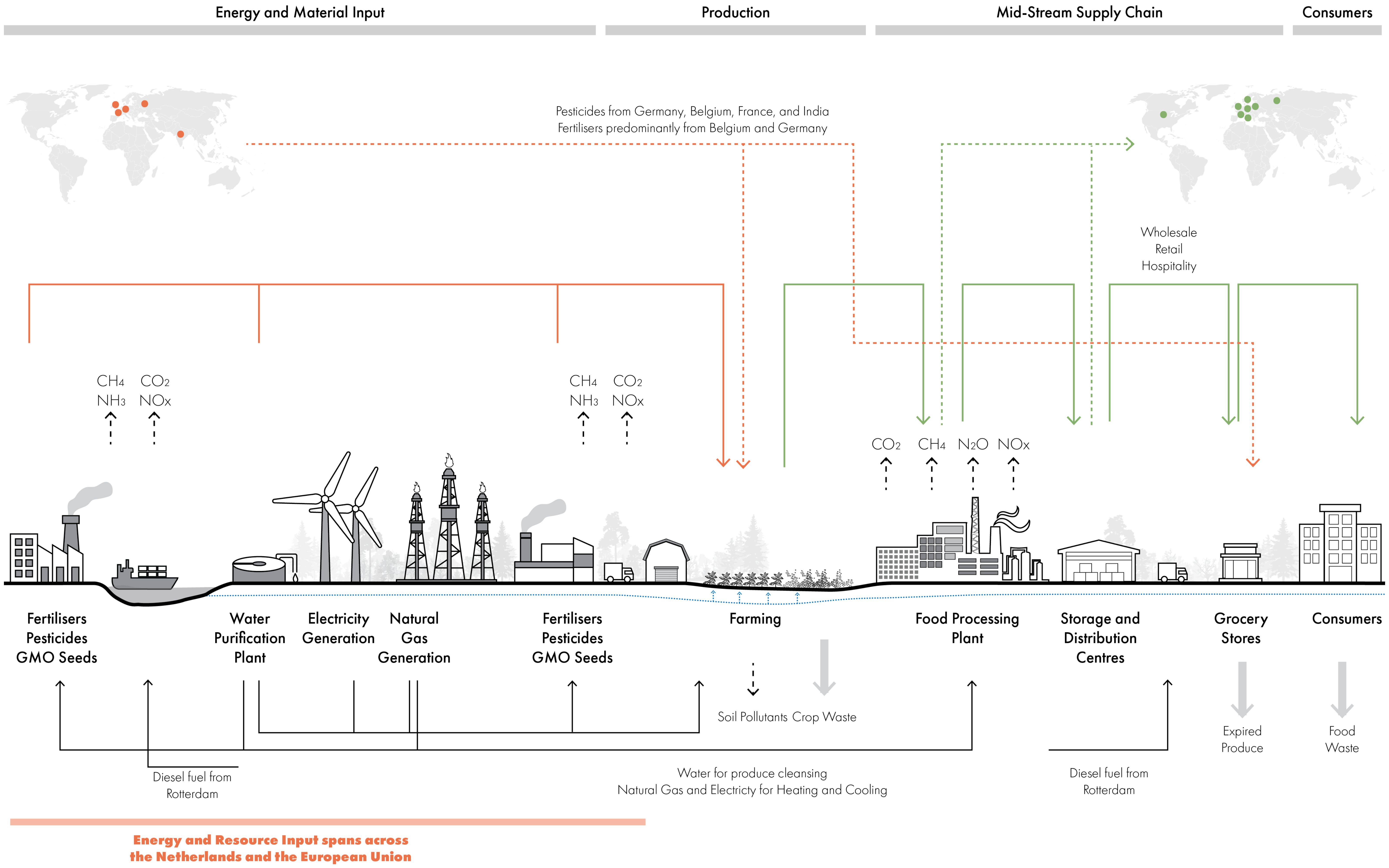


Fig. 1.5 | Systemic section of the Dutch food system

Data from: Barbieri et al. (2021); PBL (2019) Voglhuber-Slavinsky et al. (2021)

National transport
International import
National output transport
International export
Resource input
Emissions
Waste

HEALTH

The urban area and the agricultural land used to be closely connected. The surrounding farmland directly supplied the urban zones next to it. Nowadays, this direct relationship is no longer the case. The food system is now primarily based on international trade, which, according to Boersma et al. (2019), has led to "unprecedented prosperity in which food from all over the world is available year-round in more than adequate quantities" (p. 82). However, the authors also mention that this internationalisation of the food system has led to "ultra-processed factory food" (Boersma et al., 2019, p. 82). Instead of eating local seasonal food, people now tend to consume processed energy-rich and nutrient-poor food that can be eaten yearly (Boersma et al., 2019). People eat too much unhealthy food, which results in obesity being one of the leading public health challenges, according to the WHO (World Health Organisation) (Boersma et al., 2019). According to den Broeder et al. (2024), over half of the Dutch adult population is now overweight, contributing to a high prevalence of diet-related diseases (including various types of cancer) and related healthcare costs. This number is expected to rise to 64% by 2050 (den Broeder et al., 2024). Hence, there is a high urgency to make healthy food accessible and affordable to counteract the current negative health trends.

PRODUCER AND CONSUMER RELATIONSHIP

The internationalisation of the food system has also had its impact of the Dutch agricultural landscape. One of the most notable changes has been the reduction in agricultural enterprises in the Netherlands (Bock & Wiskerke, 2024). While the number of enterprises has gone down, their size has grown. The globalisation of the agricultural system requires efficient and intensive production processes, which are not feasible on smaller farms. This has been reflected in the current landscape and on a social level.

The direct connection between the producer and consumer has been lost through large-scale production, distribution and consumption of produce. They have become two separate entities, unknown to each other. Globalisation has also impacted the consumer's ability to identify with the producer's place of origin. Consumers have lost their connection to the product since it can come from anywhere in the world. The third cause of the disconnection can be found in the specialisation of different roles within the food chain, which is also a consequence of the upscaling of the agricultural system due to globalisation. Because of specialisation and optimisation, all different processes within the food chain are fulfilled by separate actors, creating a bigger gap between the original producer and the eventual consumer.

IMPORTS AND EXPORTS

The Netherlands has a highly developed economy characterised by knowledge-intensive labour and openness (Bos et al., 2023; EOCD, 2023). Knowledge-intensive labour is driven by the country's highly educated population and prosperity (EOCD, 2023). Furthermore, the open economy directly results from its strong geographical location and highly developed transport and data infrastructure. Both characteristics significantly affect the Dutch food system positively and negatively. Positively, because the Netherlands has a leading international position in agriculture due to its strong innovation and technological expertise (LLTB, 2020). As a result, the Netherlands provides the global food system through high-quality agricultural products, machinery, and technologies. However, most high-quality agricultural products are exported to adjacent countries (Jukema et al., 2025). This contradicts the often-believed perception that the Netherlands 'feeds' the world rather than its own country. This is not true because, although the Netherlands is an important export country for knowledge and expertise, it is not large enough to have a quantifiable effect on the global food supply.

On the other hand, the open economy of the Netherlands makes the country highly reliant on international trade for economic stability and employment. Open borders have led to large international flows of agricultural inputs, like pesticides and agricultural outputs (EOCD, 2023). Additionally, the high population density and the diverse Dutch consumer demand make it impossible to meet the domestic food demand with the limited arable land in the Netherlands (Bos et al., 2023). Therefore, international supply and the open economy in the Netherlands remain essential for ensuring food security.

Fig. 1.6 | Producer and consumer relationship
Images used and adapted: MaatschapWij (n.d.); Michielverbeek (2014); Sigrid (2020); VADER Magazine (n.d.)

Fig. 1.7 | Consumer expectations
Images used and adapted: Centre for Health and Longevity (n.d.); Freepik (n.d.); Praxis (n.d.)

2.

SITE AND TRANSITION COMMUNITY

In this chapter, the selected region and transition community are introduced. The historical context, spatial characteristics, and field observations of Flevoland will clarify why Flevoland was chosen. Subsequently, the transition community will be introduced by explaining biodynamic agriculture via the main biodynamic principles. Furthermore, the relevance of the biodynamic farmers as a transition community will be elaborated upon. Lastly, other stakeholders in the Dutch food system are identified, and their power and interests are determined.

FLEVOLAND

HISTORY AND SPATIAL CHARACTERISTICS

Flevoland is a province in the middle of the Netherlands. It consists of a vast amount of non-irrigated arable land yet also facilitates relatively large urban areas (as seen in Figure 2.1). The combination of both suggests the possibility of creating a connection between consumers and producers on a regional scale.

The spatial characteristics of Flevoland are explored by going through the three different polders, as the characteristics differ per polder. The ‘Programma Landschap van de Toekomst’ (The Landscape of the Future program) from Provincie Flevoland (2021) explains the design principles that shaped Flevoland and which are still important spatial carriers. The presented spatial characteristics should be considered when developing Flevoland, providing a valuable basis for the vision and strategy. Nevertheless, the considerations should be balanced with the needs of the transition community.

Starting with the history of Flevoland (see timeline Figure 2.2). While there were multiple plans for land reclamation from the Zuiderzee, the plans did not gain any real traction until 1886, when the Zuiderzee Association was established (De Pater, 2010). The association’s goals were to research the economic and technical feasibility of the plan. At that time, two engineers were appointed, one of which was the now-famous Cornelis Lely. He developed Plan-Lely, which was not initially realised due to the lack of funds. However, two drivers ensured that the plan would eventually be developed. he first of which arose during World War I, international trade came to a halt. The Dutch were suffering food shortages. To increase food security and be less reliant on neighbouring countries, more agricultural grounds were necessary. The second driver was the Zuiderzee flooding in 1916. Due to these drivers, an adapted version of Plan-Lely was accepted in the Zuiderzeeact of 1918. Part of Plan-Lely was the construction of the Afsluitdijk to ensure similar floodings were prevented in the future.

In the twentieth century, Flevoland was developed by taming the Zuiderzee (Visit Flevoland, 2025). Eventually, three polders were created: the Noordoostpolder, Oostelijk Flevoland (East Flevoland), and Zuidelijk Flevoland (South Flevoland) (Provincie Flevoland, 2021). The poldering of the Zuiderzee was first meant for the Dutch food supply. Throughout the process, the focus shifted from solely facilitating agricultural space to creating pleasant living environments that combine housing, work, innovation, and recreation (Provincie Flevoland, 2021). The original agricultural focus is still clearly visible in the polders of Flevoland. Nevertheless, each polder differs significantly in terms of spatial qualities as they reflect the guiding principles that were deemed important at the time.

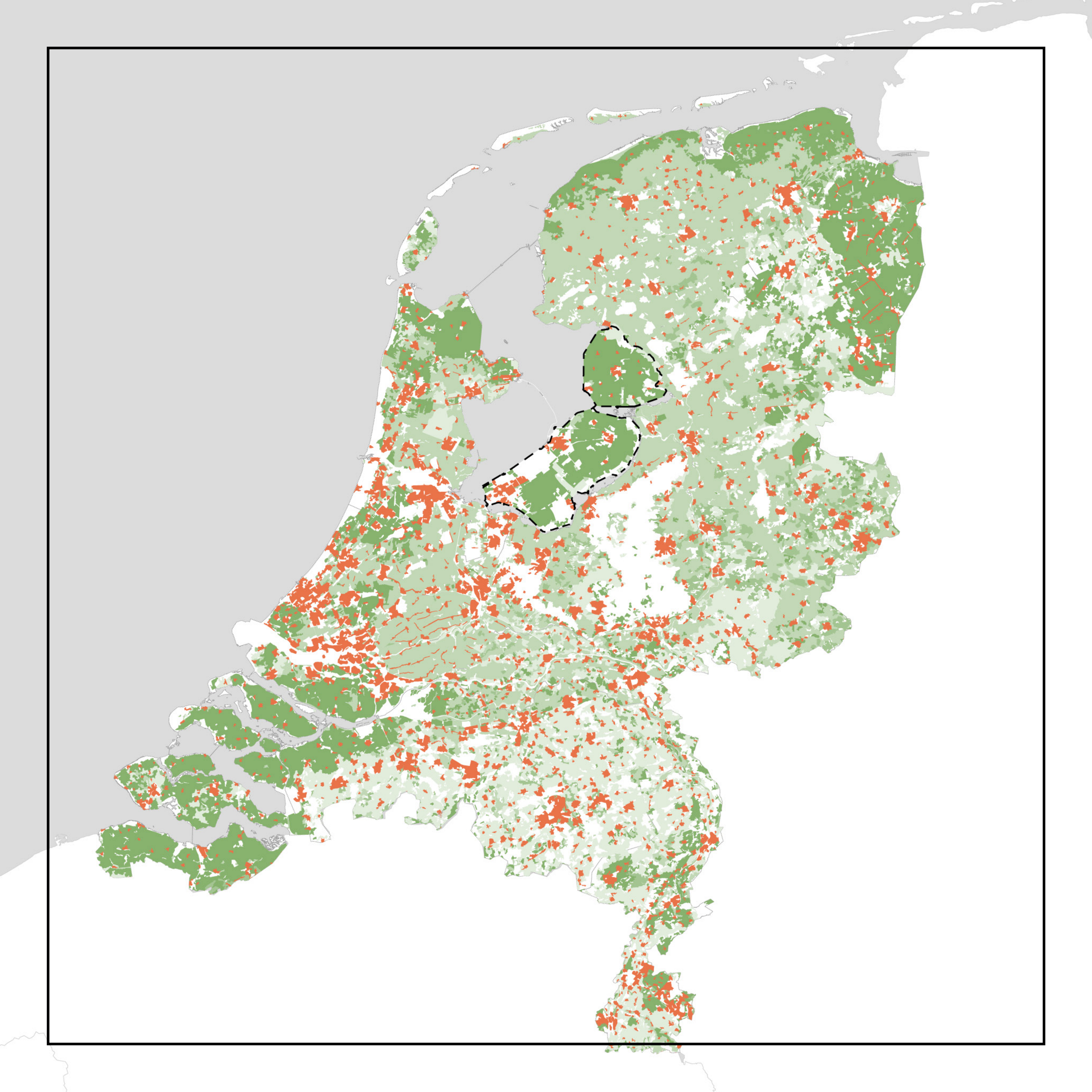
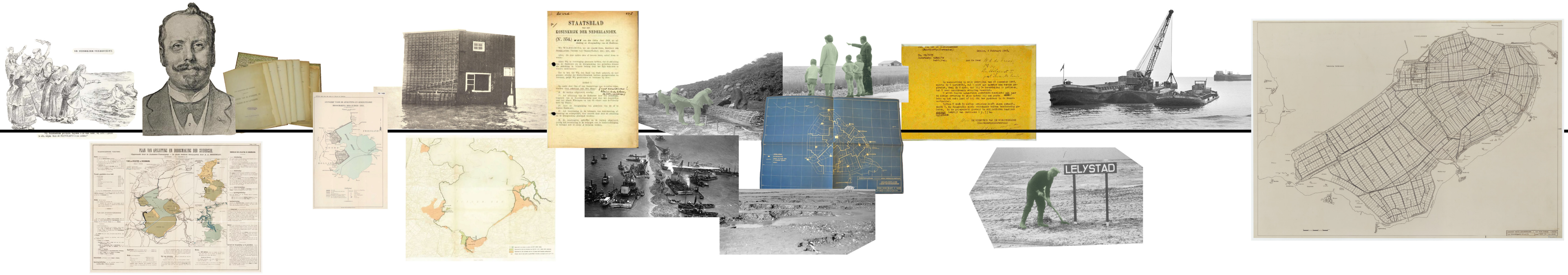


Fig. 2.1 | Land use in The Netherlands
Data from: Copernicus EU (2018)

- Urban area
- Non-irrigated arable land
- Land principle occupied by agricuulture
- Pastures
- Complex cultivation patterns

0 25 50 75 km

HISTORICAL OVERVIEW



1886 **Zuiderzeevereniging**

1891 **Plan-Lely**

1901 **first proposal Zuiderzeewet**

1916 **Zuiderzeeflood**

1918 **Zuiderzeewet**

1927 **Afsluitdijk**

1930 **Wieringermeer**

1942 **Noordoostpolder**

1947 **Selection of inhabitants**

1957 **Eastern Flevoland**

1968 **Southern Flevoland**

1986 **The Twelfth Province**

Fig. 2.2 | Historical timeline of development of Flevoland

Images from (left to right): [Illustration of Zuiderzeevereniging], (n.d.); Beekman, (1890-1900); Haverman, (1899); Geurts, (n.d.); [Map of plan for potential land reclamation from the Zuiderzee], (1900-1901); Waterlands Archief, (1916); Ramaer & Wortman, (1916); Staatsblad van het Koninkrijk der Nederlanden, (1918); [Photographs of the construction of the Afsluitdijk], (n.d.); [Photograph of reclamation Wieringermeer], (1930); [Blueprint of Noordoostpolder], (n.d.); NOS, (n.d.); Fotocollectie Nieuw Land & Boekhoven, (1966-1967); De Nijs, (1968); Directie van de Wieringermeer (Noordoostpolderwerken), Landbouwkundige Afdeling, (1975) The Noordoostpolder was primarily designed to expand the Dutch agricultural land. It has a concentric spatial layout with Emmeloord in the centre and a ring of villages around it. The city and villages are connected through radians of roads and canals (Provincie Flevoland, 2021). The drainage technology used when the polder was developed (1942) had a maximum size of 300 by 800 meters. These dimensions were used to divide the land into different sections, leading to a modular grid system with a mosaic pattern (Provincie Flevoland, 2021). This functional grid system is applied throughout the province, forming a landscape resembling Piet Mondriaan's artwork (Staatsbosbeheer, 2022). This Mondriaan structure is an important spatial characteristic of Flevoland. It can be recognized through its strong rectangular grid, openness, and variation in plot size and agriculture, as seen in Figure 2.5 (Provincie Flevoland, 2021). The strong agricultural grid was key to choosing the project's region.

In 1957, The Oostelijke Polder was developed. Here, spatial principles are more combined and less prominent. Designers aimed to focus on the human scale in contrast to the large open polder (Provincie Flevoland, 2021). Therefore, lanes and singles were applied with accompanying greenery to split the polder into smaller sections. Emphasis was put on the cities of Lelystad and Dronten, and a triangular network of "polderparkwegen" (polder park roads) was realized (Provincie Flevoland, 2021, p. 27).

The last polder to be realized was Zuidelijk Flevoland in 1968. A more hybrid approach was used, shifting the monofunctional agriculture focus. This led to a spatial layout consisting of different recognizable entities, such as the city of Almere, the Horsterwold forest, and a nature reserve called Oostvaarderplassen (Provincie Flevoland, 2021). Another key spatial characteristic of this polder is its rectangular shape of trees (referred to as the "poldercarré") that surround the main agricultural heart of this polder (Provincie Flevoland, 2021, p. 28). One main road, the Vogelweg, goes across this main agricultural space, which is accentuated by extensive greenery.

Furthermore, the province considers it important to ensure that the three different polder identities remain recognizable (Provincie Flevoland, 2021). For Oostelijk Flevoland, the main roads (polderparkwegen) should be strengthened and recognizable by giving them a green appearance. The Mondriaan landscape should be recognizable in the spaces between the main roads. Furthermore, the zone around the airport next to Lelystad is seen as a potential hybrid zone. Functions can also be more mixed by, for example, mixing the forest areas with agriculture in agroforestry (Provincie Flevoland, 2021). Finally, it is vital to maintain the cultural historic identity of the polder, so the important waterworks, such as dykes should be highlighted in the landscape. For Zuidelijk Flevoland, the poldercarré (rectangular agricultural space bounded by a green border) and the Vogelweg should remain important strong spatial carriers. Laslty, the green areas should be better connected, and urban and agricultural functions should be mixed more (Provincie Flevoland, 2021).

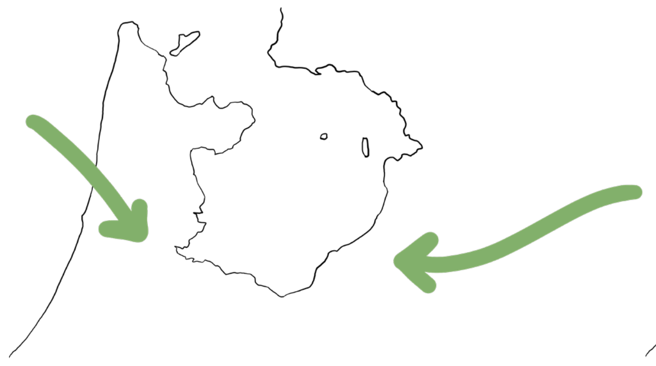


Fig. 2.3 | Netherlands is dependent on imports

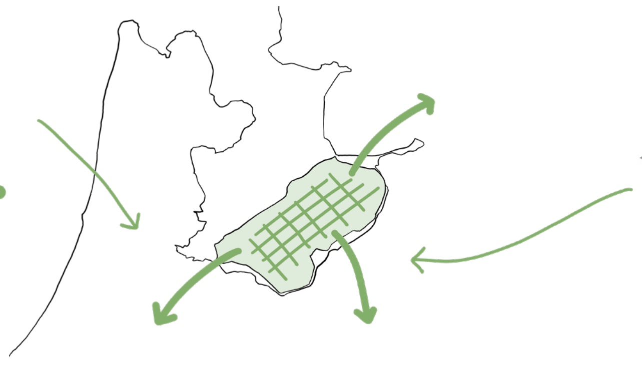


Fig. 2.4 | Flevoland for Dutch food supply

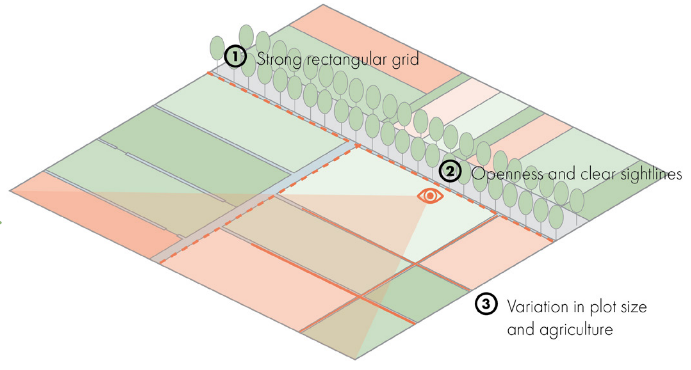


Fig. 2.5 | Mondriaan landscape
Data from: Provincie Flevoland (2021)

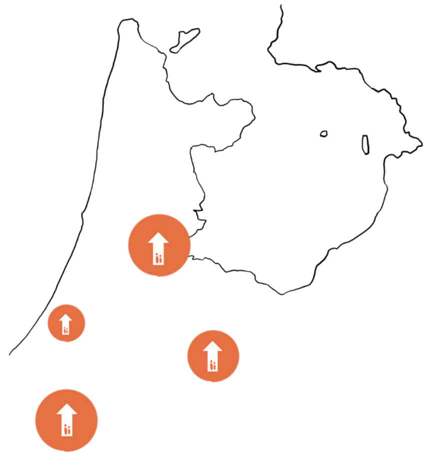


Fig. 2.6 | Large cities growing

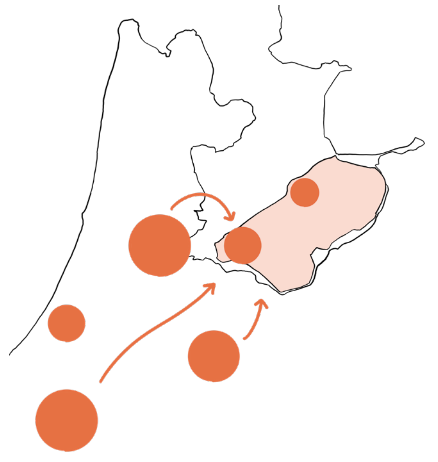


Fig. 2.7 | House overpopulation from bigger cities

Fig. 2.8 | Innovation mindset

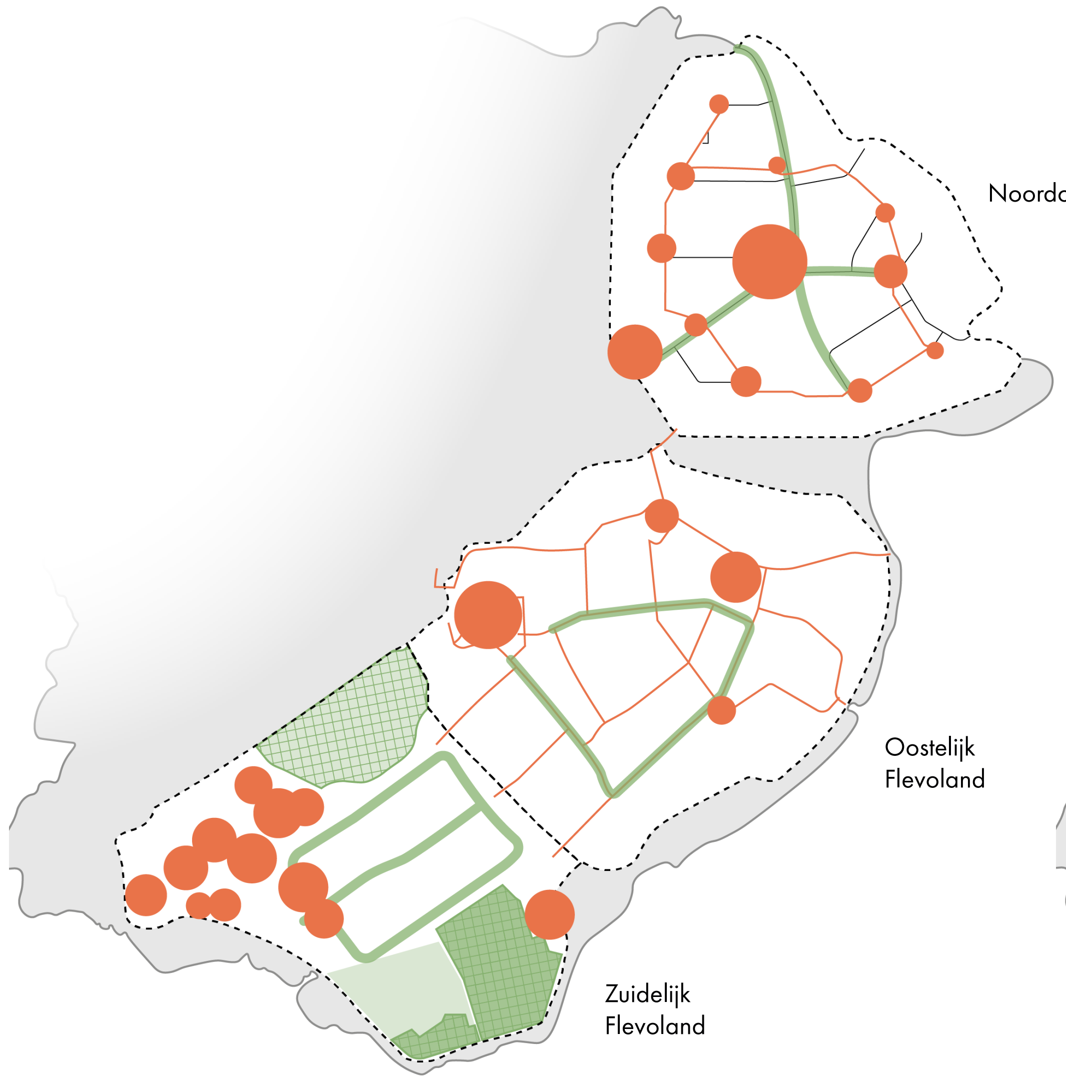


Fig. 2.9 | Original design principles Flevoland
Data from: Provincie Flevoland (2021)

- Cities and villages
- Main roads
- Main roads accentuated with greenery
- Borders of the different polders
- Protected green zones
- Water
- Network of canals

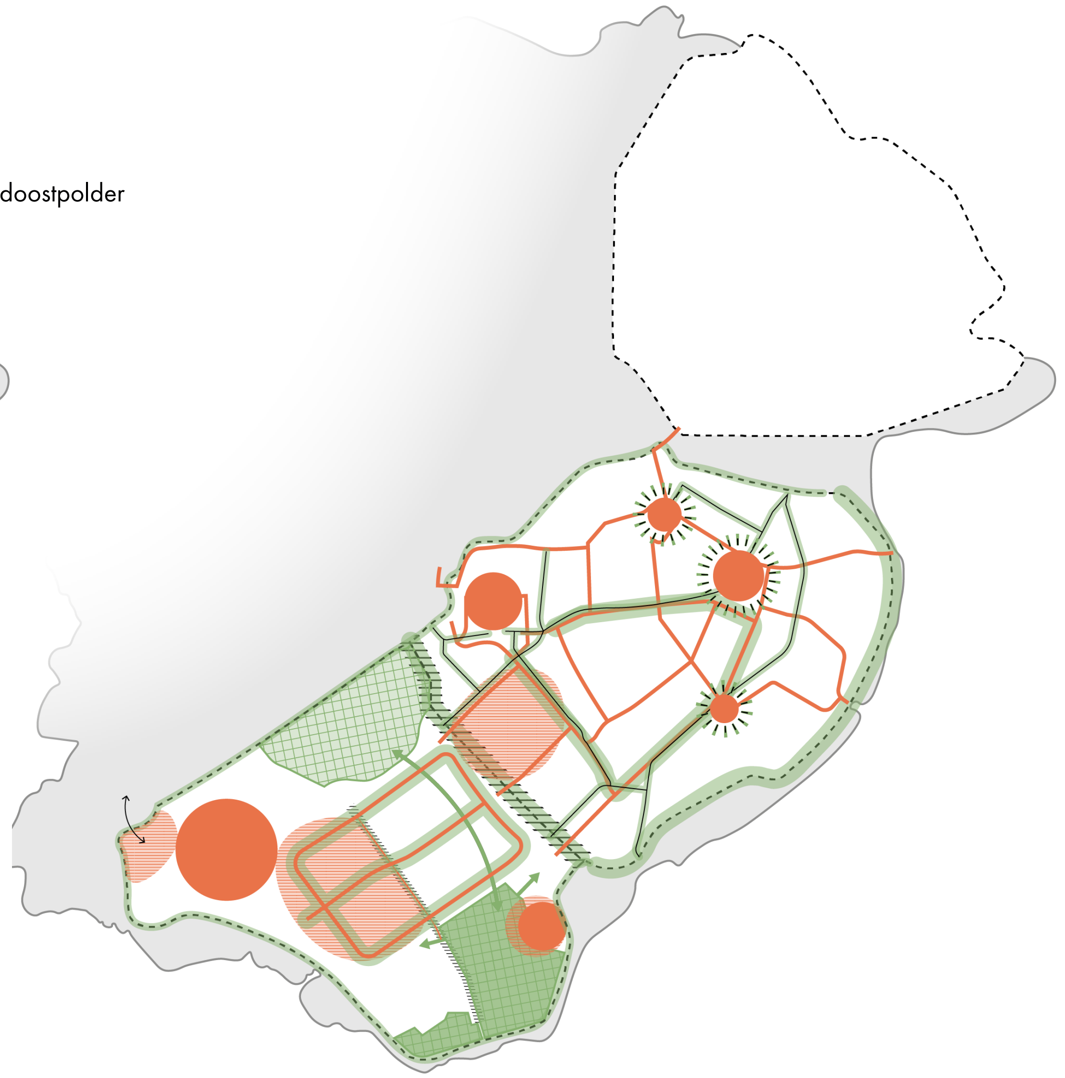


Fig. 2.10 | Important spatial elements
Data from: Provincie Flevoland (2021)

- Cities and villages
- Potential hybrid zones
- important roads
- Green enhancement
- Network of canals
- Green connections
- Waterfront connection
- Borders of the different polders
- Water
- Visual separation between polders
- Protected green areas
- Expanding green borders

MONDRIAAN LANDSCAPE

Fig. 2.11 | Google Earth image of Flevoland showing Mondriaan landscape
Google Earth (2025)

OOSTERWOLD

Oosterwold is a unique urban area where residents can design their living space. The concept of Oosterwold is to create a vast green landscape mixed with creative housing and urban design (MVRDV, n.d.). Limitations are set through percentages to maintain the area's rural character. The district was designed with the idea of minimising municipality involvement through top-down governance and stimulating a more bottom-up approach. Nevertheless, few regulations are tied to the right to live and own a plot in the area. The regulations primarily encourage residents to devote their land to agriculture partially. Despite that, an individual's creativity is encouraged and limitless within the given framework, as visible in image 2.12 (MVRDV, n.d.). In 2011, Oosterwold began her transformation into the urban area it has become today and continues to grow.

Unfortunately, the implementation of the Oosterwold concept turned out to pose some problems. Because while it was an interesting initiative to leave developing the urban areas up to the residents, general waste, energy and mobility infrastructure suffered from the lack of regulation. In 2022, an article bwas released that stated that Oosterwold was a fiasco (De Zeeuw, 2022). In this article, the author took a critical stance towards Oosterwold: "A decade after its launch, this 'radically different approach to area development' fails mercilessly." His two points of concern were the sewer systems and land use. Without the intervention of authority, the residents are left to arrange the plumbing, sewer systems, roads, water features, and utilities. He states that no one feels responsible. Which would cause many problems, and it was up to the municipality to fix this. Ultimately, the sewer systems still had to be built and paid for by the municipality.

De Zeeuw also criticised the agricultural aspect of the plan. Although the residents were instructed to use around half of their land for agriculture, not everyone has implemented this. To some, it looks like nothing is happening and that people are not upholding their end of the bargain. But the residents beg to differ. They say developing an urban area through this bottom-up approach takes time. As people are still focused on building their homes and livelihoods, it is logical that their attention is not directed towards farming. Thus, residents of Oosterwold (Omroep Flevoland, 2023).

The strong aspects of the design also lead to weaknesses. Flevoland recognizes that mistakes were made. However, it is unclear who is to be held accountable for these mistakes. Alderman Paul Tang takes part of the blame (Omroep Flevoland, 2024), but also notes that other parties have had a hand in this and are not taking responsibility; people are confused as to how this was possible. With this, Oosterwold is recognised as a great case study with valuable information. **The factors that led to problems give insights into what must be done to create a thriving transition zone**. Assigning the right actions to the right people and ensuring responsibility is taken every step of the way increases the chances of a project like this succeeding.

OTHER CASE STUDIES

Oosterwold, however, is not the only case study, there are more projects with a similar ideology: Agronica by Andrea Branzi and Broadacre City by Frank Lloyd Wright, that each bring their own valuable insight into how a zone like this can be designed. Andrea Branzi's "Agronica" is a conceptual project from the mid-1990s that envisions a harmonious integration of urban living and agriculture. Agriculture and urban areas are combined on an adaptable grid, reminiscent of the Mondriaan landscape (see Figure 2.13). This design seeks to dissolve traditional boundaries between the city and the countryside, proposing a flexible environment powered by seasonal and eco-compatible energies (Li & Zimmermann, 2023). Though Agronica is not an actual plan, but a "mental project" or an idea that took a critical stance towards the divided relationship between urban spaces and agricultural practices. Just like Agronica, Broadacre City was a theoretical model. Broadacre City was Wright's idea of a decentralized, semi-rural society (see Figure 2.14). He proposed spreading out the population across vast land parcels, giving each family at least an acre of land to live self-sufficiently and harmoniously with nature. It envisioned a low-density, car-centric, agrarian-utopian America (Kinchin, 2024).

Laying these projects side by side shows us that there has always been a desire for a switch in how our agriculture and urban fabric intertwine. These projects offer a framework which constitutes the realm of possibilities in a large-scale agricultural transition.

Fig. 2.12 | Oosterwold by MVRDV
Maak Oosterwold (n.d.)

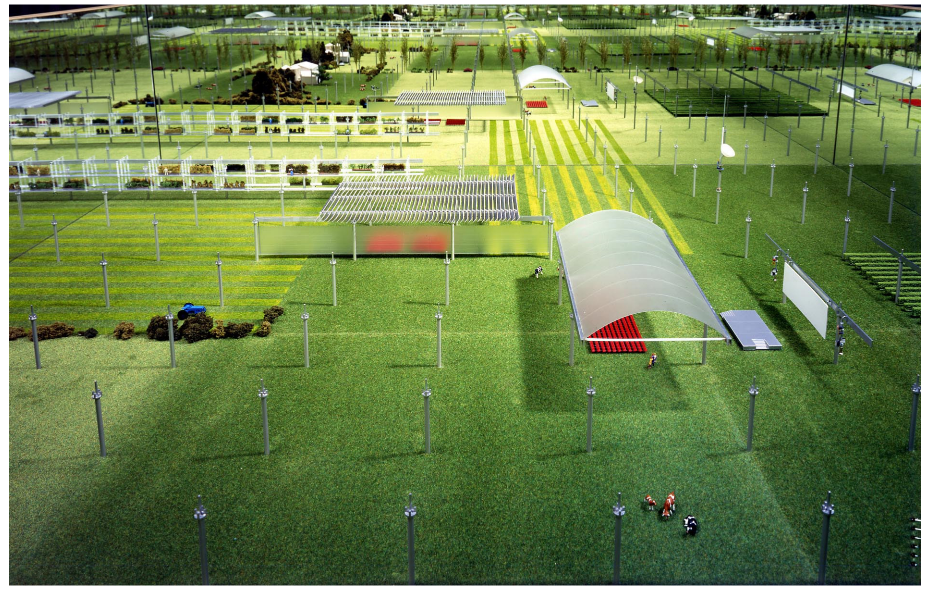


Fig. 2.13 | Agronica by Andrea Branzi
Branzi et al. (1995)

Fig. 2.14 | Broadacre City by Frank Lloyd
Weidemann (n.d.)

THE SITE

FIELD OBSERVATIONS

The site visit started at Almere's central station. It stood out that Almere is a young, planned city. On the bus trip to Oosterwold, the centric layout of Almere became clear: starting in the highly urbanised city centre, it gradually transitioned into low urbanised farmland.

In Oosterwold, it was apparent that every parcel could be bought individually, and the design was based on the owner's preferences. This resulted in a mixed, unique urban pattern with a common denominator of some agricultural practices. A close connection between nature, agriculture, and living could be recognised in Oosterwold. Within this close connection, a first transition zone was identified.

The biodynamic farm Vliervelden was the leading destination of the site visit. Strolling around, a mix of urban and agricultural functions was prominent. Furthermore, an organic supermarket and a hydrogen innovation lab were also located on the Vliervelden property. The mix of functions and the close connection between farmer and consumer were recognised as strong opportunities. Furthermore, the Vliervelden biodynamic farm was the first introduction to biodynamic farming and its possible benefits for nature. It became clear that concepts like crop rotation, soil quality and the use of manure instead of artificial fertilizer are key in biodynamic farming.

The farmer present on the Vliervelden biodynamic farm explained that the current Dutch food system has two main energy losses. First, energy is lost in the energy-intensive machinery used for agricultural purposes. Second, energy is lost via the large, outsourced flow of vegetables due to their imperfect appearance (Farmer at Vliervelden Biodynamic farm, personal communication, February 17, 2025).

Lastly, during the entire site visit, it stood out that renewable energy spatial elements are already clearly visible in the current agricultural landscape of Flevoland.

Biodynamic farm Vliervelden

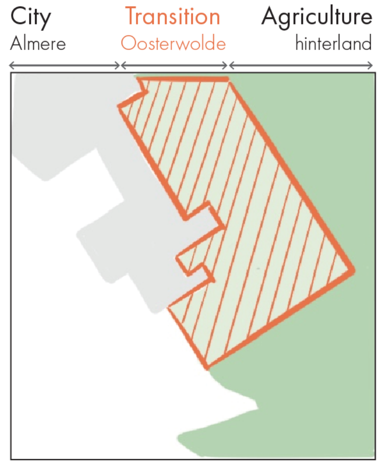
Renewable energy: Solar panels

Hydrogen storage and fuel initiative

Renewable energy spatial elements already integrated in the landscape

Beet roots are sorted out because they do not meet food standards

Cows for manure, for a more circular food system



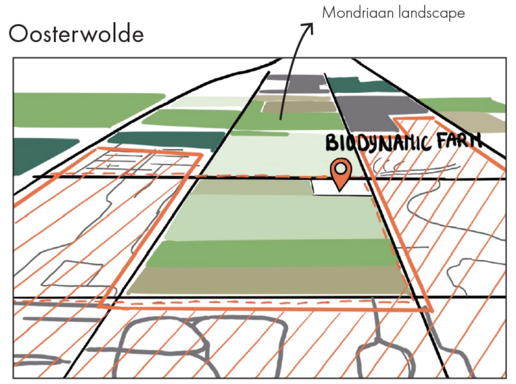


Fig. 2.15 | Findings from site visit

BIODYNAMIC FARMERS

The transition community of this project is biodynamic farmers. **Biodynamic farmers follow a holistic approach to farming and strive for healthy agriculture that produces healthy food by ensuring soil fertility, healthy plants, food quality, biodiversity, and animal welfare while also maintaining social and ecological responsibility** (Stichting Demeter, n.d. a; Biodynamische Vereniging, n.d.). Biodynamic farming originated at the beginning of the 20th century when multiple Dutch farmers grew concerned about the introduced use of chemicals in agriculture. These farmers started experimenting with nature-inclusive practices that did not include chemical inputs to improve the quality and health of their produce and livestock. In 1928, the Demeter certification mark was introduced to set specific standards to guarantee the quality of early biodynamic farmers' produce. The standards set were based on anthroposophical principles from Rudolf Steiner, an architect and philosopher of that time. In 1973, the 'Biodynamische' Association was established to aid and manage current and future biodynamic farmers. This association facilitates a close connection between producers and consumers to share knowledge and raise awareness (Stichting Demeter, n.d. b).

Figure 2.16 shows the seven principles of biodynamic farming (Stichting Demeter, n.d. c). All principles are equally important and interlinked. Furthermore, they all work towards making agriculture more resilient and self-sufficient.

1. Soil Fertility
Via biologically derived inputs like compost or (green) manure or practices like crop rotation, cover crops, and forage crops, the soil fertility is retained.

2. Food quality
It quality refers to the quality of the produce and the quality within the different processes afterward. The produce is prepared in a particular way to maintain nutritional benefits, original flavour, and essential oils. For this to happen, processing and the usage of additives are minimized, and particular processes (e.g., Chemical preservation, X-ray) are prohibited.

3. Healthy plants
Plants' health is guaranteed by allowing plants to grow at their own pace, prohibiting genetic modification, and stimulating the use of open-pollinated plant varieties. Furthermore, there is a positive relationship between soil fertility and healthy plants, as fertile and airy soil improves the health of plants and makes them more resilient towards pests and extreme weather conditions.

4. Biodiversity
Biodynamic farmers are obliged to dedicate at least 10% of agricultural land to biodiversity. Farmers could realize this by implementing polyculture, trees, long-term grassland, water bodies, and shelters for insects and birds. In this way, a healthy ecosystem will be facilitated within the agricultural land where nature can thrive.

5. Animal welfare
Animals are inherently included in biodiversity and biodynamic farming. The care of which is a great responsibility and is done with the utmost care via regulations. Animals are encouraged to show natural behaviour and are not maimed. There are possibilities for cooperation, whereby manure can be exchanged for fodder crops to ensure animal welfare.

6. Social responsibility
Social responsibility is assured through the Social Responsibility Standard. This standard includes social justice, responsibility, and fair working conditions. Social responsibility also refers to equal opportunities and safe working conditions.

7. Ecological responsibility
This principle ties the different principles of biodynamic farming together. By including ecological responsibility, it is acknowledged that the planet's health is in the hands of farmers.

The relevance of the chosen transition community is found in their belief that biodynamic agriculture could bring together nature and agriculture, as they are inextricably connected (Biodynamische Vereniging, n.d.). Furthermore, it is believed that biodynamic farming could also stimulate a closer connection between producers and consumers, mainly through the 'healthy food' and 'social responsibility' principles. However, biodynamic farmers only represent a small percentage of farmers and have a small percentage of agricultural land. Therefore, it is necessary to research possibilities for this alternative farming method to grow. Due to its social and ecological responsibility, biodynamic agriculture is considered a more resilient and future-proof practice than conventional farming in the Netherlands. So, looking into the effects of upscaling this, could prove beneficial on many levels.

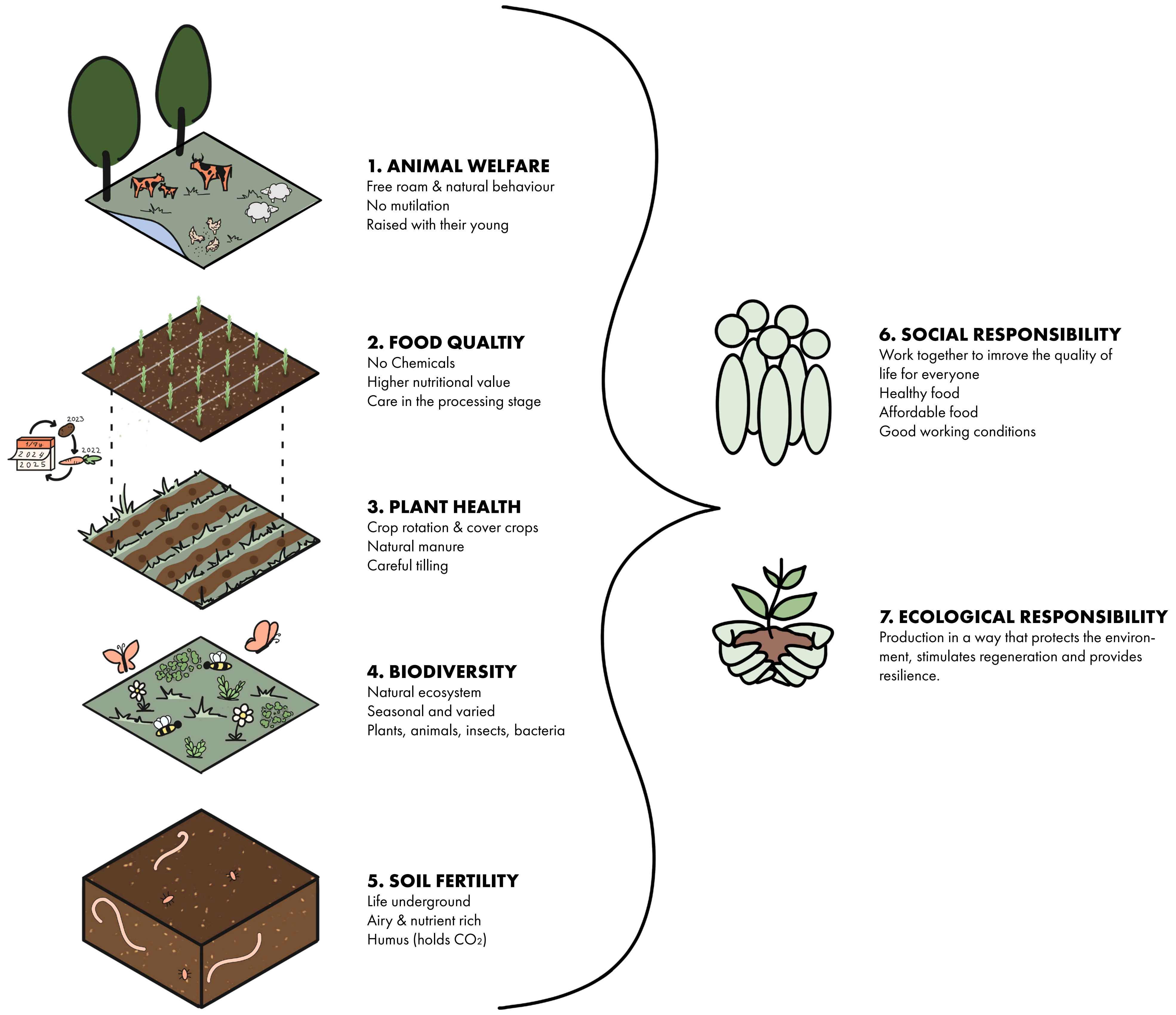


Fig. 2.16 | Biodynamic farming principles
Data from: Stichting Demeter (2025)

STAKEHOLDERS

Examining the current agricultural system and its stakeholders is essential for a more just and sustainable agri-food system. Many different actors are involved in the current agricultural system, each with different levels of power and interest (see Appendix A for detailed stakeholder profile analysis). The different stakeholders are mapped in the power-interest matrix on the right. In this power-interest matrix, the complex relations of the current system become apparent. Some stakeholders in the matrix have shared ambitions or transition roles and are, therefore, connected. These alignments, provide a strong starting point for future collaboration. This is because it is recognized that no individual stakeholder can change the system alone, so collaboration is necessary. The strategy chapter elaborates on collaboration between stakeholders.

The consumers, renewable energy companies, and biodynamic farmers are believed to lead the transition. Consumers hold the power to change the system through their consumer behaviour but rely on biodynamic farmers and the right incentives from the government. Nevertheless, supermarkets, conventional farmers, and conventional energy companies hold power and have a great interest in maintaining the status quo. These stakeholders should adapt to the transition. Therefore, it is important to identify ways to raise their interest in the food system transition.

On the other hand, inhabitants of the region, nature, and future generations are stakeholders positioned positively toward the transition. At the moment, they cannot always voice their opinions and lack the power to influence the system. It would be interesting to empower these stakeholders. Lastly, the biodynamic farmers and the planet will cater to the needs to transition.

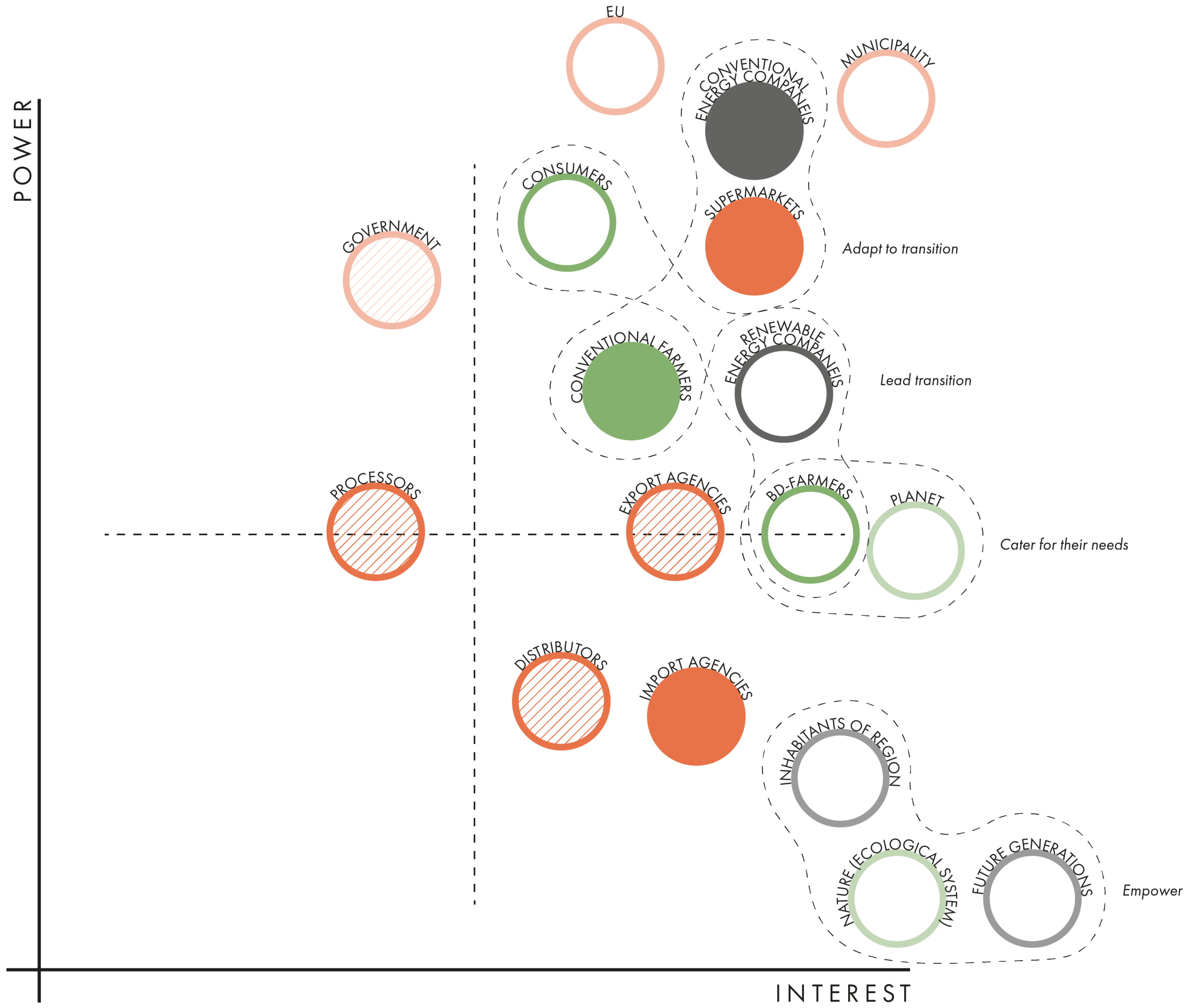


Fig. 2.17 | Overview of stakeholders

- Farmers
- Planet & nature
- Food system
- Governance
- Energy
- (Future) inhabitants

- Negative
- Fence-sitter
- Positive

- Stakeholder allignment

3.

ANALYTICAL AND CONCEPTUAL FRAMEWORK

This chapter lays the foundation and framework of the research. Further elaborating the problem and the choice of transition community. Next to that, the main research question and the sub-questions are stated. The conceptual framework shows the main themes, goals and aspects related to the project. Lastly, the methodology showcases the actions taken during every step of this assignment, enlightening the reader about the process.

PROBLEM STATEMENT

With the progressing climate change and depletion of resources, there is a dire need for energy transition in all sectors for resilience. This requires a shift in the agricultural industry and food production processes, as it is the predominant sector in the Netherlands, both in size and export. Currently, food production consumes a significant number of non-renewable resources like natural gas and coal (Paris et al., 2022). Simultaneously, the issue of high amounts of food waste prevails, which further exacerbates energy wastage. Achieving circularity in the agricultural sector and food industry has been put at the forefront of climate change, as also articulated in the Vision for Circular Agriculture 2030 (Ministry of Agriculture, Nature and Food Quality of The Netherlands, 2019).

At the heart of this sectoral change, the farmers are the ones who experience the transition first-hand. Their production processes change due to the urgent need for energy transition and consumer needs. Currently, consumer needs are impacted by a disconnection between food production and food consumption. People are not in touch with the producers of their food, might not know where it comes from and how it is processed. This ignorance affects people's habits and choices; if they knew better, would they make more conscious choices? Being in touch with the origin of their food can have various benefits for farmers and consumers.

An effort to establish a closer relationship between agricultural processes and consumers is visible in Flevoland 's communities, the combination of cities and farmland there provides an excellent opportunity to do so. The pioneering mindset in the region offers the potential to further develop this new intertwined spatial relationship. The region is developing quickly, coping with the food demands at a national and regional scale. Understanding the problems that The Netherlands currently faces regarding the energy transition, helps us realise that it is time to steer the development in the right direction. The need for sustainable and resilient development is more pressing than ever, and agriculture plays a significant role. Sustainable forms of agriculture, specifically biodynamic farming, have been an old practice. However, implementing this with new technologies presents new social and spatial challenges.

In order to go towards a more sustainable food production, we zoom in on the biodynamic farmer community. According to the Biodynamic Federation Demeter International, "Biodynamics is a holistic, ecological, and ethical approach to farming, gardening, food, and nutrition" (Biodynamic Federation Demeter International, 2023). They focus on cohesion within the farm and it's surroundings. They use circular and sustainable farming methods, leading to a more vital and healthy food system. Therefore, investigating whether this farming method can be scaled up while remaining socially, environmentally and economically sustainable can be insightful. Furthermore, the upscaling of the biodynamic farming principles can go hand-in-hand with the upscaling of the renewable energy infrastructure, including energy storage.

OBJECTIVES

For the Producers:
- Connecting the producers and consumers.
- Making the production system economically feasible.
- Participation in preparing action plans.
- Forming partnerships, cooperatives, and cross-collaborations between stakeholders.

For the Consumers:
- Affordability of and accessibility to healthy food.
- Incorporating farming positively in their living environments.
- Participation in action plans for better awareness.

For the Planet:
- Connectivity and integration of diverse landscapes.
- Creating a healthier and more resilient agricultural sector.
- Adaptability at multiple scales.
- Shifting to renewable energy and integrating hydrogen storage.

RESEARCH QUESTION

HOW can biodynamic farming principles in Flevoland be upscaled and combined with the sustainable energy transition to strengthen the (regional) food supply chain?

SUB-RESEARCH QUESTIONS

HOW
- How does the Dutch (agricultural) food system/chain currently work?
- How can the Dutch (agricultural) food system be transformed to minimise grey energy usage and transition towards a hydrogen and renewable-based food production system?

WHAT
- What are the biodynamic farming principles?
- What are the opportunities and limitations of upscaling biodynamic farming to meet the food demand on a regional scale?

WHERE
- Where can the biodynamic farms be upscaled within Flevoland?
- Where are the spatial synergies and conflicts?

WHO
- Who are the other stakeholders that influence the energy and agricultural system transition?
- Who is positively impacted by this systemic change? Conversely, who is negatively impacted by it?

CONCEPTUAL FRAMEWORK

According to Miles and Huberman (1994), "a conceptual framework explains, either graphically or in narrative form, the main things to be studied — the key factors, concepts, or variables — and the presumed relationships among them." Based on the interviews with the farmers and conducting background research, the project derived the core concept, principles, and their interrelationships within different domains, visually represented in Figure 3.1.

The project aims at a paradigmatic shift from the current bio-destructive agricultural practices to biodynamic cultivation methods. Thus, the 'Sustainable Agrifood Systems' concept is at the core of the conceptual framework, focusing on eco-friendly practices at the production level and the whole food system. The vision comprises three core principles: **biodynamic farms** that are sufficed by **resilient flows** with **just and inclusive functions** at the higher governance scale to move towards a healthier and more resilient future.

In an analysis conducted by Herrington (2020), the author evaluates the accuracy of the seminal book 'Limits to Growth' (Meadows et al., 1972) and concludes that the current scenario aligns the most with the Business as Usual (BAU) and Comprehensive Technology (CT) scenarios, both of which suggest that there will be a delayed collapse due to the pollution and resource constraints. However, post-2020, there is a slightly higher chance of aligning with the fourth scenario of the Stabilised World (ST), where the focus shifts towards renewable energy, deliberate limitation of industrial output, and global equity in resource distribution. The three principles of this project suggest that in the agricultural industry, biodynamic farms facilitate the overall sustainability and energy transition, resilient flows incorporate the ideology of regulating industrial output, and inclusive functions aim at governance that equity in accessibility and affordability of healthy food. The project aims to achieve a sustainable agrifood system with these three core principles by tackling the identified **social, spatial, and governance-related** issues through certain measures.

Starting from the end of the system, the consumers guide the food demand and can steer supply. Over half the Dutch population is overweight (den Broeder et al., 2024). With affordability issues pertaining to biodynamically and organically produced food, the shift in agricultural transition is impacted. Making it affordable and increasing consumer awareness through **socio-ecological** programs can improve their understanding of the benefits of biodynamic produce, resulting in its growing demand and consequently making the agrifood system sustainable and resilient.

Spatially, expanding on the ideas of Continuous Productive Urban Landscapes (Viljoen & Bohn, 2009), the food miles need to be shortened, ecological corridors need to be created to enhance biodiversity and productivity of landscapes, and the processes need to be decentralised through a mix of functions such as farms, residential areas, and market spaces, not just in urban spaces but also integrated in the peri-urban and rural areas. In the production processes, crop rotation and ecological corridors must be taken to maintain and further enhance the region's biodiversity.

These spatial measures need to account for circularity within the agrifood system and better address them using renewable energy resources and waste management. As the farmers are the foremost transition community that experiences the impacts first-hand, the **governance processes** need to move the transition communities up the Ladder of Citizen Participation (Arnstein, 1969) and give them some control over these processes through partnerships and delegation of responsibilities. To do so, the farmers require incentives like subsidies and forming energy ownership cooperatives to assist the energy transition. Simultaneously, for fairness in distribution for consumers and producers (Rawls, 1971), policies need to be revised to facilitate equitable healthy food distribution and the distribution of any burdens that thereby arise. For instance, mitigating flood risks in agricultural lands need to be accounted for through policies that economically support the farmers.

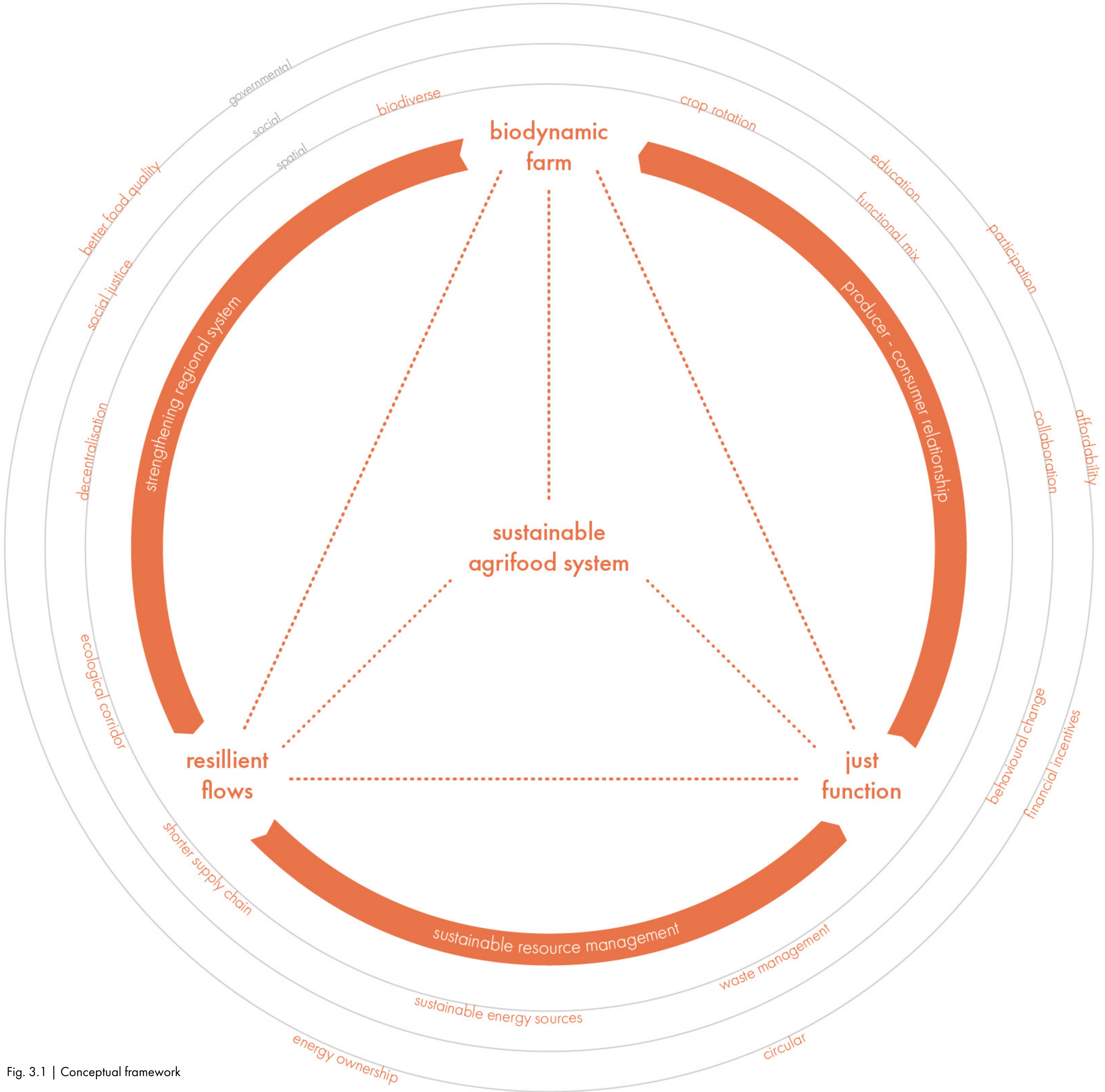
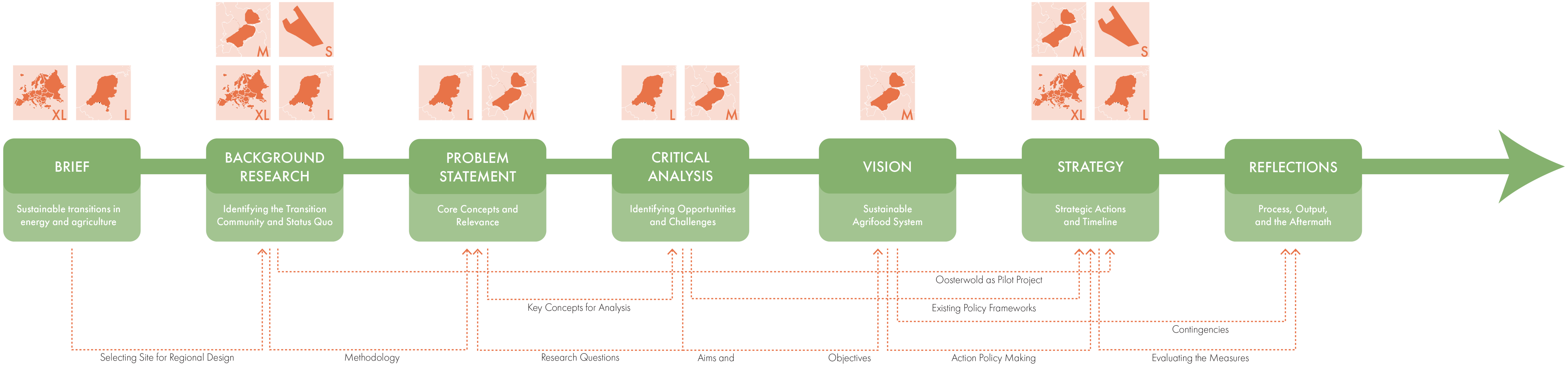


Fig. 3.1 | Conceptual framework

METHODOLOGY

Regional scale research and planning requires combinations of methods, theoretical frameworks, and actions to address the multifaceted needs of urban and regional development (MacCallum et al., 2019). This comprises understanding of places through primary research, done by conducting site visits and interviewing stakeholders, as well as secondary research to understand land characteristics, socio-economic scenarios, policy frameworks, and so on. Applying these various methods helps in a comprehensive understanding of the complexities present at the different scales and the synergies and conflicts that emerge between these scales.

The methodology framework for this project employs spatial mapping and critical analysis of the supply chain and consumer behaviour to identify opportunities and challenges, which are then translated into a spatial vision for the transition community, the biodynamic farmers. Their principles are adapted into principles for a sustainable agrifood system and translated into a spatial vision plan for Flevoland, structured across three key zones: urban, transition, and agricultural. Through policy review, synergies and conflicts are identified at various scales and across the proposed vision plan. Subsequently, scenarios are developed to derive strategic actions to address the internal dilemmas and upscaling of biodynamic farming in Flevoland. These strategies are demonstrated in a pilot project, Oosterwold, and the strategies at the regional scale of Flevoland are phased with the drivers of transition delineated for the upcoming 75 years. Lastly, the complexities within the system, insights from the process of analysis, design, and planning, as well as the results and scope for the future, are evaluated and reflected upon.



- Regional Planning
- Energy Transition
- Transition Community
- Socio-Spatial Justice

- Literature review: History of the site
- Site Observations
- Interview with farmers
- Interview with hydrogen storage company
- Media Analysis
- Case Study: Oosterwold
- Existing Policies and Regulations Research
- Existing Systemic Understanding

- Problem Statement
- Research Questions
- Conceptual Framework
- Methodology

- Critical Spatial Mapping
- Stakeholder Analysis
- Economic Frameworks
- Policy Frameworks
- Spatial Calculations
- Demand vs Supply

- Principles
- Vision Statement
- Vision Plan
- Spatial Characteristics and Programs
- Transition Zone Types

- Scenarios
- Strategic Actions
- Goals
- Strategy Plan
- Phasing Plans
- Pilot Project

- Redefined food system
- Contingencies
- Regional Complexities
- Role of Regional Planning

Fig. 3.2 | Overview of methodology

4.

OPPORTUNITIES AND CHALLENGES

In this chapter, relevant information, opportunities and challenges of Flevoland are mapped. Summaries and more detailed explanations provide a clear representation of the current context and what can be built upon. Research on themes such as producer-consumer relationships, energy, economics is examined and lay the groundwork for the vision that follows.

To fully grasp Flevoland's agricultural system, this chapter will discuss its many different aspects. Consumer and producer relationship, land quality, energy and supply chains have shaped Flevoland into an efficient, high producing food factory. These different analyses will eventually be summarized into conflicts and opportunities.

PRODUCERS AND CONSUMERS DISCONNECTION

DISCONNECTION

As stated before, globalisation has created a distance between producer and consumer, spatially and mentally (Bock & Wiskerke, 2024). Consumers are generally unaware of the origin behind the produce they eat daily. This disconnection can also be recognised spatially in Flevoland, as seen in the figure 4.1. Provincial roads and highways create physical barriers between residential areas, supermarkets, and farmlands. These physical barriers reinforce the disconnection between consumers and the origins of their produce while grocery shopping.

This existing disconnection has created tensions between the farmers in the countryside and consumers in the cities. Consumers' comprehension level concerning different aspects of farming practices, such as smell and noise, has decreased. This may lead to opposition to building farms and residential neighbourhoods near each other, especially in peri-urban and rural areas. Simultaneously, farmers are being confronted with the changing energy landscape, such as wind turbines and solar parks located on their agricultural lands. Recent farmer protests related to these concerns have raised tensions between consumers, producers, and the government.

TOWARDS INTEGRATION

Addressing this disconnection caused by the globalised food system plays an integral role in restructuring the agricultural sector towards a more sustainable system. The desire to form a closer connection is expressed by the European Commission (2020) in the Farm to Fork Strategy: "Even as societies become more urbanised, they want to feel closer to their food. They want food that is fresh, less processed and sustainably sourced" (p. 4).

A better connection between producer and consumer has also been shown to offer different benefits. For instance, buying directly from a farmer contributes to the subjective well-being of an individual (Bock & Wiskerke, 2024). Buying from the producer also ensures fresher products and creates a better awareness among the consumers concerning the origin of their products (Engelen, 2009).

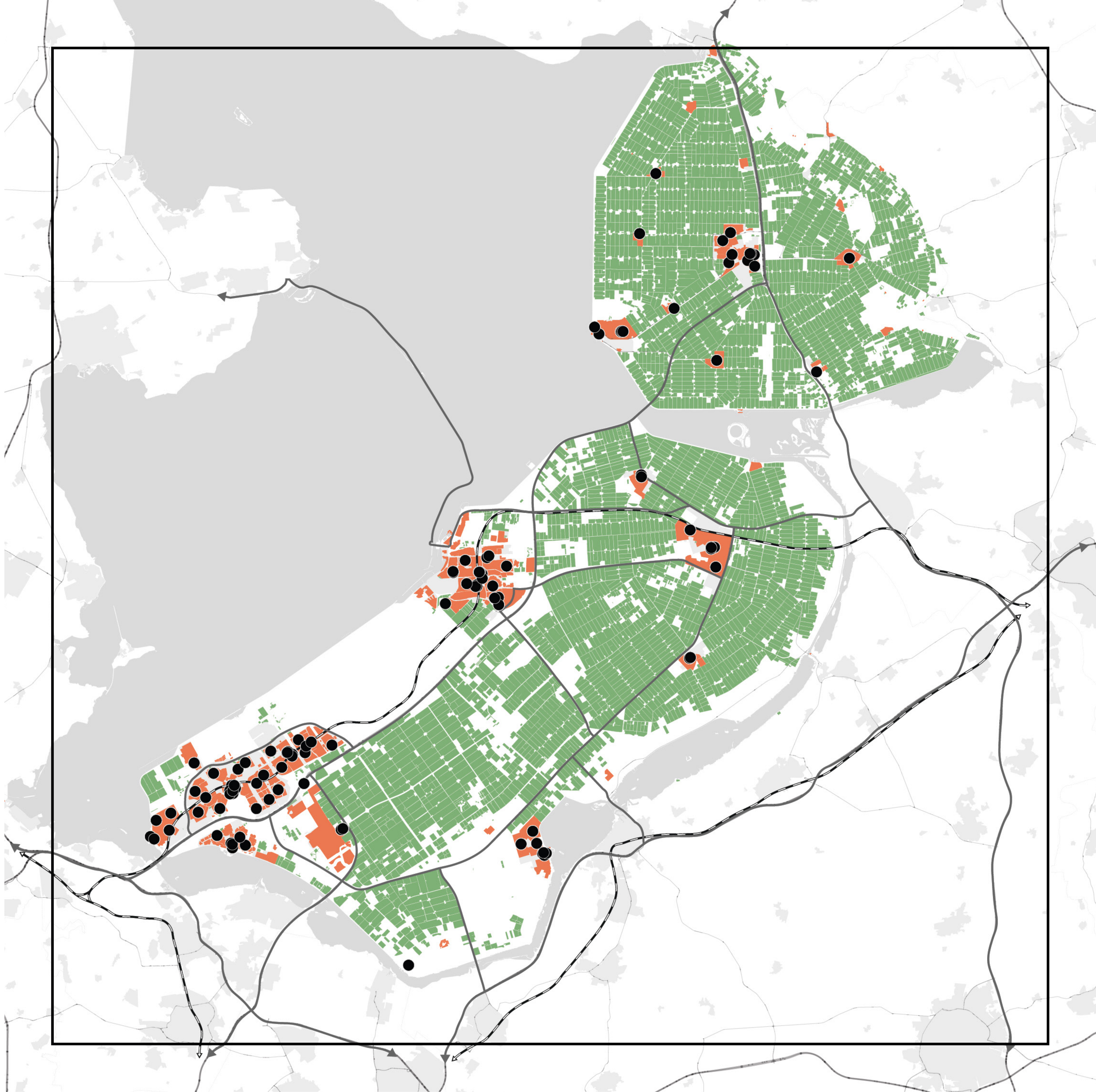


Fig. 4.1 | Location of producers and consumers in Flevoland
Data from: Geofabrik (2025)

- Residential
- Farming
- Water
- Supermarkets
- Main roadnetwork
- Rail

0 5 10 km

LAND QUALITY

Flevoland has some of the most fertile soil conditions in all of Europe, which contributes to the vast amounts of produce it yields; it gained the reputation of being the largest vegetable producer in Europe (Staps et al., 2015). However, it did not instantaneously gain its fertile soil after the land was reclaimed. While soil type plays a significant role, extensive development was required before the region could reach its full agricultural potential. For several years after reclamation, specific crops had to be harvested to enhance soil quality and make it one of Europe's most productive agricultural areas.

THREATS

Despite having been cultivated for less than a century, Flevoland's agricultural land is already showing signs of declining quality. This can be attributed to the destructive practices of conventional farming (Kwakernaak et al., 1998). Groundwater levels in Flevoland are kept low to keep the soil suitable for agriculture. However, this has caused the peat, particularly in the south of Flevoland, to oxidise when it comes into contact with oxygen. This led to soil subsidence in Flevoland, causing crops to come into contact with the saline groundwater, which damages them and reduces yields.

The use of chemicals within conventional farming has also negatively impacted soil health (Tripathi et al., 2020). Excessive pesticides and artificial fertilisers have polluted the soil and destroyed its biodiversity. The exposure of the soil to these chemicals adversely affects the soil's nutrient content and functional diversity, which will eventually cause permanent changes that will result in lower yields.

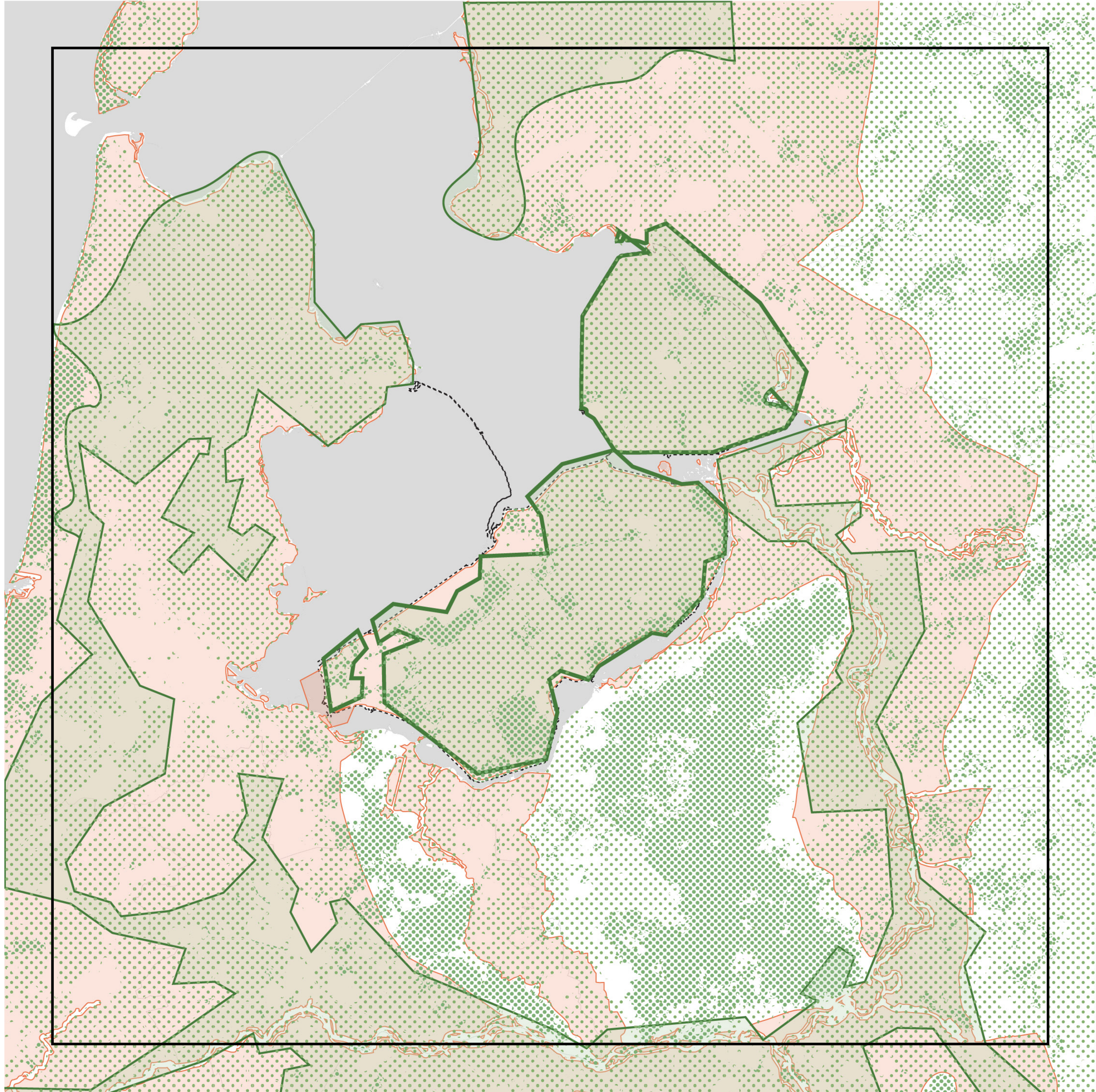
Additionally, agricultural specialisation, driven by globalisation, has contributed to soil depletion. Because the producers are primarily specialised in monoculture systems, the soil slowly loses its nutrients and beneficial organisms (Shah et al., 2021). These systems also reduce the soil's ability to retain water, making it more susceptible to drought. In contrast, crop rotation improves soil health and water retention, eventually leading to higher yields (Aziz et al., 2011).

Another threat can be found in the rising sea level. Flevoland is located entirely below sea level and surrounded by dikes. This makes the region very vulnerable to floods in case of extreme weather events (PDOK, 2025b), like the North Sea flood of 1953.

Fig. 4.2 | Land use Flevoland
Data from: PDOK (2025b)

- Forest
- Agriculture
- Good soil foragricutlure
- High flood risk

0 10 20 km



ENERGY

RENEWABLE ENERGY

Flevoland's fertile soil has led to a vast agricultural landscape. Simultaneously, the region has high wind energy potential, making it the leading province when it comes to energy generated from wind (CBS, 2024B).

However, much of this potential energy has gone to waste over the recent years. During peak hours of sun or wind, the amount of energy which can be generated exceeds the capacity of the current grid. At these moments, wind turbines and large solar parks are shut down to prevent overloading the grid. **With current projections, this is expected to happen for up to 1.500 hours in 2029** (STRATEGY, 2023; Bellini, 2024). This is equivalent to roughly 17% of an entire year's worth of peak-hour energy generation.

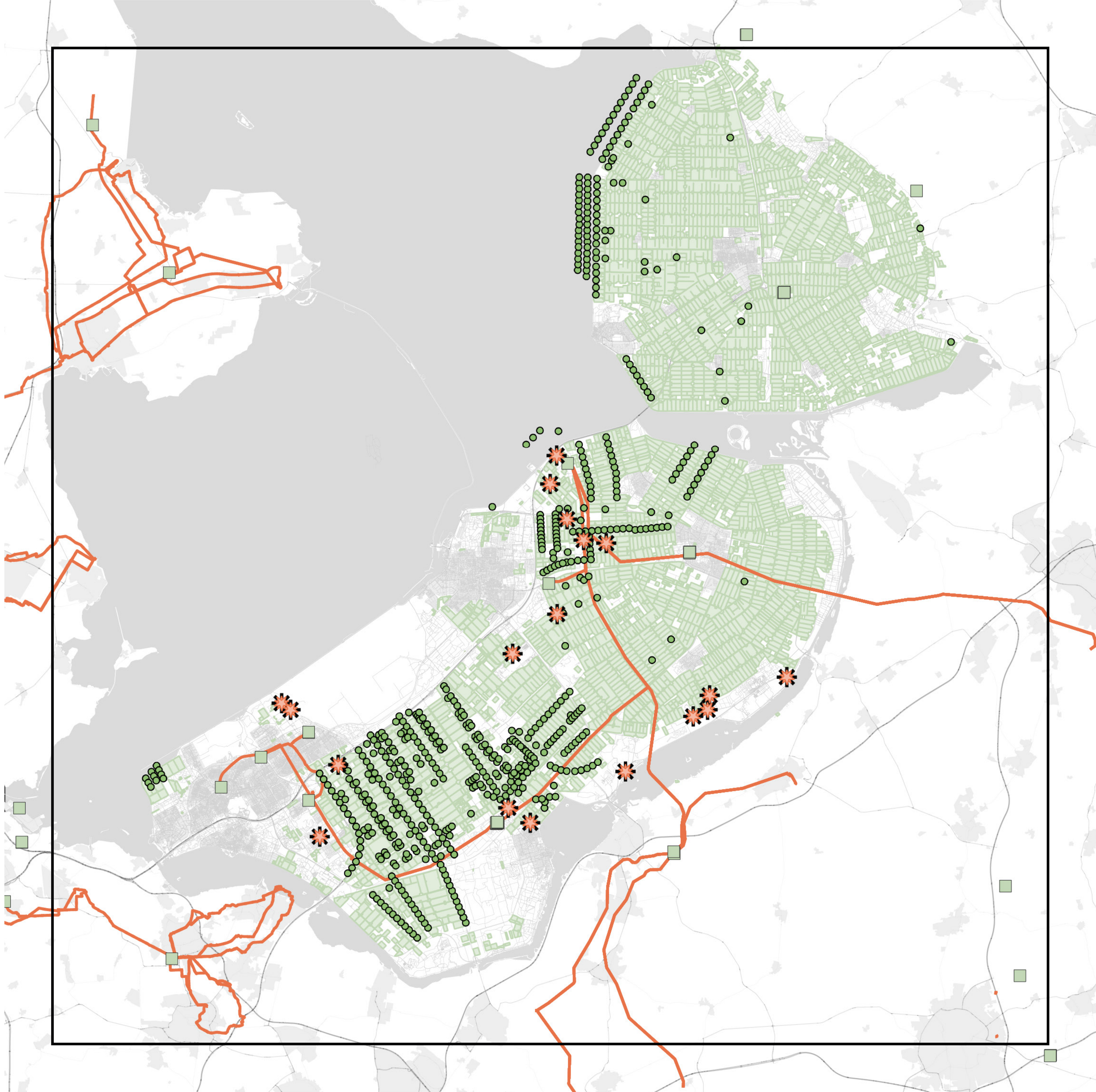


Fig. 4.3 | Renewable energy Flevoland
Data from: PDOK (2025c); Provincie Flevoland (2023)

- Windturbines
- Substations
- Solar parks
- High voltage cables
- Farmland

0 5 10 km

HYDROGEN STORAGE

The energy which is currently not being generated could be stored. The storage of energy in hydrogen offers benefits which cannot be found in the traditional lithium-based battery. Lithium-based batteries suffer from self-discharge, which makes them less compatible for seasonal storage (Bielmann et al., 2010). When energy is stored in hydrogen, it does not deplete over time, which makes it much more suitable for long-term storage, ensuring energy generated in summer can be used during winter.

Hydrogen gas can be produced through various methods, commonly categorised as grey, blue, and green hydrogen (Saha, 2024). Grey hydrogen, the most commonly used type, needs natural gas or coal to produce the hydrogen gas and has a high CO2 output. To produce blue hydrogen gas, either natural gas or biomass is used. To qualify as blue hydrogen, CO2 emissions have to at least be partially captured. Green hydrogen, which is gaining popularity, is produced without carbon emissions by using renewable energy sources, such as wind and solar, to electrolyse water into hydrogen gas. Since a lot of potential renewable energy will be going to waste by 2029, the implementation of a green hydrogen system seems necessary to shift toward a future in which reliance on fossil sources is reduced.

However, there is a slight downside to the use of hydrogen as a mechanism for energy storage. It currently does not have great efficiency when taking all different steps into consideration. Starting off with the electrolysis of water. During this process, 24% of the renewable energy is lost in the form of heat (Transport & Environment, 2020). Another 8,5% is lost during storage due to the pressurisation and temperature control of the vessel the hydrogen is kept in. The largest loss occurs when hydrogen is converted back into electricity, with 32,5% of the energy dissipating as heat. Altogether, this leads to a total efficiency of about 35%. Nevertheless, it is important to note that this process utilises energy which could otherwise not have been generated due to the limited capacity of the grid. In addition to that, opportunities are recognised in the utilisation of waste heat (Van der Roest et al., 2023) both for industrial processes and household use.

Another slight inconvenience, considering the storage of energy in hydrogen gas, can be found in the spatial impact of such storage vessels on the landscape. Two different options are to be considered when debating the storage of hydrogen gas. If such a project is being developed on a larger scale one would typically choose a centralised vessel. While this does have an enormous impact on the landscape, it would only be localised to one place. A different consideration could be a decentralised system. The spatial impact of such a system is shown in image 4.6 for both a wind turbine and a solar park (see Appendix B for detailed calculations). A solar park generally generates more energy per square meter; however, this is not as easily intertwined in the agricultural landscape as a wind turbine. The solar park would also need a storage vessel with a volume of fifty times larger than the storage vessel required for a wind turbine. Storing hydrogen gas on site also creates the possibility for farmers to participate in the energy transition.

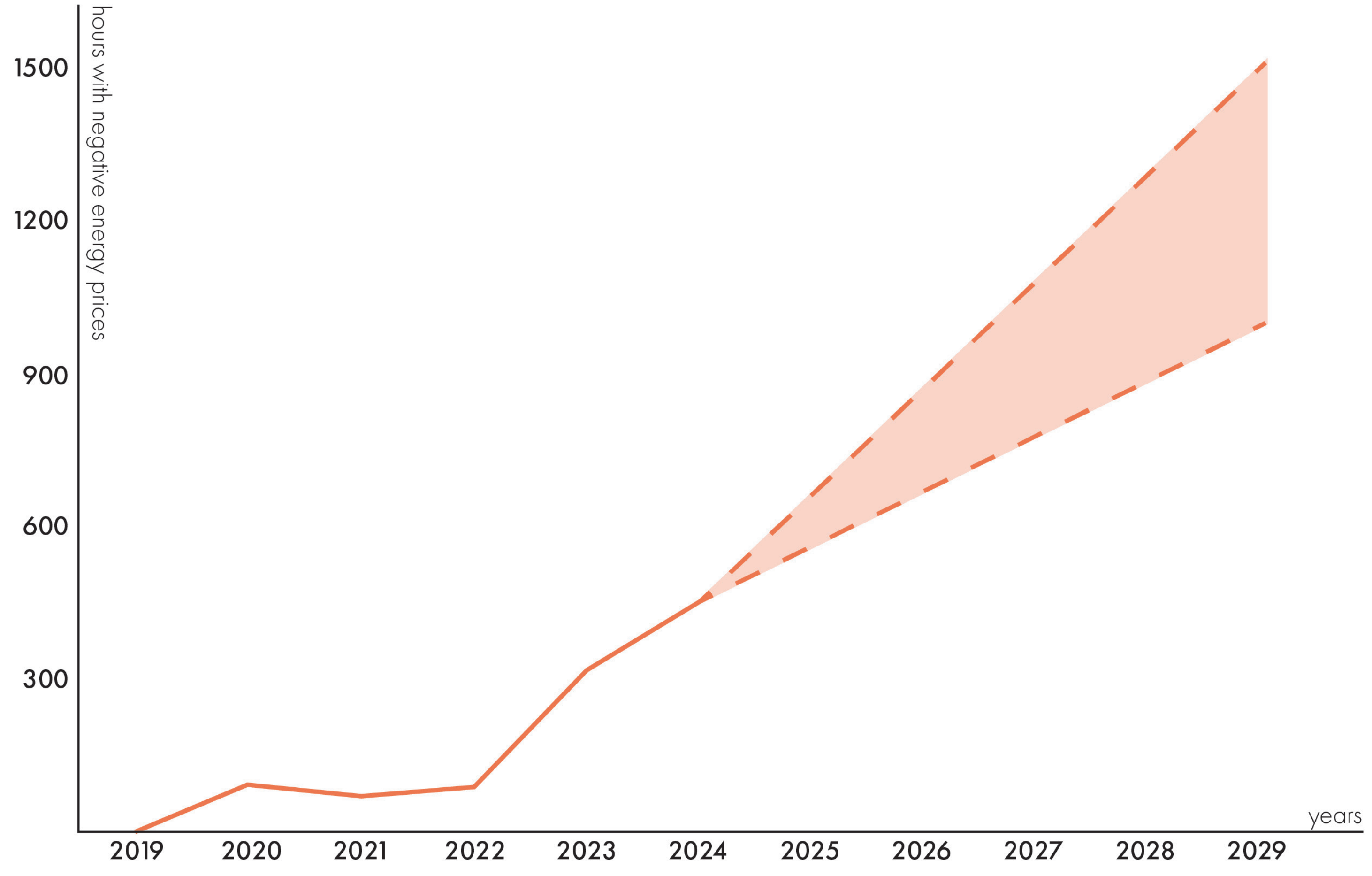


Fig. 4.4 | Wasted energy potential
Data from: STRATEGY (2023); Bellini (2024)

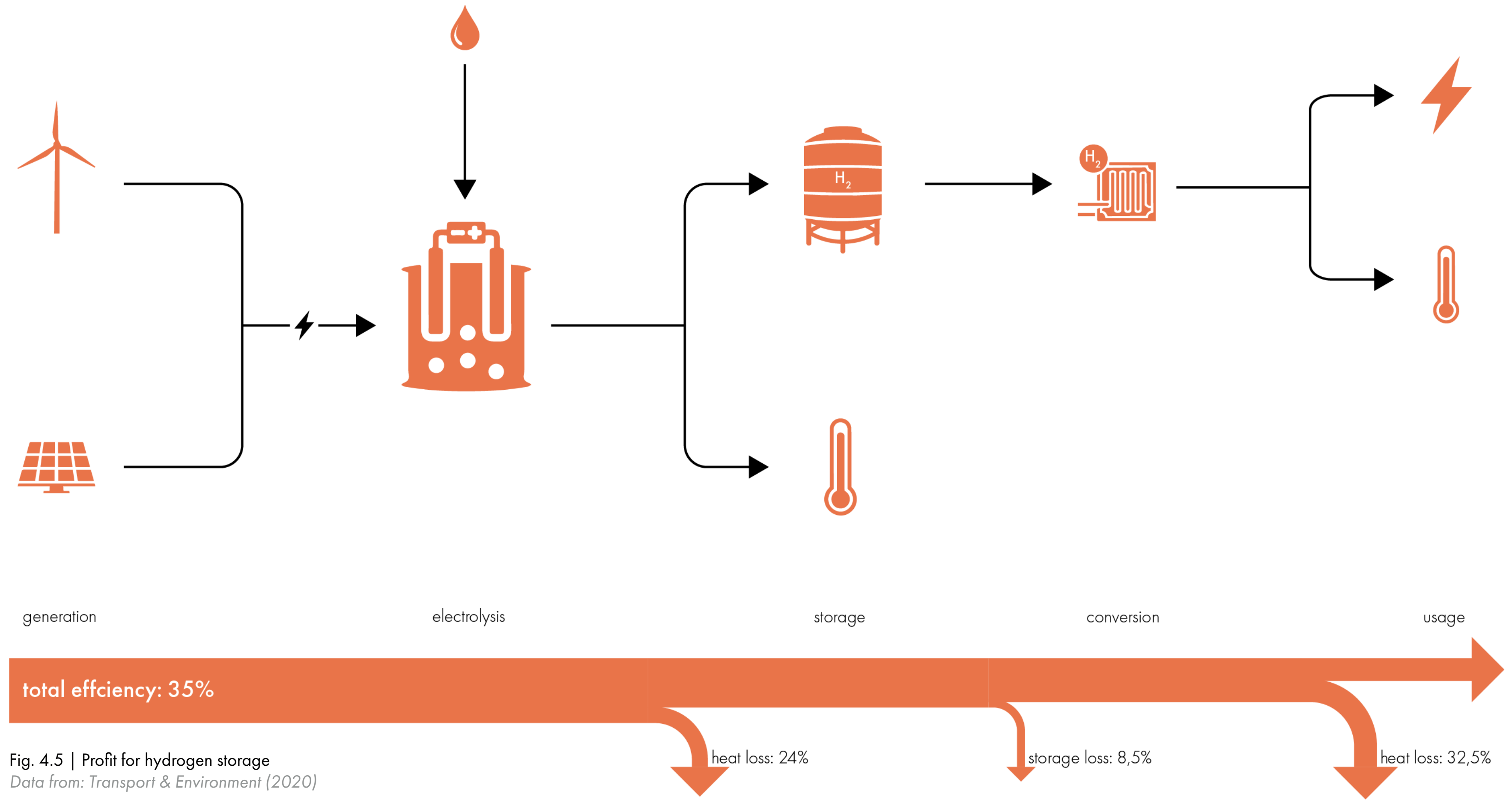


Fig. 4.5 | Profit for hydrogen storage
Data from: Transport & Environment (2020)

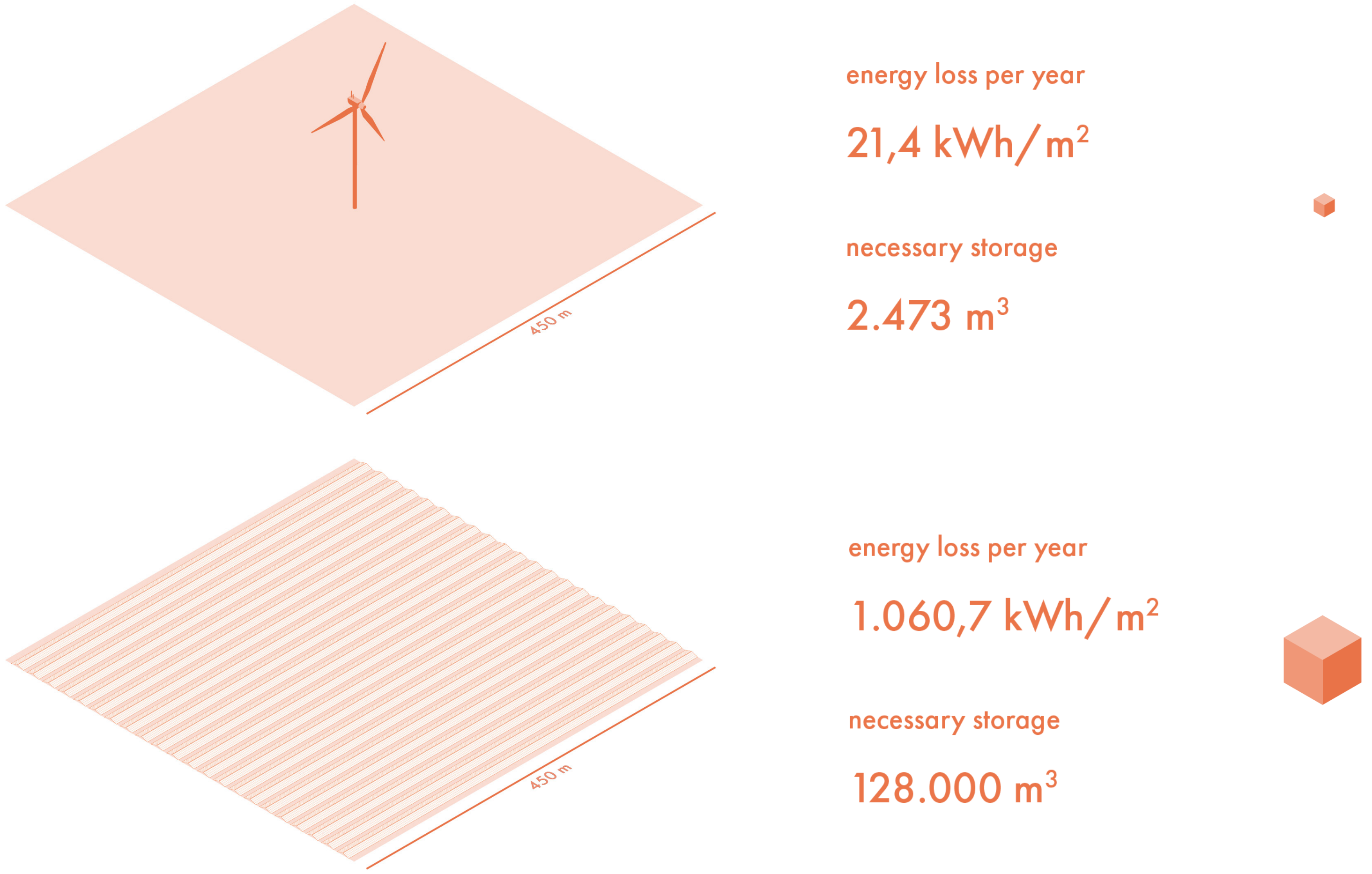


Fig. 4.6 | Space required for hydrogen storage
Data from: CBS (2024b); CBS (2025); Andersson and Grönkvist (2019); HVC (n.d.)

MIDSTREAM SUPPLY CHAIN

IMPORT AND EXPORT

In the introduction, the important role of the Netherlands in the international food chain was shortly stated. This status was gained through its vast amounts of production and trade of agricultural goods (Jukema et al., 2025). Within this system, two flows can be identified: international and national. The Netherlands' position in international trade is heavily supported by the Port of Rotterdam, through which 93% of international food transportation occurs via freight shipping (Li et al., 2022). Domestically, food distribution is dominated by road transport, with 94% of goods transported by truck.

When taking a further look at the origin of produce, specifically potatoes and other native vegetable crops, the inefficiency of the current food system becomes evident. Germany and Belgium, both in the top three trading partners for the Netherlands, import and export many of the same products, including vegetables like onions and potatoes (Jukema et al., 2025). Germany holds the top position in both imports and exports. This exchange of identical goods adds unnecessary transportation costs, both economic and environmental.

At a more local scale, Flevoland's role in the flow of organic biologically produced food reveals some interesting statistics. The statistic which stands out most among this list is the share of biologically produced milk and other dairy products destined for Dutch consumption. While 65% of conventionally produced dairy is exported (Dekking et al., 2020), the vast majority of biologically produced dairy is consumed within the Netherlands. This could indicate a possible shortage in this category when a large-scale transition would take place. The same concern applies to organic potato production (see Appendix C).

FOOD MILES

Looking solely at the volume of imports and exports does not provide a complete picture of the environmental impact of the current food system. To fully understand this impact, the concept of food miles, measured in tonne-kilometres, combined with the carbon footprints of the respective modes of transport offers a more accurate representation.

When looking at the food miles, freight shipping contributes the most, accounting for nearly 60% (Ritchie, 2020). This is due to the larger capacity of freight ships, which can transport more goods compared to trucks, trains, or aeroplanes. Road transport follows as the second-largest contributor, making up around 30% of food miles, while rail transport represents almost 10%. Air transport is seldom used in the food chain and thus only accounts for 0,16% of food miles.

However, food miles also do not provide the complete picture of the environmental impact of each transport mode, as the carbon emissions associated with these different modes vary (Crippa et al., 2021). Transportation over water is fairly efficient in terms of emissions per tonne-kilometre and only contributes 3,4% of the total CO2 output. While air transport would contribute the most per tonne-kilometre, it is scarcely used and thus has the least amount of impact. The highest share of carbon emissions is generated by road transport at 81%. Trucks emit significantly more CO_2 per tonne-kilometre and are used extensively in national and regional food distribution, making them the largest contributor to the sector's carbon footprint.

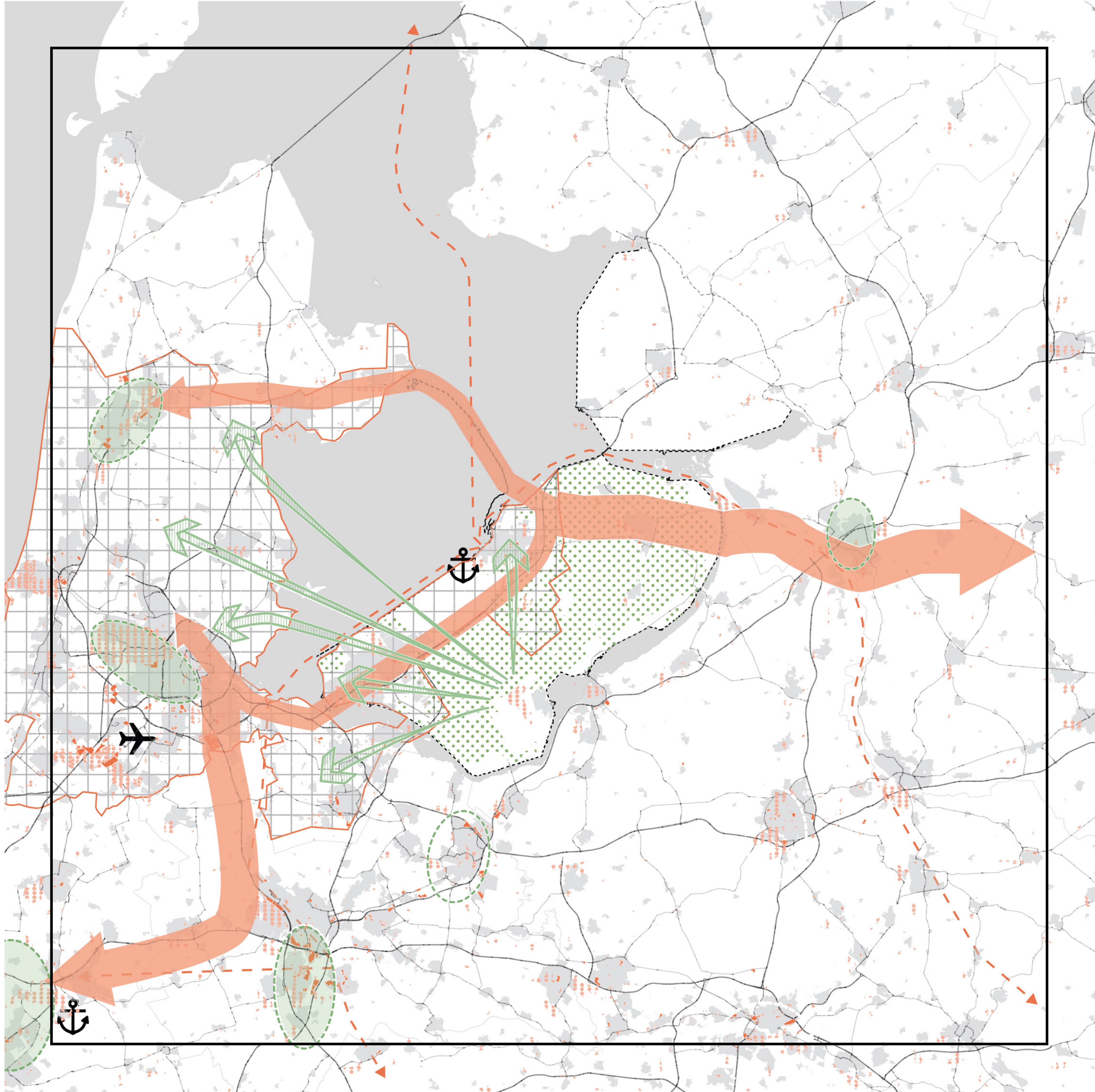


Fig. 4.7 | Midstream supply chain
Data from: Geofabrik (2025); Nefs (2023)

- Distribution center
- Metropolitan area Amsterdam
- Urban area
- Food supply facilities
- Freight corridor by train or truck
- Container ship trade route
- Harbour
- Airport (for cargo flights)
- Short supply chain to MRA
- Logistic cluster
- Logistic cluster along freight corridor
- Agriculture in Flevoland

0 10 20 km

ECONOMICS

CURRENT FOOD CHAIN

Since trucks account for the vast majority of transport on the national and regional level, it is important to look at these flows in the province of Flevoland. The different flows can be subdivided into 3 categories:

1) Farm to Processor
2) Processor to Distributor
3) Distributor to Supermarket

These flows have been visualised through a space syntax analysis based on the attraction betweenness when travelling a distance of ten kilometres.

EXPLANATION MAPS

Figure 4.11 indicates the most used roads for transporting produce from the farm to the processors. **This map clearly depicts the importance of the road structure generated by the Mondriaan grid**. Farms are equally distributed throughout the countryside, which is why most roads are equally important. Processors located around cities highlight certain roads around and within the larger cities.

The next step in the food chain, from the processor to the distributor, is visualised in Figure 4.12. Both processors and distributors are commonly found around cities, with some exceptions for distributors located in the countryside. This makes for a highly used network around densely populated areas. Some important routes within the Mondriaan grid also become recognisable.

To transport the produce to the supermarket for the consumer to buy, roughly the same routes can be identified (Figure 4.13). Especially Almere lights up with a high number of commonly used roads due to its high number of supermarkets. These last two maps also show the importance of Dronten in the distribution of agricultural goods. Despite its low number of supermarkets, it still has a highly integrated network surrounding it due to the presence of many distributors.

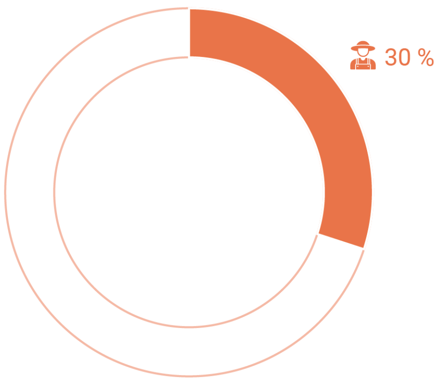


Fig. 4.8 | Percentage profit share farmers
Based on Dutch averages from Van Galen et al. (2020) and Baltussen et al. (2014)

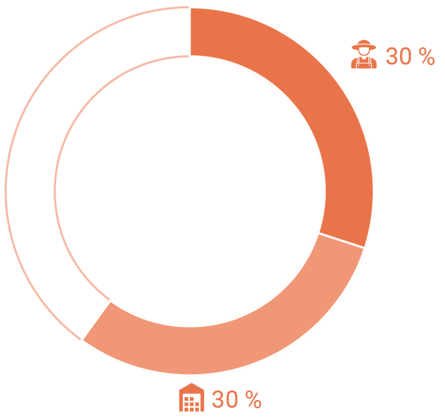


Fig. 4.9 | Percentage profit share processors and distributors
Based on Dutch averages from Van Galen et al. (2020) and Baltussen et al. (2014)

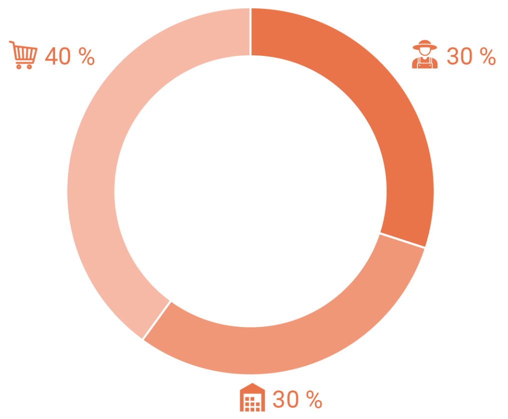


Fig. 4.10 | Percentage profit share supermarkets
Based on Dutch averages from Van Galen et al. (2020) and Baltussen et al. (2014)

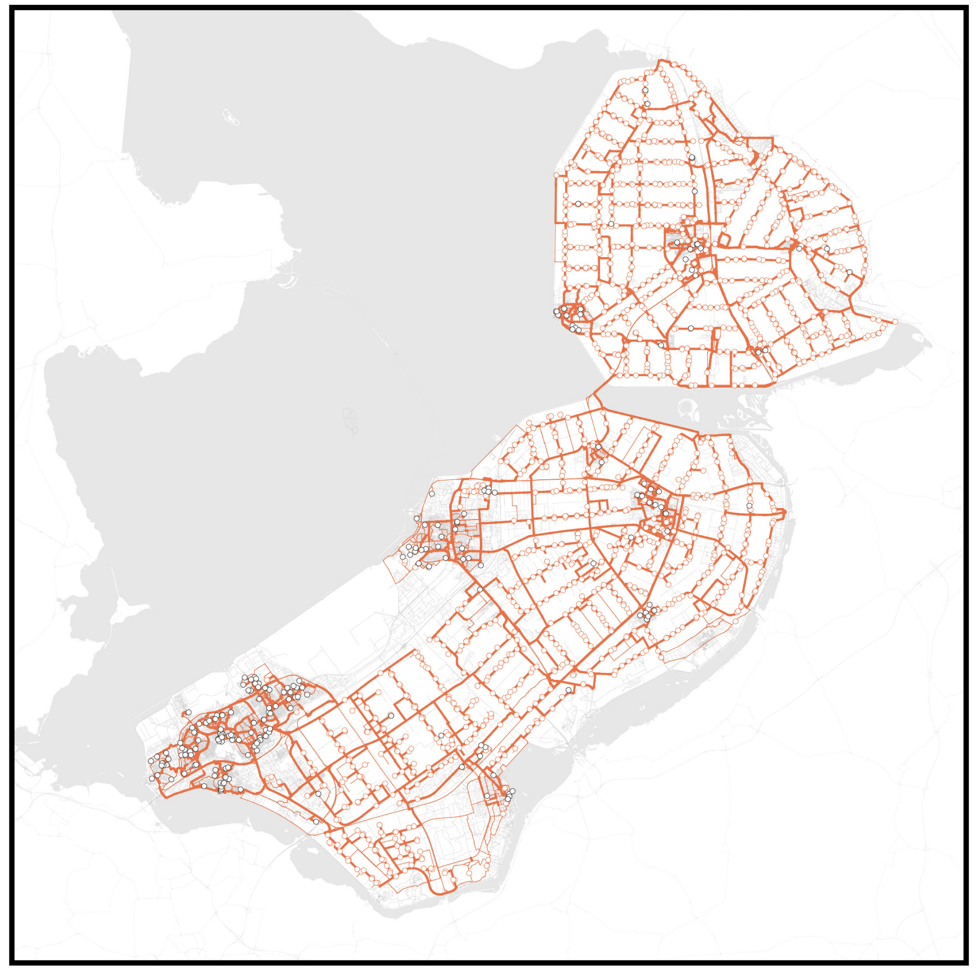


Fig. 4.11 | Farm to processor
Data from: Geofabrik (2025); Stichting LISA (2024)

- Farm
- Processor
- Most used roads
- Used roads
- Roads

0 10 20 km

Fig. 4.12 | Processor to distributor
Data from: Geofabrik (2025); Stichting LISA (2024)

- Processor
- Distributor
- Most used roads
- Used roads
- Roads

0 10 20 km

Fig. 4.13 | Distributor to supermarket
Data from: Geofabrik (2025); Stichting LISA (2024)

- Distributor
- Supermarket
- Most used roads
- Used roads
- Roads

0 10 20 km

SYNTHESIS MAP

Synthesising these different flows into one conclusion map gives insights into which streets within the network are integral. Almere has a high number of commonly used roads. Many different facilities within the food chain are located in and around Almere because of its relatively high population density compared to other places in Flevoland. Again, Dronten stands out because of its role in the distribution of produce. Furthermore, the most important routes of the Mondriaan grid are highlighted, especially the Vogelweg in the middle of the province. Lastly, it is important to note that the highways A6 and A27 do not cater to the needs of the regional food system. They do not show any importance based on the space syntax method.

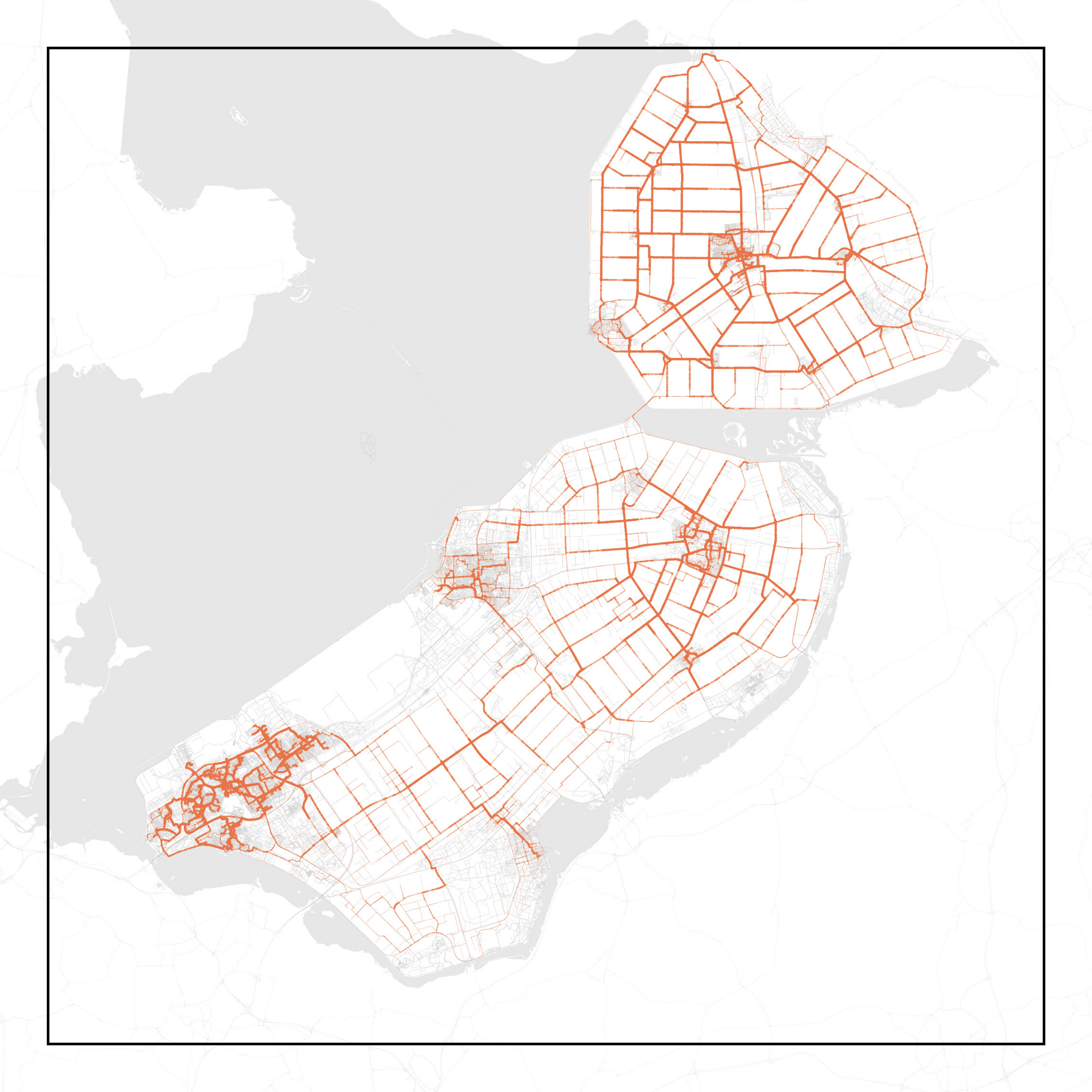


Fig. 4.14 | Synthesis map of place syntax
Data from: Geofabrik (2025); Stichting LISA (2024)

Low intensity

High intensity

Roads

0 5 10 km

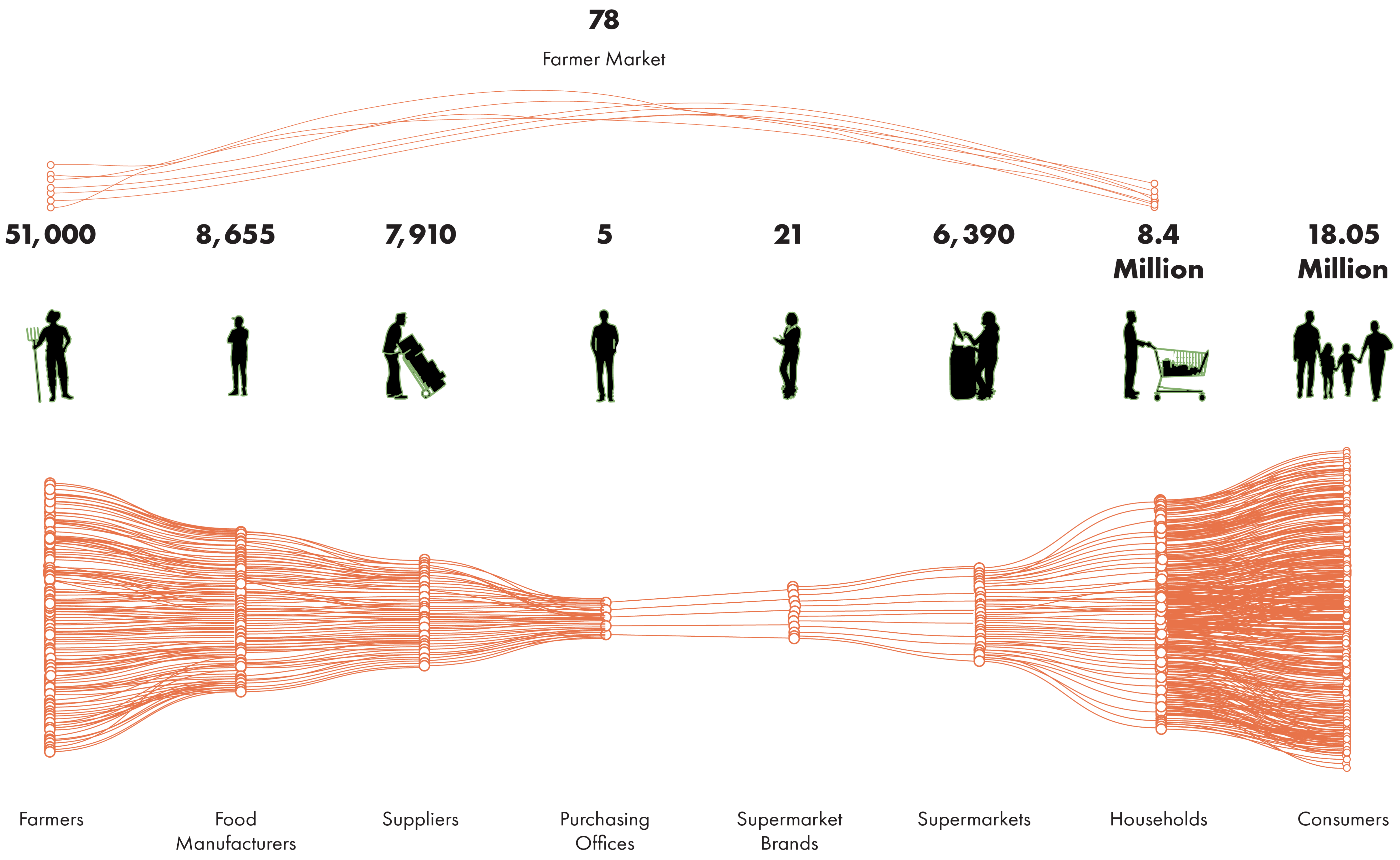


Fig. 4.15 | Food system actors and their share
Data from: CBS Statline (2025)
Visualisation adapted from the diagram from PBL (2014)

BENEFITS SHORTER CHAIN

Apart from the benefits of subjective well-being of a person that come with buying directly from the farmer (as previously stated), there are other benefits which can directly be linked to a shortened supply chain. Because fewer actors are involved when buying directly from the farmer, a better price can be found for both producers and consumers (Lanfranchi & Giannetto, 2015). The environmental impact can also be lowered, with positive effects on the environmental costs.

In the current Dutch system, the better price associated with farmers' markets cannot be recognised. Regional production and direct selling are activities which are widely spread throughout the south of Europe, while countries such as the Netherlands, Germany, and the UK have been focused on sustainability, animal welfare, and innovation within the agricultural system (Vecchio, 2009). **While developing a more regional approach, including direct selling, it is likely that a fair price for both consumer and producer can eventually be reached.**

SUMMARY OF OPPORTUNITIES

With this analysis it is evident that Flevoland presents a lot of opportunities for upscaling the principles of biodynamic farming while also facilitating the energy transition. The region presents a good potential for energy transition through wind energy (Figure 4.17), which can be integrated with biodynamic farms in places with good soil conditions. For flood mitigation and maintaining soil fertility, ecological corridors that connect and integrate agricultural lands with existing forest areas can be beneficial, as can be seen in Figure 4.18.

There is a contrast between urban zones and agricultural zones currently, which elongates the producer-consumer relationship. The agricultural land can serve as a transition zone between cities to make this situation better (see Figure 4.19). Additionally, the distribution networks can be strengthened through these connections.

In these large swaths of good soil conditions, there are opportunities for establishing regional-scale production biodynamic farms, as shown in Figure 4.20. These can be strategically placed, feeding proximate clusters of cities.

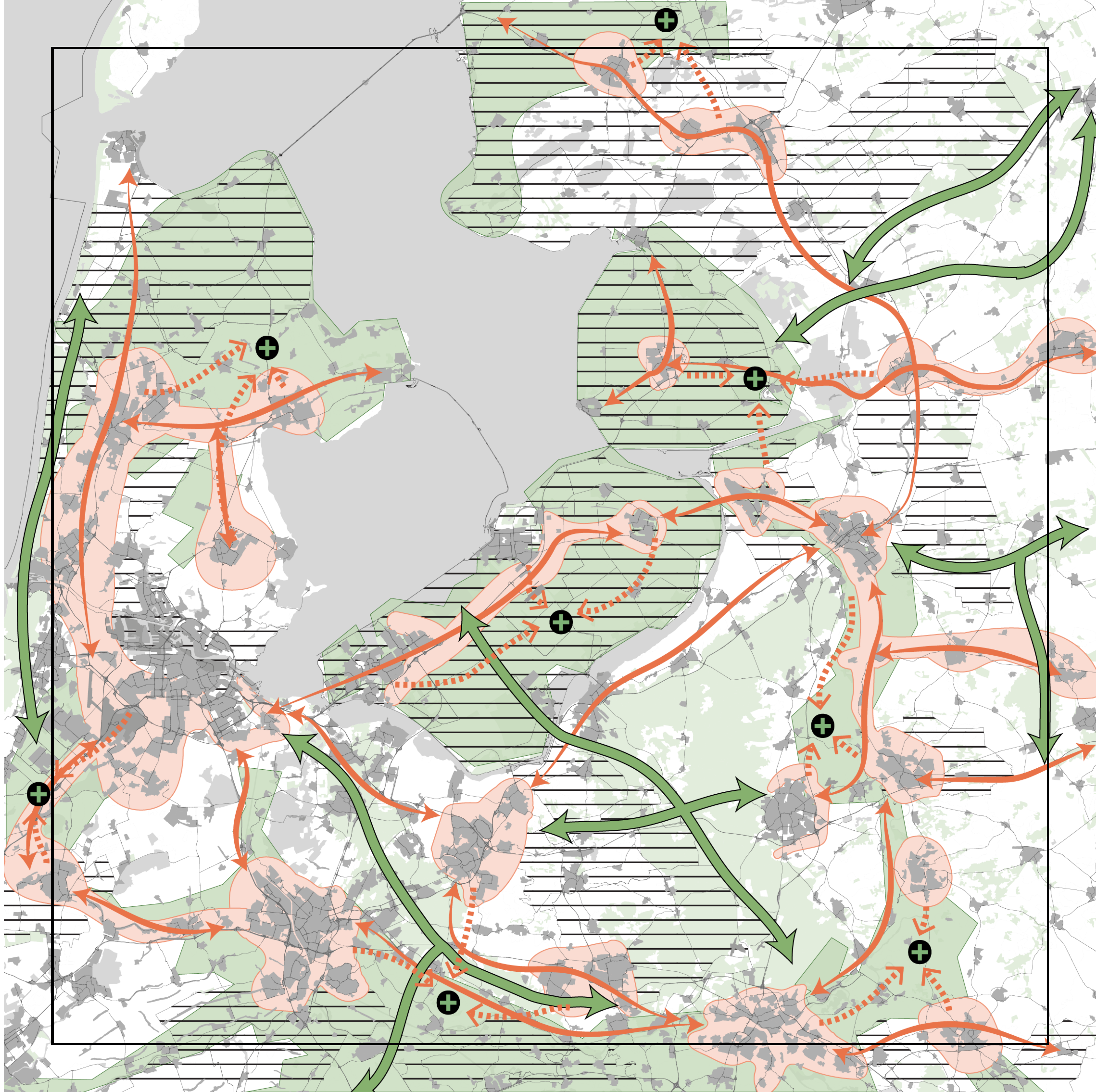


Fig. 4.16 | Summary map of opportunities, overview
Data from: features from PDOK (2025a), retrieved via QGIS

- Urban fabric
- Water bodies
- Agricultural land
- Wind energy potential
- Good soil for agriculture
- Existing forest area
- Potential ecologocial corridor enhancement
- Potential intercity connection
- Transition zones
- Potentional regional scale production with functional mix
- Consumer-production interaction

0 10 20 30 km

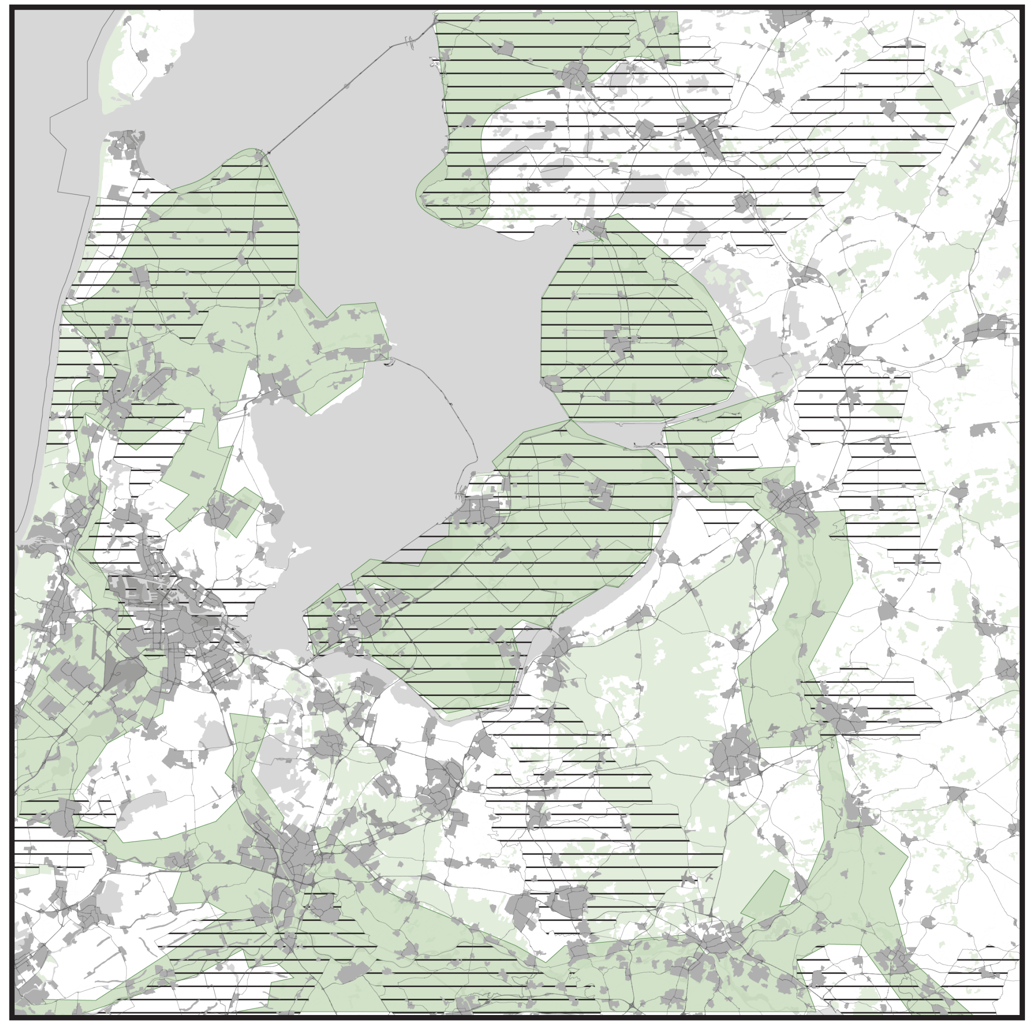


Fig. 4.17 | Summary map of opportunities, part 1
Data from: features from PDOK (2025a), retrieved via QGIS

- Urban fabric
- Water bodies
- Agricultural land
- Wind energy potential
- Good soil for agriculture
- Existing forest area

0 10 20 30 km

Fig. 4.18 | Summary map of opportunities, part 2
Data from: features from PDOK (2025a), retrieved via QGIS

- Urban fabric
- Water bodies
- Agricultural land
- Good soil for agriculture
- Existing forest area
- Potential ecological corridor enhancement

0 10 20 30 km

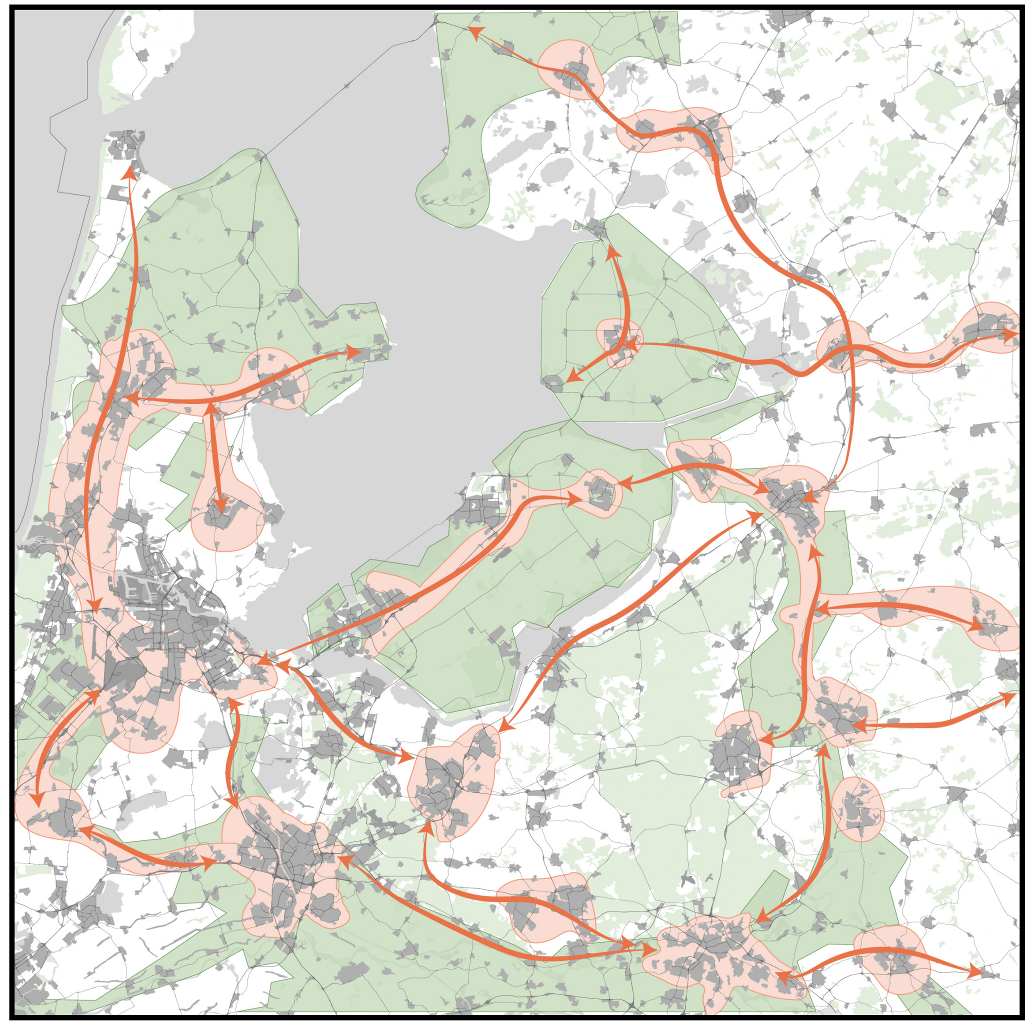


Fig. 4.19 | Summary map of opportunities, part 3
Data from: features from PDOK (2025a), retrieved via QGIS

- Urban fabric
- Water bodies
- Agricultural land
- Good soil for agriculture
- Existing forest area
- Potential intercity connection
- Transition zones

0 10 20 30 km

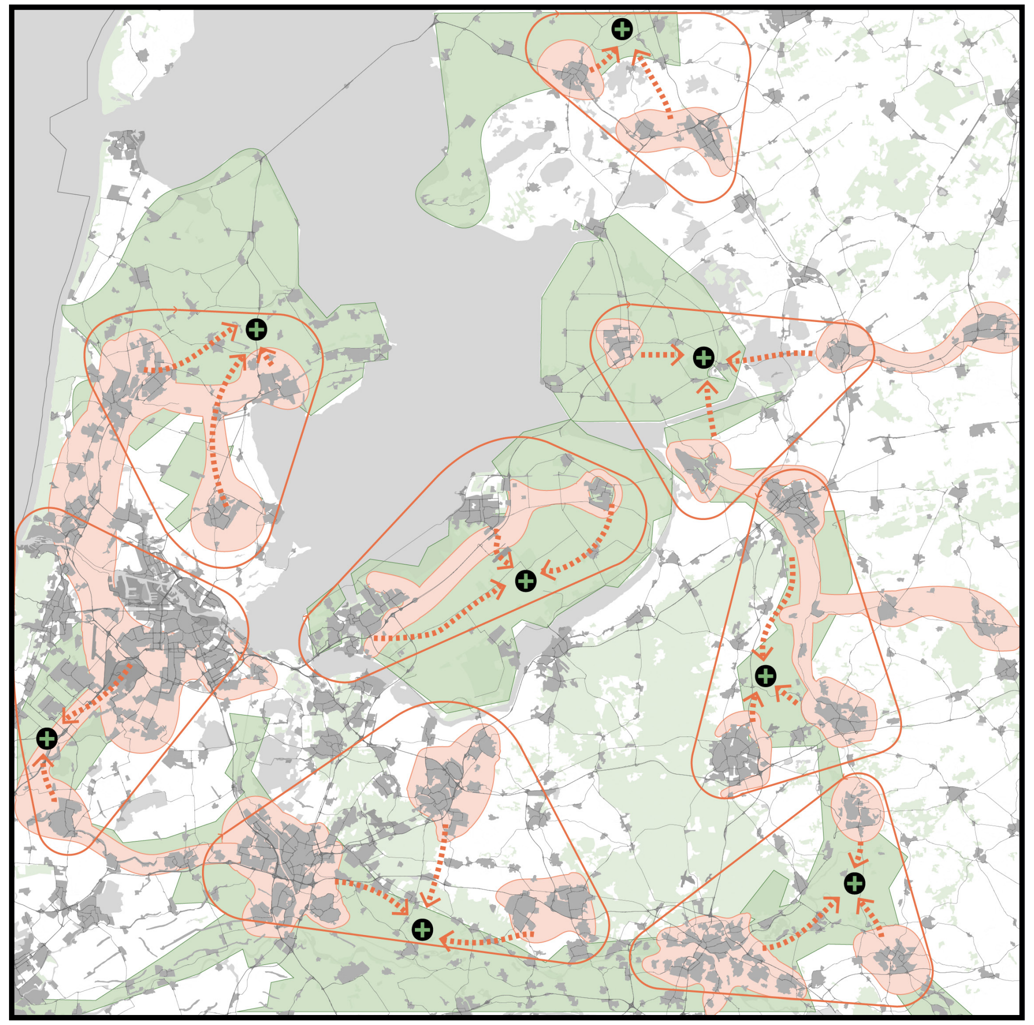


Fig. 4.20 | Summary map of opportunities, part 4
Data from: features from PDOK (2025a), retrieved via QGIS

- Urban fabric
- Water bodies
- Agricultural land
- Good soil for agriculture
- Existing forest area
- Potentional regional scale production with functional mix
- Consumer-production interaction

0 10 20 30 km

SUMMARY OF CHALLENGES

However, there are socio-spatial contestations and challenges present within the region as well. Wind energy potential, while an opportunity, also poses socio-spatial contestations. As evident in the previous calculations, they take up space, and it has historically invoked feelings of Not-In-My-Backyard by the inhabitants.

Additionally, considering the elevation of the Netherlands, flood mitigation and drought periods both need to be accounted for (see Figure 4.22). The Natura 2000 protected areas (see Figure 4.23) do not pose a conflict but indicate proceeding with caution in proximate areas to not have any negative impact. Lastly, in Figure 4.24, the emissions and pollution caused by proximate industries such as the fertiliser and pesticide industries or the airports are shown. This could deteriorate crop production and need to be factored in. The areas near the airports also have building restrictions that need to be accounted for.

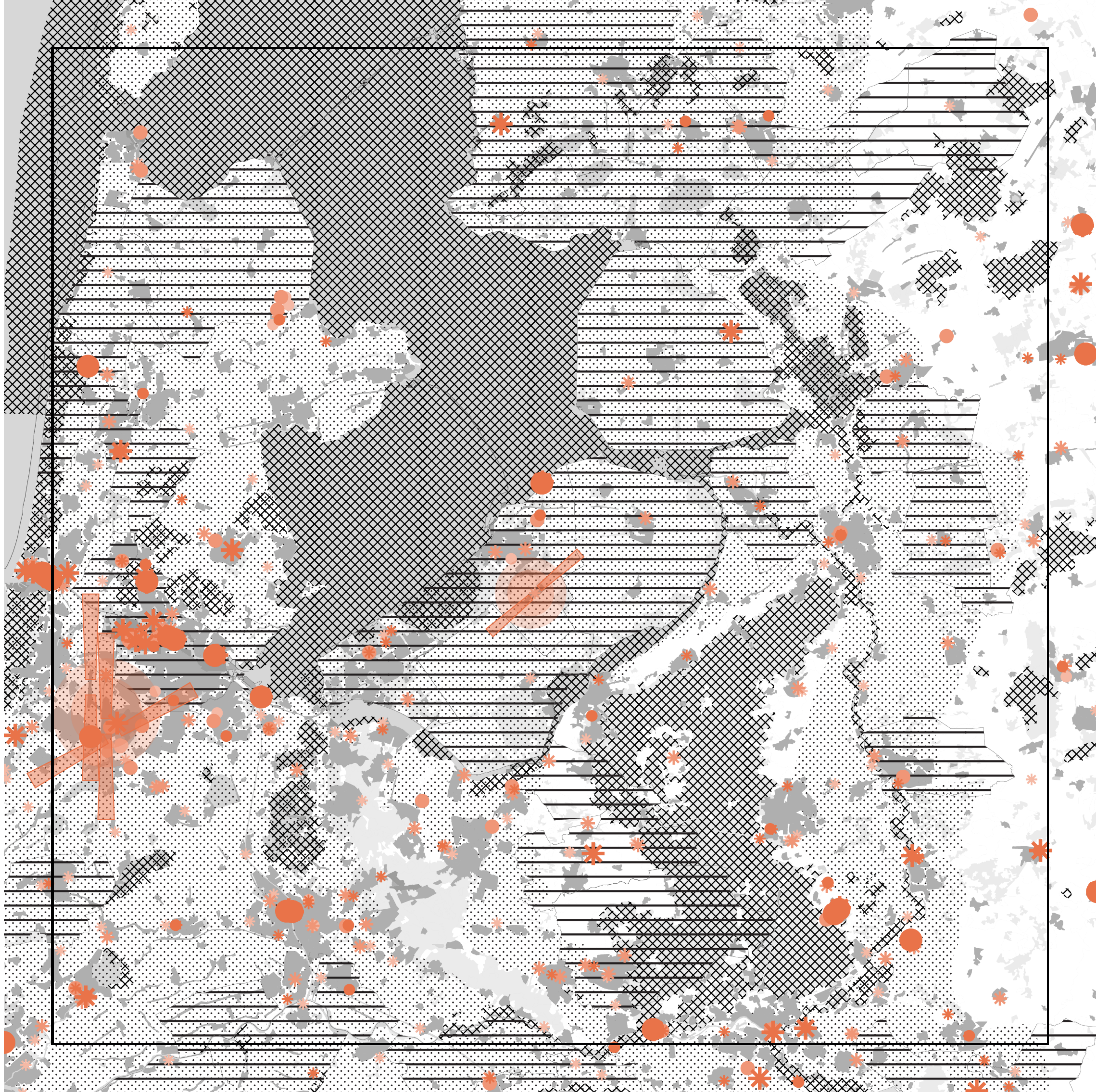


Fig. 4.21 | Summary map of challenges, overview
Data from: features from PDOK (2025a; 2025b), retrieved via QGIS

- Urban fabric
- Water bodies
- Agricultural land
- Forest
- Flood risk
- Wind energy projects
- Natura 2000
- ETS Business CO_2 emissions
- Business CO_2 emissions
- Airport OLS

0 10 20 30 km

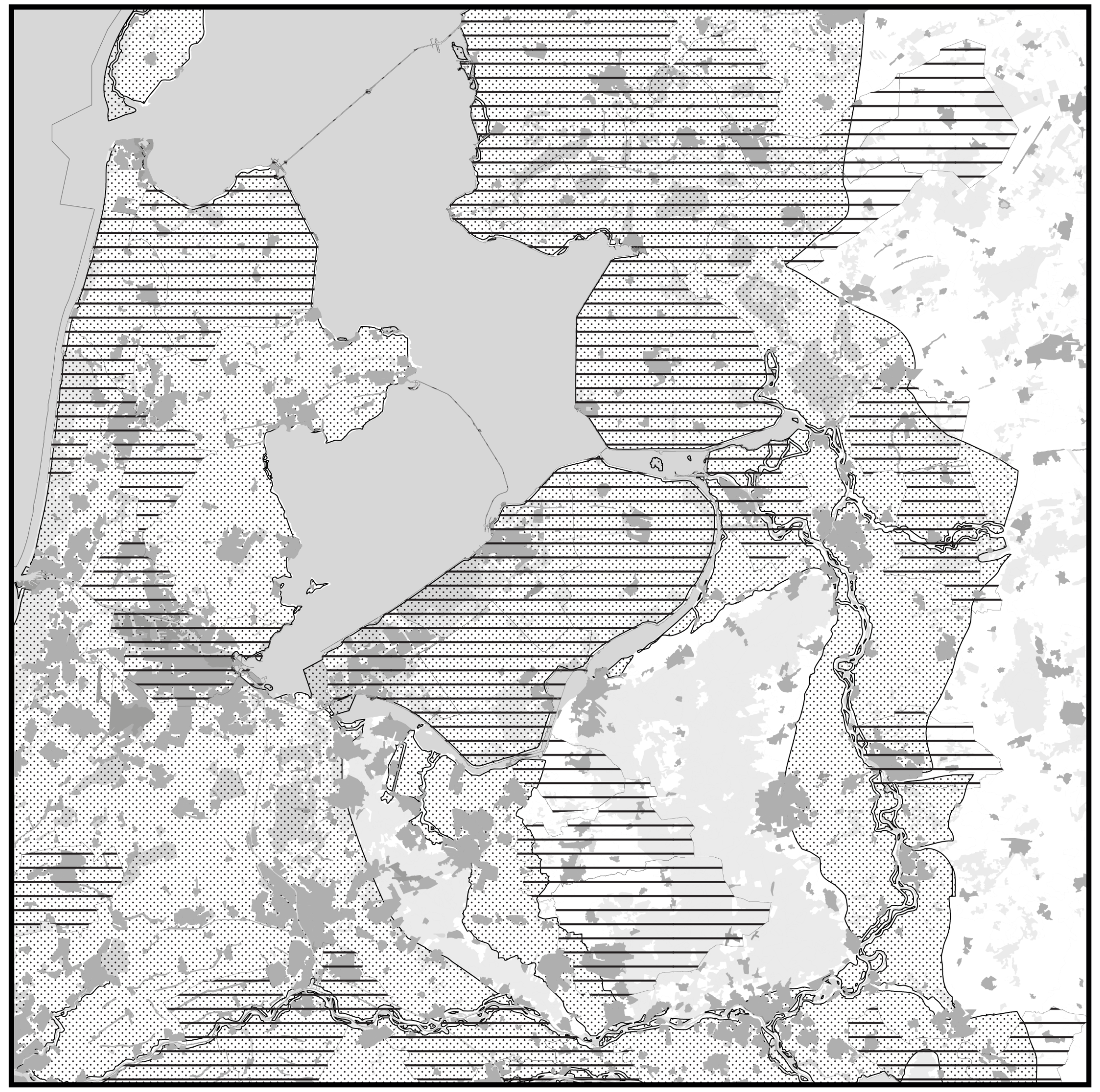


Fig. 4.22 | Summary map of challenges, part 1

Data from: features from PDOK (2025a; 2025b), retrieved via QGIS

- Urban fabric
- Water bodies
- Agricultural land
- Forest
- Flood risk
- Wind energy projects

0 10 20 30 km

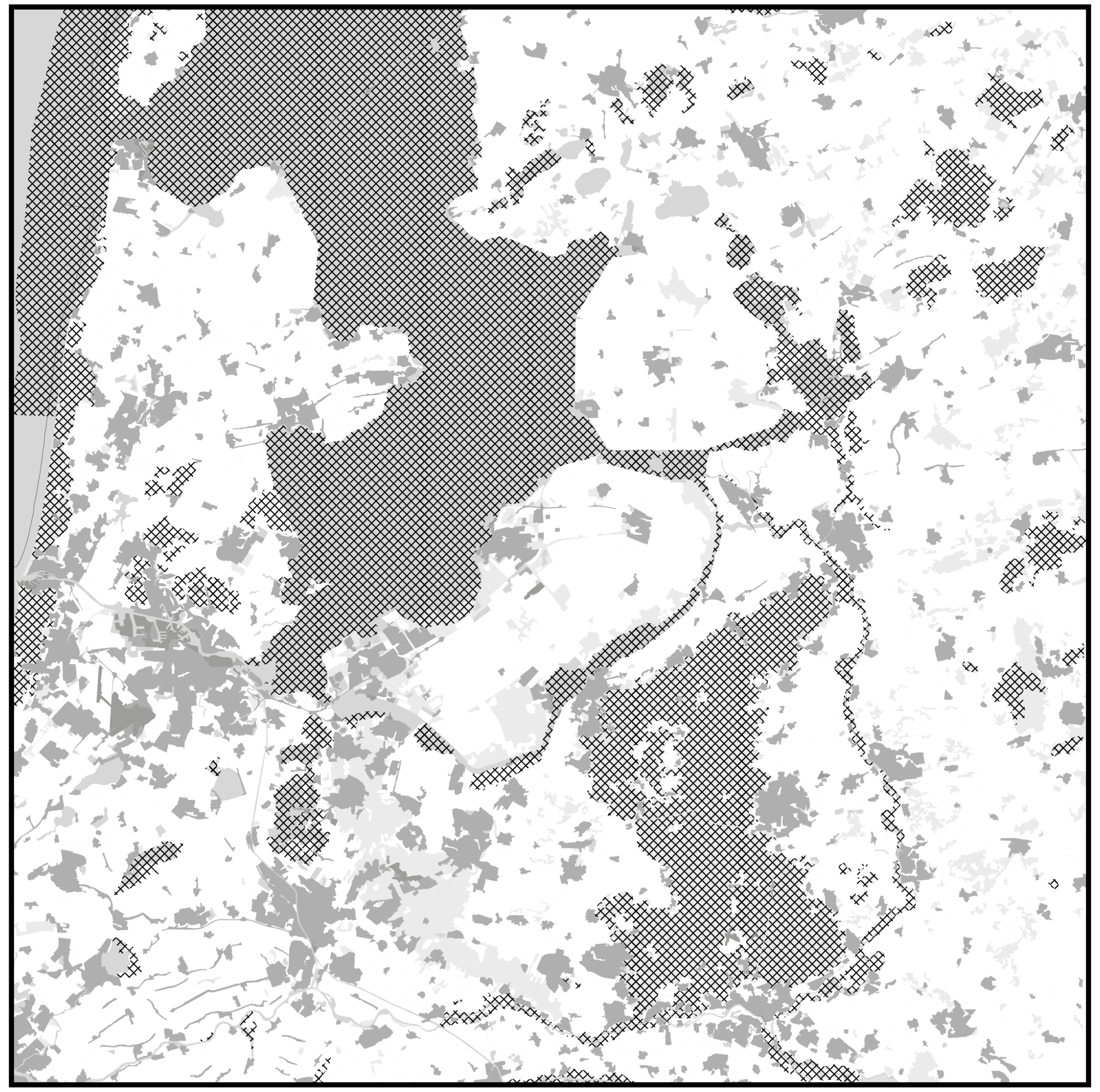


Fig. 4.23 | Summary map of challenges, part 2

Data from: features from PDOK (2025a; 2025b), retrieved via QGIS

- Urban fabric
- Water bodies
- Agricultural land
- Forest
- Natura 2000

0 10 20 30 km

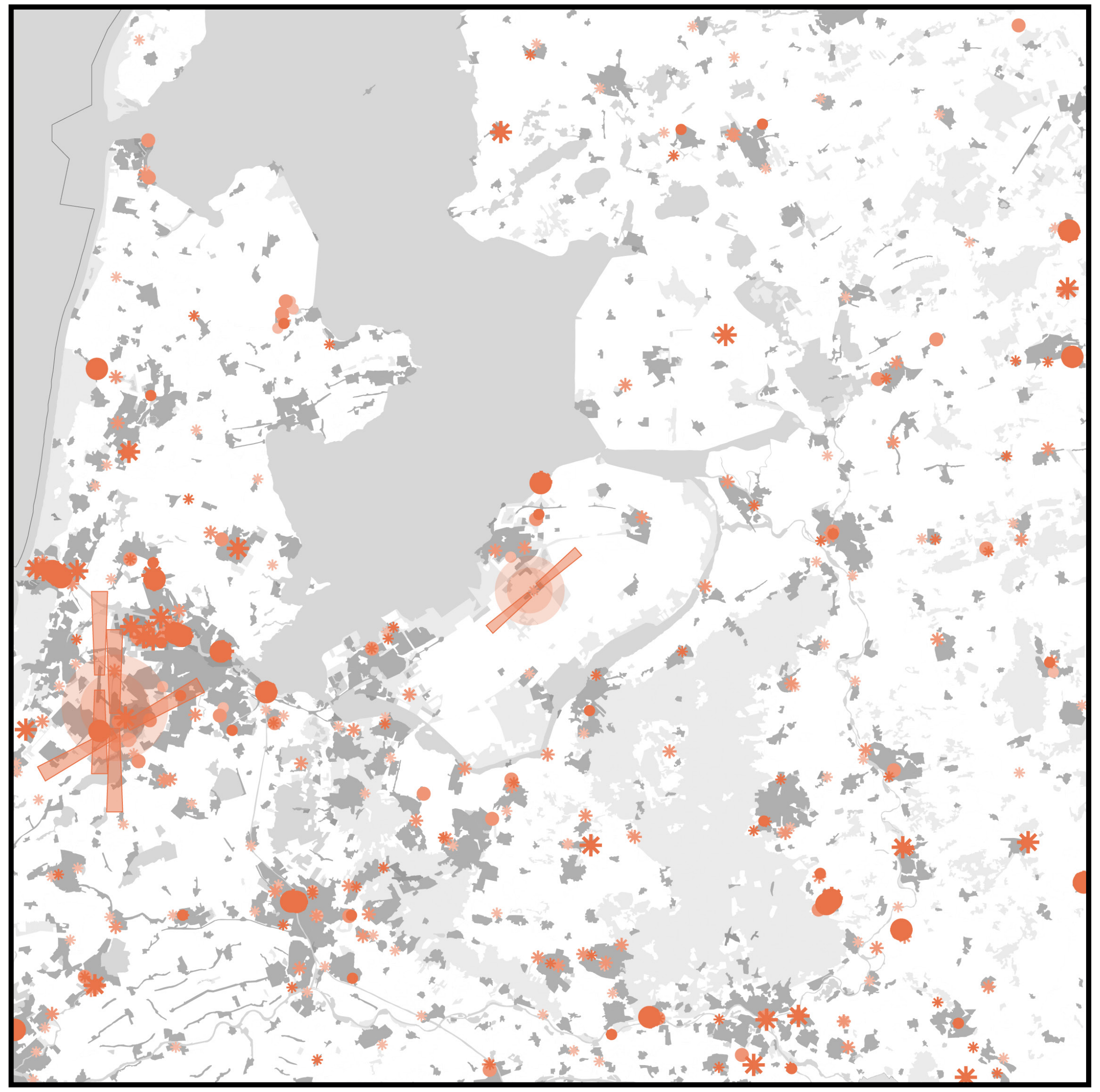


Fig. 4.24 | Summary map of challenges, part 3

Data from: features from PDOK (2025a; 2025b), retrieved via QGIS

- Urban fabric
- Water bodies
- Agricultural land
- Forest
- ETS Business CO_2 emissions
- Business CO_2 emissions
- Airport OLS

0 10 20 30 km

5.

VISION

In this chapter, the vision is outlined. The vision built upon the principles of biodynamic farmers, the transition community of the project. The vision considers the main opportunities and challenges recognised in the Dutch food system and the spatial characteristics of the province. The Chapter starts with the vision statement. The vision statement is translated into principles. These principles are developed into a vision map. For the vision, the transition zones are key. The physical location of the transition zones is identified through a typology construction. Subsequently, a spatial translation of the vision is shaped to identify the spatial characteristics of the urban, transition, and agricultural zones. Then, the spatial characteristics of each transition zone are identified. Lastly, the redefined system is elaborated.

VISION STATEMENT

A manifesto for making biodynamic farming the new conventional farming. For the biodynamic farmers in Flevoland, a sustainable and just agrifood system is envisioned that connects producers with consumers across regions while facilitating the energy transition towards a resilient future.

DESIGN PRINCIPLES

This vision statement translates into the transition community's design principles that are closely interlinked with and build on the biodynamic farming principles.

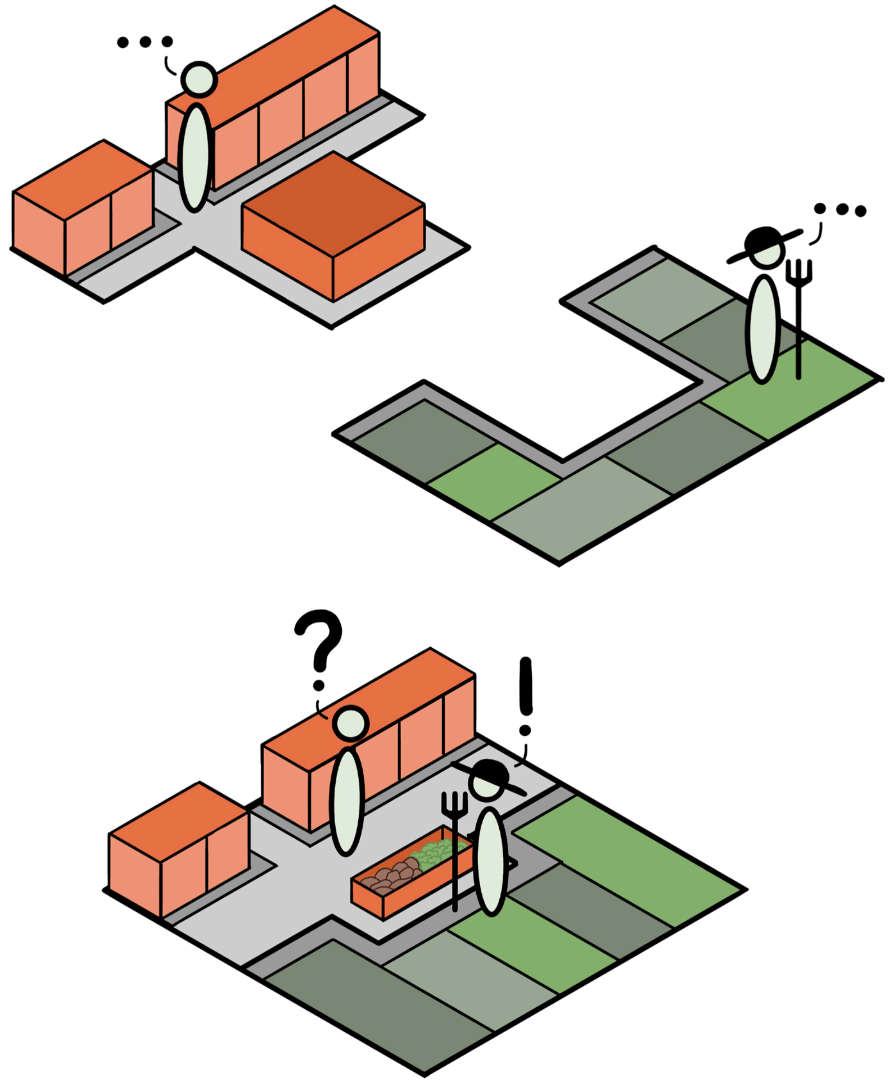


Fig. 5.1 | Design principle 1

FORMING A CLOSER CONNECTION BETWEEN CONSUMERS AND PRODUCERS:
The closer connection between producers and consumers aims at bringing consumers and farmers physically and socially closer together. Physically, in terms of space. Socially, in terms of awareness and consumer education. This principle corresponds with the biodynamic principle of social responsibility.

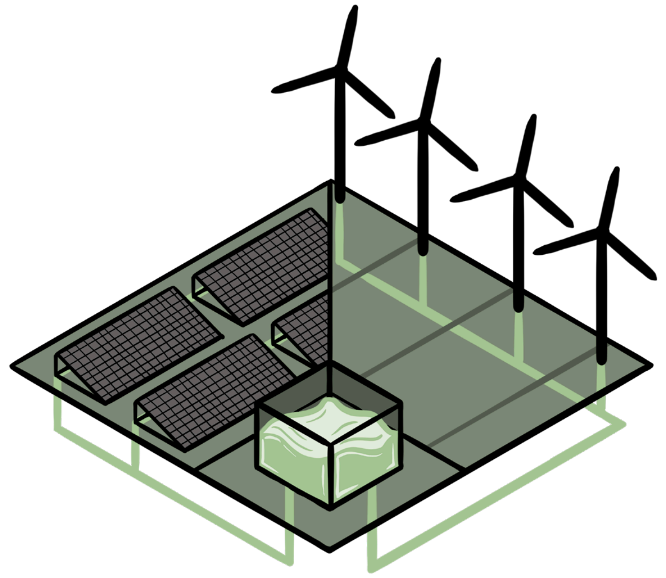
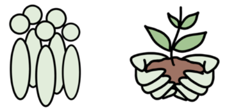


Fig. 5.2 | Design principle 2

CREATING A SYSTEM RELIENT ON RENEWABLE ENERGY:
The renewable energy and hydrogen storage principle intends to reduce reliance on fossil fuels and become more energy neutral via renewable energy and more efficient use of renewable energy through hydrogen storage. Furthermore, collective ownership could make this renewable energy transition interesting for biodynamic farmers. This principle is related to the social and ecological responsibility of the biodynamic principles.



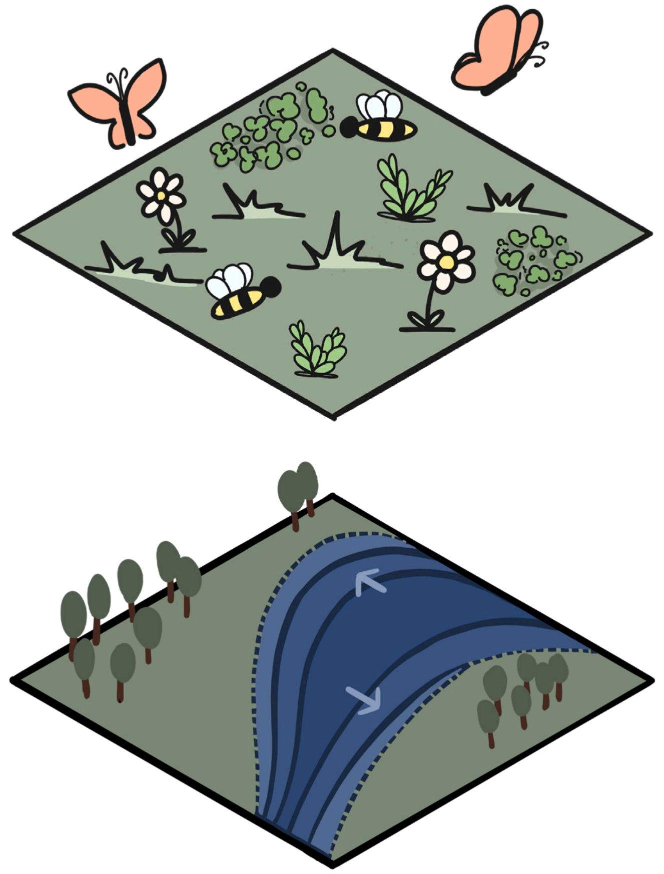
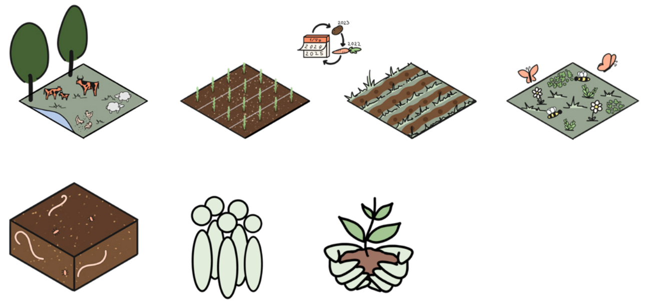


Fig. 5.3 | Design principle 3

BIODIVERSITY AND CREATING MORE ROOM FOR WATER AND NATURE:
This biodiversity principle focuses on developing more space for nature by integrating nature and water. This can be done by mixing water, nature, and agriculture or leaving more space for water and nature. Furthermore, on a larger scale, applying biodynamic farming principles of animal welfare, biodiversity, soil fertility, and ecological responsibility can enhance biodiversity.



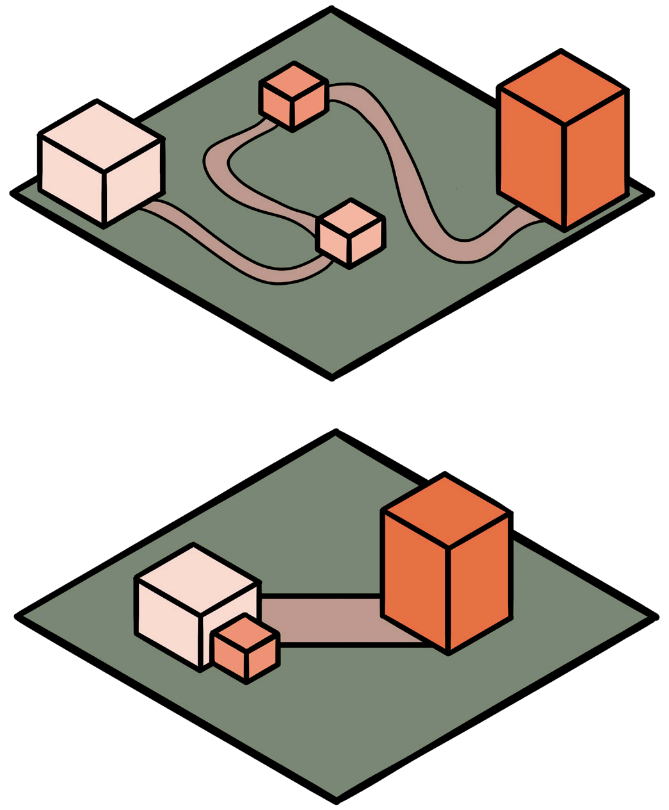
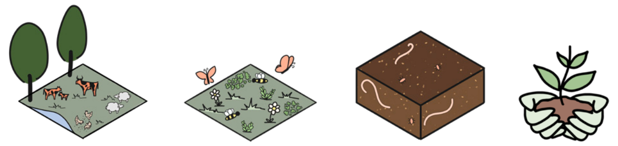


Fig. 5.4 | Design principle 4

SHORTENING THE CHAIN:
Shortening the food supply chain is important to make the food system more sustainable through shorter travel distances. Furthermore, shortening the chain creates a closer connection between the consumer and producer.



VISION

VISION MAP

For biodynamic farmers, a sustainable and just agrifood system is one in which nature and agriculture are interconnected and thrive, the connection between producers and consumers is strengthened, and waste is minimised. The connection between producers and consumers can be strengthened by making healthy food more accessible and affordable. Biodynamic agricultural practices will be adapted and integrated in three zones to achieve the community's goals while also considering the Dutch food system context and the region. The different zones are the urban, transition, and agricultural zones.

Within the **urban zones**, farming is integrated into the everyday life of citizens through innovations. It comprises a mix of functions such as housing, agriculture, innovation, and education, densely spaced in the limited available space. The **transition zones** combine biodynamic farming with living. Here, further innovations and educating the inhabitants are key. Some conventional farms may still be present to meet provincial demands. The **agricultural zones** focus solely on food production and efficiency, using agroparks for production at a regional scale. Agroparks are mixed land-use areas where multiple parts of the food supply system come together (Boersma et al., 2019). Cees Veerman, a professor of sustainable rural development at Wageningen University, first introduced the concept. Agroparks pursue the most effective use of space, distance, scale, and waste flows. The chain is shortened in the agricultural zones, as food production, processing, and storage occur in the agroparks. In the redefined agrifood system, the focus is on the regional level. Nevertheless, imports and exports on a European scale will be considered for resilience and economic stability. The international trade will be rethought to accommodate future needs. Besides these three zones, there is room for preserving the protected natural areas and water while integrating with eco-sensitive biodynamic practices through establishing ecological corridors. Furthermore, the different zones also allocate space to facilitate the energy transition.

Furthermore, a shift from conventional farming towards biodynamic farming will reduce inefficient and indirect energy consumption, mainly through eliminating artificial fertilisers and pesticides and the associated energy usage. Simultaneously, it aims to combine cleaner energy with hydrogen storage to create a resilient energy infrastructure through wind turbines and solar parks. The vision map demonstrates spatially the biodynamic farmer's vision for Flevoland. The different zones are shown in the vision map. The transition and agricultural zone are based on the already existing Mondrian grid.

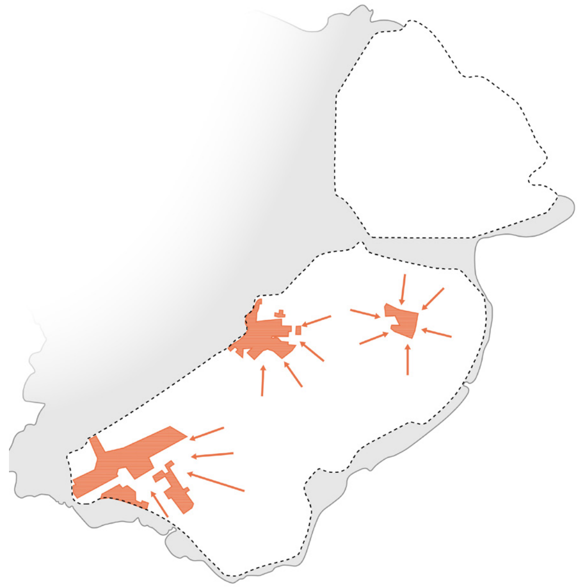


Fig. 5.5 | Urban zone

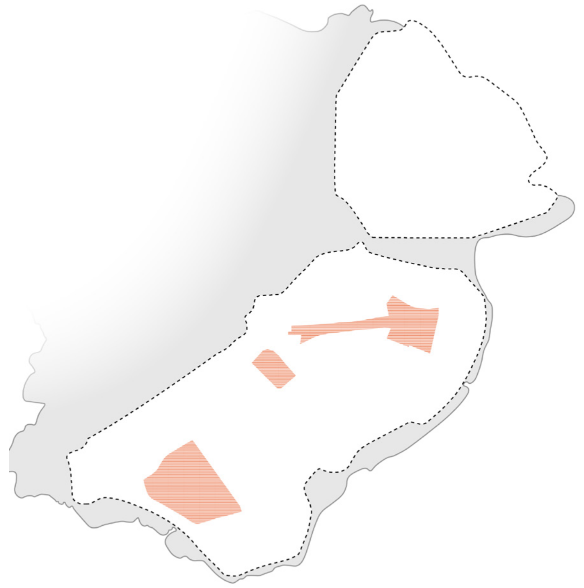


Fig. 5.6 | Transition zone

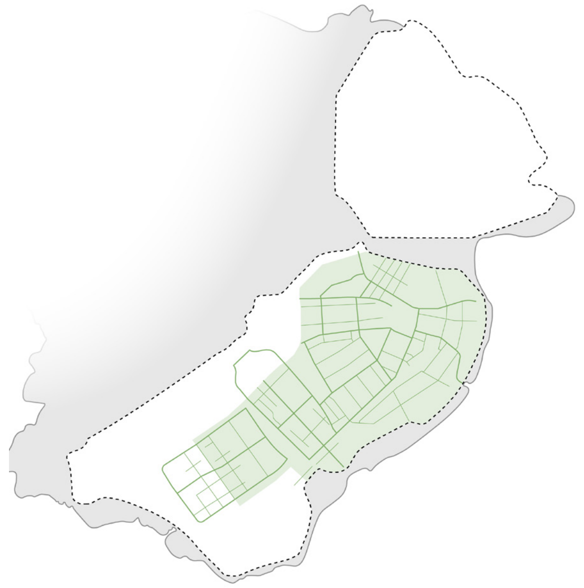


Fig. 5.7 | Agrocultural zone

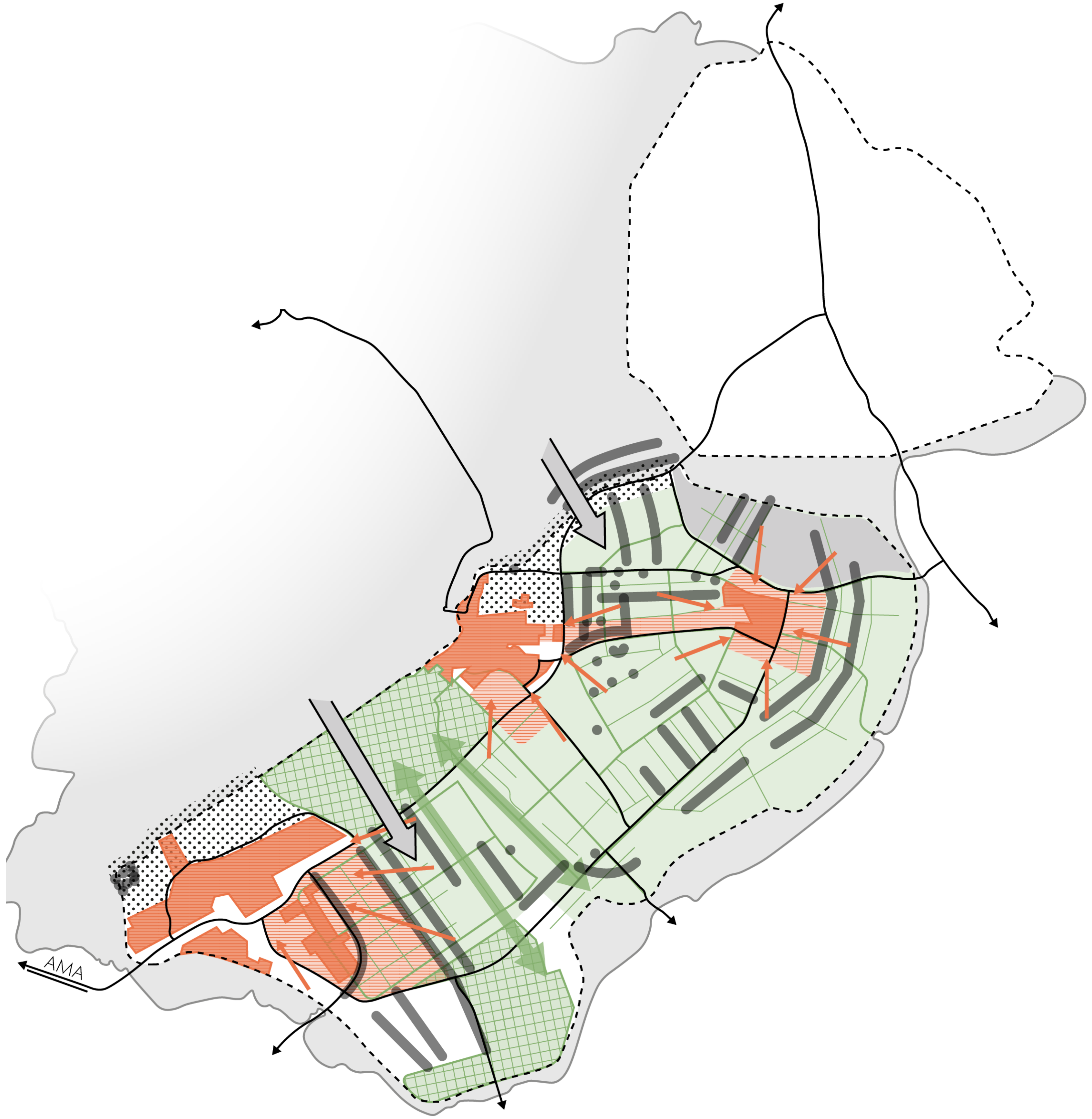


Fig. 5.8 | Vision map
Data from: Provincie Flevoland (2023)

Besides the proposed zones, space will be allocated for nature by developing ecological corridors that connect the protected Natura 2000 sites and integrate the natural habitats with the proposed biodynamic farms to enhance biodiversity. Space for water will be allocated to mitigate flood risks.

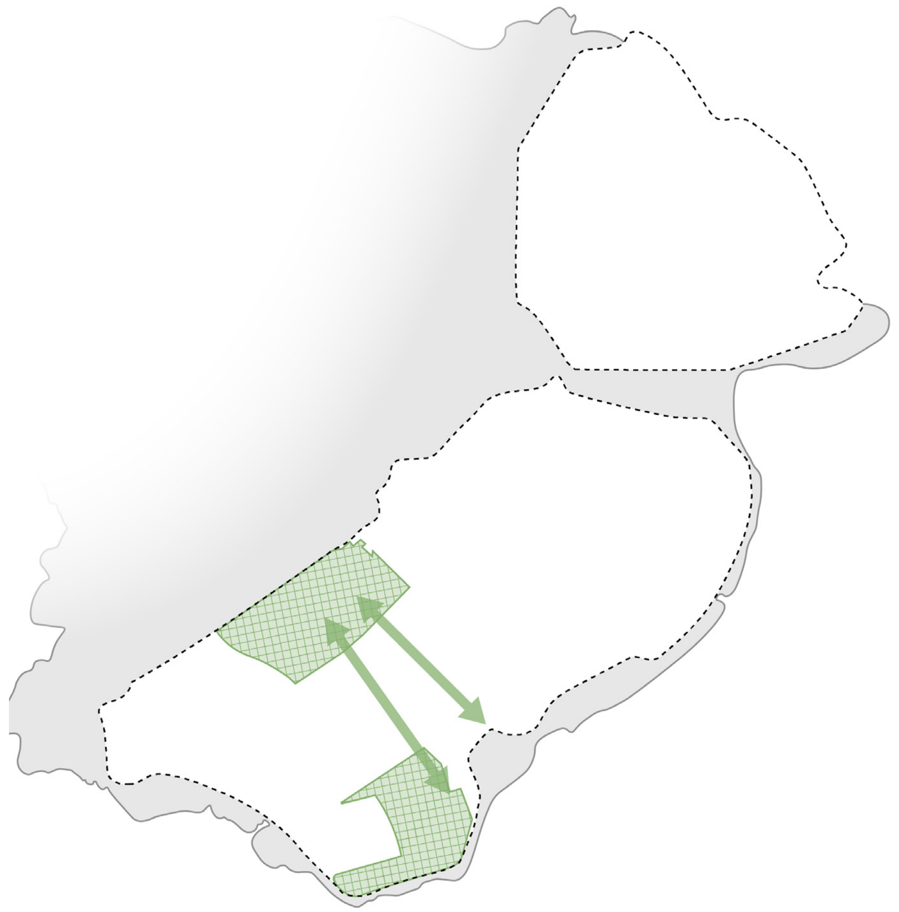


Fig. 5.9 | Transition zone for agriculture and nature

Agroparks zone
Ecological corridor

To cater to Flevoland's flood risk, retention areas around canals and proximate to the coast are proposed. Additionally, channels could be integrated into agriculture to effectively use water in the area.

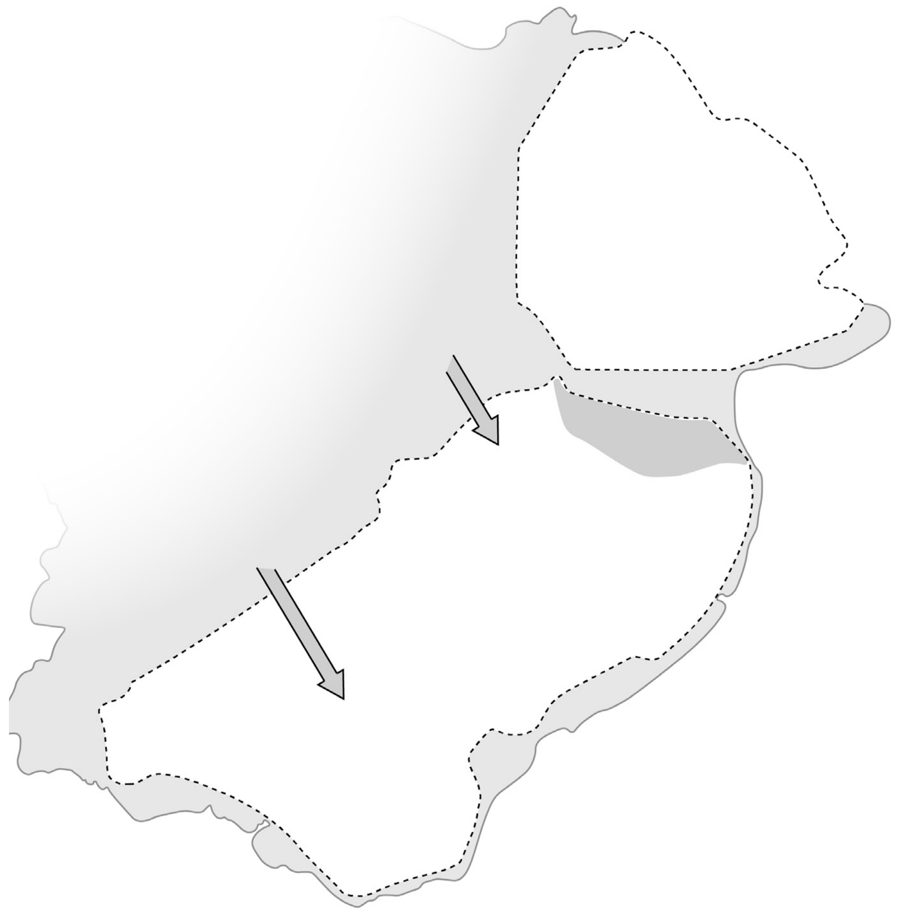


Fig. 5.10 | Transition zone between agriculture and water

Water
Room for excess water

The vision integrates agricultural landscapes with sustainable energy infrastructure, strategically incorporating space for energy transition initiatives. The proposed wind turbine locations are embedded within the design, ensuring efficient land use while maintaining ecological balance, promoting renewable energy, and enhancing the vitality of both agricultural and urban environments.

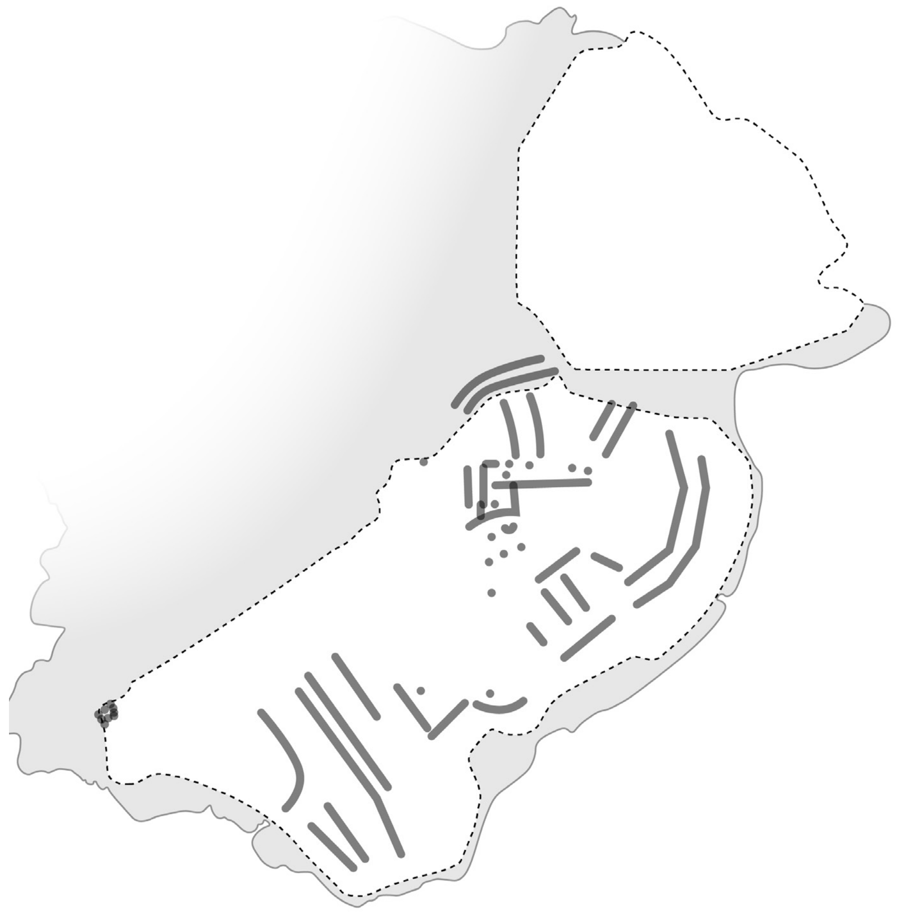


Fig. 5.11 | Transition zone between agriculture and energy landscape (plan 2030)
Data from: Provincie Flevoland (2023)

Windmills according to 2030 plan

Finally, agriculture in integrated with urban development on the west side of Flevoland, prioritising a balance between green spaces, farming spaces, and high-density urban areas. This approach aims to achieve sustainable growth, promote local food production, and enhance the quality of life in urban landscapes.

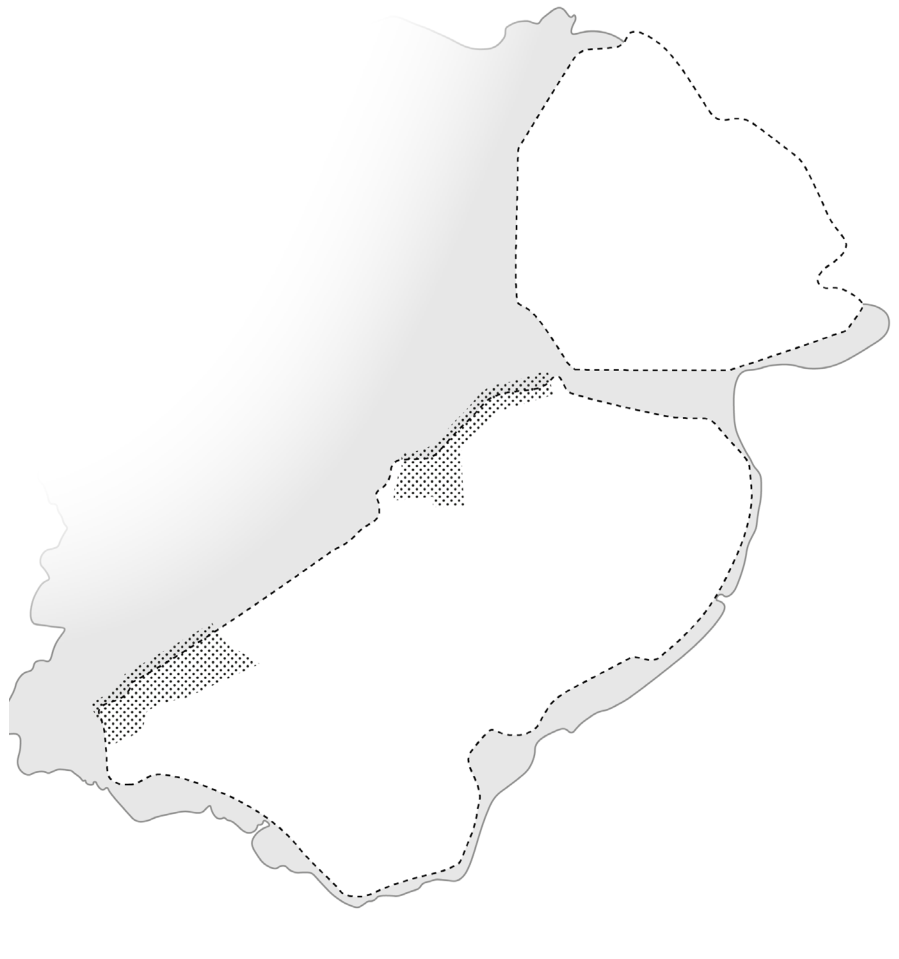


Fig. 5.12 | Room for urban development

Urbanised strip (potential)

IDENTIFYING TRANSITION ZONES

To transition from a biodestructive to a biodynamic food system, transition zones are envisioned. These zones could provide a closer relationship between farmers and their surroundings. A typology construction is undertaken to help identify where these transition zones should be. The first step for this typology construction is to visualize land use per square of 500 by 500 meters. For this step, the land use was categorised into urban areas, agricultural land, natural land, and wetlands. Then, all the squares with monofunctional land use can be filtered out. In this way, the mixed-function squares remain, facilitating two or multiple functions like farming, housing, shopping, education, nature, or water.

The next step is to identify the areas with a medium-dense population. Inspired by the work of Wandl (2019), a population size of 38 to 1250 inhabitants per 500 by 500 meters was selected (p. 96). These medium densely populated areas are suitable for transition zones, as these areas could facilitate a mix of agriculture and residential functions. When these areas are filtered, the squares with mixed functions and medium-dense population overlap. Additionally, a 15-minute biking radius is visualised from the most densely populated squares. This step filters out areas that are not easily accessible to residents. Combining the different filtering steps, led to the map showing the potential transition zones (Figure 5.18). The identified transition zones will be used in the overall vision for Flevoland.

Fig. 5.13 | Step 1: visualise land use
Data from: CBS (2023); Copernicus EU (2018)

- Urban area
- Agricultural land
- Natural land
- Wetlands/water

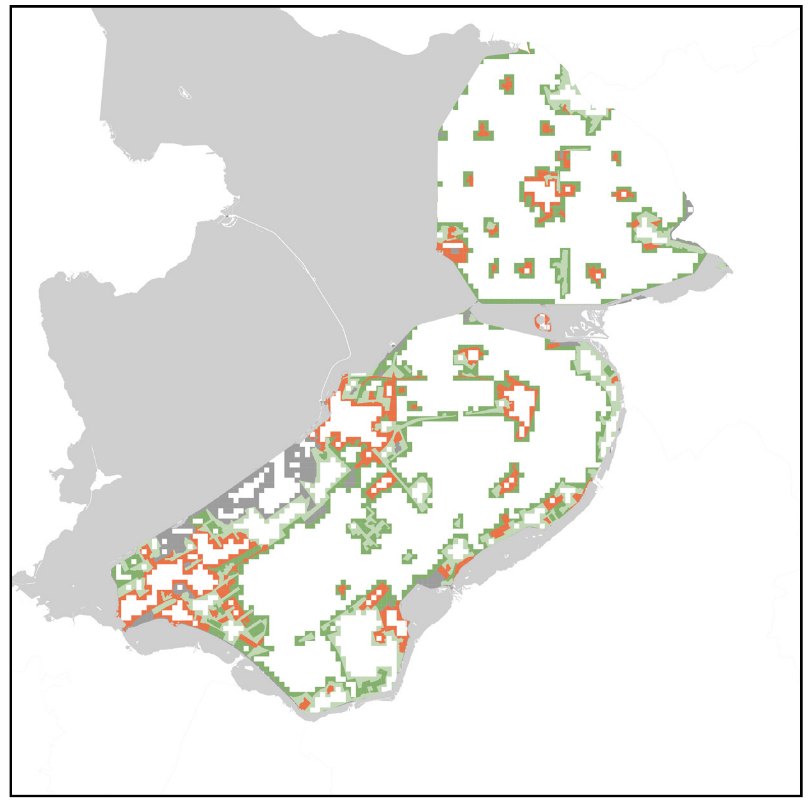


Fig. 5.14 | Step 2: only mixed-use squares
Data from: CBS (2023); Copernicus EU (2018)

- Urban area
- Agricultural land
- Natural land
- Wetlands/water

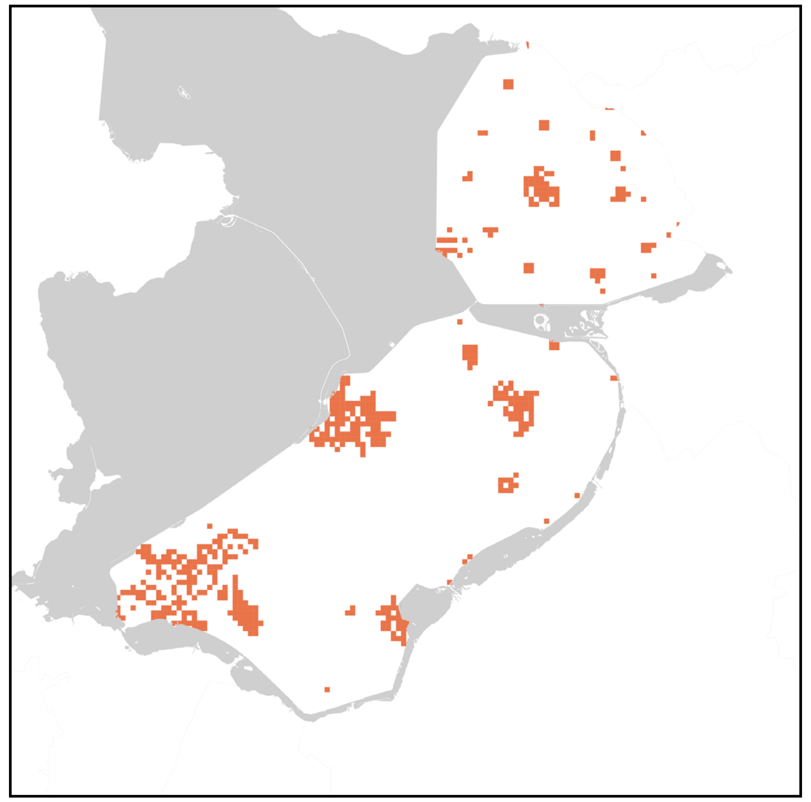


Fig. 5.15 | Step 3: medium densities
Data from: CBS (2023); Copernicus EU (2018)

- Number of inhabitants (between 38 and 1250 inhabitants)

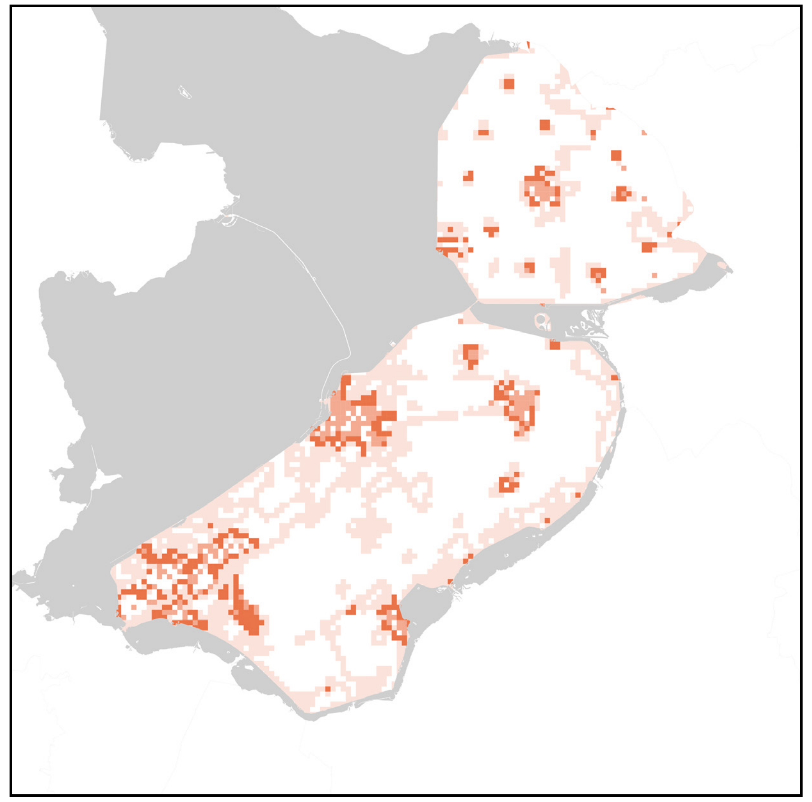


Fig. 5.16 | Step 4: show overlapping areas
Data from: CBS (2023); Copernicus EU (2018)

- Mixed functions
- Number of inhabitants (between 38 and 1250 inhabitants)
- Overlapping areas

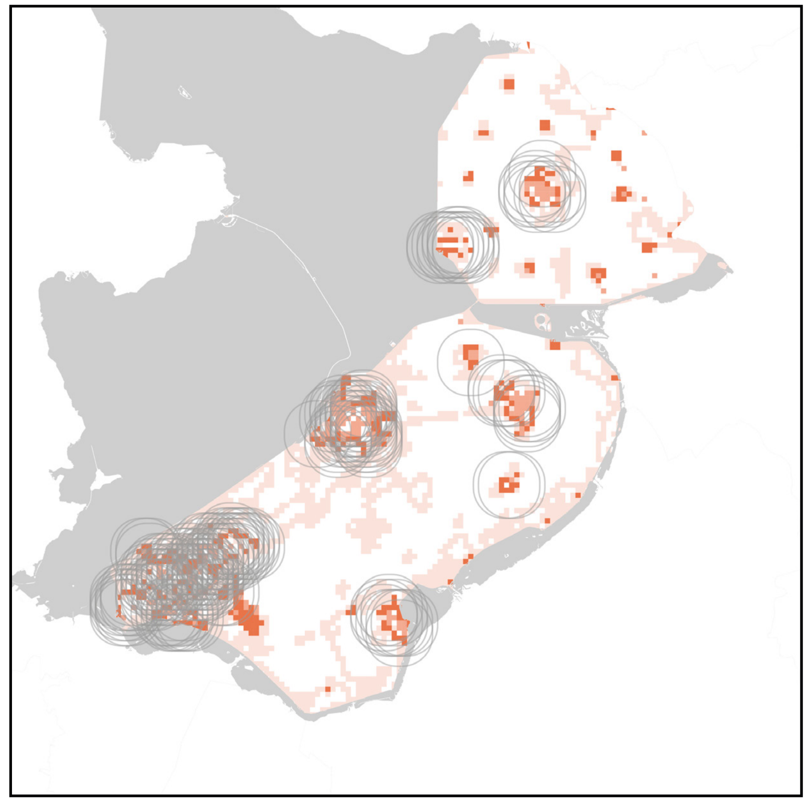


Fig. 5.17 | Step 5: 15 min biking proximity
Data from: CBS (2023); Copernicus EU (2018)

- Mixed functions
- Number of inhabitants (between 38 and 1250 inhabitants)
- Overlapping areas
- 15 min biking distance from populated squares (more than 1000 inhabitants)

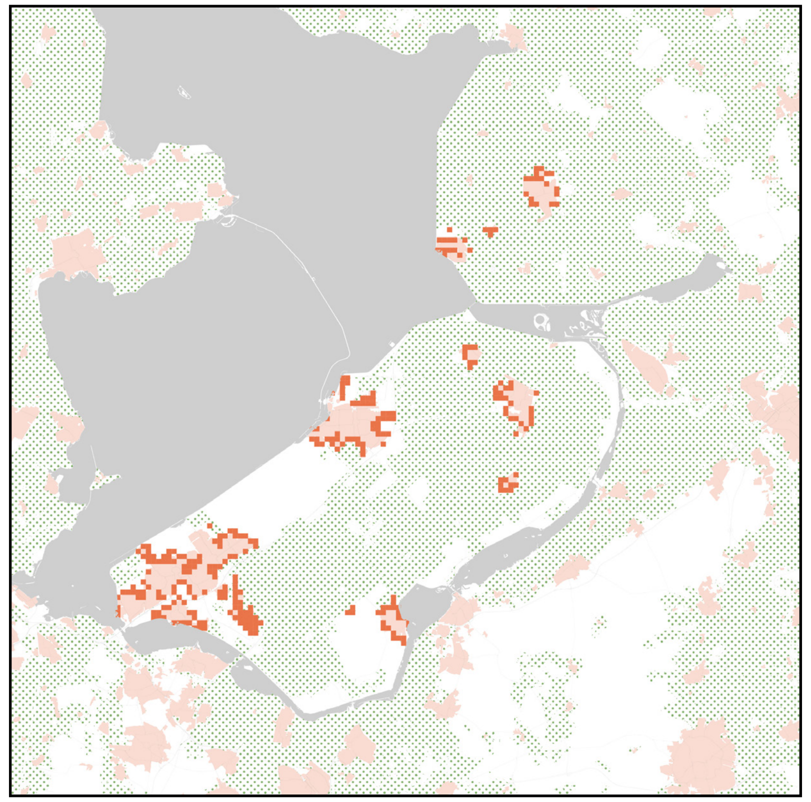


Fig. 5.18 | Step 6: resulting transition zones
Data from: CBS (2023); Copernicus EU (2018)

- Potential transition zones
- Urban area
- Agricultural land
- Main roads

0 10 20 km

SPATIAL CHARACTERISTICS

The proposed vision is translated into different spatial characteristics per zone. As mentioned in the previous section, the vision recognises three zones: urban, transition, and agricultural. The transition and agriculture zone will follow the Mondriaan structure already present in Flevoland. This is because the Mondriaan structure is recognised as a strong grid that allows change and adaptability in the long term.

The urban zone prioritises living and, therefore, facilitates consumers. To create a closer link between consumers and producers in the urban zone, urban farming will be integrated into the cities and villages of Flevoland. The spatial translation for this will be roof farming, vertical farming, and vegetable gardens. Supermarkets and farmers' markets within the urban zone will sell products harvested in Flevoland, enhancing the vision's short supply chain principle. Renewable energy will be integrated into the urban zone via solar panels. Furthermore, greenery within the urban zones will be linked to the ecological corridors outside the city to enhance biodiversity.

The transition zones facilitate a mix of producers and consumers to create a closer connection. Urban farming and biodynamic farming will come together and form a rich network of nature-inclusive agriculture. Furthermore, the transition zones will facilitate areas for innovation and education to raise awareness about the benefits and resilience of biodynamic farming. Renewable energy will be included via a grid of solar parks, wind turbines, and hydrogen storage. Smaller patches in the Mondriaan grid will be used for temporary hybrid water management areas and retention ponds.

Lastly, the agricultural zones primarily facilitate producers in Agroparks for regional-scale food production. In these Agroparks, different chains of the food system will be mixed, including agriculture, processing, and supply facilities. Conventional farmers within the agricultural zones will gradually transition to become biodynamic farmers. Within the agricultural zone, hybrid areas and new forms of farming will be developed (e.g. agroforestry). Green corridors and buffer zones between farms will be developed, forming a natural grid surrounding the Agroparks. Like the transition zone, renewable energy will be integrated via a network of solar parks, wind turbines, and hydrogen storage.

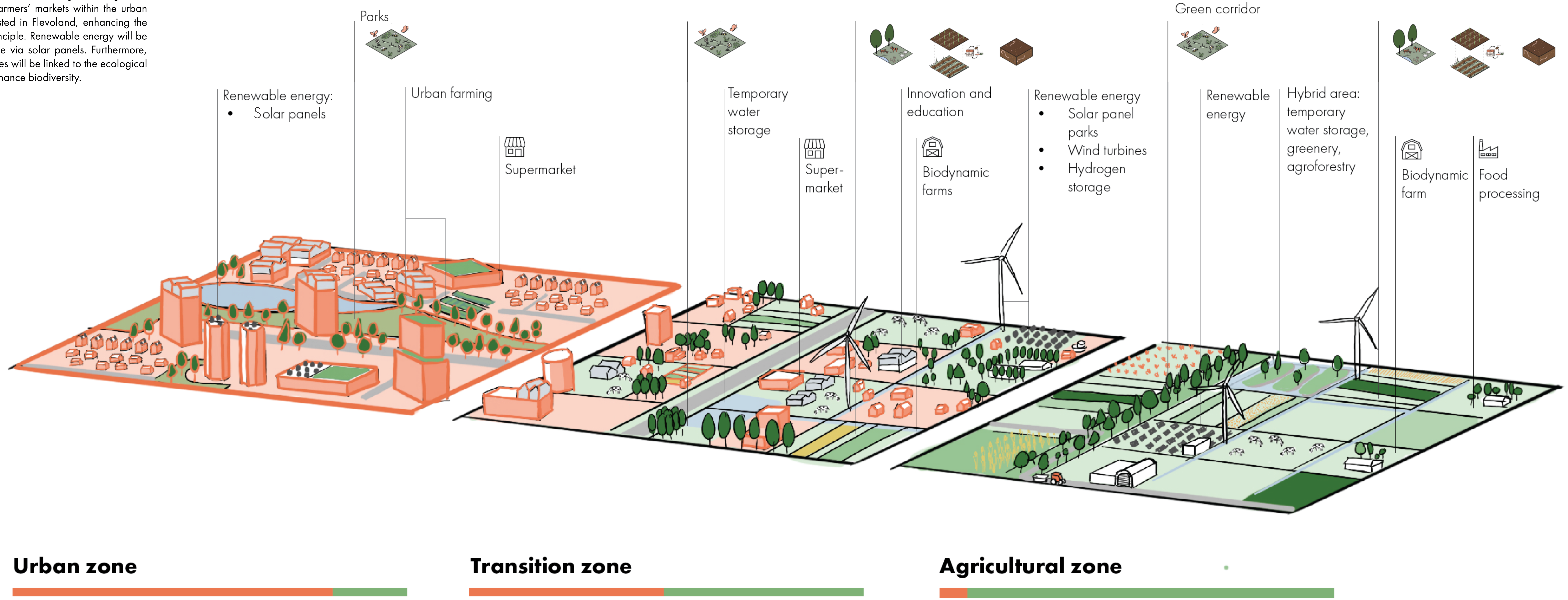


Fig. 5.19 | Spatial characteristics of the different zones

Consumers
Producers

TRANSITION ZONES CHARACTERISTICS

The proposed vision includes three different transition zones. The transition zone outlined in the previous section is between urban and agricultural areas. However, the two other transition zones identified are nature and agriculture and water and agriculture. The existing Mondriaan structure is a consistent and reliable starting point for all transition zones. However, spatial elements will be added to the different transition zones to add spatial qualities. The added layers are divided into the following themes: vegetation and ecological function, social-ecological interrelationships, and diversities.

The added elements in the transition zone between agriculture and nature primarily focus on enhancing biodiversity via more organic structures, vegetation gradients, and designing spaces for bees and birds. The added elements in the transition zone between agriculture and water focus on increasing water management and absorption possibilities.

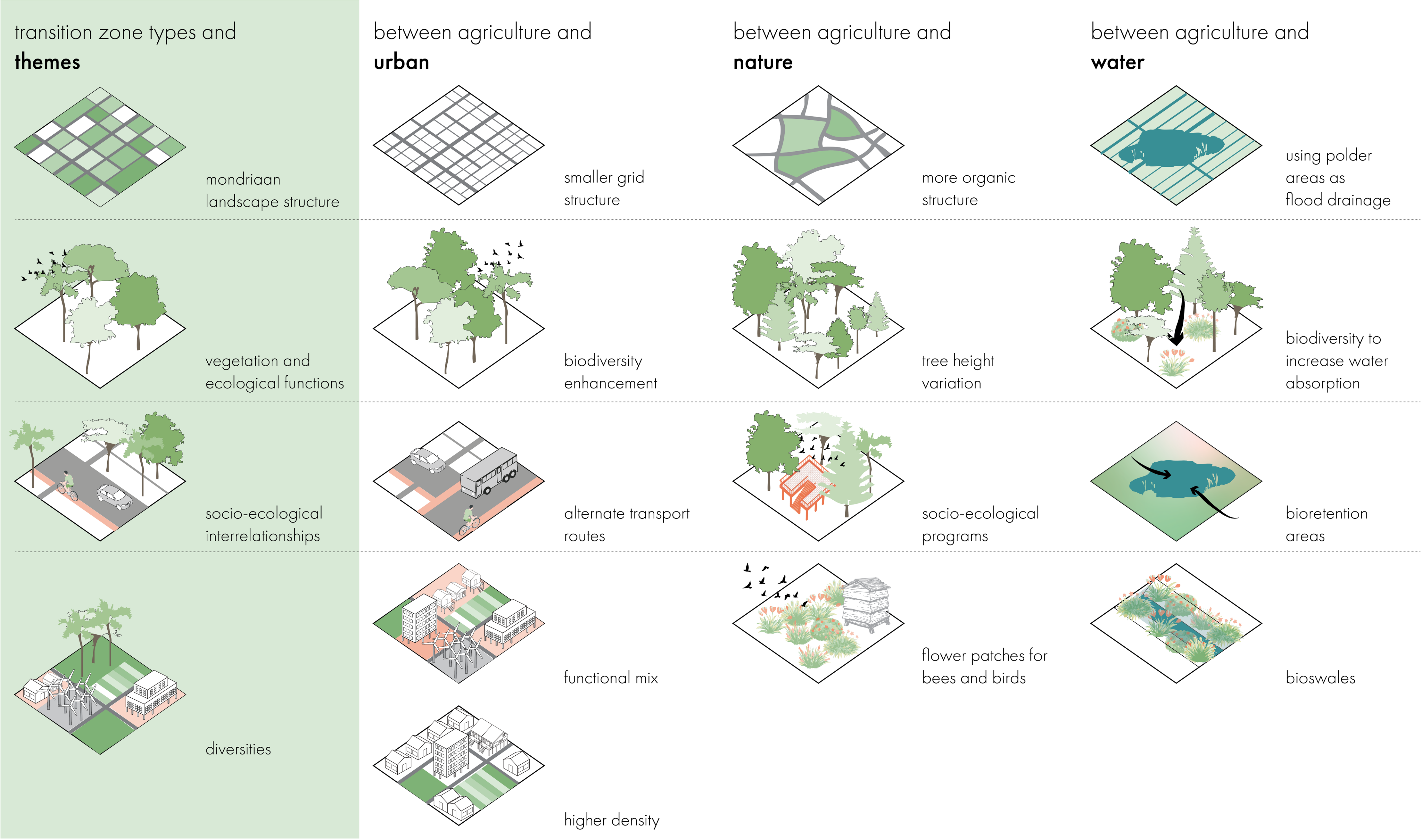


Fig. 5.20 | Overview of transition zones characteristics

REDEFINED FOOD SYSTEM

The proposed vision for upscaling biodynamic farms redefines the food system to prioritise sustainability, resilience, and local engagement. By reimagining the flow of energy and resources at a provincial scale and the substantially decreased requirement of fertilisers and pesticide industries, the aim is to reduce food miles and minimise associated energy consumption. The shift is achieved by establishing biodynamic systems that operate with an integrated and circular approach across agricultural zones. Biodynamic farms will serve as the central hub at the neighbourhood scale, incorporating a functional mix of livestock, crop rotation, local markets, consumers, and food storage facilities.

This holistic approach ensures that each component functions in harmony. The cows produce fertilisers for the farms, and the farmlands allocate space for the cows to grow fodder. There are biogas plants, each of which caters to clusters of farms. The integration of local markets brings consumers closer to food production, enabling the communities to engage directly with the sources of their nourishment. In the vision, waste is reduced, and local food security is enhanced through this circular relationship between production, consumption, and processing. Ultimately, this vision seeks to create a biodynamic and efficient food system that supports ecological health and community well-being while minimising environmental impact and reinforcing the connection between people and the land that sustains them.

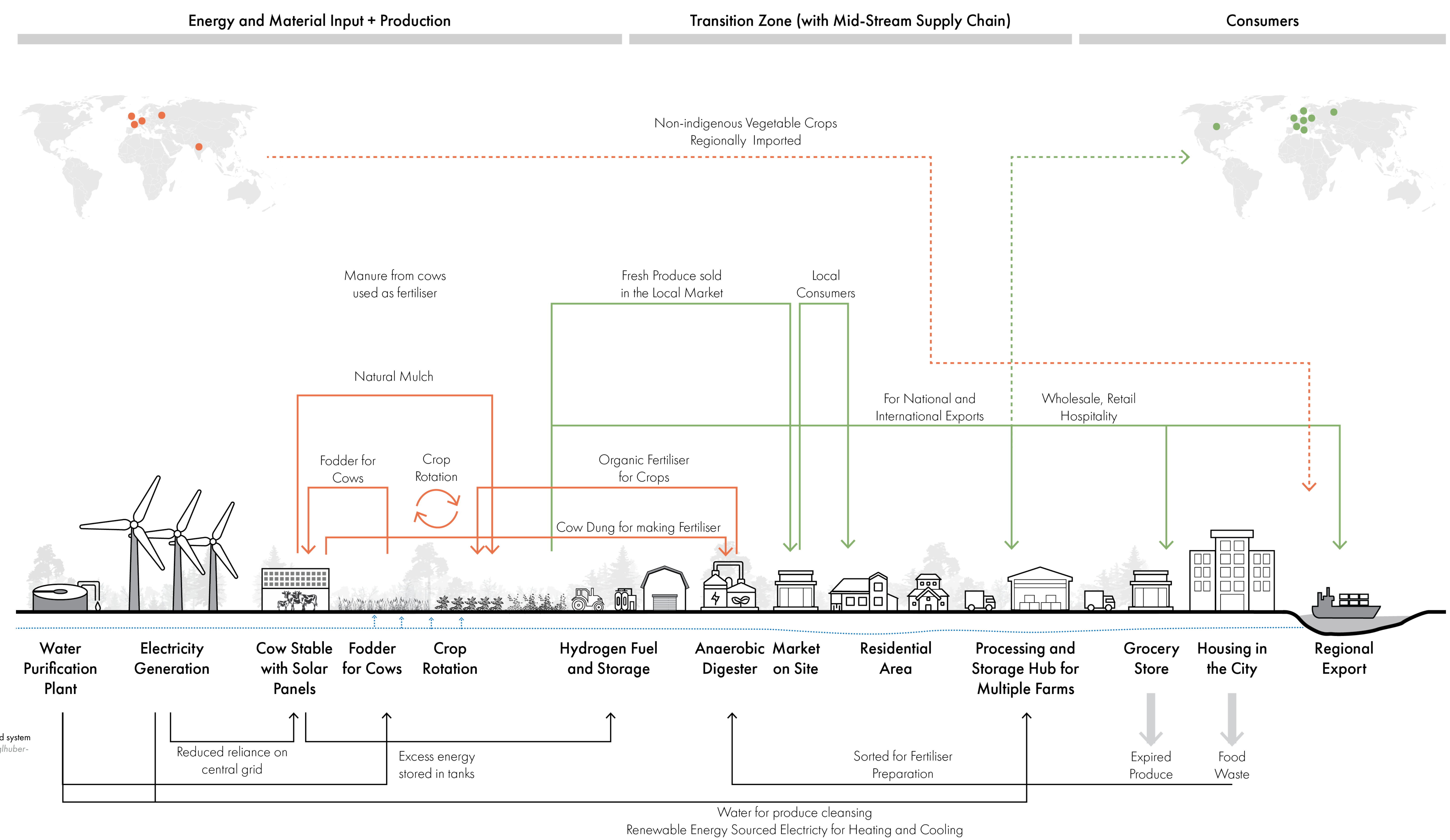


Fig. 21 | Redefined systemic section of Dutch food system
Data from: Barbieri et al. (2021); PBL (2019) Voglhuber-Slavinsky et al. (2021)

- National transport
- International import
- National output transport
- International export
- Resource input
- Emissions
- Waste

Energy and Resource Input reduces to Province Scale

6.

STRATEGY

This chapter outlines the process of creating the strategy. Considering policies, laws and regulations is the first step. Based on these, scenarios are envisioned, each focusing on a possible future for agriculture. The insights from the scenarios are translated into strategic actions. Divided into five different categories, these cards give clear directives on the steps to take and which goals they achieve. The timeline delineates the duration of the phases, key events and actions to achieve the vision plan. These phases and actions are mapped together on the regional scale of Flevoland, in sections, and on Oosterwold, the pilot case. Lastly, the collaborations and shifts between stakeholders are visualised.

FRAMING

POLITICAL CONTEXT

The vision at hand is one in which the preferred future of the biodynamic farmers is visualised. While the strategy will aim to develop a future for Flevoland in which the wishes of the chosen community can be exploited to the fullest extent, it would be unethical to directly enforce the vision of a community which is small in size upon the large share of conventional farmers. The opinions of conventional farmers matter and should be considered; top-down governance will only lead to resistance, as we have seen in the farmers' protests of 2019 (Van Der Ploeg, 2020). During the protests, it became apparent that farmers did not feel like they were being involved in the decision-making process of laws that would directly impact their work. They also did not feel connected to the political playing field, both on a national and international level.

These protests have caused a huge shift in Dutch politics (Siegmann, 2024). During the protests, many Dutch citizens became sympathetic to the cause, forming a new political party, especially aimed at the issues the farmers were protesting against. This party, the BBB (BoerBurgerBeweging), eventually gained great popularity among the Dutch population, giving them a seat in the current cabinet. When transforming the vision into a strategy, the party program of the BBB can be viewed as a reflection of the interests of conventional farmers. It is an absolute requirement to study the party program and understand the standpoints of the conventional farmer to create a strategy that incorporates the biodynamic farmer's vision while including the large number of conventional farmers in the conversation. This way, a strategy can be developed in a manner that considers social and environmental ethics.

Many contrasting opinions, but also a fair number of resemblances, can be found in the BBB party program on the different aspects considered in the vision. Starting with a large-scale transition towards a biodynamic approach to farming, while the BBB aims to provide farmers with the necessary means to explore different, more sustainable approaches to agriculture, they are strongly against a law that obliges biological farming (BBB, 2023). However, similarities also exist in market dynamics, where the BBB aims to stimulate regional systems by proposing a system in which local produce would become available for a lower price than foreign fruit and vegetables. They also believe local initiatives deserve more support than they are currently receiving. However, this category also offers the most significant contrast in international trade. While the project's vision proposes less international trade, the BBB party program states the importance of large-scale production and the possibilities to expand international trade further.

Regarding energy, the BBB recognises opportunities for energy storage in hydrogen gas for agricultural companies. However, at the same time, they propose to stop the development of sustainable energy initiatives on agricultural lands, favouring nuclear energy. The BBB is also a strong proponent of the use of natural fertilisers in place of artificial fertilisers, leading to an overall lesser energy consumption in the production process. The most significant difference in opinions can be found in the value of ecological systems. While the vision of biodynamic farmers includes additional natural reserves and connecting different Natura 2000 zones, the BBB proposes the transformation of natural reserves to agricultural lands.

While developing the strategies, these viewpoints will be considered, and the similarities will be given priority in the strategy. Attempting to incorporate contrasting viewpoints at later phases will give the conventional farmer time to adapt to the large transition.

EXISTING POLICIES

In order to further elaborate on the policy aspect of the strategy, the table shown in Figure 6.1 was constructed to depict the strategic context of the vision. In the table, the project vision is related to existing policies to understand its relevance and how it could complement current goals. The project vision is categorised into five themes corresponding to its main goals. Policies related to the proposed vision are similarly categorised on the right side of the table. The policies included in the table are visions, ambitions, law and regulation, spatial planning, or protected areas. Per policy, it is defined whether they exercise power on a European, National, or provincial scale. Often, European-level policies are translated into national or regional policies.

One of the most important policies for the proposed vision is the Common Agricultural Policy (CAP). This policy ensures food security while protecting farmers and nature (European Commission, n.d.). Dutch farmers must operate following the CAP policy setting (EOCD, 2023). When they do so, they will be subsidised via CAP funding. The Dutch translation of the CAP, The GLB ('Gemeenschappelijk landbouwbeleid'), defines how they are subsidised. In the Netherlands, this is primarily done via direct support through basic-income support and eco-schemes (pillar 1) and rural development programs (pillar 2). Currently, the CAP strategic plan is to transition towards more sustainable and nature-inclusive farming while preserving high food productivity. Another important European policy is the Green Deal. This policy is focused on accelerating the transition towards a more sustainable agrifood system (Bos et al., 2023). Part of the green deal is the Farm-to-Fork strategy that aims for a closer connection between producer and consumer. The NOVI and Flevoland omgevingsvisie are important policies for spatial planning and land use. The Environmental Management Act and Natura 2000 areas are key for the energy transition and nature policies.

For every policy, it is investigated how they would conflict or align with the proposed vision. In the table, the most important conflicts or synergies are shown. For this finding, it was recognised that the internal dilemmas correspond not only to the proposed vision but also to current dilemmas in the Dutch and European food systems. The identified dilemmas are the starting point for the project's strategy, and these are made clear in the table.

The environmental responsibility versus food security dilemma refers to the crop yield gap between biodynamic and conventional farming (De Ponti et al., 2012). A prioritised biodynamic farming network would increase the environmental responsibility of the agricultural sector but decrease international food security.

Secondly, directed consumer behaviour versus free market choices. The transition to a more sustainable food system is challenging due to its close connection to consumer behaviour, including economic, social, and cultural factors (Bos et al., 2023). The main problem is that food prices do not consider externalised costs. As a result, unhealthy and unsustainable food is cheaper, and supermarkets make more profit. Directing consumer behaviour could help the food system transition but decrease consumers' freedom.

The third internal dilemma is between regional supply and global integration. On the one hand, regional supply should be stimulated to become more sustainable and create a closer link between consumer and producer. On the other hand, the resilience of the Dutch economy and the food system strongly relies on international trade (Bos et al., 2023).

Lastly, land-sparing versus land-sharing poses an internal dilemma. Land sharing could create a closer link between producers and consumers in the agricultural sector and enhance healthy soil and agrobiodiversity (Bos et al., 2023). However, land sparing via monofunctional land use is also vital for conserving nature.

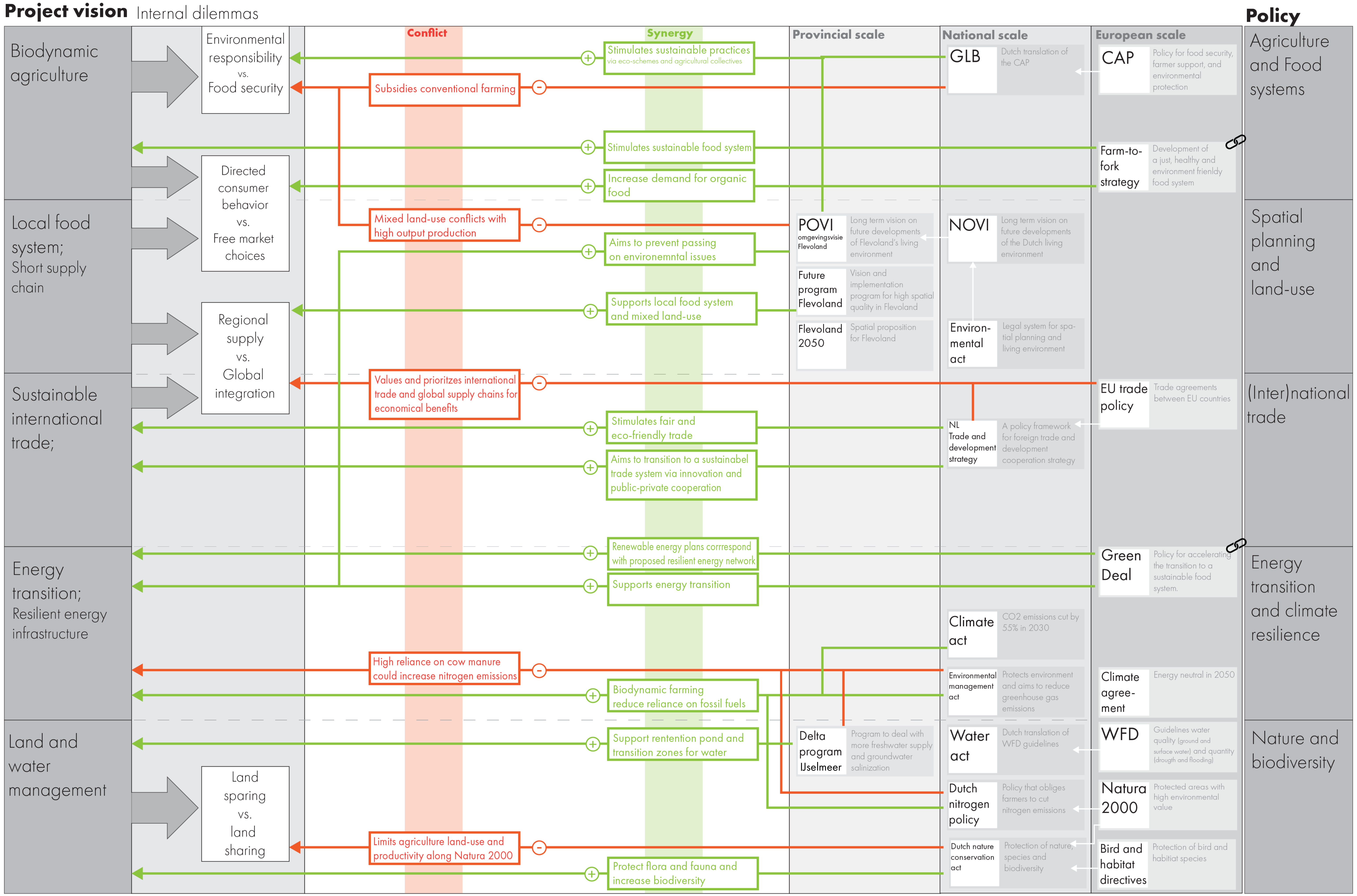


Fig. 6.1 | Overview of relevant policies related to the vision
Based on information from Bos et al. (2024); OECD (2023); European Commission (n.d.), Ministry of Foreign affairs (2020); Ministry of infrastructure and water management (2024); Ministry of Infrastructure and Water Management & The Chair of the House of Representatives of the States-General (2025); Ministry of Education, Culture and Science (2024); Provincie Flevoland (2024a); Provincie Flevoland et al. (2023)

SCENARIOS

Four scenarios were created and analysed at different biodynamic and conventional farming levels. The first scenario includes 100% innovative and sustainable conventional farming. The second scenario comprises 0% conventional farming and 70% biodynamic farming. The third scenario shows a switch to 100% biodynamic farming. Lastly, the fourth scenario is one in which neither is the focal point but instead advocates for nature.

ENERGY EFFICIENCY INNOVATIONS
This scenario starts with a focus on the export of produce on an international scale. Agriculture is focused on producing larger quantities of food, which is done with the help of energy-efficient innovations such as precision agriculture. This scenario aligns with the current plans and policies for agriculture and the energy transition. Here, biodynamic farming is not practised, but conventional farming is much less harmful than the current methods. An energy landscape and larger farm sizes characterise the area. Biodiversity and nature generally take more of a backseat, though policies push for improvement using eco-schemes. Collaboration can be found in the ownership of green energy sources and hydrogen storage. The focus on international export causes more emissions during the process and a divide between producers and consumers.

FUNCTIONAL MIX
The functional mix focuses on maintaining a healthy balance. The share of produce in international exports decreases but is replaced by knowledge exports. Farming is biodynamic primarily, and the farm sizes are equal to those of conventional farms. These farmers share their knowledge in their areas of expertise and practice resource pooling, creating benefits for all the farmers involved. Policies promote a shift towards biodynamic products and align with the energy transition.

The land use is divided into agricultural areas designed with land-sparing and land-sharing; this means areas where functions are mixed and areas where functions are separated. A more consistent mix of city, housing, nature, water, and transition zones can be experienced in residential areas. The producer-consumer relationship is strengthened with the regional export, increasing awareness and demand.

ONLY BIODYNAMIC COOPERATIVES
The production of crops is mainly destined for regional consumption; innovation and knowledge are the main exports at the level of international trade. A healthy regional export calls for close collaboration in all stages of the food supply chain and production process. Farming is entirely biodynamic; the first part of collaboration being applying all the principles and working together with nature and each other, which is essential to sustain it. With the government investing in green energy instead of fossil fuels and creating incentives, farmers can more easily maintain this production method.

Another aspect of the collaboration is that it is done with a bottom-up approach. Grassroots initiatives grow and assist and manage collaboration on multiple levels. Finally, the collaboration between producers and consumers and the use of transition zones increases awareness and connection, strengthening the demand and supporting the supply. All this collaboration and cooperation calls for proximity and a greater mix of land use.

NATURE THRIVES
This scenario switches from "agriculture collaborating with nature" to "agriculture as an asset for nature to thrive." Nature, in this scenario, means plants, water, and biodiversity. Inhabitants are given the luxury of experiencing and being part of the landscape. With rising sea levels, it is vital to keep the flood risk in mind. It can be sufficed to create wetlands and areas where water can be guided to ensure resilience. This area can be seen as another transition zone. Behind it, the urban fabric slowly starts to weave with the energy landscape. Farming is scattered, cooperation is low, and energy infrastructure functions on a smaller scale. Exports are done with provincial-scale production and distribution, keeping the supply chain short. The producer-consumer relationship is well-kept, and government policies are in place to ensure nature-agriculture management, combining a top-down and bottom-up approach.

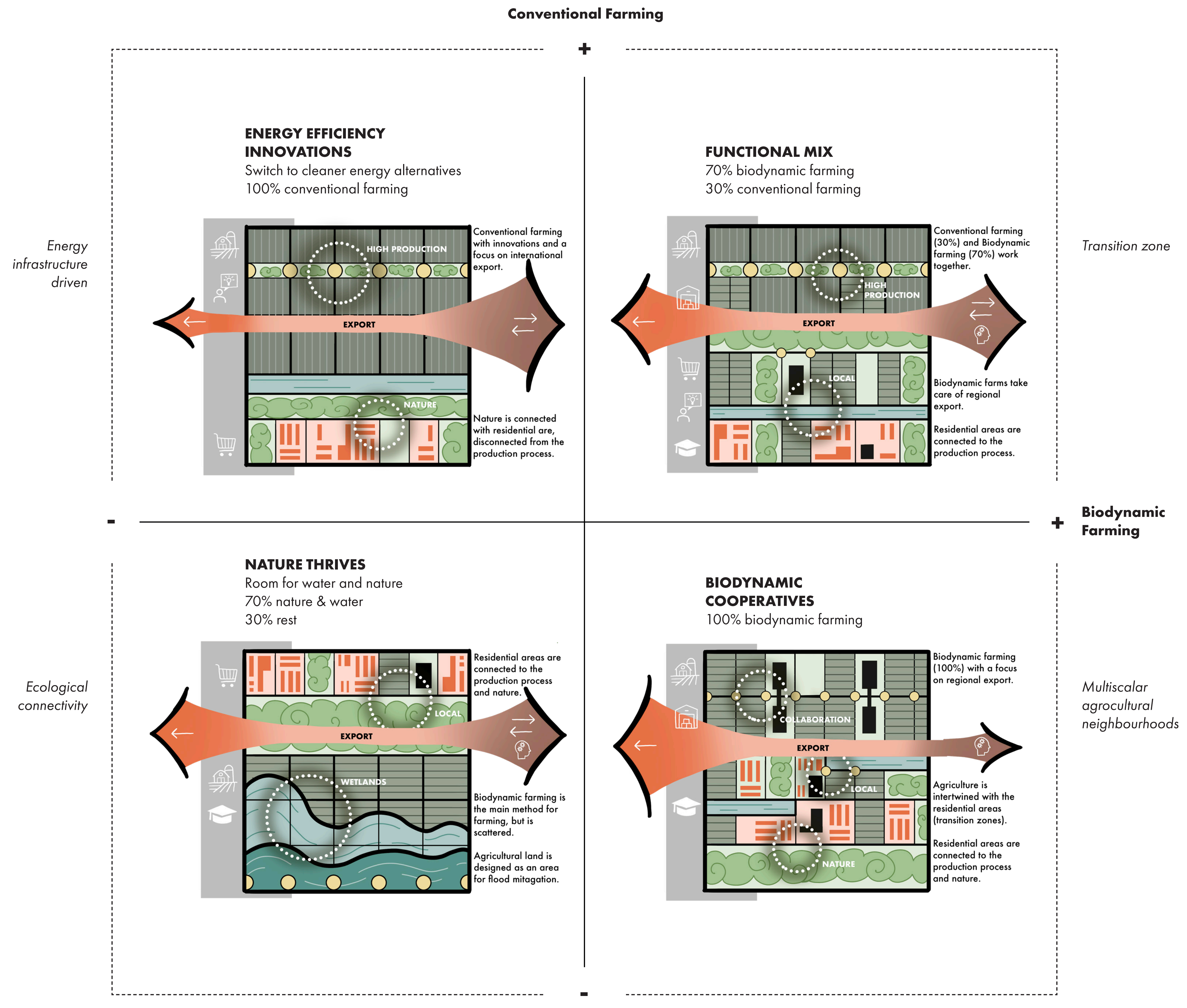
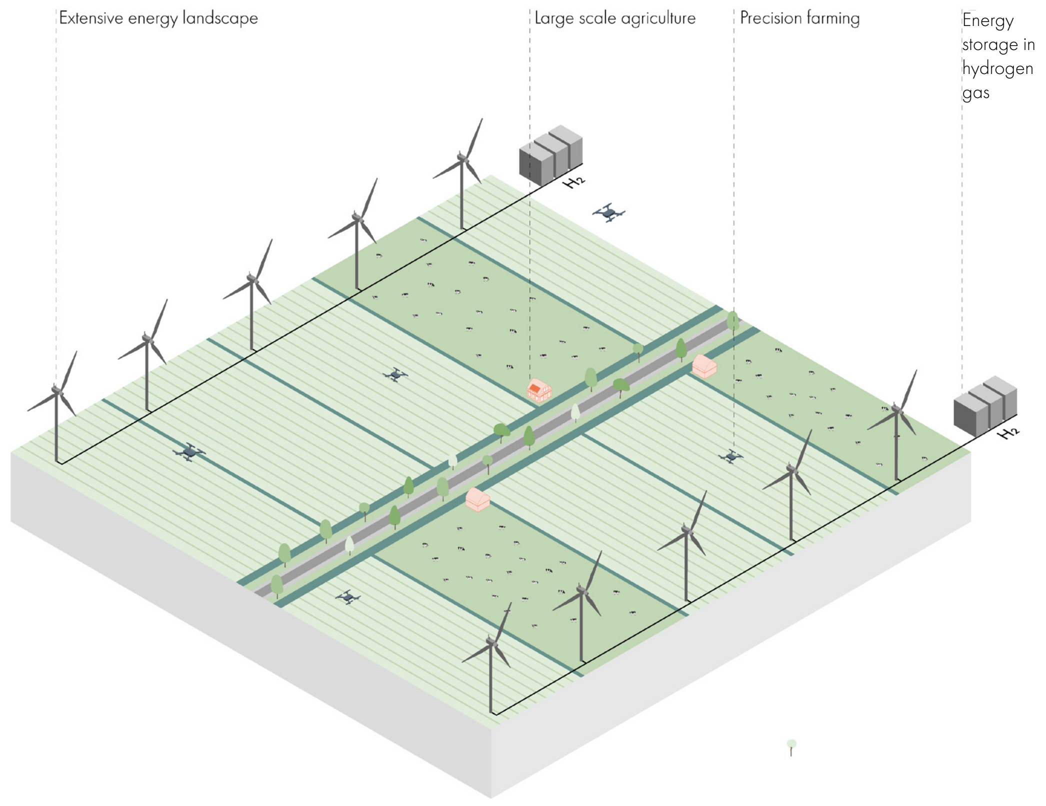


Fig. 6.2 | Spatial layout of scenarios

- Nature
- Electricity
- Residential
- Biodynamic farming
- Conventional farming
- Production
- Water
- Pasture



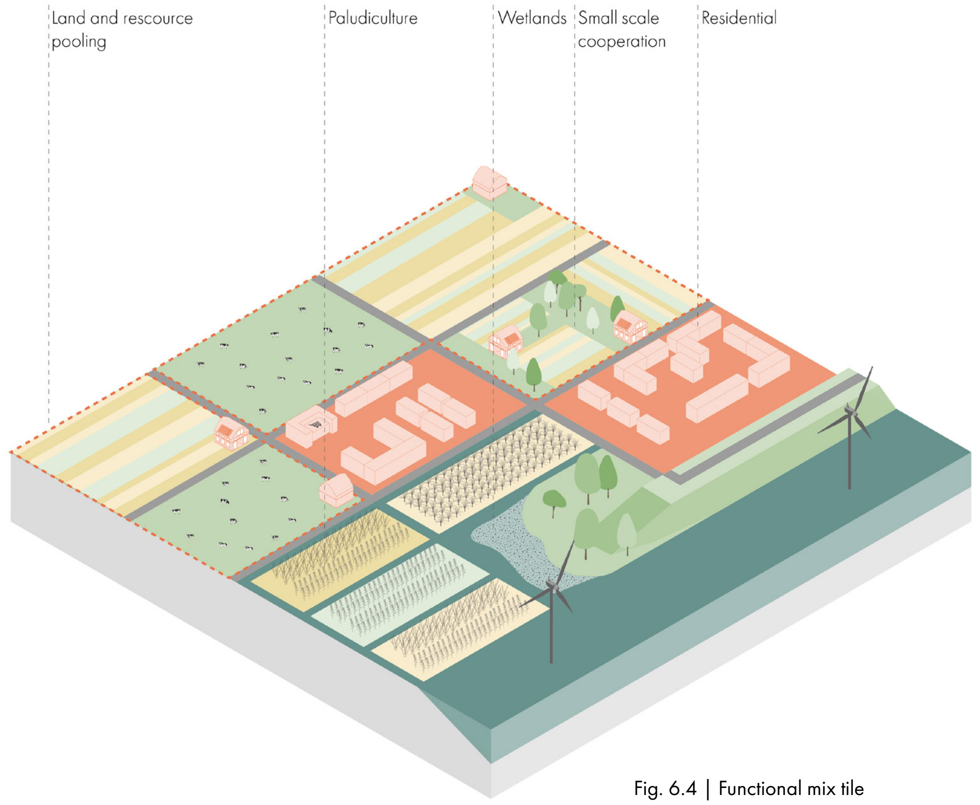


Fig. 6.4 | Functional mix tile

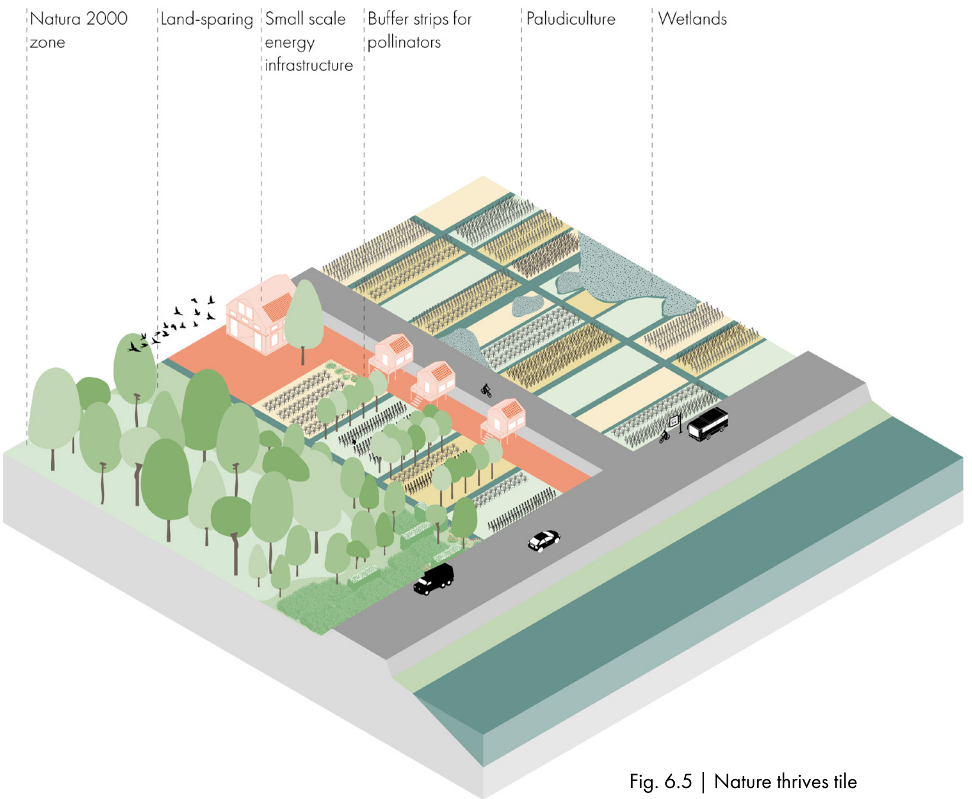


Fig. 6.5 | Nature thrives tile

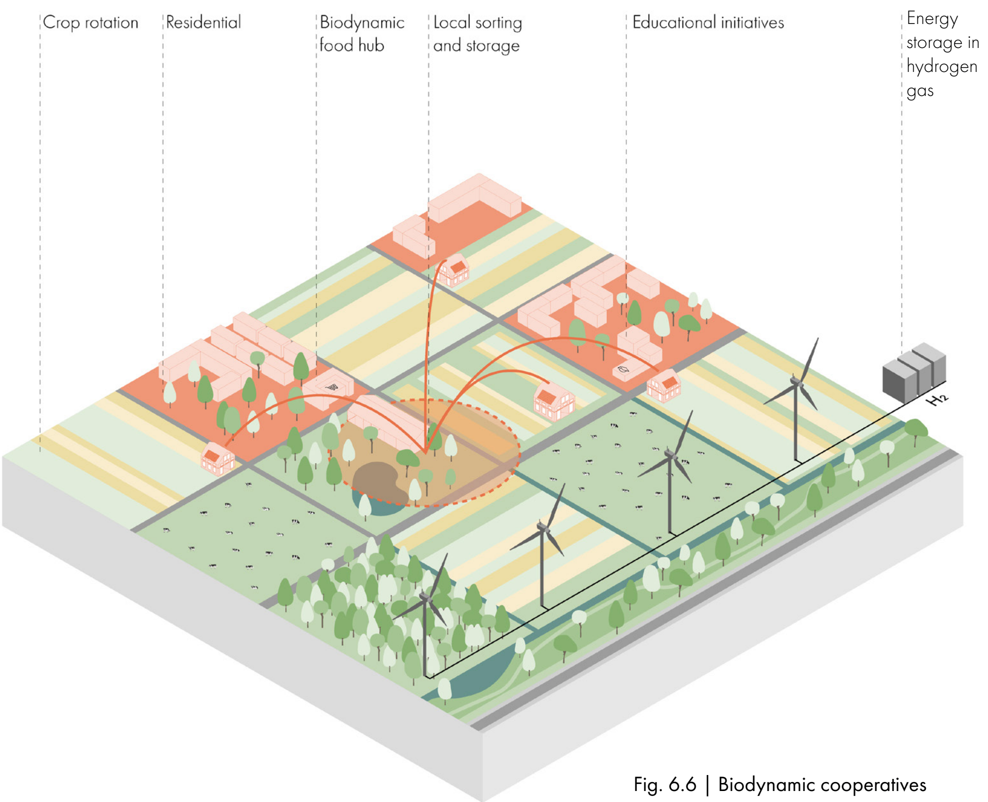


Fig. 6.6 | Biodynamic cooperatives

STRATEGIC ACTIONS

THE DIFFERENT LAYERS

Based on the scenarios created to address the internal dilemmas and upscale the biodynamic farms in Flevoland, exemplary measures were derived and further translated into interconnected strategic actions. These are predominantly physical spatial interventions and policies to regulate market dynamics and facilitate the energy transition. All of these are supported by collaborations between stakeholders with varying vested interests and raising their awareness through educational reforms. These different layers are combined and spatially intertwined at the regional scale of Flevoland. The strategic actions aim to form an advocacy strategy in which the vision of the biodynamic farmers can be realised while also taking the wishes of conventional farmers into account.

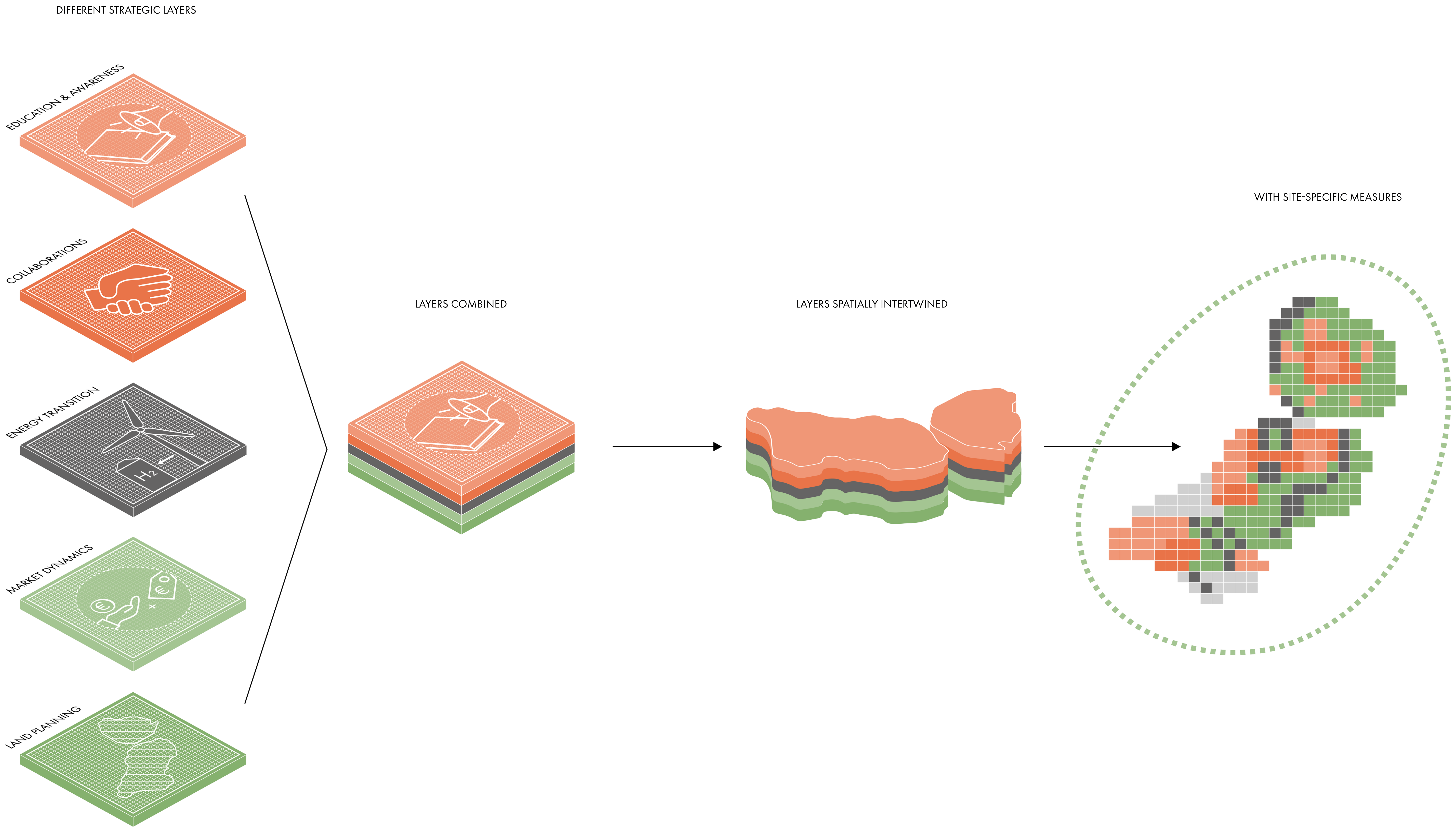


Fig. 6.7 | Visualisation of the layers of strategic actions

OVERVIEW OF ACTIONS

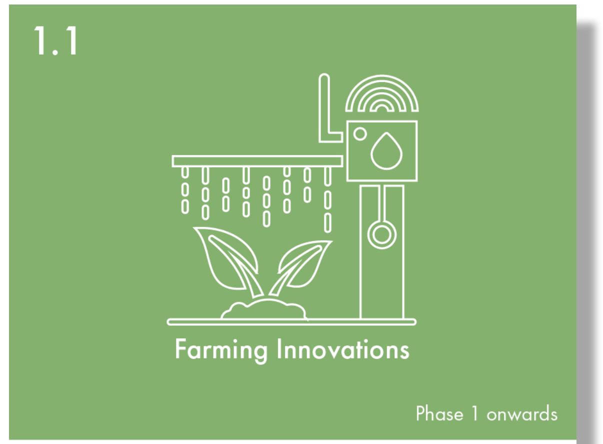
The project delineated specific aspects, policies, and design measures to achieve the vision plan within these five overarching facets. The strategic actions are represented in the form of cards; this representation is adapted from the *Cities of Making* project (Hill, 2020). A colour corresponds to the five overarching facets within each of these cards. A card code distinguishes them, each with a description of the action. Under the representative diagram, it is outlined which phase that action will be implemented and carried forward. Furthermore, CROP goals are set for the vision and strategy plan, which are the acronyms for Consumer Benefits, Resilience, Operational Management, and Producer Benefits. These goals have specific criteria and are used to evaluate each strategic action, how they fare with these goals, and the criteria they cater to for facilitating the implementation of the vision plan. These actions are interrelated, and each card specifies the other cards that should be considered in tandem with it.

Each of these actions involves various stakeholders at various scales. For instance, take strategic action '1.9 Agro-Nature Interrelation'. This proposal needs to be carried out at a regional level. However, the implementation and action plans must be outlined through the involvement of farmers, landscape experts, municipalities, and government agencies that bridge the nation and the European Union. While it may not contribute to the Operational Management and Producer Benefits criteria, this action helps make the system resilient. It lays the foundation for agricultural practices to be implemented. This action also needs to be implemented alongside other strategic actions, such as creating buffer zones in areas with endangered species, creating a landscape mix in the farms, and requiring the associated minimum tree cover to enhance biodiversity and facilitate their integration with natural ecosystems.

The cards are used to symbolise these strategic actions to be are shown to the various stakeholders during collaborative and knowledge-sharing meetings. This way, it is easier to understand what they can implement, with whom they can collaborate, how they can become more aware, and how it can be feasible for the farmers and the governance agencies to upscale the biodynamic farms while also ensuring that these processes are transparent to the consumers. In doing so, the consumers can be better informed about healthy and affordable choices.

Fig. 6.8 | Explanation of strategic actions

Fig. 6.9 | Overview of strategic actions themes



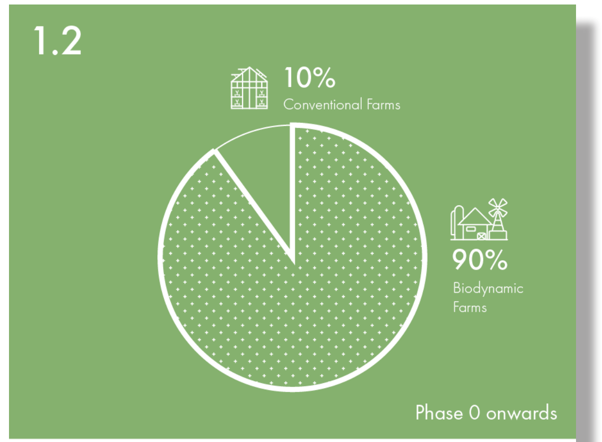
URBAN ZONE

The urban zones need to incorporate sustainable and resilient farming innovations such as vertical farming, aquaponics, and so on for self-sufficiency.

Goals

Consumer Benefits — C1 C2 C3 C4
Resilience — R1 R2 R3 R4 R5
Operational Management — O1 O2 O3 O4
Producer Benefits — P1 P2

See also 1.9, 2.6, 3.2, 4.2, 5.6



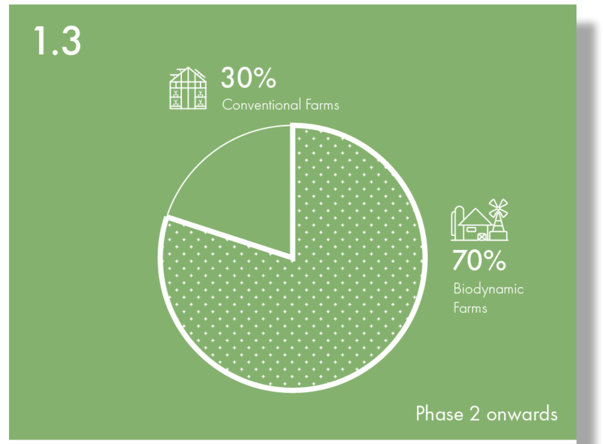
TRANSITION ZONES

The transition zones will predominantly have biodynamic farms for enhancing the producer-consumer relations. Some conventional farming would be present to meet provincial demands.

Goals

Consumer Benefits — C1 C2 C3 C4
Resilience — R1 R2 R3 R4 R5
Operational Management — O1 O2 O3 O4
Producer Benefits — P1 P2

See also 2.5, 2.6, 2.9, 4.1, 4.3, 4.4, 4.5



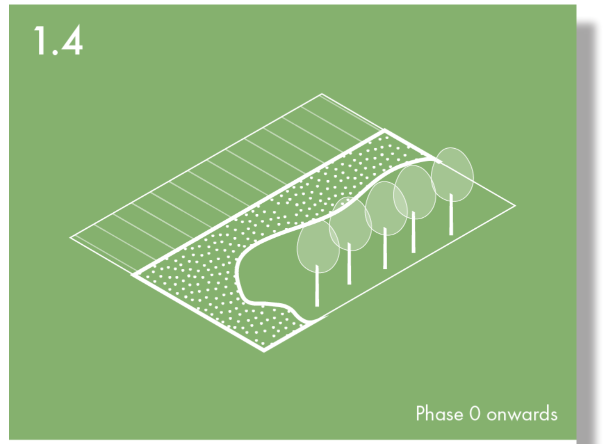
AGROCULTURAL ZONES

The transition zones will have mix of both farm types for meeting both the local and regional demands.

Goals

Consumer Benefits — C1 C2 C3 C4
Resilience — R1 R2 R3 R4 R5
Operational Management — O1 O2 O3 O4
Producer Benefits — P1 P2

See also 2.5, 2.6, 2.9, 4.1, 4.3, 4.4, 4.5



BUFFER ZONES

Buffer zones will be created around protected landscapes such that they separate yet still integrate agriculture with nature.

Goals

Consumer Benefits — C1 C2 C3 C4
Resilience — R1 R2 R3 R4 R5
Operational Management — O1 O2 O3 O4
Producer Benefits — P1 P2

See also 1.5, 1.6, 1.7, 1.8, 1.9

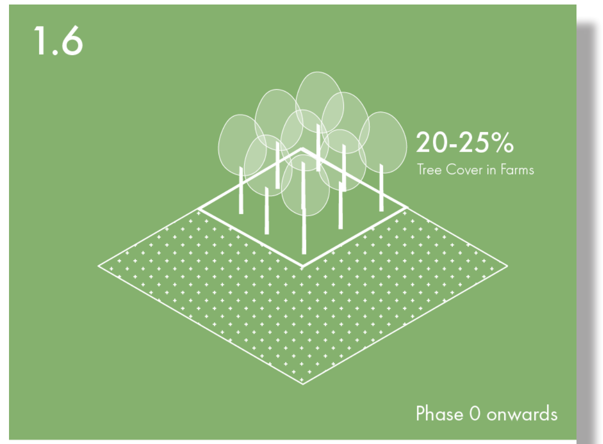
LANDSCAPE MIX IN FARMS

There will be a mix of crops, shrubs, trees, and flower bushes in order to enhance biodiversity and maintain landscape connectivity.

Goals

Consumer Benefits — C1 C2 C3 C4
Resilience — R1 R2 R3 R4 R5
Operational Management — O1 O2 O3 O4
Producer Benefits — P1 P2

See also 1.4, 1.6, 1.7, 1.8, 1.9



TREE COVER

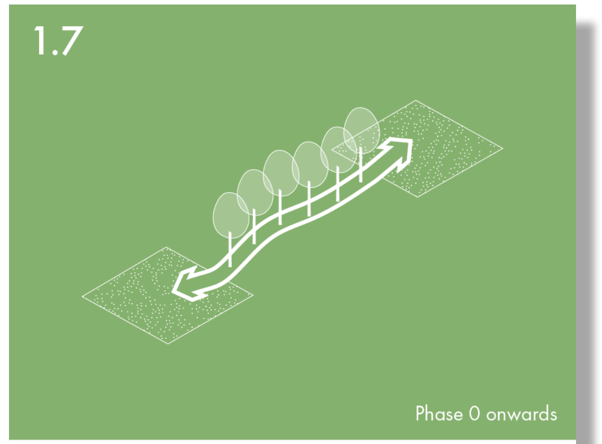
There should be a tree cover of 20% - 25% in each of the farmlands to maintain landscape connectivity and enhance biodiversity. This is approximately 40-50 trees per hectare of land.

Goals

Consumer Benefits — C1 C2 C3 C4
Resilience — R1 R2 R3 R4 R5
Operational Management — O1 O2 O3 O4
Producer Benefits — P1 P2

See also 1.4, 1.5, 1.7, 1.8, 1.9

Fig. 6.10 - 6.15 | Strategic actions



ECOLOGICAL CORRIDORS

Corridors between natural landscapes to be established to ensure that species can traverse across natural landscapes, for improving air quality, and promoting climate resilience, like for flood mitigation.

Goals

Consumer Benefits — C1 C2 C3 C4
Resilience — R1 R2 R3 R4 R5
Operational Management — O1 O2 O3 O4
Producer Benefits — P1 P2

See also 1.4, 1.5, 1.6, 1.8, 1.9

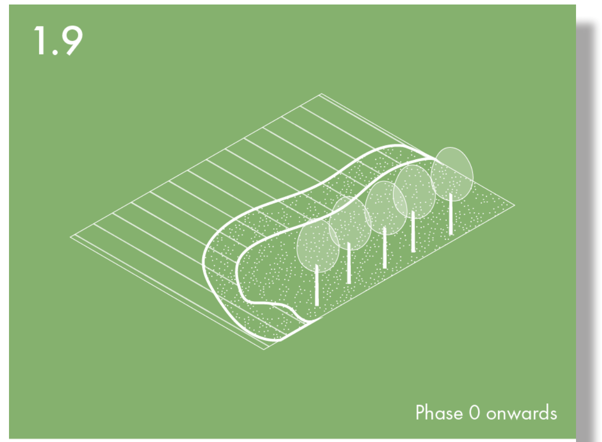
FLOOD RESILIENT LEASES

In flood risk areas, the land will be owned by the government and leased at a subsidised rate to farmers (to alleviate flood risk's financial impacts) for practicing paludiculture.

Goals

Consumer Benefits — C1 C2 C3 C4
Resilience — R1 R2 R3 R4 R5
Operational Management — O1 O2 O3 O4
Producer Benefits — P1 P2

See also 2.5, 2.6, 2.9



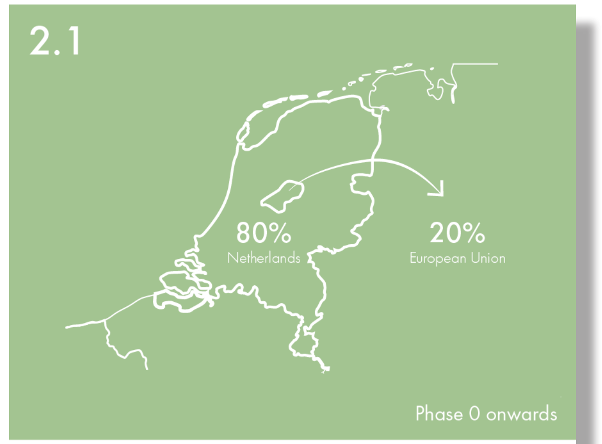
AGRO-NATURE INTERRELATION

Considering biodynamic farming practices are ecosensitive, they can be integrated with natural landscapes to promote ecological resilience.

Goals

Consumer Benefits — C1 C2 C3 C4
Resilience — R1 R2 R3 R4 R5
Operational Management — O1 O2 O3 O4
Producer Benefits — P1 P2

See also 1.4, 1.5, 1.6, 1.7, 1.8



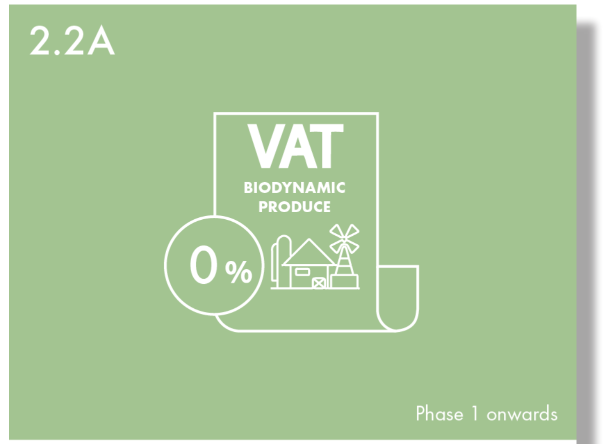
EXPORT POLICY

80% of the biodynamically produced crops would be to meet provincial and national demand. The rest will be export to adjacent countries in the European Union.

Goals

Consumer Benefits — C1 C2 C3 C4
Resilience — R1 R2 R3 R4 R5
Operational Management — O1 O2 O3 O4
Producer Benefits — P1 P2

See also 2.2A, 2.2B, 2.3, 2.4, 2.9



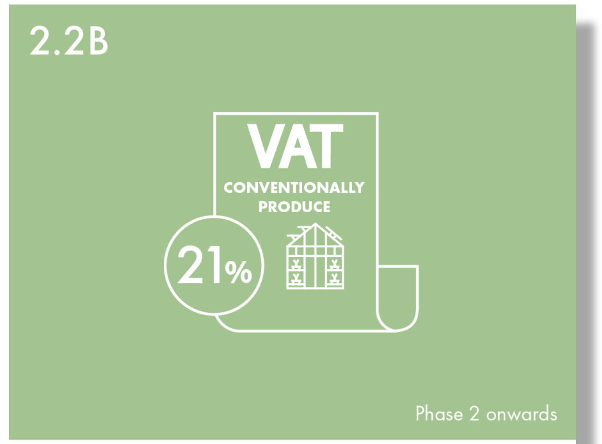
TAX POLICY

To incentivise consumers to switch to consuming biodynamically produced crops, the VAT on the these would be 0%.

Goals

Consumer Benefits — C1 C2 C3 C4
Resilience — R1 R2 R3 R4 R5
Operational Management — O1 O2 O3 O4
Producer Benefits — P1 P2

See also 2.1, 2.2B, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9



TAX POLICY

To decrease reliance on conventionally produced crops, the VAT on the these would be increased to 21%.

Goals

Consumer Benefits — C1 C2 C3 C4
Resilience — R1 R2 R3 R4 R5
Operational Management — O1 O2 O3 O4
Producer Benefits — P1 P2

See also 2.1, 2.2A, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9

Fig. 6.16 - 6.21 | Strategic actions

2.3

Phase 1 onwards

TAX CREDIT FOR COMPANIES

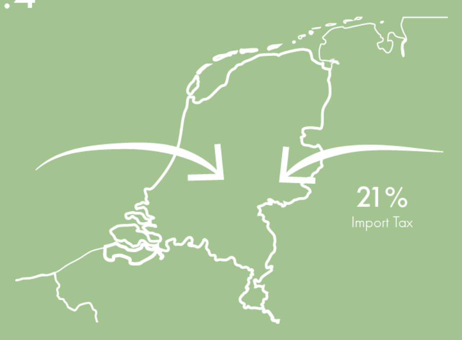
Companies that will buy biodynamic produce for their daily food essentials will get tax credit.

Goals

- Consumer Benefits: **C1** **C2** C3 **C4**
- Resilience: R1 R2 R3 **R4** R5
- Operational Management: O1 O2 O3 O4
- Producer Benefits: P1 **P2**

See also 2.1, 2.2A, 2.2B, 2.4, 2.5, 2.6, 2.8, 2.9, 2.9

2.4



Phase 1 onwards

IMPORT TAX

For crops that are already biodynamically produced within the Netherlands, import tax on those crop types from other nations will be 21%.

Goals

- Consumer Benefits: C1 C2 C3 C4
- Resilience: R1 R2 R3 R4 R5
- Operational Management: O1 O2 **O3** **O4**
- Producer Benefits: P1 P2

See also 2.1, 2.2A, 2.2B, 2.3, 2.5, 2.6, 2.7, 2.8, 2.9

2.5

Phase 1 onwards

FARMER'S SHARE

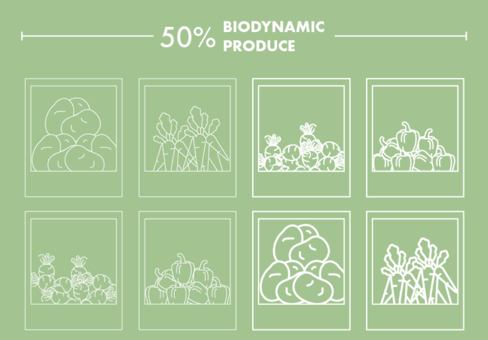
More farmer markets will be established to ensure farmers get a higher percentage of the share. This will also increase accessibility to healthy and affordable food for consumers.

Goals

- Consumer Benefits: **C1** **C2** **C3** **C4**
- Resilience: **R1** **R2** **R3** R4 R5
- Operational Management: O1 **O2** O3 O4
- Producer Benefits: **P1** **P2**

See also 2.1, 2.2A, 2.2B, 2.3, 2.4, 2.6, 2.7, 2.8, 2.9

2.6



Phase 2 onwards

SUPERMARKET POLICY

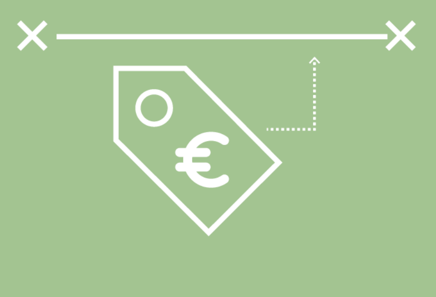
Half of the agriculture produce in the supermarkets should be biodynamically produced. This will help increase accessibility to healthy food for the consumers.

Goals

- Consumer Benefits: **C1** **C2** C3 **C4**
- Resilience: R1 R2 **R3** R4 R5
- Operational Management: O1 O2 **O3** O4
- Producer Benefits: **P1** P2

See also 2.1, 2.2A, 2.2B, 2.3, 2.4, 2.5, 2.7, 2.8, 2.9

2.7



Phase 1 onwards

MAXIMUM RETAIL PRICE

To tackle food poverty, the government can set a maximum retail price on biodynamically produced crops such that farmers get a fair share while ensuring consumer affordability isn't compromised.

Goals

- Consumer Benefits: **C1** **C2** C3 **C4**
- Resilience: R1 R2 **R3** R4 **R5**
- Operational Management: O1 O2 O3 O4
- Producer Benefits: **P1** P2

See also 2.1, 2.2A, 2.2B, 2.3, 2.4, 2.5, 2.6, 2.8, 2.9

2.8

Phase 1 onwards

BIODYNAMIC FARMING INCENTIVE

To encourage ecosensitive farming practices,farmers switching from conventional farming to biodynamic farming will receive financial assistance and access to free skill-learning seminars in the beginning.

Goals

- Consumer Benefits: **C1** **C2** **C3** **C4**
- Resilience: R1 R2 **R3** **R4** **R5**
- Operational Management: **O1** **O2** **O3** O4
- Producer Benefits: **P1** **P2**

See also 2.1, 2.2A, 2.2B, 2.3, 2.4, 2.5, 2.6, 2.7, 2.9

Fig. 6.22 - 6.27 | Strategic actions

2.9

Phase 1 onwards

EXPORTING KNOWLEDGE

The focus will shift from exporting quantity of produce to exporting knowledge and best practices insights to other regions and countries to amplify their self-sufficiency.

Goals

- Consumer Benefits: C1 C2 C3 C4
- Resilience: **R1** R2 **R3** R4 **R5**
- Operational Management: **O1** O2 **O3** **O4**
- Producer Benefits: **P1** P2

See also 2.1, 2.2A, 2.2B, 2.3, 2.4

3.1

Phase 0 onwards

ENERGY COOPERATIVES

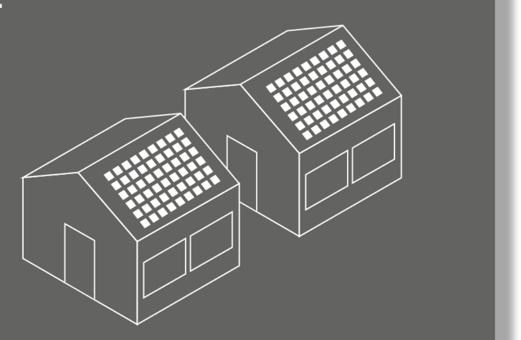
The biodynamic farmers will be a part of a cooperative and own a percentage of the energy within their farmland as well.

Goals

- Consumer Benefits: C1 **C2** **C3** C4
- Resilience: R1 R2 **R3** **R4** **R5**
- Operational Management: **O1** O2 **O3** O4
- Producer Benefits: **P1** P2

See also 3.4, 3.5, 4.1, 4.2, 4.3, 4.4, 5.5

3.2



Phase 0 onwards

SOLAR PANELS ON ROOFTOPS

For enhancing self-sufficiency and decreasing reliance on a centralised grid, all proposed buildings will include rooftop solar panels.

Goals

- Consumer Benefits: C1 **C2** **C3** C4
- Resilience: R1 R2 **R3** R4 R5
- Operational Management: **O1** O2 O3 O4
- Producer Benefits: P1 P2

See also 3.1, 3.4, 3.5, 4.2, 4.4, 5.5

3.3

Phase 0 onwards

HYDROGEN PROGRAM

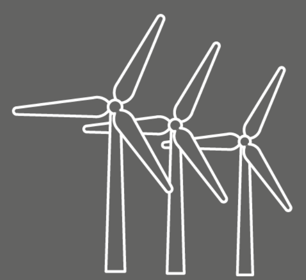
The National Hydrogen Program will be accelerated to achieve climate resilience through clean energy usage.

Goals

- Consumer Benefits: C1 C2 C3 C4
- Resilience: R1 R2 **R3** R4 R5
- Operational Management: **O1** **O2** **O3** O4
- Producer Benefits: **P1** P2

See also 3.1, 3.4, 3.5, 4.1, 4.2, 4.3, 4.4, 5.5

3.4



Phase 0 onwards

WIND ENERGY RELIANCE

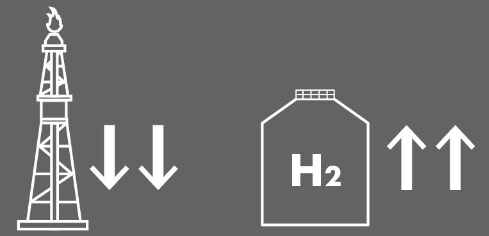
Wind energy in agriculture provides a sustainable, cost-effective solution for powering irrigation systems and other farm operations. It promotes environmental and economic resilience in all zones.

Goals

- Consumer Benefits: C1 **C2** **C3** C4
- Resilience: R1 R2 **R3** **R4** **R5**
- Operational Management: **O1** **O2** **O3** O4
- Producer Benefits: **P1** P2

See also 3.1, 3.3, 3.5, 4.1, 4.2, 4.3, 4.4, 5.5

3.5



Phase 0 onwards

DECREASING NATURAL GAS RELIANCE

Removing the subsidy on natural gas can help reduce reliance on it for energy needs, especially after the accelerated National Hydrogen Program has provided hydrogen energy as a sufficient alternative.

Goals

- Consumer Benefits: **C1** C2 **C3** C4
- Resilience: R1 R2 R3 R4 R5
- Operational Management: **O1** O2 O3 O4
- Producer Benefits: **P1** P2

See also 3.1, 3.3, 3.4, 4.1, 4.2, 4.3, 4.4, 5.5

Fig. 6.28 - 6.33 | Strategic actions

4.1

Phase 0 onwards

LAND CO-OWNERSHIP

The biodynamic farmers can collectively own and manage production within a set of land parcels. This will help with crop rotation and maintaining soil fertility.

Goals

C onsumer Benefits C1 C2 C3 **C4**

R esilience R1 **R2** **R3** **R4** **R5**

O perational Management **O1** **O2** **O3** O4

P roducer Benefits **P1** P2

See also 1.8, 3.1, 3.3, 3.4, 4.2, 4.3, 4.4, 4.5, 5.5

4.2

Phase 2 onwards

CITIZEN INVESTMENT

Citizen investment in biodynamic farming promotes sustainability, environmental stewardship, and enhance producer-consumer relations, while reducing urban ecological footprints and boosting local food security and economic growth.

Goals

C onsumer Benefits **C1** **C2** C3 **C4**

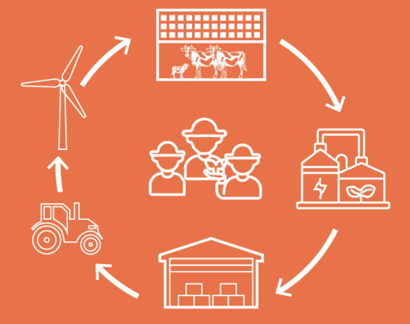
R esilience R1 R2 **R3** **R4** **R5**

O perational Management O1 **O2** **O3** O4

P roducer Benefits **P1** **P2**

See also 3.1, 3.3, 3.4, 4.1, 4.3, 4.4, 4.5, 5.5

4.3



Phase 0 onwards

RESOURCE SHARING

Resource sharing amongst biodynamic farmers promotes equitable access to essential resources and boosts their income from the output.

Goals

C onsumer Benefits C1 C2 C3 C4

R esilience **R1** **R2** **R3** R4 **R5**

O perational Management **O1** **O2** **O3** O4

P roducer Benefits **P1** P2

See also 3.1, 3.3, 3.4, 4.1, 4.2, 4.4, 4.5, 5.5

4.4

Phase 0 onwards

PUBLIC-PRIVATE PARTNERSHIPS

Public-private partnerships in biodynamic agriculture promote collaborative innovation, ensuring sustainable land use allocation, enhances environmental stewardship, and supports local food systems within the different zones.

Goals

C onsumer Benefits **C1** **C2** C3 **C4**

R esilience R1 R2 **R3** R4 **R5**

O perational Management O1 **O2** **O3** **O4**

P roducer Benefits **P1** P2

See also 3.1, 3.3, 3.4, 4.1, 4.2, 4.3, 4.5, 5.5

4.5

Phase 1 onwards

SUPERMARKET - FARMER PARTNERSHIPS

Collaborations between supermarkets and farmers will facilitate access to healthy and affordable food to all, while also ensuring production feasibility.

Goals

C onsumer Benefits **C1** **C2** **C3** **C4**

R esilience R1 R2 **R3** **R4** R5

O perational Management O1 **O2** **O3** O4

P roducer Benefits **P1** P2

See also 3.1, 3.3, 3.4, 4.1, 4.2, 4.3, 4.4, 5.5

5.1

Phase 0 onwards

EDUCATING CHILDREN

Integrating visits to biodynamic farms into educational curriculum will promote food system literacy, enhancing their ecological awareness through hands-on learning experiences, and inculcate healthy food practices since a young age.

Goals

C onsumer Benefits **C1** **C2** **C3** **C4**

R esilience **R1** R2 R3 **R4** R5

O perational Management O1 O2 O3 O4

P roducer Benefits P1 **P2**

See also 5.2, 5.3, 5.6, 5.7

Fig. 6.34 - 6.39 | Strategic actions

5.2

Phase 0 onwards

FARMER KNOWLEDGE SHARING

Facilitating peer-to-peer knowledge exchange through cooperative networks, digital platforms, and community workshops to empower farmers to implement biodynamic practices for a resilient agro-ecosystem and sustainable local economies.

Goals

C onsumer Benefits C1 C2 C3 C4

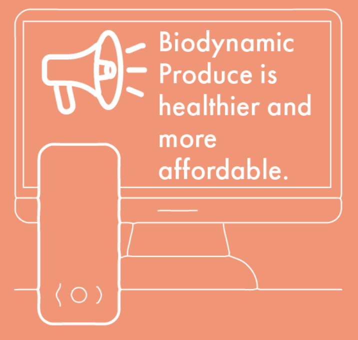
R esilience R1 R2 R3 **R4** R5

O perational Management O1 **O2** **O3** O4

P roducer Benefits **P1** P2

See also 1.1, 2.9, 4.1, 4.3, 5.1, 5.3, 5.4, 5.5, 5.6, 5.7

5.3



Phase 1 onwards

NATIONWIDE ADVERTISEMENT

Nationwide advertisement and campaign can help educate consumers, influence market demand, and integrate ecosensitive agricultural practices into policy frameworks for resilient food systems.

Goals

C onsumer Benefits **C1** **C2** **C3** **C4**

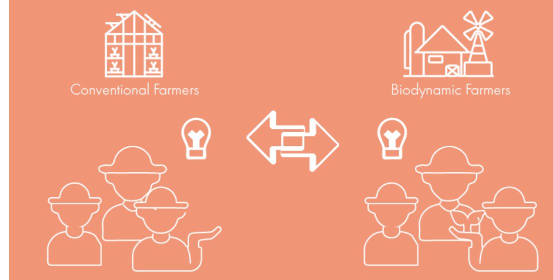
R esilience R1 R2 R3 R4 R5

O perational Management O1 O2 O3 O4

P roducer Benefits P1 P2

See also 5.1, 5.2, 5.4, 5.5, 5.6, 5.7

5.4



Phase 1 onwards

KNOWLEDGE EXCHANGE

Knowledge exchange between biodynamic and conventional farmers through workshops and seminars can help expand on and combine best practices from both perspectives and help derive contextualised action plans for the region.

Goals

C onsumer Benefits C1 C2 C3 C4

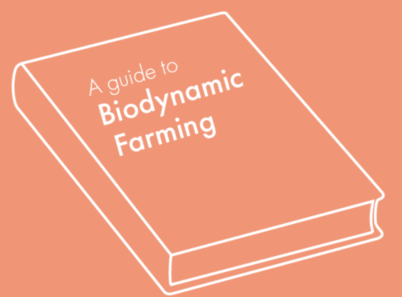
R esilience R1 **R2** **R3** **R4** **R5**

O perational Management **O1** **O2** **O3** **O4**

P roducer Benefits **P1** P2

See also 1.1, 2.9, 4.1, 4.3, 5.1, 5.2, 5.3, 5.5, 5.6, 5.7

5.5



Phase 2 onwards

TOOLKIT FOR PRACTICE

A comprehensive toolkit on biodynamic farming practices is essential not only for farmers but also planners, providing them with practical frameworks to enhance food security, soil health, and ecological resilience in the different zones.

Goals

C onsumer Benefits C1 C2 C3 C4

R esilience **R1** **R2** **R3** **R4** **R5**

O perational Management O1 O2 O3 O4

P roducer Benefits **P1** P2

See also 1.1, 2.9, 4.1, 4.3, 5.1, 5.2, 5.3, 5.4, 5.6, 5.7

5.6

Phase 1 onwards

LOCATING NEAREST BD FARMS

An online platform can be created and integrated with Google Maps in which consumers can locate the nearest biodynamic farm or farmers market to ensure that they have access to healthy and affordable food.

Goals

C onsumer Benefits **C1** **C2** **C3** **C4**

R esilience **R1** R2 R3 **R4** R5

O perational Management O1 O2 O3 O4

P roducer Benefits P1 **P2**

See also 1.1, 1.2, 1.3, 4.3, 5.1, 5.2, 5.3, 5.4, 5.5, 5.7

5.7

Phase 1 onwards

INFORMATION DISSEMINATION

A shift in consumer mindset can be through knowledge dissemination via calendars and everyday items on how biodynamic practices are good for them and the nature, the seasonal crops they can access, and so on.

Goals

C onsumer Benefits **C1** **C2** **C3** **C4**

R esilience R1 R2 **R3** R4 R5

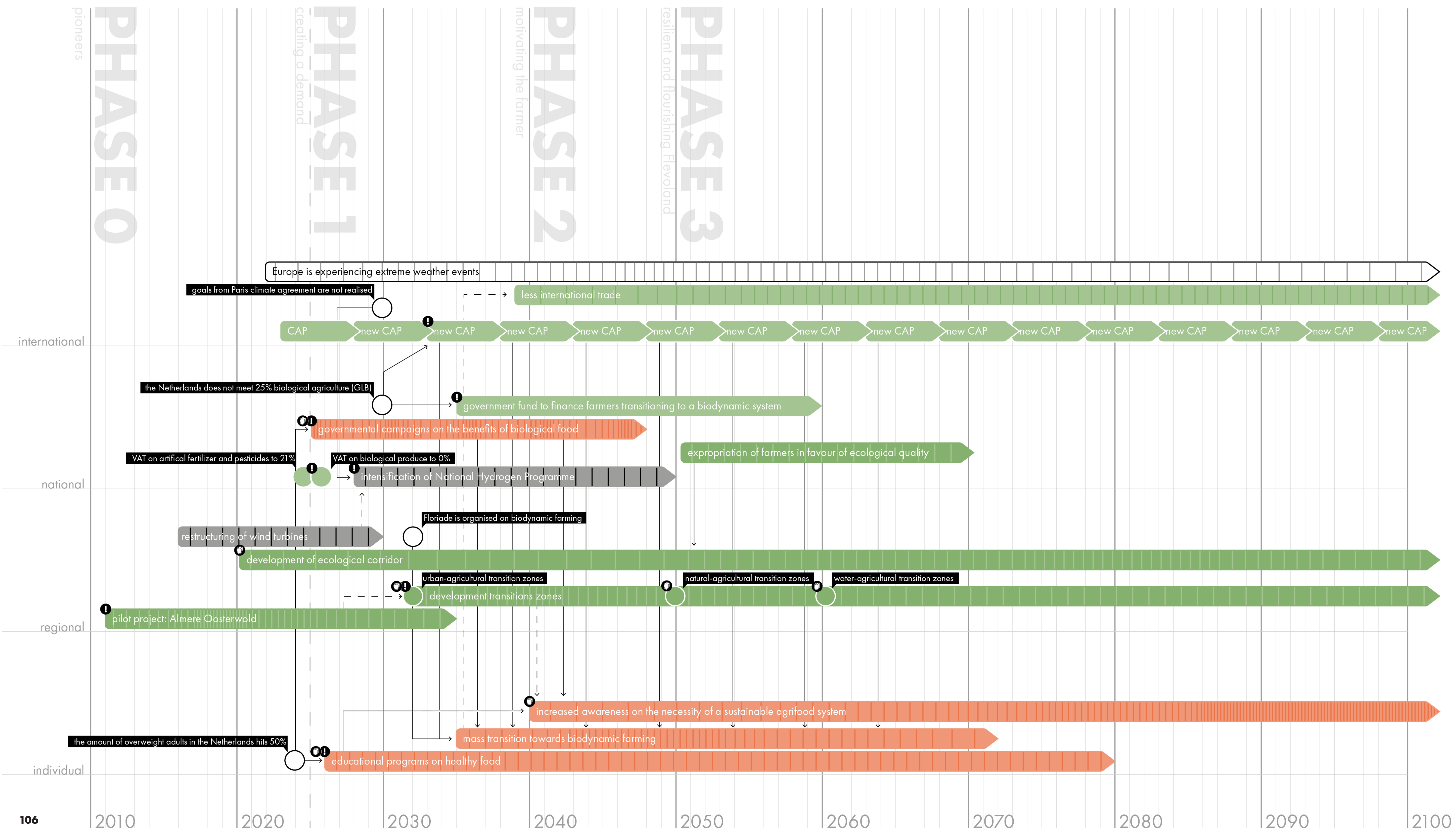
O perational Management O1 O2 O3 O4

P roducer Benefits P1 **P2**

See also 5.1, 5.3, 5.4, 5.5, 5.6

Fig. 6.40 - 6.45 | Strategic actions

TIMELINE



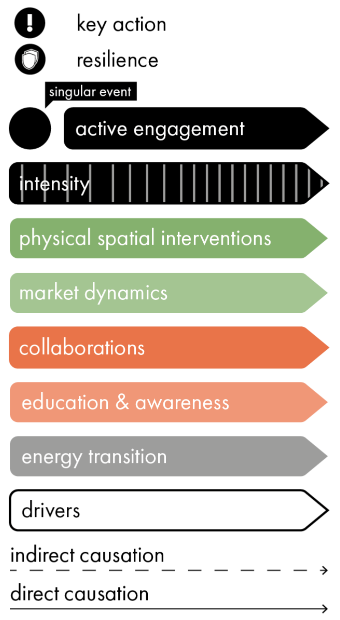
Farmers have been subject to many top-down regulation changes over the past few years, leading to much resistance, which was reflected in the extensive farmers' protests in 2019 (Van Der Ploeg, 2020). In this project, the aim is to include less top-down governance while changing the conventional agricultural system. Instead of governmental institutions, **the consumers should be at the forefront of this transition.**

This is why the timeline starts in the past, with the pioneers of this system. Consumers and producers have created their own communities, proving the transition towards a biodynamic system is possible. To further develop this strategy from within the consumers, systemic changes will be made to generate a higher demand for biological produce in Phase 1. This increased demand will motivate conventional farmers to transition towards more sustainable farming practices in Phase 2, supported by the government but without top-down enforcement. Lastly, a focus will be placed on improving the ecological quality of Flevoland in Phase 3. Within all phases, some strategic actions are defined as key actions. They are necessary for the transition to happen (refer to pages 108 and 109). Actions that cater towards a more resilient system are also specifically defined.

These phases provide an overall guideline for the main actions and focus areas over time. The spatial translation of the strategy phases is based on the Mondriaan structure. This is because the Mondriaan structure is a well-functioning grid that allows for adaptability over time. However, the phases, in combination with the Mondriaan structure, could be misinterpreted as a static and fixed urban plan. It should be emphasised that this is not the case. The strategy is an adaptive strategy with no fixed regional plan. Moreover, during Phase 1, small-scale developments in Phase 2 could already emerge. The phases only indicate the prioritised actions, not a fixed outline.

Within this timeline, the project details out the 'Development of the Transition Zones' through the pilot case of Oosterwold (refer to pages 122-129).

Fig. 6.46 | Timeline



KEY ACTIONS

Phase 0, the pioneering phase, is driven by the development of a transition zone, Oosterwold, as a pilot case where innovations can be tested. The farmers will be educated and brought together to work on action plans through public-private partnerships. The energy transition will be accelerated by implementing the wind turbines (as planned) and giving farmers ownership and agency by forming energy cooperatives.

Phase 1 focuses on creating a demand through nationwide advertisement. Conventional and biodynamic farmers would engage in knowledge-sharing sessions to meet the growing demand, which would also suffice and be promoted through supermarket-farmer collaborations, such as sales of biodynamic produce, sharing pamphlets, etc. With the wind turbines in place, the reliance on wind energy would increase, with a simultaneous decrease in natural gas usage.

Phase 2 focuses on motivating the farmers to practice sustainably. Agrocultural zones, focusing on production on the provincial and regional scale, would be created, and farmers would experience land co-ownership. Those practising biodynamic farming will receive incentives through subsidies for various aspects. The farmers will gain ownership of energy through energy cooperatives and facilitate the energy transition through the storage and usage of hydrogen at various scales. The conventional and biodynamic farmers will exchange knowledge for practising in the agrocultural zones.

Phase 3 focuses on achieving resilience and Flevoland flourishing as a region. The agricultural land and natural landscapes would be integrated to enhance biodiversity. The farmers would have an increased share in returns by establishing farmers' markets. Natural gas usage would be substantially reduced with the renewable energy alternatives in place. With the upscaled biodynamic farms, citizens would also receive opportunities to invest in these farms for healthy food access and ownership. Everyone, especially the children, would be educated about the benefits of biodynamic produce, and the producer-consumer relationship would be enhanced.

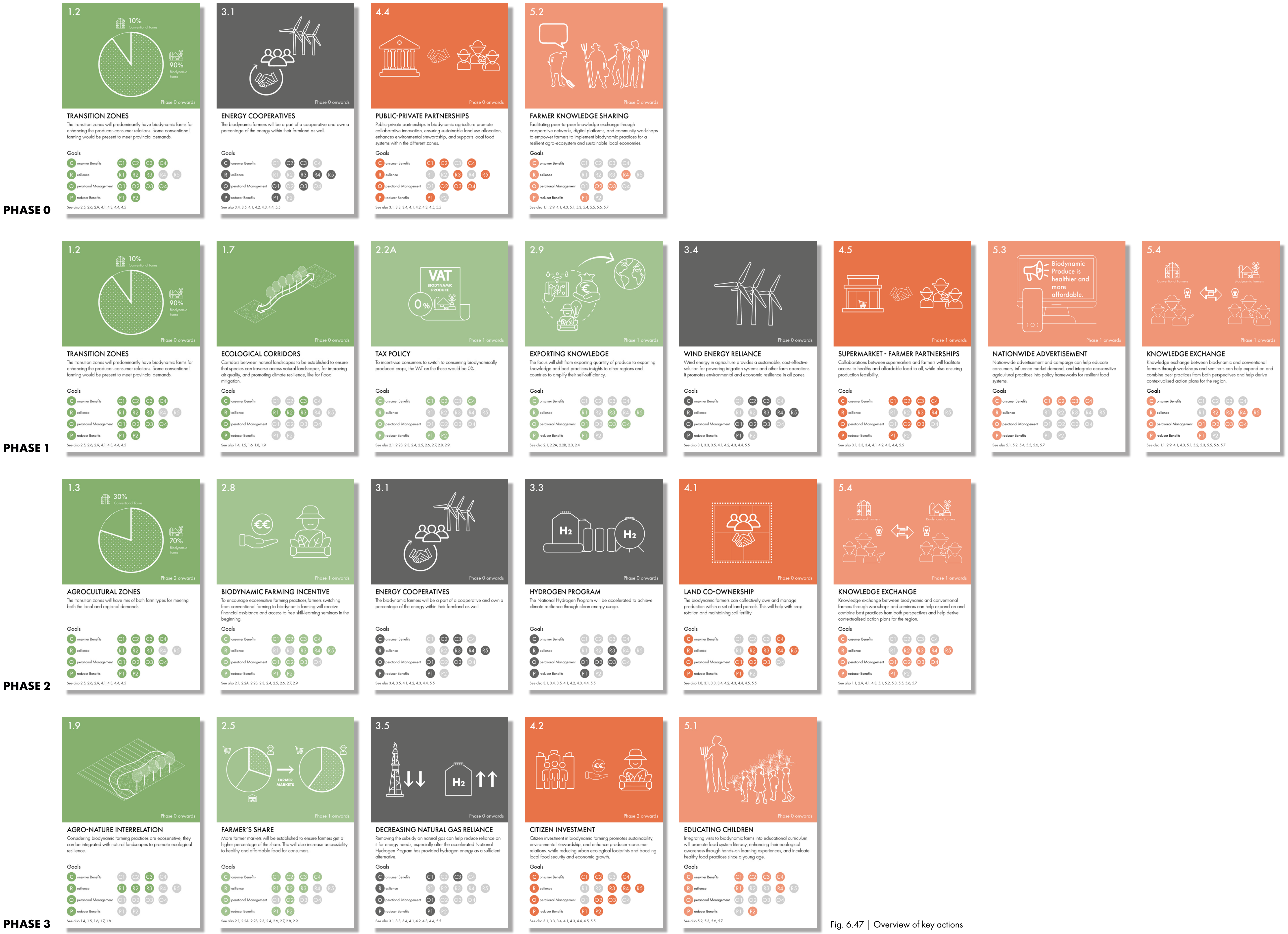


Fig. 6.47 | Overview of key actions

PHASING IN MAPS

PHASE 0

The idea is that phase zero builds upon the existing transition zone Oosterwold. This phase is focused on pioneering development on a small scale to test, gain knowledge, and start to raise awareness. Due to the mixed residential and agricultural areas, a close connection between consumer and producer will be realised. In this phase, public-private collaboration is key for supporting and stimulating innovation.

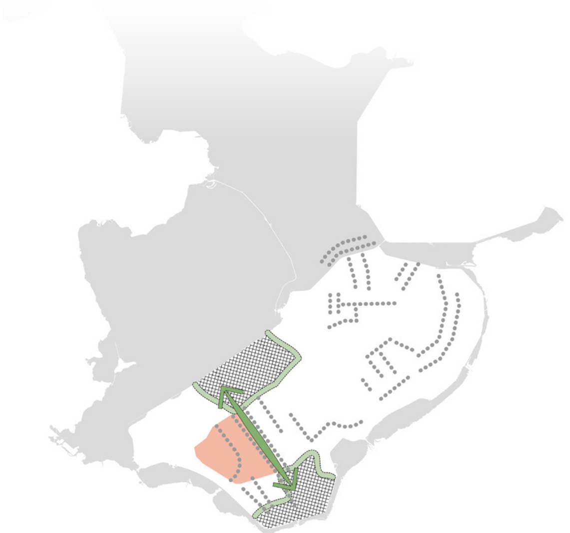


Fig. 6.49 | Phase 0, diagram 1

- Ecological corridors connecting the protected landscapes.
- Implementation of the proposed wind turbines.

Fig. 6.48 | Strategy map phase 0

Land-use
- Urban
- Mixed land-use (urban and agriculture)
- Business & innovation
- Biodynamic agriculture
- Nature-inclusive agriculture

Energy
- Wind turbine and hydrogen network
- Hydrogen storage
- Wind turbine

Nature
- Ecological corridor
- Natura 2000

Strategy action
- Innovation hub
- Knowledge hub/ export
- International trade
- Education

Stakeholders
- Supermarket
- Conventional farmer
- Government
- Collaboration

Other
- Freight route

0 5 10

PHASE 1

The first phase aims to create demand for biodynamic products and biodynamic or nature-inclusive farming. This phase is meant to upscale innovation and develop all transition zones. The development of the transition zones is included in this phase to create a closer connection between producers and consumers and create a higher demand for biodynamic and regional products. Policies within this phase will be focused on making biodynamic regional food more visible and accessible without too many adverse effects for regional stakeholders. Two key actions related to this area are a nationwide advertisement and a tax policy of 0% VAT for regional biodynamic products, a policy adapted from the proposed BBB policy of a general reduction of 0% VAT on all fruits and vegetables (BBB, 2023). The first step in transitioning to more nature-inclusive agricultural practices will be made via small-scale adjustments on every farm, like adding a buffer zone or more crop diversity. Furthermore, the windmill grid will be developed in this phase. Regarding international trade, a shift will be made from bulk conventional food exports to an increased focus on knowledge export and high-quality biodynamic products. Within this phase, cooperation between biodynamic farmers and conventional farmers will be stimulated, as well as cooperation between biodynamic farmers and supermarkets. Lastly, within this phase, green corridors will be developed between the Natura 2000 areas in Flevoland.

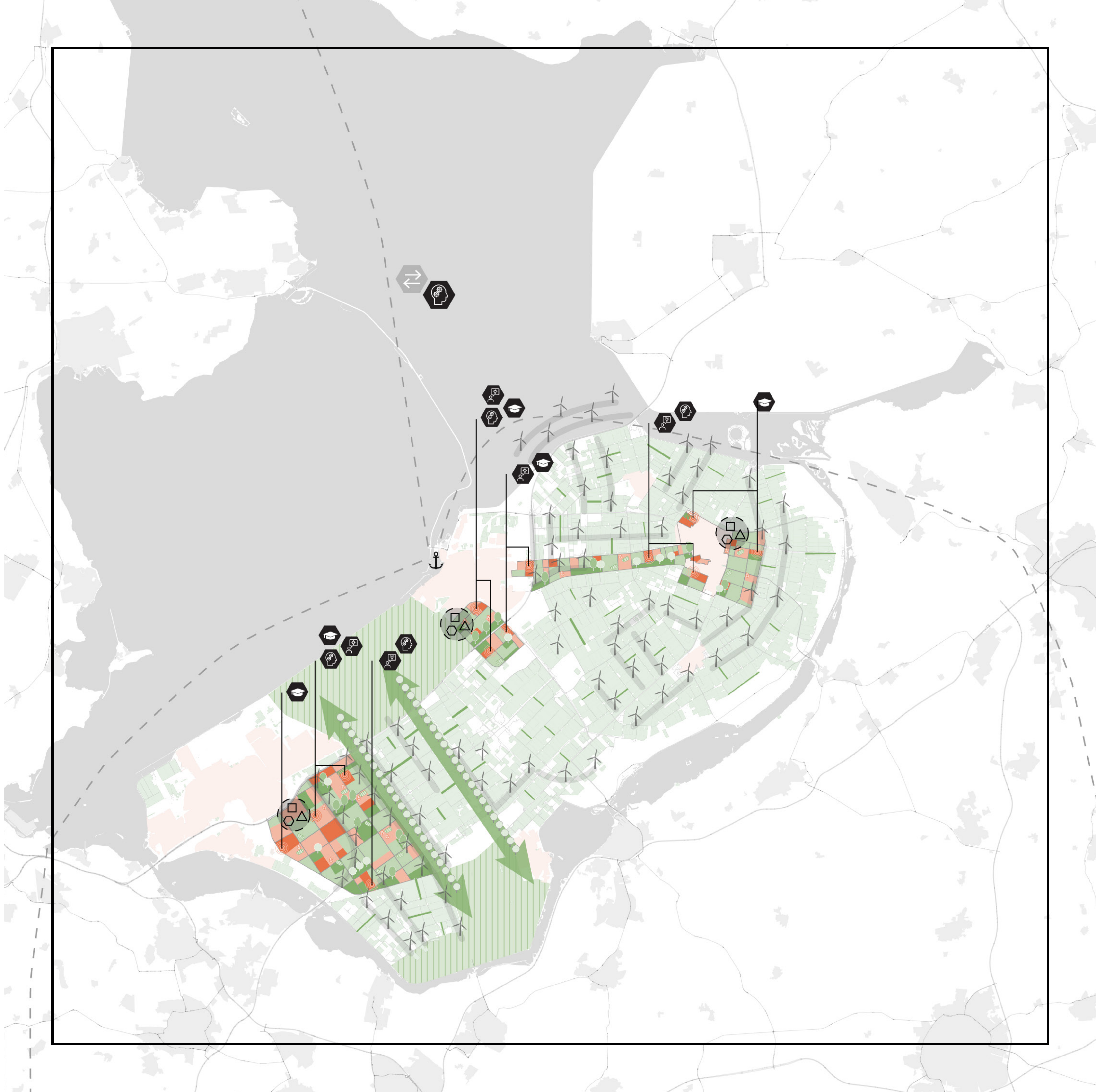


Fig. 6.50 | Strategy map phase 1

Land-use
- Urban
- Mixed land-use (urban and agriculture)
- Business & innovation
- Biodynamic agriculture
- Nature-inclusive agriculture

Energy
- Wind turbine and hydrogen network
- Hydrogen storage
- Wind turbine

Nature
- Ecological corridor
- Natura 2000

Strategy action
- Innovation hub
- Knowledge hub/ export
- International trade
- Education

Stakeholders
- Supermarket
- Conventional farmer
- Government
- Collaboration

Other
- Freight route

0 5 10

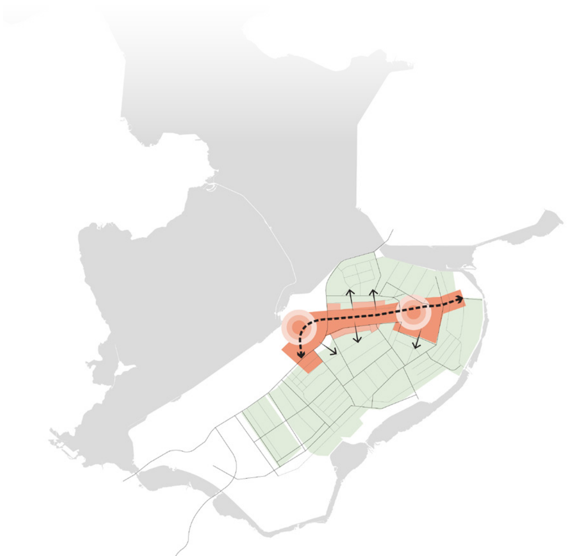


Fig. 6.51 | Phase 1, diagram 1

- Creating adaptive transition zone between the dense urban zones, that follows the Mondriaan grid.

Fig. 6.52 | Phase 1, diagram 2

- Buffer zones around protected landscapes, with a bit of integration with biodynamic farms.
- Main infrastructure layout in terms of defining primary roads and buffer zones between farms.

PHASE 2

In the second phase, farmers will be motivated to transition towards more nature-inclusive and primarily biodynamic agriculture. Within this phase, the monofunctional agricultural land will be transformed into an area with mixed land use in agroparks and transition zones for agriculture, water, and nature. The government will own the transition zones between water and agriculture and lease them to farmers. Cooperation between farmers will be stimulated via resource pooling and land co-ownership. Moreover, cooperation between biodynamic farmers and consumers or supermarkets will become even more prominent. The policies used in this phase will be stricter and more compelling to stimulate change. The renewable energy grid will be further developed by adding a hydrogen storage network next to the wind turbines. International trade will shift to a knowledge-driven and high-quality biodynamic food export. In this phase, the strategic export network will be developed via trade partnerships with other countries with corresponding agricultural systems, ensuring resilience to adversity. These partnerships are for specific moments rather than continuous trade but are maintained through community events.

Fig. 6.53 | Strategy map phase 2

Land-use
- Urban
- Processing
- Biodynamic agriculture
- Nature-inclusive agriculture
- Hybrid area; water and agriculture

Energy
- Wind turbine and hydrogen network
- Hydrogen storage

Nature
- Ecological corridor
- Natura 2000

Strategy action
- Innovation hub
- Knowledge hub/ export
- International trade
- Education
- Resource Pooling
- Knowledge exchange

Stakeholders
- ○ Supermarket
- △ Conventional farmer
- ▲ Biodynamic farmer
- □ Government
- Collaboration

Other
- – – Freight route

0 5 10

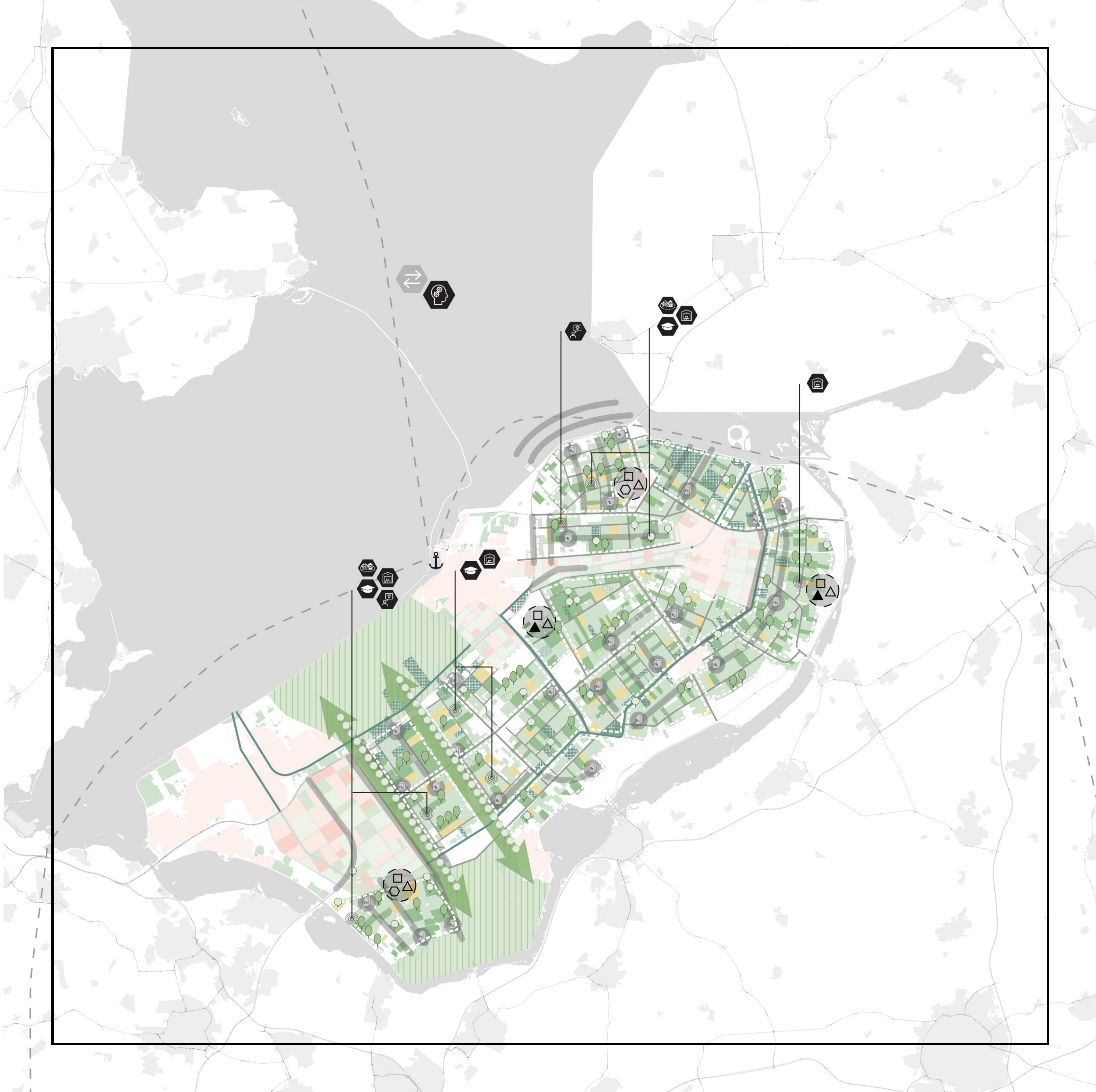


Fig. 6.54 | Phase 2, diagram 1

- Agroparks outlined as per primary street network.

Fig. 6.57 | Phase 2, diagram 4

- Processing units proximate to biodynamic farms and the distribution network.

Fig. 6.55 | Phase 2, diagram 2

- Hydrogen storage connection with the wind energy grid.

Fig. 6.58 | Phase 2, diagram 5

- Areas for water retention and paludiculture along the water channels.

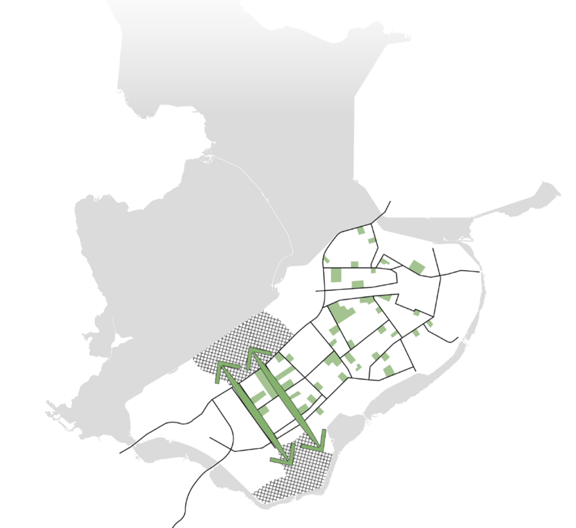


Fig. 6.56 | Phase 2, diagram 3

- Biodynamic farms proximate to primary streets, ecological corridors, and protected landscapes.

PHASE 3

The third phase is the resilient and flourishing Flevoland phase. This phase proposes to finalise and maintain the transitioned regional food system. The share of biodynamic or nature-inclusive farmers is higher. Furthermore, more transition zones are developed between agriculture, water, and nature. A green corridor will be developed between the Oostervaardersplassen (Natura 2000 area) and the Veluwe underneath Flevoland. In this way, an inter-provincial natural connection will be made to strengthen the green network on a regional scale. This phase aims to decrease natural gas usage in terms of the renewable energy transition. The energy plant near Lelystad will be transformed into a hydrogen power plant to accommodate the decreased reliance on fossil fuels. For the last phase, the idea is that cooperations are no longer stimulated by the government but will be strong enough to be sustained on their own accord.

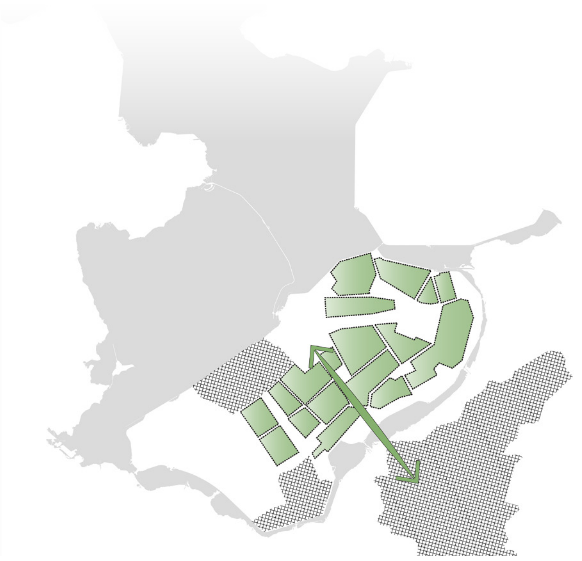


Fig. 6.60 | Phase 3, diagram 1

- Ecological corridors connecting at provincial scale. Agroparks achieving the aim of including 70% biodynamic farms.

Fig. 6.59 | Strategy map phase 3

Land-use
- Urban
- Mixed land-use (urban and agriculture)
- Business & innovation
- Processing
- Nature
- Biodynamic agriculture
- Nature-inclusive agriculture
- Hybrid area; water and agriculture

Energy
- Wind turbine and hydrogen network
- Hydrogen storage
- Hydrogen power plant

Nature
- Ecological corridor
- Natura 2000

Strategy action
- Innovation hub
- Knowledge hub/ export
- International trade
- Education
- Resource Pooling

Stakeholders
- Supermarket
- Conventional farmer
- Biodynamic farmer
- Collaboration

Other
- Urban farming
- Freight route

0 5 10

PHASING IN SECTIONS

KEY DRIVERS AND SPATIAL PHASING

The sections depict the spatial phasing of the strategies to achieve the vision plan and highlight which stakeholders are the drivers for each phase.

Phase 0 will focus on the expansion of Oosterwold, which will serve as a testing ground for public-private partnerships to establish an area with a functional mix. The energy infrastructure will be implemented, and the ownership framework will be defined for the agroparks simultaneously.

Phase 1 will focus on creating a demand, and supermarket-farmer collaborations will drive this effort, complemented by nationwide advertisement and implementation of revised tax policies. The transition zones will be expanded, and the main infrastructure and ecological corridors will be laid out in the agropark zone.

Fig. 6.61 | Key map for the sections

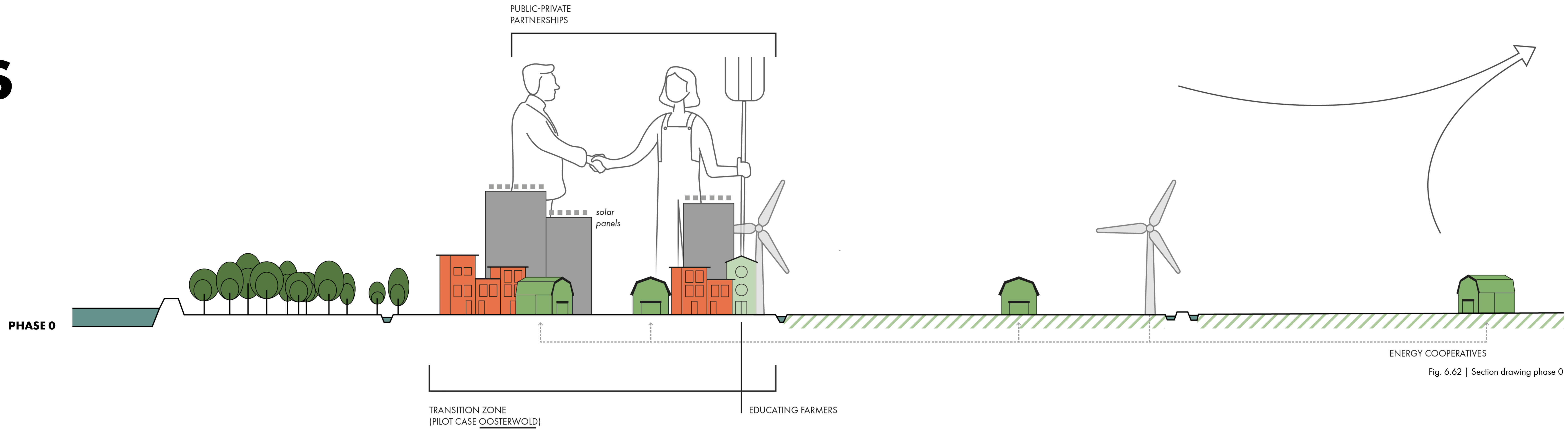


Fig. 6.62 | Section drawing phase 0

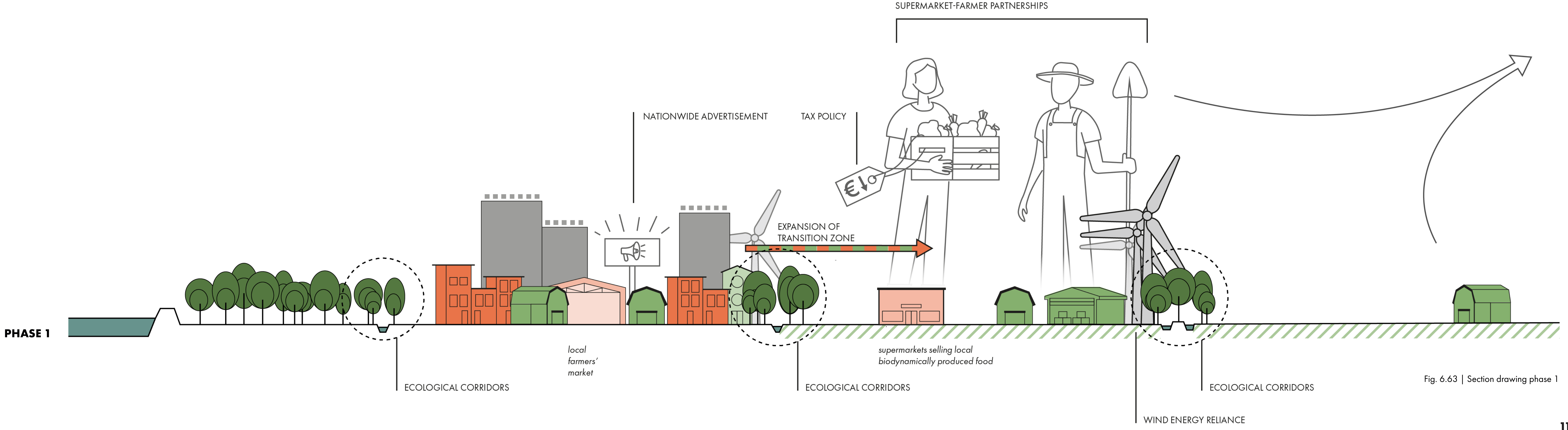


Fig. 6.63 | Section drawing phase 1

Phase 2 will focus on expanding agropark zones, driven by land co-ownership between farmers, resource pooling, and integrating hydrogen storage to the primary grid to suffice the energy needs within the zones.

Phase 3 will focus on bringing closer the producers and consumers driven by citizen investments in farms and educating everyone. The ecological corridor will begin to thrive. Collaborations and connections between the different zones will occur through knowledge sharing and socio-ecological programs such as farm visits, farming conventions, etc.

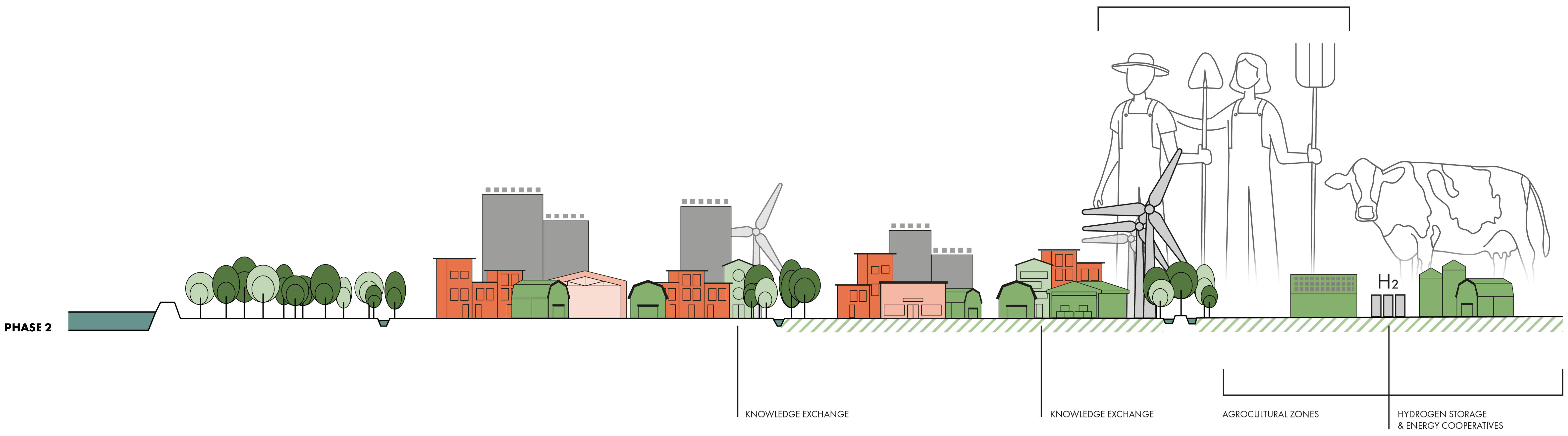


Fig. 6.64 | Section drawing phase 2

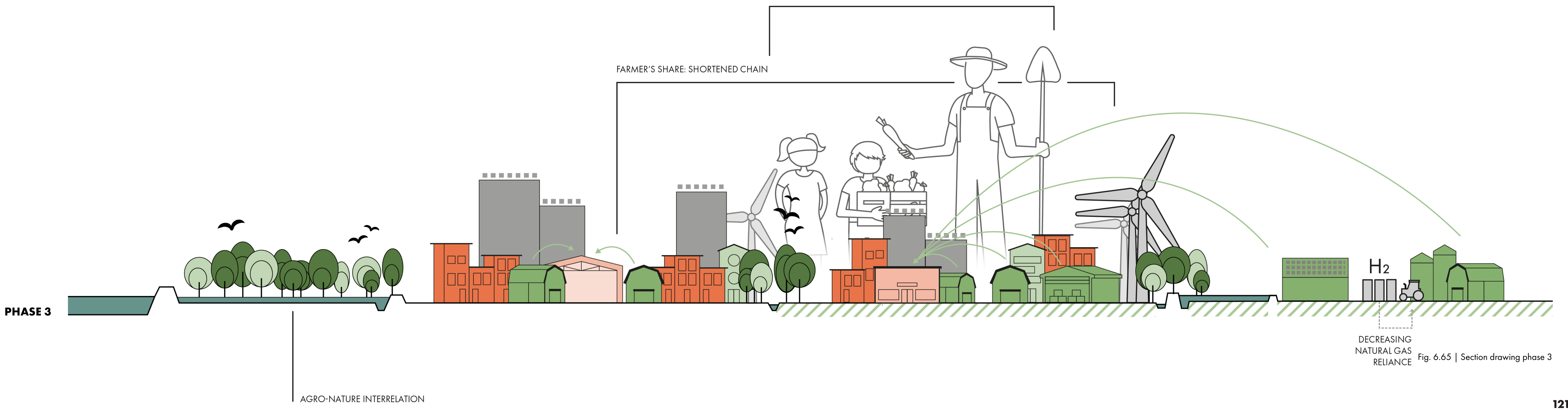


Fig. 6.65 | Section drawing phase 3

PILOT CASE: OOSTERWOLD

2011

The development of Oosterwold can be used to learn from for the development of future transition zones. The neighbourhood of Oosterwold and its different phases are highlighted in the timeline. Strategic actions outside the timeline involve the future of Oosterwold and other transition zones, as well as actions that have not taken place in Oosterwold but are proposed for a smoother development process of other possible transition zones (see Appendix D for complete timeline).

The first steps entail the development of a plan in which current farmers are included in participation events. This would eventually lead to a renewed zoning plan, after which the sale of land can start.

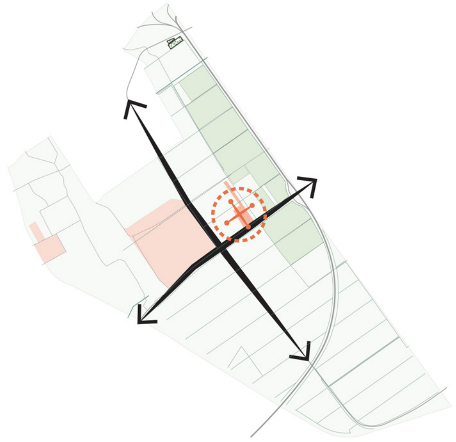


Fig. 6.67 | Diagram Oosterwold 2011

- Farms along the main street.
- Farms as anchor for residential development.

Fig. 6.68 | Map Oosterwold 2011
PDOK (2025d)

Residential
Suburb
Pastures
Forest
Conventional agriculture
Sustainable crop farming
Cattle farming
Water
Water retention zones
Recreational (golf park)
Solar park
Wind turbine
Land and resource sharing
Roads
Farmers
Supermarkets
Education
Resource pooling

0 1 2 km

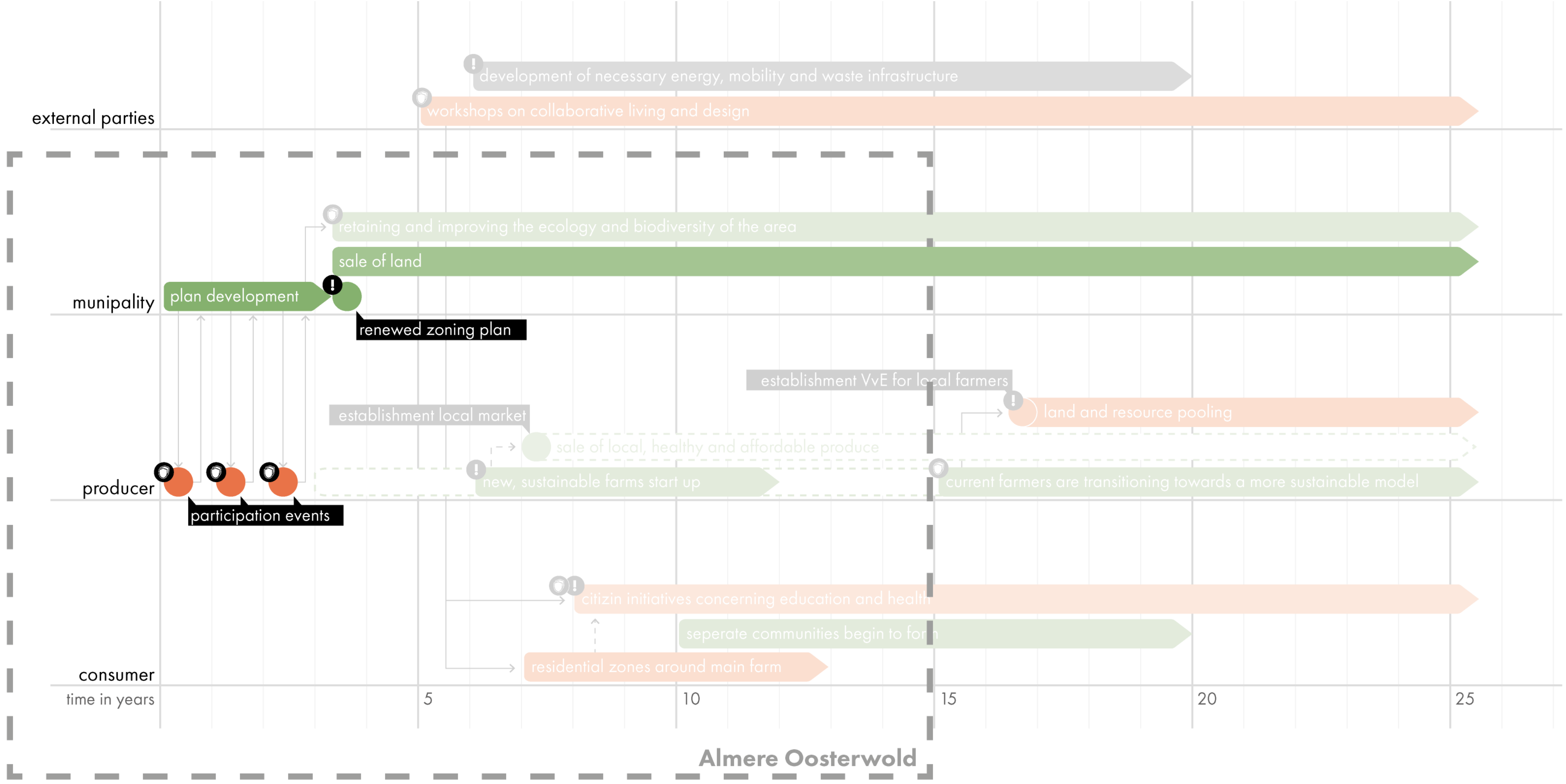


Fig. 6.66 | Timeline Oosterwold, 2011

2018

With the development of a new, central nature-inclusive farm, residential development arises around the farm. Some residents will directly participate and collaborate with the farm. Other farms may also transition towards more sustainable farming methods when they sell their produce directly to the consumer in this step. In Oosterwold, citizens were responsible for the development of their infrastructure. This will be done by external parties in the future since it has led to different problems in the past. The new citizens will also be invited to participate in workshops to support collaboration further.

Fig. 6.70 | Diagram Oosterwold 2018

- Integration of grocery stores within farmlands.
- Farms as anchor for residential development.
- Forest area earmarked as protected land.

Fig. 6.71 | Map Oosterwold 2018
PDOK (2025d)

- Residential
- Suburb
- Pastures
- Forest
- Conventional agriculture
- Sustainable crop farming
- Cattle farming
- Water
- Water retention zones
- Recreational (golf park)
- Solar park
- Wind turbine
- Land and resource sharing
- Roads
- Farmers
- Supermarkets
- Education
- Resource pooling

0 1 2 km

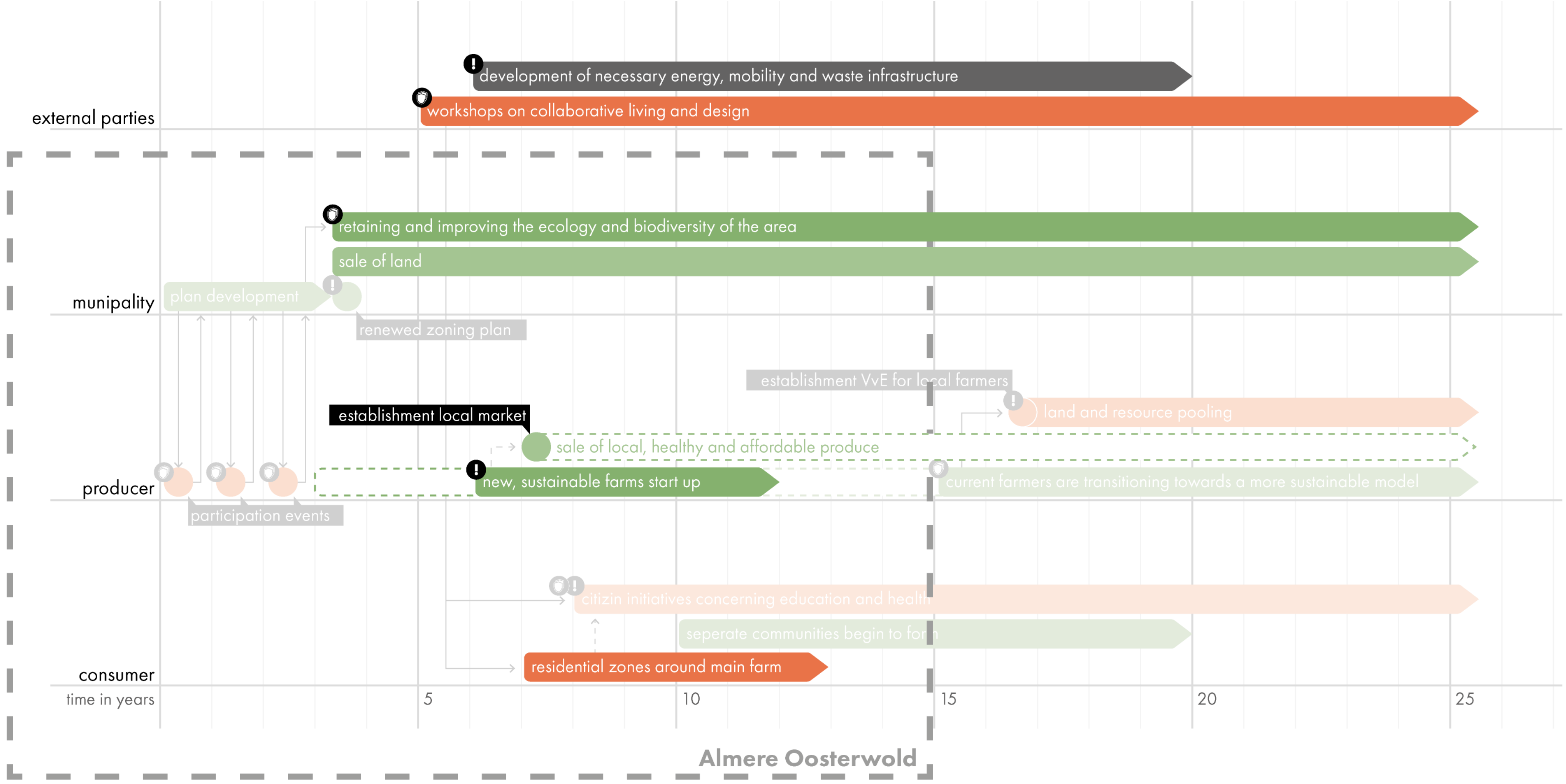


Fig. 6.69 | Timeline Oosterwold, 2018

2024

After the first step, the main farm and its surrounding residential zone will be in place, and many different communities will begin to form. They will also develop different initiatives, as has happened with different educational facilities in Oosterwold. The surrounding farms support these educational facilities.

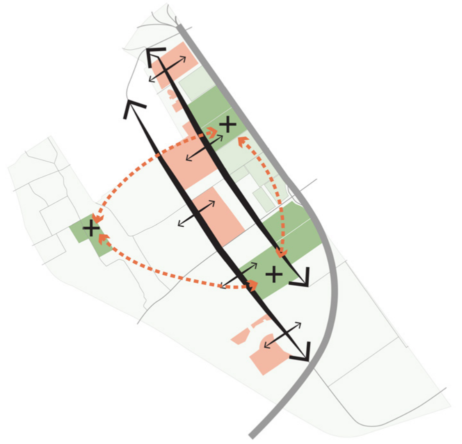


Fig. 6.73 | Diagram Oosterwold 2024

- Streets as anchors for residential development.
- Cross collaboration between farmers.
- Biodynamic farm expansion.

Fig. 6.74 | Map Oosterwold 2024
PDOK (2025d)

- Residential
- Suburb
- Pastures
- Forest
- Conventional agriculture
- Sustainable crop farming
- Cattle farming
- Water
- Water retention zones
- Recreational (golf park)
- Solar park
- Wind turbine
- Land and resource sharing
- Roads
- Farmers
- Supermarkets
- Education
- Resource pooling

0 1 2 km

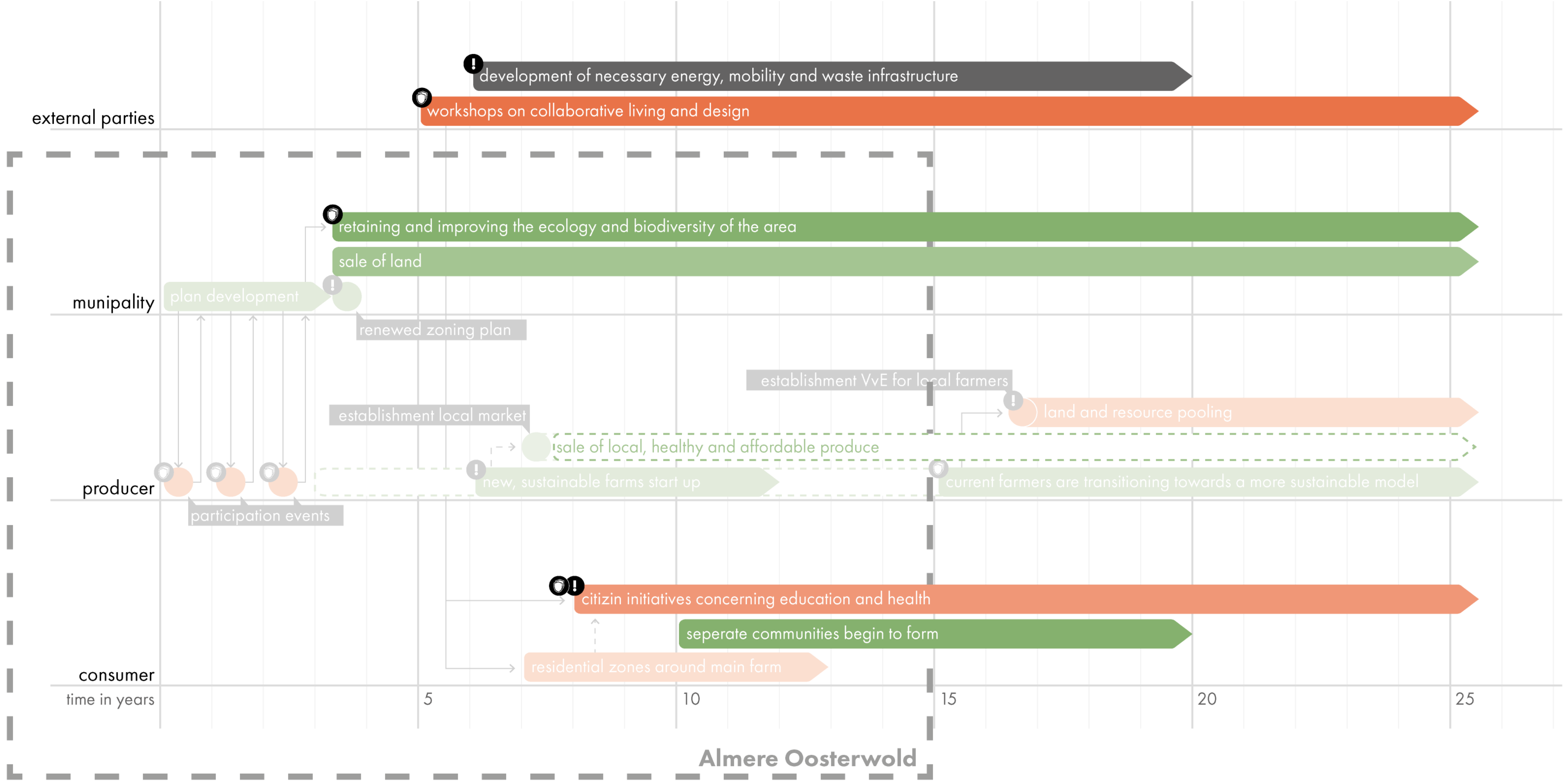


Fig. 6.72 | Timeline Oosterwold, 2024

2035

As a last step, the surrounding farms are proposed to fully transition into a nature-inclusive system, using land and resource sharing. Their small-scale distribution centres will be located along the most used roads of the Mondriaan grid. All farms deliver their produce to the local shop, ensuring consumers can buy healthy food at a centralised location within the shortened chain. A more resilient landscape will also be developed, incorporating water retention zones.

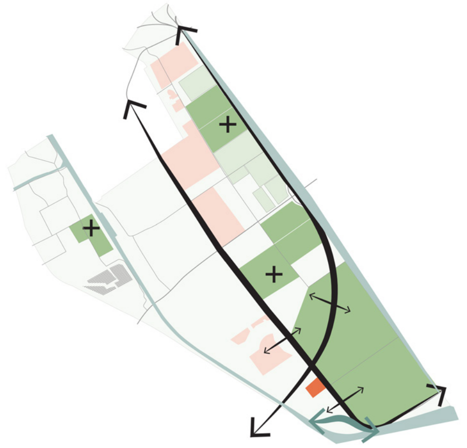


Fig. 6.76 | Diagram Oosterwold 2024

- Crossing over the highway that was acting as an expansion barrier.
- Supply units placed around the main axis.
- Farmlands incorporating ecosensitive practices.

Fig. 6.77 | Map Oosterwold 2035
PDOK (2025d)

- Residential
- Suburb
- Pastures
- Forest
- Conventional agriculture
- Sustainable crop farming
- Cattle farming
- Water
- Water retention zones
- Recreational (golf park)
- Solar park
- Wind turbine
- Land and resource sharing
- Roads
- Farmers
- Supermarkets
- Education
- Resource pooling

0 1 2 km

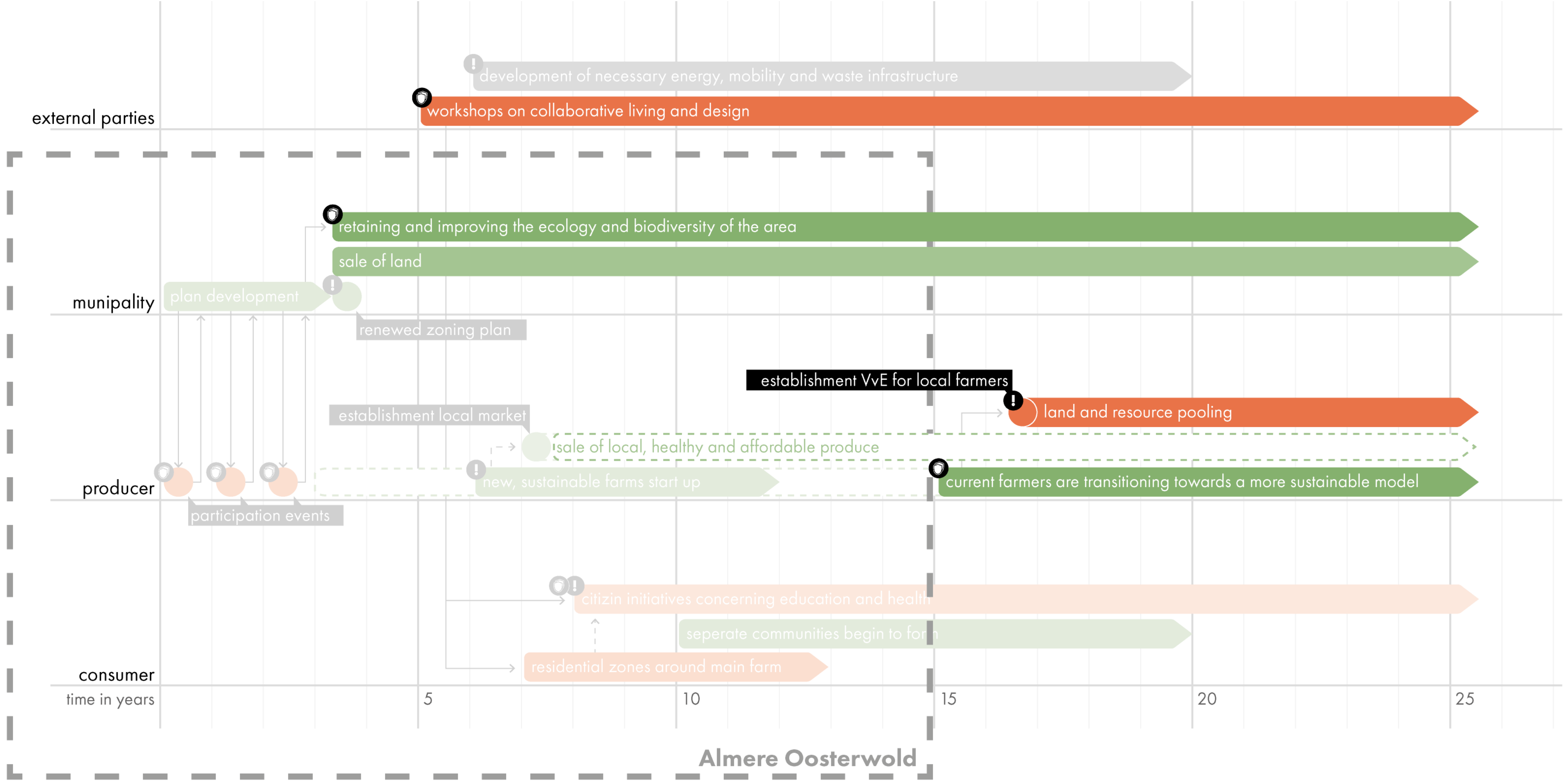


Fig. 6.75 | Timeline Oosterwold, 2035

ADAPTIVE CYCLE

The adaptive cycle was developed at the start of this century to understand complex systems, such as social-ecological systems like the agricultural transition. This tool, developed by Gunderson and Holling (2002), consists of a loop containing four phases: growth, conservation, release and reorganisation. The first half of the loop, the foreloop, is a phase of growth in which a system slowly improves leading up to a period of stability. This eventually crashes down in the release phase, the start of the backloop. Momentary chaos leads to fast-moving innovation and eventual system reorganisation before completing the loop.

Some systems consist of multiple loops which interact with each other. These loops typically can be organised in smaller loops, depicting faster-moving processes. They can spark the growth of another loop. The largest cycle depicts a process with a more significant duration; this cycle has to be considered or remembered during the other simultaneous cycles. While this was initially developed as a metaphor, it has since been proven to accurately represent complex systems (Sundstrom & Allen, 2019).

In this project, the different cycles can be categorised as consumer behaviour (phase 1), agricultural transition (phase 2) and the environmental system (phase 3). The change in consumer behaviour is a fast-moving process which will eventually spark the agricultural transition. Changing consumer behaviour has the least impact on the landscape. This is more prominent in the agricultural transition, a cycle that will take longer. Together, these two cycles are responsible for the systematic change in the food system. The redevelopment of the environmental system is a very long process, which should be considered when redeveloping the agricultural system.

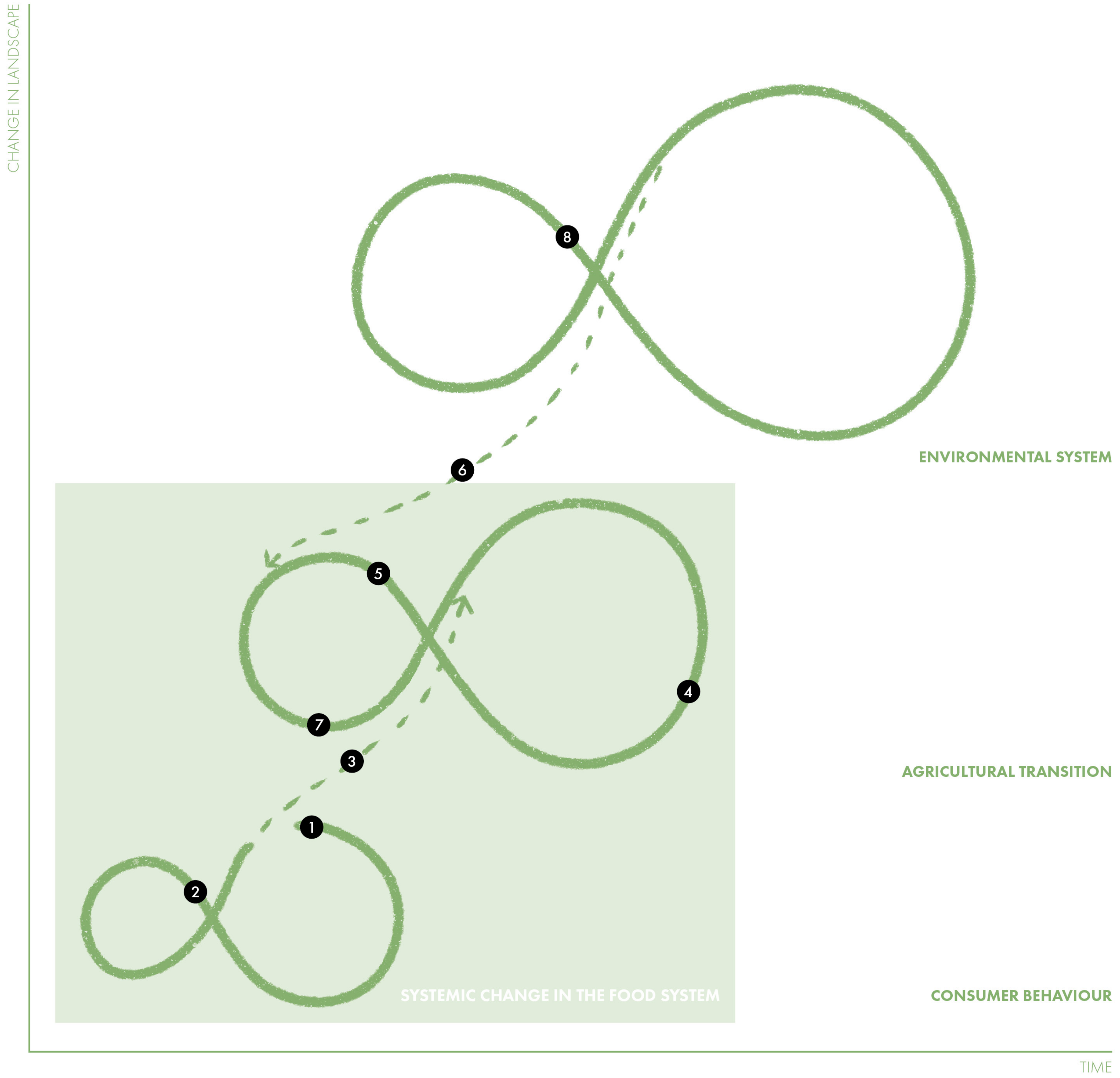


Fig. 6.78 | Adaptive cycle

1. Status quo
2. A bigger demand for biological produce is being created through education and campaigns
3. The increased demand for biological produce is requiring a transition in the agricultural system
4. The conventional agricultural system collapses, resulting in a short period of chaos
5. Reorganisation is taking place on multiple levels, i.e. the allocation of government funds
6. The transition of the environmental system is taken into account while reorganising the agricultural system
7. A combination of conventional and biodynamic farming ensures a resilient system
8. Large parts of Flevoland require restructuring in favour of the ecological system after the large scale agricultural transition

STAKEHOLDER COLLABORATION AND REPOSITIONING

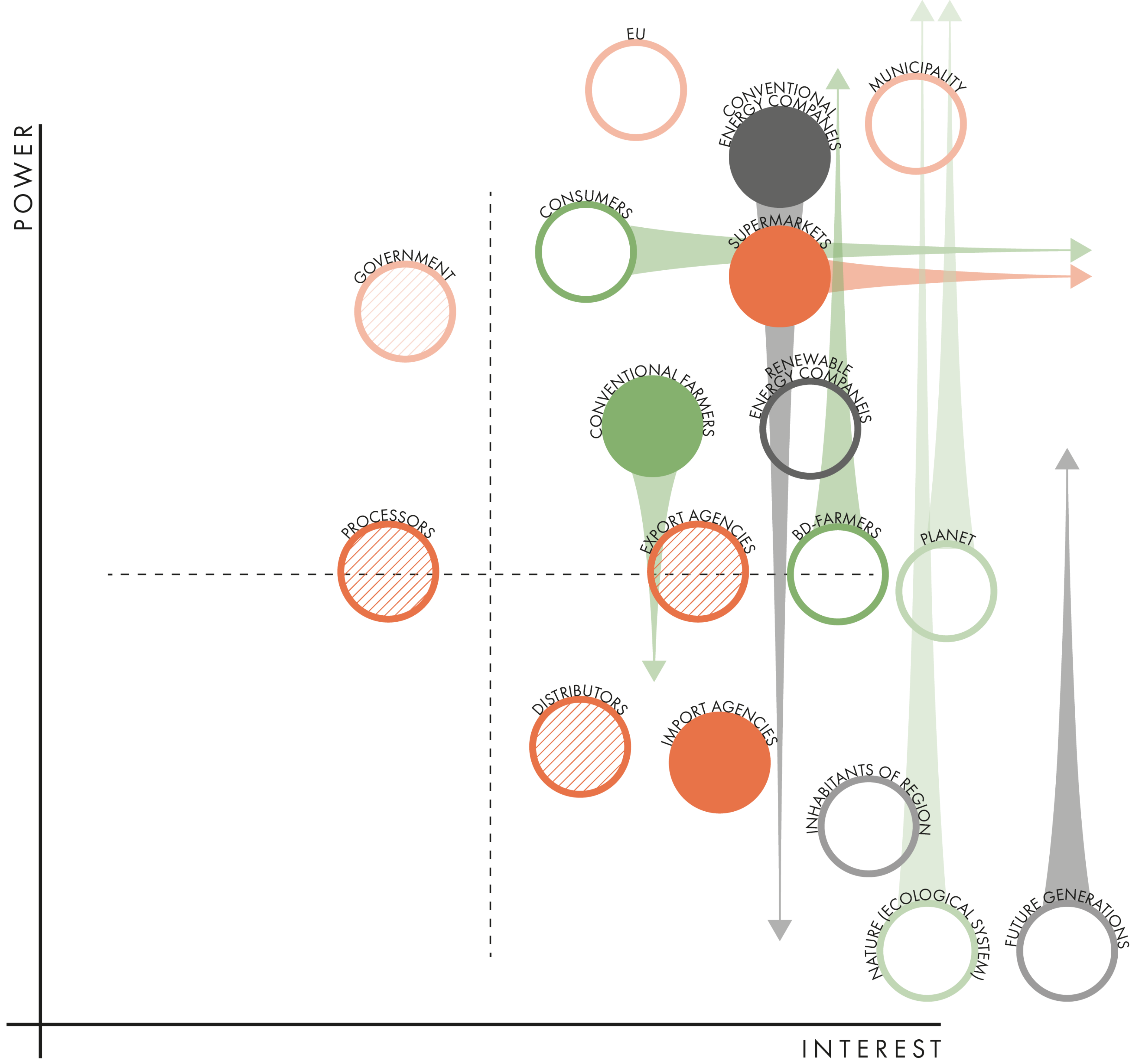
The redevelopment causes a shift in the power-interest matrix. In every phase, stakeholders are engaged, but their power and interests alter. As was mentioned in a previous chapter, certain stakeholders in the matrix have shared ambitions or transition roles and are, therefore, connected. Some shifts happen gradually, such as consumer interest; through education, their awareness is increased and changes the demand changes, taking supermarkets with them. The most significant shift occurs on the power axis, as biodynamic farmers, ecological systems, and the planet start to hold more power; conventional farmers and conventional energy companies either lose power or choose to transition. **Through honest, transparent and just collaboration, this transition is smoothened.**

Fig. 6.79 | Overview of stakeholders

- Farmers
- Planet & nature
- Food system
- Governance
- Energy
- (Future) inhabitants

- Negative
- Fence-sitter
- Positive

- Stakeholder alignment
- Proposed repositioned power/interest



7.

REFLECTION

GROUP REFLECTION

SCOPE AND LIMITATIONS

The project 'Biodestructive to Biodynamic: Towards a Resilient Food System with Healthy, Regional, and Energy-efficient Food Production' began with five individuals concerned about the food system's resilience. Flevoland presented a great opportunity due to its fertile soil condition, the energy landscape and potential, and a cluster of cities to understand the interrelations between urban zones and agricultural areas. However, similar conditions would not be present everywhere. So, while the principles of this project's vision plan are applicable everywhere through the creation of the three zones, the spatial translation of each zone would be unique to every region, meaning the type of transition zones would differ, too.

One of the project's challenges was defining how the food systems can be analysed. The systemic analysis could also consider fuel costs and consumptions involved in transporting imported and exported resources, and to a certain extent, they were considered. However, carefully defining the extent of the system to include what causes impacts and is impacted in the food flow was challenging. Similarly, while the project computed the space required for production in the upscaled biodynamic farms, the energy infrastructure, and the policies to regulate pricing, the economic aspect of upscaling biodynamic farming was challenging to grasp given the plethora of financial models that could influence the market dynamics and the team's limited understanding of those models given the time frame.

The adaptive cycle considers the ratchet-hatchet-pivot cycle (DeFries, 2014). Cultivation was the ratchet phase, when humanity shifted from foraging to farming. The world is currently in the hatchet phase, where intensive cultivation practices have led to drastic climate change with nitrogen emissions, soil degradation, fossil fuel depletion, and so on. Through technological innovations, the world aims to reach the pivot stage where stability (seemingly) will be attained, and this project tries to find ways to do so. However, it is challenging to account for and predict the unpredictable challenges. Through the scenario-building exercise, the project tried to imagine the worst-case scenarios and the exemplary measures to do so. However, what if World War III occurred or a natural calamity occurred? Some of these were a part of the discussions, and the phasing accounted for which measures needed to be implemented, and which could accommodate some delays.

ALIGNING WITH THE SDGs

The project supports primarily 'SDG 2: Zero Hunger', aiming to achieve food security, improve nutrition, and promote sustainable agriculture, 'SDG 7: Affordable and Clean Energy', aiming to ensure access to affordable, reliable, sustainable, and modern energy for all, and 'SDG 11: Sustainable Cities and Communities', aiming to make cities and human settlements inclusive, safe, resilient, and sustainable Independent Group of Scientists Appointed by the (Secretary-General & United Nations, 2019). Additionally, and equally important are the goals of SDG 3 (Good Health and Well-being), SDG 9 (Industry, Innovation, and Infrastructure), SDG 12 (Responsible Consumption and Production), SDG 13 (Climate Action), SDG 15 (Life on Land), SDG 16 (Peace, Justice, and Strong Institutions), and SDG 17 (Partnerships for the Goals). The other goals are, however, included within the project, even if not mentioned explicitly.

SUSTAINABILITY

The project set out the goal of a sustainable agrifood system such that the current generation and the generations to come forth will all have access to healthy food while ensuring that the ecosystem thrives. This is reflected in the need for an 'Education and Awareness' layer within the strategy actions. The SEE Framework (Social, Economic, and Environmental) also guided the project's strategic actions, with the Economic factor steering the other two aspects. The overarching layer of 'Market Dynamics' specifies import-export policies, taxes, and food pricing in stores to create a demand for biodynamically produced food. Through such incentives, consumers are motivated to improve their food habits, addressing the issues of being overweight and a small percentage of food insecurity in the Netherlands. Simultaneously, all the layers deal with environmental resilience, and the strategic actions are correlated and specified on each card.

SPATIAL JUSTICE AND ETHICS

Coming across the biodynamic farming methodology seemed like an incredible revelation, even though the farming practice has been around for 100 years. Biodynamic farming has not been as pronounced due to its small scale. The nitrogen emission reduction policies, livestock use (even if not as drastic as conventional livestock farmers), and the integration of renewable energy infrastructure on their land make them a vulnerable community. With the progress of climate change, the planet can be categorised as the most vulnerable community, which the project realised while analysing the stakeholders and their position in the Power-Interest matrix.

The public goods created within the project are farmer markets, healthy food, accessible agroecological habitats, nature, education, and a liveable environment, all connected to the values of room for nature, intergenerational responsibility, accessibility, collaboration, and increased agency of all citizens. Equitable distribution is at the forefront of the project's aim and is also evident in the conceptual framework's principle of 'Just Functions'.

However, food import-export is steered by collaborations and agreements predominantly between countries on a European scale. Taking a stance of only feeding the country and exporting a limited amount of food, besides exporting innovation and ideas to make other countries self-sufficient, is like having a coin with two sides. On the one side, contingency plans need to be in place for disruptions in a cycle, such as pandemics, droughts, floods, and so on, when the countries come together to cater to each other. So, the countries must have these agreements and feed each other over time. On the other side, the Netherlands could commit to international food security but has to bear the burden of the aftereffects such as soil degradation, increased energy consumption by larger industries, and the decreased variation within the living environment, to state a few. The global scale considerations thus include many more stakeholders in analysing the degree of spatial justice achieved.

SCIENTIFIC AND SOCIETAL RELEVANCE AND FUTURE RECOMMENDATIONS

While the project focuses on upscaling biodynamic farming, other farming innovations must accompany a more resilient system, such as aquaponics, vertical farming, and more sustainable greenhouse practices for achieving carbon neutrality and livestock farming. These require collaborations between farmers and professionals with technical proficiency from various domains, such as engineering and soil climate specialists.

To educate the current generation, especially the children who will grow up to see the transition, the curricula would have to be adapted such that these healthy practices are inculcated from a young age.

A lot of conventional farmers are already incorporating sustainable practices. Transitioning to a time and space where biodynamic farms are large-scale would disturb the visions of a few conventional farmers who want to maintain the status quo. The disparity of five major supply offices holding the most significant share within the system would have to adapt to the proposals. The economic incentives would require time to be put in place, which would require time when the damage could already be done. Deincentivising conventionally produced crops can lead to protests and dissent against the government and political parties. Keeping them satisfied requires a lot of collaborative workshops and consulting economists to create newer and more relevant models.

GROUP WORK

The group generally worked together rigorously throughout the quarter, with each member contributing their knowledge and skills. The group discussed, brainstormed, outlined, and allocated the tasks. However, at times, everyone worked separately on different subjects. Integrating and connecting all the information into a cohesive one was challenging and would require extended discussions and creating mind maps. A strength of the discussions was the constructive feedback provided for integration attempts. Furthermore, the Miro board helped tackle the individual work issue, as everyone could see what the other people had found and try to connect or find conflicts between the gathered information.

While the group decided on a colour palette, which helped throughout the quarter, more time could have been invested in creating a more extensive palette. At the end of the project, four more colours were added to depict water bodies, supply units, and processing units. Even though we acknowledge that adapting over time is sometimes necessary, earlier decisions could have saved us time and effort throughout the project.

Initially, the group could have taken more time to communicate and assess individual strengths and weaknesses. This could have been advantageous in dividing the tasks and the workload.

Overall, the group also had some fun conversations that geared everyone to work toward the shared vision.

Addressment Level
- Very High
- High
- Moderate

Fig. 7.1 | Sustainable Development Goals
UN Global Compact Network Netherlands (2015)

INDIVIDUAL REFLECTION

APARNAA CHANDRASEKARAN

INTERCONNECTED WITH Q1

Our project 'From Biodestructive to Biodynamic' for this R&D studio Spatial Strategies for the Global Metropolis, was a very intense exploration of regional design that looked at the nexus of three things: agricultural transition, energy transition, and the transition community of biodynamic farmers. I perceived this quarter as an expansion of Q1 proposals, where I looked at polder lands in the Netherlands from an (agricultural) productivity perspective. This quarter, the multiscalar and interconnected understanding of policies, historical events that shaped the landscape that we see today, the role of energy infrastructure in facilitating and being facilitated by agriculture, and the economic aspects gave insights not only for this project but also on how my previous project could be redefined to include biodynamic farming and how greenhouses can be made more sustainable through innovations and energy transition. In my first quarter's reflection, I looked forward to the upcoming quarters to learn how logistics can make these vision plans and design ideas viable. I believe I achieved that goal and learnt about the Dutch agriculture system far better with this quarter's project, but many further questions also arose.

REGIONAL DESIGN PROCESS

I looked forward to exploring regional design and planning for the first time this quarter, and it was an interesting and very insightful experience. A key learning was to learn how to carefully determine at which scale what concerns are at the forefront while simultaneously outlining their scope across different scales. Even while working at the smallest scale of a building, I believe it is integral to design contextually at multiple scales rather than in silos and say, "Fuck Context" (Koolhaas et al., 1995). However, in the case of regional design, I believe it is inherent to have a multiscalar approach; otherwise, design is inconsequential.

At the regional scale, design challenges intensify due to the complex, multifaceted nature of the territory. While advocating for a bottom-up approach is essential, decision-making must often occur at higher governance levels, where international collaborations play a significant role. This dynamic can create tensions, particularly with communities resistant to change—such as conventional farmers relying on large-scale, bulk agriculture. Here, I learnt that it is crucial to incentivise reforms as well as the practices to be phased out to encourage adaptation.

Historically, my approach has been linear—analysing past events to understand the present and envision the future. However, the fast-paced nature of this quarter underscored the importance of a research-by-design methodology. Peter Pelzer's lecture on using future visions to shape the present (Beckert, 2013) was particularly insightful. Over the first five weeks, we iterated on a vision plan, grounding it in concurrent research. In the next phase, strategies were derived directly from this vision. The vision plan thus became a central guiding tool, informing both our research and the strategic approach.

Defining and designing for a transition community is an insightful way to achieve a vision. Within agriculture, our group began with identifying the different types of agriculture. While all agricultural practices are taking sustainable measures, we evaluated which kind has the least impact and needs to be empowered. Another valuable workshop was understanding how to conduct stakeholder analysis, know their attitudes, their hopes and dreams, and where they lie in the power-interest matrix. This helped us understand the various collaborations to achieve the hopes and dreams of our transition community at the regional scale.

COLLABORATION

Through this collaborative project, I was able to leverage my strengths and address my weaknesses. Writing is a key strength of mine, allowing me to synthesise ideas and identify connections, which I applied extensively during the report compilation. As a mapping enthusiast, I contributed my skills in creating representative diagrammatic maps. I also took the initiative to develop strategic action cards, experimenting with different visualisation techniques. Although communication in group settings can be challenging, I remained fully engaged, focusing on producing well-thought-out, high-quality work. Being from another country, understanding the local socio-cultural nuances took time, but my team was supportive, helping me learn about things like the political party BBB. Overall, it was very engaging to work in a group with consistent discussions, constructive feedback, and a few light-hearted, witty conversations that helped us all achieve a project for which we mutually care.

Aparnaa

My interest is in the intersection of food systems and mobility within urban landscapes. Dutch greenhouses drive production but at high energy and environmental costs. With expansive polder lands viable for agriculture, why isn't land-based farming prioritised? How can the sector transition to climate neutrality while optimising spatial efficiency? Additionally, food transport is integral to the energy transition—can long-haul logistics adopt electric or low-emission alternatives? Reducing food miles is essential for lowering carbon emissions. Current practices significantly impact communities near greenhouse clusters, such as Steenbergen B.V. and Rotterdam Port, alongside broader regional stakeholders. *How can there be a better mix of residential and agricultural functions?*

Inclination written at the beginning of the quarter

References

Beckert, J. (2013). Imagined futures: fictional expectations in the economy. Theory and Society, 42(3), 219–240. https://www.jstor.org/stable/43694686

Koolhaas, R., Mau, B., Werlemann, H., & Sigler, J. (1995). S, M, L, XL. Monacelli Press.

INKE MOOI

This individual reflection aims to reflect on the group's regional design process. It begins by reflecting on the project's content through the community-driven vision, translating the vision to strategy, and the project's relevance to societal challenges. The second part will focus on personal learning and include group dynamics, knowledge gained through SDS lectures and workshops, and my evolving perspective on the role of spatial designers.

The first part of the project was focused on formulating a community-driven vision. The vision emerged from understanding the transition community's interest and their relevance in transitioning towards a more sustainable and just food system. Focusing on a particular transition community helped shape the narrative and formulate a convincing vision. Nevertheless, a challenge for the vision was to have a neutral stance. I sometimes realized that framed ideas for the vision were based on my perspective. This raised my awareness about the biases one could bring in regional design and planning.

For the translation between vision and strategy, the shift from representing the transition community to representing Flevoland's interest was more difficult than anticipated. The main reason for this was the additional layers that had to be considered, such as current policies and the power and interest of other stakeholders. The added context made it difficult to understand the cohesive story and how to shift from the vision to the strategy. These difficulties made me sometimes question whether the proposed vision was adaptable enough to provide a strong base for the strategy. Nevertheless, the developed strategy is expected to be relevant due to its attempt to propose manageable strategic (spatial) actions in a timeframe to improve the regional food system. Moreover, the strategy corresponds to recognized internal dilemmas in the Dutch food system.

Regarding personal learning, my goal was to participate actively in group discussions. In hindsight, I was relatively active during group discussions by sharing my opinions or ideas each time we met. Besides, I think what worked well in our group were the intermediate meetings and deadlines we set, as they made the group work more efficiently and improved communication throughout the project. I can improve my contribution to teamwork by sharing difficulties earlier so the group can work towards a solution. Moreover, the group could improve by taking more time to reflect on improving collaboration during the project.

Throughout the weeks, I learned how to translate a community-driven vision or regional strategy to spatial implementation. The systemic section (Workshop from Alexander Wandl) was a valuable tool for spatially understanding the complexity of the project's theme. The power-interest matrix (Workshop from Marcin Dabrowski) and participation lectures (Lecture from Fred Hobma) were interesting lectures to understand the political and social-cultural aspects of developing a strategy. Furthermore, the project helped evolve my perspective on the role of spatial designers. Throughout the project, it became apparent that regional design also entails political and cultural practices. I now believe a strategy should be closely connected to existing policies and facilitate solutions to societal dilemmas. Furthermore, the importance of encouraging resilience and adaptability has also become more evident. It is vital to recognize opportunities and challenges throughout the project and develop a regional plan that allows for resilience in the long term.

JOOST BASTIAANSEN

After the studio courses on the city scale in Q1 and the neighbourhood scale in Q2, this course would discuss the regional scale, one which I initially was not looking forward to. My personal preference in urban design lies in the small-scale developments, such as neighbourhoods. A scale which is deeply intertwined with different social dynamics, the main reason I opted to do a masters in Urbanism. A studio course on regional design which should focus on the subject of the energy transition could not have been further out of my comfort zone. However, the incorporation of communities made it possible to work with different social dynamics. With these communities in mind, the choice to work on a project within the agricultural sector seemed like an obvious one. Farmers are generally not seen as a proponent of the energy transition, and these clashing viewpoints were exactly the difficult social dynamics which pique my interest.

Throughout the process, I was not able to find my footing until the development of the strategy. During the making of the one-sided vision from the viewpoint of biodynamic farmers, I struggled not to implement the contrasting viewpoint of the conventional farmer. Now, at the end of the project, I can recognize the value of the vision for the eventual development of the strategy. It was necessary to have an ideal to work towards and see how other stakeholders can be included in this vision.

Working from the vision of a transition community poses certain risks in a project solely developed by students from the Urbanism master. It is important to recognize that we, as urbanists, form a bubble. While an effort was made to include the wishes of the conventional farmer, our perception on the energy transition will remain different to the perception of farmers affected by the proposed strategy. In practice, regional development has to include more participation from all involved stakeholders as discussed by Fred Hobma. Conversations with those affected by the changing agricultural system can ensure a more nuanced and just design.

An essential step in the development of this project has been the mapping of flows, discussed in the SDS workshop by Alexander Wandl. Being able to compare the material input in the current agricultural system to the proposed biodynamic system clearly illustrates the manner in which this project can contribute to the energy transition. However, complex systems such as the agricultural one cannot solely be simplified in the systemic section, as it does not account for the changing social landscape. An effort was made to represent the social dynamics through scientific research.

In general, the methods used during this project have given me a greater understanding of the complexities involved in regional design. A subject which I initially considered to be largely spatial, turned out to have multiple different facets including politics and people. During this course, I have extended my knowledge on GIS, in particular space syntax analyses, which will be beneficial for future research. In projects to come on a regional level, I would like to dive deeper into the spatiality of regional design, as my focus during this project has been mainly on spatial and social analysis. These past ten weeks have been an intensive, but overall meaningful learning experience and I look forward to implementing my extended skillset in projects to come.

SUSANNA KORVER

To express what a vision means, could best be done with the literal sense of the word, the ability to imagine how a country, society, industry, etc. could develop in the future. A vision can be seen as a goal, an idea that should be achieved, something to look forward to, something to prepare for and work towards. In this case, we developed a vision based on our chosen transition community. In my experience it helped the project and even myself, as a guide and made it easier to grasp the assignment. It was a shared goal we all worked towards together, which helped with the group dynamic.

During the development strategy we still held the vision close, because it was also something we as “urbanists” stood/stand behind. The lectures helped us to step back and take a critical look at the project on a larger scale. So, comparing the vision with the existing policies and finding the conflicts was a valuable experience and strengthened our strategy. Many policies were in line with our vision, but there were also a few conflicts. Had we had more time, we could have done more research concerning market dynamics and conventional farmers to form a stronger argument. I would have liked to interview more biodynamic farmers on their ideas and approach to farming, because it interests me personally. The vision still formed a baseline for our eventual strategy.

I think designing for a specific transition community is a nice principle, but if not done correctly, can lead to big problems. Collaboration, transparency and social justice need to be actively present during every step of the way to avoid excluding any other communities. Obviously, this is something that is difficult to incorporate in a short period of time. Given the circumstances I think we managed to do so fairly well, by trying to keep a broader perspective and taking other stakeholders into account. Pleasing everyone is impossible, but so long as best interests are kept at heart, it is possible to make everyone feel heard taken seriously.
Depending on the community, it might be difficult to understand what their hopes and dreams are. Some communities are easily defined and might already have representation or documents about their vision. For other communities it might be more difficult to even get an idea, extensive research through for example interviews might be required to sketch a vision. Our transition community, the biodynamic farmers, form a relatively small community. So, we thought we might not find enough information, there was however quiet a lot. Upon doing more research we discovered that, although small, they were a loud and proud group advocating for nature and put effort into sharing their vision. Their motivation motivated us in a way. Planning with the use of a transition community was an interesting assignment, and taught us valuable lessons.

Working in a group of five people was new for me too. The group dynamic was interesting and was something I had to get used to, I found it difficult to find my place and asses myself among my peers. Eventually you get to know each other and what their strengths are, making it easier to work together. Altogether, I have learned valuable things that will stick with me from these classes. Having started this Master in Q3, it has been a very interesting first taste of what urbanism has to offer.

TESSA BREEN

The large scale of this project was at first quite daunting because of the many stakeholders and aspects that were involved. The wicked problems that are associated with the energy transition seemed impossible to solve. Therefore, it helped to focus on a particular transition community during the vision forming. In our case, we envisioned a future for Flevoland from the perspective of biodynamic farmers. This is a community with clear standpoints and a strong desire for change. It was very useful to visit a biodynamic farm and talk to a knowledgeable biodynamic farmer. As urbanists, I believe we must avoid designing cities based on our personal beliefs and preconceived biases. Instead, we must consider and listen to the people we are designing for. Although the interview with the farmer was beneficial, it would be even better to do many more in-depth interviews with other members of the community to gain a more comprehensive understanding of their wishes. Furthermore, the vision would ideally be formed together with this transition community through hosting feedback moments and collaboration sessions. It is believed that co-creation would eventually lead to more just spatial planning. However, this desired participation process is difficult to do within a nine-week timespan.

Still, I experienced that considering the needs and wishes from one specific transition community helped to think big. Sometimes, when the aim is to consider and please all stakeholders, the urban project lacks ambition due to all the compromises that must be made. The envisioning from our community's perspective helped to translate their big dreams to concrete spatial consequences that truly spark systematic change. Through scaling up the biodynamic farming principles, a systemic change in the agricultural sector is proposed that transforms the entire food production system into a more sustainable one.

After having developed a strong vision for what the biodynamic food system should entail, it could then be analyzed which other stakeholders and sectors are influenced by the proposed transition. Doing this, the project became more complex, but keeping the envisioned future in mind was helpful in staying focused. Analyzing possible conflicts helped with understanding which barriers needed to be overcome or which parties needed to be persuaded to achieve the vision. Analyzing synergies helped investigate where collaboration can occur, and which interventions should be the key drivers. For instance, by considering the perspectives of consumers as well, it was found that the unsustainable food system is also very much enabled by consumers' unhealthy eating habits and uninformed behavior. At the same time, many consumers don't have access to affordable biological or biodynamic food. Hence, strategic spatial, social and economic measures could then be proposed to convince stakeholders (like consumers) and involve them in the envisioned transition to a more just, sustainable and healthy food system.

Comparing our vision to the (political) context and considering a range of stakeholders made us aware of possible conflicts. These found conflicts were beneficial, as they helped to critically think about how consensus can be built and required us to come up with well-argued interventions. Doing this from an advocacy perspective with the wishes of our transition community on the foreground, helped to develop carefully considered plans without compromising on progressive sustainability goals. All in all, our advocacy approach during this project allowed us to think about what is possible instead of what is not. It led to a spatial plan that actually creates hope for a more sustainable future.

8.

REFERENCES

REFERENCES

Andersson, J., & Grönkvist, S. (2019). Large-scale storage of hydrogen. *International Journal of Hydrogen Energy, 44*(23), 11901–11919. https://doi.org/10.1016/j.ijhydene.2019.03.063

Arnstein, S. R. (1969). A ladder of citizen participation. *Journal of the American Institute of Planners, 35*(4), 216–224. https://doi.org/10.1080/01944366908977225

Aziz, I., Ashraf, M., Mahmood, T., & Islam, K. R. (2011). *Crop rotation impact on soil quality. Pakistan Journal of Botany, 43*(2), 949-960. http://pakbs.org/pjbot/PDFs/43(2)/PJB43(2)0949.pdf

Baltussen W.H.M., Kornelis, M., Van Galen, M.A., Logatcheva, K., Van Horne, P.L.M., Smit, A.B., Janssens, S.R.M., De Smet, A., Van Zelst, N.F., Immink, V.M., Oosterkamp, E.B., Gerbrandy, A., Van Bockel, W.B., & Pham, T.M.L. (2014). *Prijsvorming van voedsel; Ontwikkelingen van prijzen in acht Nederlandse ketens van versproducten.* (LEI 14-112). LEI Wageningen UR, Universiteit Utrecht Departement Rechtsgeleerdheid – Internationaal en Europees Recht http://www.agripress.be/_STUDIOEMMA_UPLOADS/downloads/0-7__2__0.pdf

Barbieri, P., Pellerin, S., Seufert, V., Smith, L., Ramankutty, N., & Nesme, T. (2021). Global option space for organic agriculture is delimited by nitrogen availability. *Nature Food, 2*(5), 363–372. https://doi.org/10.1038/s43016-021-00276-y

BBB. (2023). *Iedere dag BBBeter. Van Vertrouwenscrisis naar Noaberstaat.* (Verkiezingsprogramma 2023-2027). Retrieved March, 2025 from https://boerburgerbeweging.nl/wp-content/uploads/2023/10/BBB_VERKIEZINGSPROGRAMMA_NOV2023_Corr5.pdf

Bellini, E. (2024, August 16). *Netherlands posts more negative energy prices.* pv magazine. Retrieved March, 2025 from https://www.pv-magazine.com/2024/08/16/netherlands-posts-more-negative-energy-prices/

Bielmann, M., Vogt, U.F., Zimmermann, M., & Züttel, A. (2010). Seasonal energy storage system based on hydrogen for self sufficient living. *Journal of Power Sources, 196*(8), 4054–4060. https://doi.org/10.1016/j.jpowsour.2010.11.096

Biodynamic Federation Demeter (2023). *About.* Retrieved March 2025 from https://demeter.net/about/

Biodynamische Vereniging (n.d.) *Wat is biodynamisch.* Retrieved March 2025, from https://bdvereniging.nl/biodynamisch/wat-is-biodynamisch/

Bock, B. B., & Wiskerke, J. S. C. (2024). Voedsel van ver en dichtbij: verschuivende relaties in de voedselketen. In A. van der Heide (Ed.), *Tien essays over de internationale verwevenheid van ons voedselsysteem* (pp. 113-123). Sociaal en Cultureel Planbureau. https://edepot.wur.nl/676358

Boersma, H., Faber, Y., Lanjouw, J., Lohman, J., Methorst, R., Scholten, M., Smeets, P., & Wertheim-Heck, S. (2019). *Feeding the city: Farming and the future of food.* Uitgeverij van Gennep.

Bos, A.P., Breman, B.C., de Wolf, P.L., van Meijl, J.C.M., Geerling-Eiff, F.A., Jellema, A., de Jonge, E.L., Dekker, J., Fuchs, L.M., Puente-Rodríguez, D., van Ree, M., van Wassenaer, L., Wesselink, M., & Wigboldus, S.A. (2024). *WUR perspectives on agriculture, food and nature.* Wageningen University & Research. https://doi.org/10.18174/643823

Burgering, C. (2024). *ESG - Dutch agriculture not on track to meet climate targets.* ABN AMRO Bank. Retrieved April, 2025 from https://www.abnamro.com/research/en/our-research/esg-economist-dutch-agriculture-not-on-track-to-meet-climate-targets

CBS (2023). *Kaart van 500 meter bij 500 meter met statistieken* [Dataset]. Retrieved March 2025 from https://www.cbs.nl/nl-nl/dossier/nederland-regionaal/geografische-data/kaart-van-500-meter-bij-500-meter-met-statistieken

CBS (2024a). *Hernieuwbare energie in Nederland 2023.* Retrieved March, 2025 from https://www.cbs.nl/nl-nl/longread/rapportages/2024/hernieuwbare-energie-in-nederland-2023?onepage=true#c-1--Inleiding

CBS (2024b). *Windenergie op land; productie en capaciteit per provincie.* Retrieved March, 2025 from https://www.cbs.nl/nl-nl/cijfers/detail/70960ned

CBS (2025). *Zonnestroom; vermogen en vermogensklasse, bedrijven en woningen, regio.* Retrieved March, 2025 from https://www.cbs.nl/nl-nl/cijfers/detail/85005NED

CBS Statline (2023). *Bodemgebruik; uitgebreide gebruiksvorm, per gemeente.* Retrieved March, 2025 from https://opendata.cbs.nl/statline/#/CBS/nl/dataset/70262ned/table?ts=1741870629436

CBS Statline (2025). *Bedrijven; bedrijfstak.* Retrieved March, 2025 from https://opendata.cbs.nl/#/CBS/nl/dataset/81589NED/table?dl=B7CD

Copernicus EU (2018). *CORINE Land Cover 2018 (vector/raster 100 m), Europe, 6-yearly* [Dataset]. Retrieved from https://land.copernicus.eu/en/products/corine-land-cover/clc2018#download

Crippa, M., Solazzo, E., Guizzardi, D., Monforti-Ferrario, F., Tubiello, F. N., & Leip, A. (2021). Food systems are responsible for a third of global anthropogenic GHG emissions. *Nature Food, 2*(3), 198–209. https://doi.org/10.1038/s43016-021-00225-9

DeFries, R. (2014). A Bird's-Eye View. In R. DeFries (Ed.), *The Big Ratchet: How Humanity Thrives in the Face of Natural Crisis* (pp. 1–15). https://doi.org/10.5860/choice.187652

Dekking, A., Jansma, J.E., Janssens, B., Smit, B., (2020). *Biologische landbouw in Flevoland; Omvang en productstromen.* (Rapport WPR-822) Wageningen Research. https://doi.org/10.18174/511396

Den Broeder, L., Hilderink, H., Polder, J., Dekker, L., Janssen-van Eijndt, T., van der Lucht, F., Spijkerman, A., van Bakel, M., Deuning, C., Kupper, N., & Couwenbergh, C. (2024). *Volksgezondheid Toekomst Verkenning 2024: Kiezen voor een gezonde toekomst.* (RIVM-rapport 2024-0110) RIVM. https://research.hanze.nl/files/68177455/2024-0110.pdf

De Pater, B. (2010). Conflicting images of the Zuider Zee around 1900: nation-building and the struggle against water. *Journal of Historical Geography, 37(*1), 82–94. https://doi.org/10.1016/j.jhg.2010.04.002

De Ponti, T., Rijk, B., & Van Ittersum, M. K. (2012). The crop yield gap between organic and conventional agriculture. *Agricultural Systems, 108*, 1–9. https://doi.org/10.1016/j.agsy.2011.12.004

De Zeeuw, F. (2022, September 30) *Het fiasco van Oosterwold.* ROmagazine. Retrieved April, 2025 from https://romagazine.nl/artikel/28066/het-fiasco-van-oosterwold

Eerens, H. & Van Dam, D. (2022). *Decarbonisation options for Large Volume Organic Chemicals Production, DOW Chemical Terneuzen.* (PBL: 4883; TNO2021 P11711) PBL Netherlands Environmental Assessment Agency and TNO Energy Transition. https://www.pbl.nl/sites/default/files/downloads/pbl-2022-decarbonisation-options-for-large-volume-organic-chemicals-production-dow-terneuzen-4883.pdf

Engelen, C.J.M. (2009). *Wie zorgt voor wie?: op weg naar een duurzame relatie tussen stad en platteland* (Rapportnummer 253). Wetenschapswinkel Wageningen. https://edepot.wur.nl/165606

European Commission (2020). *Farm to Fork Strategy.* European Union.

European Commission (n.d.). *Common agriculture policy, agriculture and rural development.* Retrieved March 2025, from https://agriculture.ec.europa.eu/common-agricultural-policy_en

Eurostat. (2024, August). *Agri-Environmental Indicator - Energy use.* Retrieved April, 2025, from https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Agri-environmental_indicator_-_energy_use

Ferraro, D. (2007). Energy Cost and Use in Pesticide Production. In D. Pimentel (Ed). *Encyclopedia of Pest Managment, Volume II.* (pp. 153–156). https://doi.org/10.1201/9781420068467.ch39

Geofabrik (2025). *Download OpenStreetMap data for this region: Flevoland* [Dataset]. Retrieved March, 2025 from https://download.geofabrik.de/europe/netherlands/flevoland.html

Gunderson, L.H. & Holling, C.S. (2002). *Panarchy: Understanding Transformations in Human and Natural Systems.* Island Press, Washington D.C.

Hebinck, A., Villarreal, G., Oostindie, H. & Hebinck, P. (2014). *Deliverable 2.2 National Report : the Netherlands.* Retrieved from https://www.researchgate.net/publication/283069583_Deliverable_22_National_Report_the_Netherlands

Herrington, G. (2020). Update to limits to growth: Comparing the World3 model with empirical data. *Journal of Industrial Ecology, 25*(3), 614–626. https://doi.org/10.1111/jiec.13084

Hill, A.V. (Ed.). (2020) *Foundries of the Future: a Guide to 21st Century Cities of Making.* With contributions by: Croxford, B., Domenech, T., Hausleitner, B., Meyer, H., Orban, A., Sanz, V. M., Vanin, F., & Warden, J. TU Delft Open. https://doi.org/10.47982/bookrxiv.9

HVC (n.d.). Zonnepark Zuyderzon Almere. Retrieved March, 2025 from https://www.hvcgroep.nl/ons-verhaal/onze-groene-projecten/zonnepark-zuyderzon-almere

Independent Group of Scientists Appointed by the Secretary-General & United Nations. (2019). *Global Sustainable Development Report 2019: The Future is Now - Science for Achieving Sustainable Development.* https://sdgs.un.org/sites/default/files/2020-07/24797GSDR_report_2019.pdf

IPLO (n.d.) *Introductie omgevingswet.* Retrieved April, 2025, from https://iplo.nl/regelgeving/omgevingswet/introductie/

Jukema, G.D., Ramaekers, P. & Woltjer, P.J. (2025). *De Nederlandse agrarische sector in internationaal verband – editie 2025.* (Wageningen Social & Economic Research Rapport 2025-016). Wageningen Economic Research. https://doi.org/10.18174/684406

Kinchin J. (2024) *One on One: Frank Lloyd Wright's Broadacre City.* MoMA Retrieved April, 2025 from https://www.moma.org/magazine/articles/1107

Kwakernaak, C., Ypma, K., Klijn, J., Van Bakel, P., & Van Der Gaast, J. (1998). *Ruimtelijke gevolgen van klimaatverandering en bodemdaling; effecten van veranderingen in de waterhuishouding op het ruimtegebruik.* (Rapport 618) DLO Staring-Centrum. http://library.wur.nl/WebQuery/wurpubs/308955

Lanfranchi, M. & Giannetto, C. (2015), "A case study on the role of farmers' markets in the process of shortening the food chain and the possible economic benefits for consumers", *Quality– Access to Success, 16*(144), pp. 94-98. https://iris.unime.it/retrieve/handle/11570/3063237/51123/Q-as_Vol.16_No.144_February-2015_p94-98_Lanfranchi.pdf

Li, M., Jia, N., Lenzen, M., Malik, A., Wei, L., Jin, Y., & Raubenheimer, D. (2022). Global food-miles account for nearly 20% of total food-systems emissions. *Nature Food, 3*(6), 445–453. https://doi.org/10.1038/s43016-022-00531-w

Li, Y., & Zimmermann, J. (2023). *Agronica: Agrarian Urbanism.* AOT Retrieved from https://www.topalovic.arch.ethz.ch/Courses/Student-Projects/FS23-Agronica-Agrarian-Urbanism

MacCallum, D., Babb, C., & Curtis, C. (2019). *Doing research in urban and regional planning.* Routledge. https://doi.org/10.4324/9781315818894

Meadows, D. H., Meadows, D. L., Randers, J., & Behrens, W.W. (1972). *The Limits to Growth: A report for the Club of Rome's Project on the Predicament of Mankind.* Universe Books. https://doi.org/10.1349/ddlp.1

Miles, M. B., & Huberman, A. M. (1994). Qualitative Data Analysis: an expanded Sourcebook. *Journal of Environmental Psychology, 14*(4), 336–337. https://doi.org/10.1016/s0272-4944(05)80231-2

Ministry of Agriculture, Nature and Food Quality of The Netherlands (2019). *Plan of action. The Dutch government's plan to support the transition to circular agriculture.* https://www.government.nl/binaries/government/documenten/policy-notes/2019/11/30/plan-of-action---supporting-transition-to-circular-agriculture/Plan+of+action+-+supporting+transition+to+circular+agriculture.pdf

Ministry of Foreign Affairs (2022). *Doen waar Nederland goed in is, strategie voor buitenlandse handel & ontwikkelingssamenwerking.* (Beleidsnotitie 2022). Retrieved March, 2025, from https://open.overheid.nl/documenten/ronl-98f1d520800bbb8067bdd271ab313cb10a986b93/pdf

Ministry of Infrastructure and Water Management (2024, 3 September). *Wet milieubeheer.* Retrieved March, 2025, from https://www.rijkswaterstaat.nl/leefomgeving/wetten-regels-en-vergunningen/natuur-en-milieuwetten/wet-milieubeheer

Ministry of Infrastructure and Water Management & The Chair of the House of Representatives of the States-General (2025). *Towards a new balance in the living environment: Room to live with water.* (National Delta Programme 2025). https://english.deltaprogramma.nl/binaries/delta-commissioner/documenten/publications/2024/09/17/dp2025-complete-version/252.105_Deltaprogramma+2025+EN.pdf

Ministry of Education, Culture and Science (2024, 3 January). *Nationale Omgevingsvisie (NOVI).* Retrieved March, 2025, from https://www.cultureelerfgoed.nl/onderwerpen/omgevingswet/omgevingsvisie/nationale-omgevingsvisie-novi

Muilwijk, H., Huitzing, H., De Krom, M., Prins, A. G., Vonk, M., &Westhoek, H. (2020). *Our daily diet.* (PBL publication number: 3486) PBL. https://www.pbl.nl/uploads/default/downloads/pbl-2020-our-daily-diet-3486.pdf

MVRDV (n.d.). *Almere Oosterwold.* Retrieved April, 2025 from https://www.mvrdv.com/projects/32/almere-oosterwold

Nefs, M. (2023). *Dutch Distribution Centres 2021 Geodata (Version 2)* [Dataset]. 4TU.ResearchData. Retrieved March, 2025 from https://doi.org/10.4121/19361018.V2

OECD (2023). *Policies for the Future of Farming and Food in the Netherlands.* OECD Agriculture and Food Policy Reviews, OECD Publishing. https://doi.org/10.1787/bb16dea4-en.

Omroep Flevoland (2023, December 4). *Is de stadslandbouw in Oosterwold mislukt?* Omroep Flevoland. Retrieved April, 2025 from https://www.omroepflevoland.nl/nieuws/359079/is-de-stadslandbouw-in-oosterwold-mislukt

Omroep Flevoland (2024, July 5). *Almere geeft gemaakte fouten in Oosterwold toe, lessen laten even op zich wachten.* Omroep Flevoland. Retrieved April, 2025 from https://www.omroepflevoland.nl/nieuws/387073/almere-trekt-boetekleed-aan-over-fouten-oosterwold-lessen-laten-even-op-zich-wachten

Paris, B., Vandorou, F., Balafoutis, A. T., Vaiopoulos, K., Kyriakarakos, G., Manolakos, D., & Papadakis, G. (2022). Energy use in greenhouses in the EU: A review recommending energy efficiency measures and renewable energy sources adoption. *Applied Sciences, 12*(10), 5150. https://doi.org/10.3390/app12105150

PBL, TNO, CBS & RIVM (2024). *Klimaat- en Energieverkenning 2024.* (PBL-publicatienummer: 5490) PBL. https://edepot.wur.nl/676529

PDOK. (2025a). *Natura2000* [Dataset]. Retrieved March 2025 from https://service.pdok.nl/rvo/natura2000/wms/v1_0?request=GetCapabilities

PDOK. (2025b). *ROR significant overstromingsrisico vlakken [overstromingsrisico_v}* [Dataset]. Retrieved March 2025 from https://service.pdok.nl/rvo/natura2000/wms/v1_0?request=GetCapabilities

PDOK. (2025c) *Liander elektriciteitsnetten* [Dataset]. Retrieved March 2025 from https://www.pdok.nl/introductie/-/article/liander-elektriciteitsnetten-1

PDOK. (2025d) *Luchtfoto Actueel Ortho 8cm RGB* [Dataset]. Retrieved April 2025 from https://service.pdok.nl/hwh/luchtfotorgb/wms/v1_0?request=GetCapabilities&service=wms

Provincie Flevoland (n.d.) *Het verhaal van Flevoland.* Retrieved April, 2025 from https://www.flevoland.nl/wat-doen-we/omgeving/omgevingswet/omgevingsvisie-flevoland/flevolandstraks/opgaven/het-verhaal-van-flevoland

Provincie Flevoland (2021) Programma landschap van de Toekomst- ontwerp 31-02-2021. Retrieved April, 2025, from https://flevoland.tercera-ro.nl/SiteData/9924/Publiek/SV00081/b_NL.IMRO.9924.ProgrLandschapFlev-ON01_152.pdf

Provincie Flevoland (2023). *Wind, Toekomstbeeld 2030.* Retrieved April, 2025 from https://www.flevoland.nl/wat-doen-we/energie/wind

Provincie Flevoland (2025). *Visie op landbouw.* Retrieved April, 2025 from https://www.flevoland.nl/dossiers/visie-op-de-landbouw

Provincie Flevoland, zes Flevolandse gemeenten & Waterschap Zuiderzeeland (2023, December 6). *Bouwen aan de samenleving, ruimtelijk voorstel Flevoland 2050.* Retrieved from https://www.commissiemer.nl/projectdocumenten/014205_3826_DOCUVITP-3201790-v4-Eindversie_Ruimtelijk_Voorstel_Flevoland_pdf.pdf

Rawls, J. (1971). *A theory of justice.* Harvard University Press. https://doi.org/10.4159/9780674042605

RIVM. (2024). *Nederland; toestand (2020-2023) en trend (1992-2023)* (RIVM-rapport 2024-0113). RIVM. https://www.rivm.nl/bibliotheek/rapporten/2024-0113.pdf

Ritchie, H. (2020). *Very little of global food is transported by air; this greatly reduces the climate benefits of eating local.* Our World in Data. Retrieved from https://ourworldindata.org/food-transport-by-mode

Saha, P., Akash, F. A., Shovon, S. M., Monir, M. U., Ahmed, M. T., Khan, M. F. H., Sarkar, S.M., Islam, K., Hasan, M., Vo, D.N., Aziz, A.A., Hossain, J. & Akter, R. (2024). Grey, blue, and green hydrogen: A comprehensive review of production methods and prospects for zero-emission energy. *International Journal of Green Energy, 21*(6), 1383-1397. https://doi.org/10.1080/15435075.2023.2244583

Shah, K. K., Modi, B., Pandey, H. P., Subedi, A., Aryal, G., Pandey, M., & Shrestha, J. (2021). Diversified Crop rotation: An approach for sustainable agriculture production. *Advances in Agriculture, 2021*, 1–9. https://doi.org/10.1155/2021/8924087

Siegmann, A. (2024). The farmers' revolt in the Netherlands: Causes and consequences. *European View, 23*(2), 156–166. https://doi.org/10.1177/17816858241288396

Staatsbosbeheer (2022). *Rijk voorland.* Retrieved April, 2025 from https://www.staatsbosbeheer.nl/-/media/14-over-staatsbosbeheer/rijk-voorland-groene-visie-flevoland.pdf

Staps, J.J.M., Ter Berg, C., Van Vilsteren, A., Lammerts van Bueren, E. & Jetten T.H. (2015). *Van bodemdilemma's naar integrale verduurzaming: casus 'Vruchtbaar Flevoland': van bodemdegradatie en diepploegen naar integrale duurzame productie in Flevoland.* Wetenschappelijke Raad voor Integrale Duurzame Landbouw en Voeding. https://www.ridlv.nl/sites/default/files/RIDLV%20rapport%20bodemcasus.pdf.

Stichting Demeter (n.d. a). *Landbouw van de toekomst.* Retrieved April, 2025 from https://stichtingdemeter.nl/biodynamisch/landbouw-van-de-toekomst/

Stichting Demeter (n.d. b). *Geschiedenis - 100 jaar landbouw van de toekomst.* Retrieved April, 2025 from https://stichtingdemeter.nl/over-ons/geschiedenis/

Stichting Demeter (n.d. c). *Principes van Biodynamisch landbouw.* Retrieved April, 2025 from https://stichtingdemeter.nl/over-ons/12-voordelen-biodynamische-landbouw/

Stichting LISA (2024, V5). *LISA Dutch Company Data.* DANS Data Station Social Sciences and Humanities https://doi.org/10.17026/SS/AQNXQ9

STRATEGY (2023). *Strategy Energierapportage Mei 2023.* Retrieved from https://www.stratergy.nl/post/negatieve-energie

Sundstrom, S. M., & Allen, C. R. (2019). The adaptive cycle: More than a metaphor. *Ecological Complexity, 39*, 100767. https://doi.org/10.1016/j.ecocom.2019.100767

Transport & Environment (2020, December 7). *Electrofuels? Yes, we can… if we're efficient.* Retrieved March, 2025 from https://www.transportenvironment.org/articles/electrofuels-yes-we-can-if-were-efficient

Tripathi, S., Srivastava, P., Devi, R. S., & Bhadouria, R. (2020). Influence of synthetic fertilizers and pesticides on soil health and soil microbiology. In M.N.V. Prasad (Ed.) *Agrochemicals, Detection, Treatment and Radiation* (pp. 25–54). Elsevier. https://doi.org/10.1016/b978-0-08-103017-2.00002-7c

Van Der Ploeg, J. D. (2020). Farmers' upheaval, climate crisis and populism. *The Journal of Peasant Studies, 47*(3), 589–605. https://doi.org/10.1080/03066150.2020.1725490

Van der Roest, E., Bol, R., Fens, T., & Van Wijk, A. (2023). Utilisation of waste heat from PEM electrolysers – Unlocking local optimisation. *International Journal of Hydrogen Energy, 48*(72), 27872–27891. https://doi.org/10.1016/j.ijhydene.2023.03.374

Van Galen, M., Baltussen, W., Gardebroek, K., Herceglic, N., Hoste, R., Ihle, R., Jager, J., Janssens, B., Jukema, G., Kornelis, M., Logatcheva, K., Oosterkamp, E., Roskam, J., Silvis, H., & Stokkers, R. (2020). *Agro-Nutri Monitor 2020: Monitor prijsvorming voedingsmiddelen en analyse belemmeringen voor verduurzaming.* (Economic Research Rapport 2020-014) Wageningen Economic Research https://doi.org/10.18174/528928

Vecchio, R. (2009). European and United States farmers' markets: Similarities, differences and potential developments. *Paper prepared for presentation at the 113th EAAE seminar.* Retrieved from https://ageconsearch.umn.edu/record/58131/

Viljoen, A., & Bohn, K. (2009). Continuous Productive Urban Landscape (CPUL): essential infrastructure and edible ornament. *Open House International, 34*(2), 50–60. https://doi.org/10.1108/ohi-02-2009-b0006

Visit Flevoland (2025). *History.* Retrieved April, 2025 from https://www.visitflevoland.nl/en/we/history

Voglhuber-Slavinsky, A., Derler, H., Moller, B., Dönitz, E., Bahrs, E., & Berner, S. (2021). Measures to Increase Local Food Supply in the Context of European Framework Scenarios for the Agri-Food Sector. *Sustainability, 13*(18), 10019. https://doi.org/10.3390/su131810019

Wandl, A. (2019). Territories -in- between: A Cross-case Comparison of Dispersed Urban Development in Europe. *A+BE | Architecture and the Built Environment, 10*(02), 1–392. https://doi.org/10.7480/abe.2019.14.4340

IMAGE REFERENCES

Figure 1.6
MaatschapWij. (n.d.). Lokaal én gifvrij: doe je boodschappen bij deze natuurboerderijen [Photograph]. Retrieved March, 2025 from https://maatschapwij.nu/vitaal/eet-lokaal-gifvrij-voedsel-natuurboerderijen/

Michielverbeek. (2014). Almere, skyline and Weerwater [Photograph]. Retrieved March, 2025 from https://nl.wikipedia.org/wiki/Bestand:Almere,_skyline_met_het_Weerwater_foto5_2014-03-09_16.08.jpg

Sigrid. (2020). Biodynamisch boer Tom Saat tegenover CBL directeur over voedselprijs [Photograph]. Retrieved March, 2025 from https://www.livegreenmagazine.nl/biodynamisch-boer-tom-saat-tegenover-cbl-directeur-over-voedselprijs/

VADER Magazine. (n.d.). Eten met het hele gezin: dit zijn de voordelen [Photograph]. Retrieved March, 2025 from https://vadermagazine.nl/blog/eten-met-het-hele-gezin-voordelen/

Figure 1.7
Center for Health and Longevity. (n.d.). Imperfect Produce and the Movement Against Senseless Food Waste [Photograph]. Retrieved March, 2025 from https://smchl.com/imperfect-produce-and-the-movement-against-senseless-food-waste/

Praxis. (n.d.). Engels groene afvalcontainer – 120 liter, HDPE kunststof [Photograph]. Retrieved March, 2025 from https://www.praxis.nl/onderhoud-schoonmaak/vuilnis-afvalbakken/prullenbakken/kleine-afvalcontainers/engels-groene-afvalcontainer-120-liter-hdpe-kunststof/10049373

Figure 2.2 (from lef to right)
[Illustration of Zuiderzeevereniging] (n.d.). Retrieved April, 2025 from https://marismits.nl/?p=321

Beekman, A.A. & Zuiderzeevereniging, (1890-1900). Plan van Afsluiting en droogmaking der Zuiderzee [Poster]. Retrieved from April, 2025 https://geheugen.delpher.nl/nl/geheugen/view/plan-afsluiting-droogmaking-zuiderzee-zuiderzeevereniging?coll=ngvn&maxperpage=36&page=1&query=beekman+lely&identifier=ZZM01%3A022207

Haverman, H.J., (1899). Portret van Cornelis Lely [Drawing]. Retrieved April, 2025 from https://geheugen.delpher.nl/nl/geheugen/view/portret-cornelis-lely-haverman-hendrik-johannes?coll=ngvn&maxperpage=36&page=1&query=cornelis+lely&identifier=WITS01%3A110971

Geurts, A., (n.d.). Plan-Lely: de acht Technische Nota's [Photograph]. Retrieved April, 2025 from https://genootschapflevo.nl/media/100_jaar_zuiderzeewet_artikel_2_(definitief).pdf

[Map of plan for potential land reclamation from the Zuiderzee], (1900-1901). Retrieved April, 2025 from https://boudewijnhuijgens.getarchive.net/amp/media/kaarten-sgd-ontwerp-voor-de-afsluiting-en-gedeeltelijke-droogmaking-der-zuider-bf3108

Waterlands Archief (1916). Watersnoodramp 1916 [Photograph]. Retrieved April, 2025 from https://waterlandsarchief.nl/archieven?mizig=279&miadt=131&miaet=14&micode=BEELDBANK&minr=5588647&miview=ldt

Ramaer, J.C. & Wortman, H., (1916). Verslag over den stormvloed van 13/14 januari 1916 [Map]. Retrieved April, 2025 from https://resolver.tudelft.nl/uuid:3ff3fdab-003b-477e-bad3-2d89361420d3

Staatsblad van het Koninkrijk der Nederlanden, (1918). Zuiderzeewet [Newspaper]. Retrieved April, 2025 from https://www.demeerpeen.nl/nieuws/lokaal-nieuws/100-jaar-zuiderzeewet-deel-1-van-zuiderzee-naar-ijsselmeer-2-2/

[Photographs of the construction of the Afsluitdijk], (n.d.) Retrieved April, 2025 from https://deafsluitdijk.nl/historie/

[Photograph of reclamation Wieringermeer], (1930). Retrieved April, 2025 from https://www.regionaalarchiefalkmaar.nl/collecties/beelden/beelden-2/detail/6cde66d2-48b0-a238-1dec-983ad65c236c/media/647eb2ed-8f7e-86ce-aba7-197428dea711?mode=detail&view=horizontal&q=1516_0028_0011&rows=1&page=1

[Blueprint of Noordoostpolder], (n.d.). Retrieved April, 2025 from https://www.visitnoordoostpolder.nl/nl/ontdek/watererfgoed#:~:text=Op%20de%20bodem%20van%20de,viel%20de%20Noordoostpolder%20officieel%20droog

NOS, (n.d.). De nieuwe bewoners van de Noordoostpolder [Photograph]. Retrieved April, 2025 from https://nos.nl/op3/artikel/2236403-100-jaar-zuiderzeewet-zo-werd-nederland-een-stuk-groter

Fotocollectie Nieuw Land & Boekhoven, B. (1966-1967). Plaatsing van een bord met het opschrift 'Lelystad' om de plek aan te geven waar de polderhoofdstad zal verrijzen, 1966/1967 [Photograph]. Retrieved April, 2025 from https://www.flevolandsgeheugen.nl/page/2374/plaatsing-van-een-bord-met-het-opschrift-lelystad-om-de-plek-aan-te-geven-waar

De Nijs, J., (1968). Persexcursie Zuidelijk Flevoland, nummer 12 baggermolens Zuidelijk Flevopolder [Photograph]. Retrieved April, 2025 from https://www.nationaalarchief.nl/onderzoeken/fotocollectie/ab35d3d4-d0b4-102d-bcf8-003048976d84?searchKey=5c1ebe3773b9cc896df62cafd902fe07

Directie van de Wieringermeer (Noordoostpolderwerken), Landbouwkundige Afdeling, (1975). Verkavelingsplan Oostelijk en Zuidelijk Flevoland [Map]. Retrieved April, 2025 from https://www.hetflevolandsarchief.nl/collectie?%20mizk_alle=&mivast=35&mizig=408&miadt=35&miview=gal1&milang=nl&misort =nr%7Cdesc&mistart=36&mif1=58&mif3=true

Figure 2.11
Google Earth. (2025). Flevoland, Netherlands [Satellite Imagery]. Google. https://earth.google.com/web/search/flevoland/@52.44370969,5.68287046,-10.69562104a,80662.73320969d,35y,359.99960635h,0t,0r/data= CiwiJgokCWGTMihXOUpAEQfBO7GgLUpAGcTs0fZXARZAIQ2jGT8WUxVAQgIIAToDCgEwQgIIAEoNCP___________wEQAA

Figure 2.12
Maak Oosterwold (n.d.). Aerial photo of Oosterwold [Photograph]. Retrieved April, 2025 from https://maakoosterwold.nl/kavels-in-oosterwold/

Figure 2.13
Branzi, A., Donegani, D., Petrillo, A., Raimondo, C. & David, T.B. (1995). Photograph of the physical model [Photograph]. Retrieved April, 2025 from https://www.andreabranzi.it/portfolio/agronica/

Figure 2.14
Weidemann, S. (n.d.). Photograph of the physical model taken from above [Photograph]. Retrieved April, 2025 from https://franklloydwright.org/reading-broadacre/

Figure 7.1
UN Global Compact Network Netherlands. (2015). Sustainable Development Goals [Image]. Retrieved April, 2025 from https://www.unglobalcompact.nl/sustainable-development-goals

Icons and images used throughout the resport were retrieved and adapted from:

The Noun Project (n.d.). Various icons. Retrieved throughout February, March and April, 2025 from https://thenounproject.com/

Freepik (n.d.). Various media. Retrieved throughout February, Marcha and April, 2025 from https://www.freepik.com/

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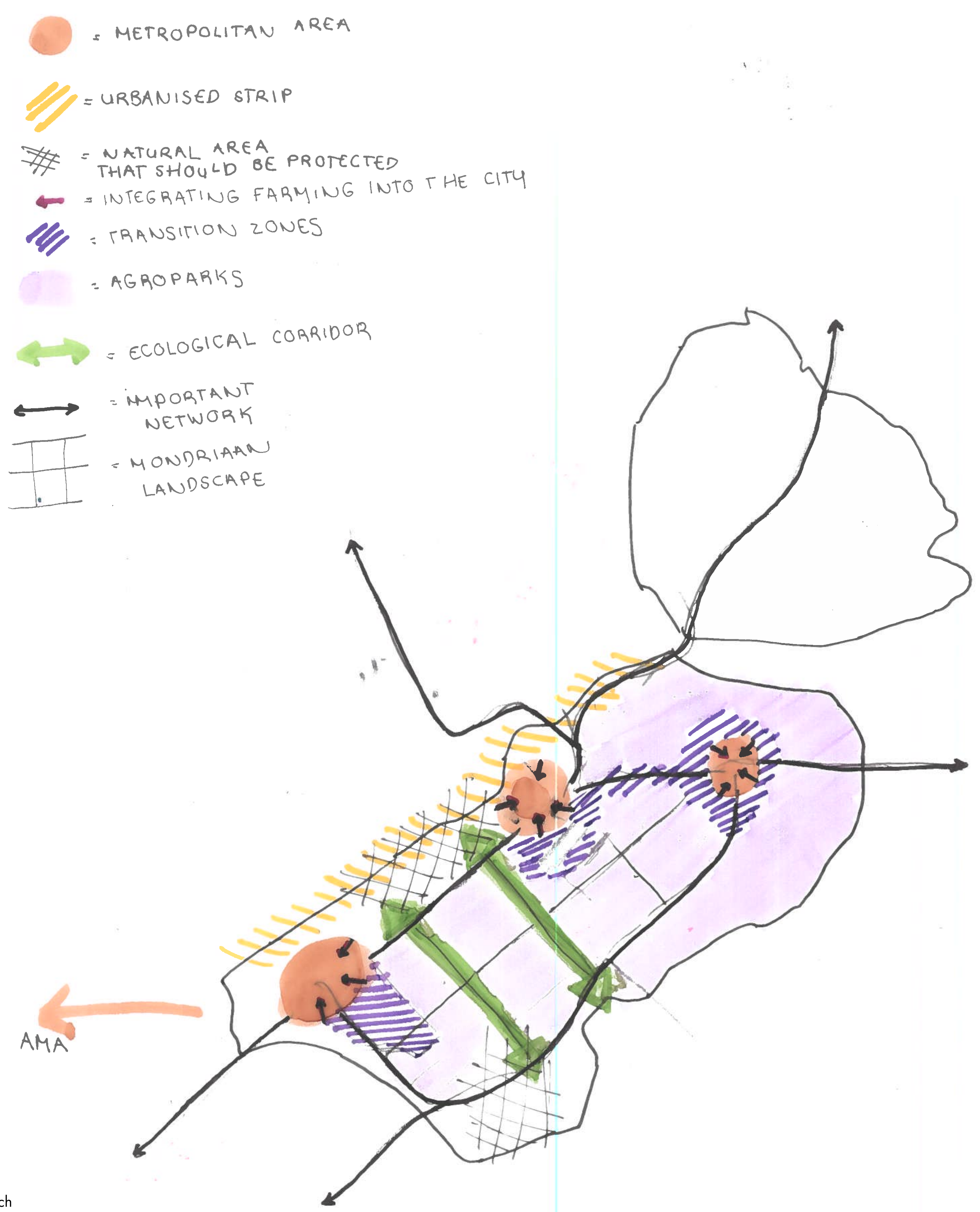
APPENDIX

APPENDIX A

Stakeholder profiling

Stakeholders	Interests	Problem Perception	Attitude	Power	Resources	What to do
(1) Biodynamic Farmers	BD-Farmers would like for these green and healthy ways of farming to be the norm	(our vision is based on them.) Regarding the energy transition, they would like to see change and their way of farming is already in line with the energy transition.	positive	They have less power as they are a smaller group. Compared to the other stakeholders they have less influence. However, due to their nature, they have a good foot to stand on.	Evidence that it is a better way of farming. (Knowledge) They can influence or inspire people to make the right choices.	Empower
(2) Conventional Farmers	The conventional farmers want to be able to continue in their profession. They would also prefer to get a fair price for their produce.	The shift towards a biodynamic system requires structural changes in the current farming practices, something which will be very inconvenient for the conventional farmer. However, they could be slightly persuaded by the fair price for produce.	negative	They have both blocking and production power. Conventional farmers own most of the agricultural lands and decide what happens on those lands. They hold the key in this transition.	Financial incentives will be the main motivator for conventional farmers. The structural change that is being asked of them also needs to work in their interests.	Mindset change and Adapt
(3) Municipality	The municipality should represent it's inhabitants and has the responisibility to care for those most vulnerable. Food poverty should be a large concern for them.	The municipality consists of multiple parties. Like many other governmental bodies, there is not one perception towards the problem. Many different opinions will need to be considered.	fence-sitter	The municipality has the power to change the zoning-plan. This will play a large role in the development of the transition zones, which are an integral part of the vision.	The main resource of the municipality is their power. They have the ability to change regional plans and laws.	
(4) Supermarket	highest profit and lowest cost on products	Supermarkets are profit-driven and therefore do not necessarily care about sustainability or affordable healthy food.	negative: non-biodynamic food is cheaper and sells better.	blocking power: supermarkets hold a lot of power. However, as long as there are no rules about prices, supermarkets are driven by profit and the demands of consumers (who prefer cheap and 'easy' food) which conflicts the vision of only biodynamic food	finance, linking producers and consumers	Adapt (to the new proposed consumption)
(5) Planet	For natural and ecological processes to not be hampered. Room for water and nature.	Intensive agriculture may change soil fertility; use a lot more water; cows may emit more nitrogen	Positive: There is room for nature and water channeling. Negative: What if the number of cows increases and subsidence increases?	Production Power: Providing room for agriculture and energy transition through wind turbines placation and solar panel farms. Blocking Power: Flooding	Influence agricultural practices and enery infrastructure	Empower
(6) Consumers	Affordable and healthy food Easily accessible	They want to eat healthy food but often times this type of more biologically produced food is also a lot more expensive (and therefore not very accessible). Furthermore, many consumers have consumption patterns that are not very sustainable and are in conflict with the biodynamic farming. The, for instance, expect exotic vegetables and fruits the whole year around.	Fencesitter: they will likely transition towards buying food produced on biodynamic farms when they are considered to be affordable.	Production power: they can facilitate the growth of biodynamic farms by buying their products. Blocking power: if the goods are not bought, there is no incentive for biodynamic farmers to produce. This could lead to more exporting of the produce.	Power to decide what goods they buy or not buy.	Inform and need to Adapt
(7) Renewable Energy Companies	They are looking to expand their business across scales and consumer types.	They require quite a bit of space to achieve the same efficiency. Currently, they only work with small-scale farmers. The natural gas companies still avail subsidies which is slightly hampering the expansion of the renewable energy companies.	Positive: In favour of the energy transition.	Production Power: Ability to cater to the needs of the farms and other agencies in the food system.	Knowledge and ability to facilitate. They have some power in influencing and mobilising governing agencies and business to switch to renewable energy sources.	Adapt (to the new proposed consumption)
(8) Inhabitants of the Region	A nice place to live, build a home and a community.	They are mostly affected by the spatial aspect of our vision.	Fence-sitters: some might be opposed to our vision (nimby) others might have a more positive attitude as they might agree with our reasoning.	Production & Blocking Power: if enough people want something, they have the power to propose changes or stop something from happening.	Voice. Inhabitants can use their voice to bring up concerns, objections or new ideas. Regardless of their stance, their input must always be considered when making a plan.	Inform and Participate
(9) Conventional Energy Companies	Want to sell their energy. They also want to excist in the long-term, so they might feel the urge to also be part of the transition.	The subsidies for natural gas use still excist. This makes natural gas use still quite attractive. Therefore, unclean energy is still a large part of our society.	Negative: if they are replaced by more clean energy alternatives.	Blocking: as long as unclean energy is financially attractive, people and companies will remain using it.	Lobbying power, influencing rules and regulations.	Adapt to new sources
(10) Export agencies	increase export	The vision for a short-supply chain and focus on regional food production system will decrease export.	negative	blocking power; they could make it more interesting for farmers to export their products	link to international trade	Effected

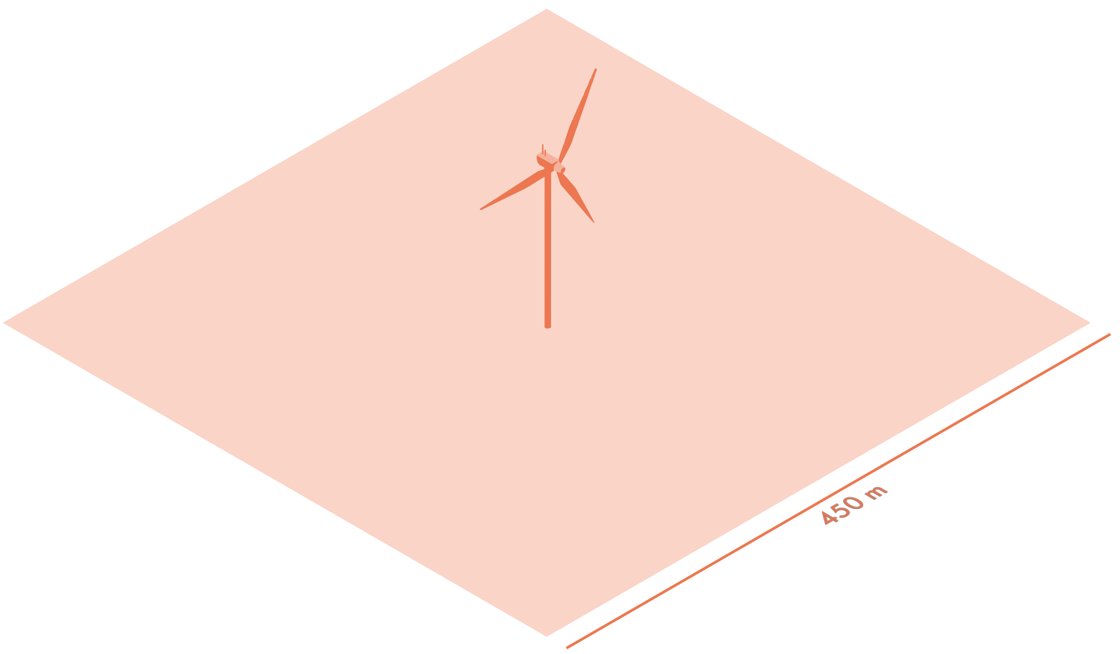


Draft Vision Plan Sketch

APPENDIX B

Calculations of spatial consequences of hydrogen storage.

total amount of windturbines in Flevoland:	689
total capacity:	1.992 MW
$\frac{1.992}{689}$	= 2,891 MW per windturbine
	= 2.891 kWh/h
hours with negative energy prices (2029):	1.500
2.891 x 1.500	= 4.336.720 kWh/y
spatial impact:	202.500 m^2
$\frac{4.336.720}{202.500}$	= **21,4 kWh/m^2**
efficiency electroliser:	76%
4.336.720 x 0,76	= 3.295.907 kWh/y
energy density of hydrogen:	33,33 kWh/kg
density of hydrogen at 700 bar:	40 kg/m^3
33,33 x 40	= 1333 kWh/m^3
$\frac{3.295.907}{1333}$	= **2.473 m^3 per windturbine**



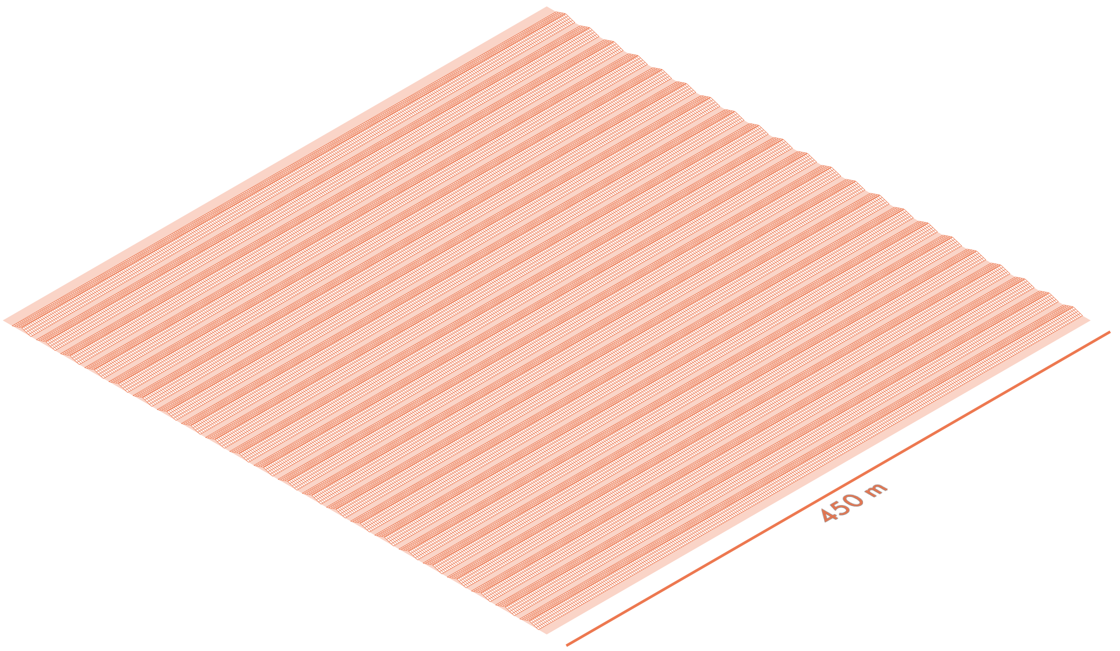
energy loss per year

21,4 kWh/m^2

necessary storage

2.473 m^3

total amount of solar panels in Flevoland:	80.486
total capacity:	1.263.114 kWp
$\frac{1.263.114}{80.486}$	= 15,693 kWp per solar panel
	= 15.693 kWh/y
$\frac{15.693}{8.766}$	= 1,79 kWh/h
hours with negative energy prices (2029):	1.500
1,79 x 1.500	= 2.685 kWh/y
density solar panels in solar park Zuyderzon:	0,395 solar panel/m^2
spatial impact:	202.500 m^2
potential amount of solar panels:	= 80.000
80.000 x 2.685	= 214.800.000 kWh/y
$\frac{214.800.000}{202.500}$	= **1.060,7 kWh/m^2**
efficiency electroliser:	76%
2.685 x 0,76	= 2.041 kWh/y
energy density of hydrogen:	33,33 kWh/kg
density of hydrogen at 700 bar:	40 kg/m^3
33,33 x 40	= 1.333 kWh/m^3
$\frac{2.041}{1.333}$	= **1,6 m^3 per solar panel**
1,6 x 80.000	= **128.000 m^3**

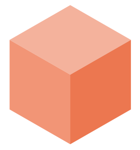


energy loss per year

1.060,7 kWh/m^2

necessary storage

128.000 m^3



Data from: CBS (2024b); CBS (2025); Andersson and Grönkvist (2019); HVC (n.d.)

APPENDIX C

Estimation of share of biological products that remain in The Netherlands.

Tabel 7 *Inschatting van het aandeel biologisch product dat in Nederland blijft*

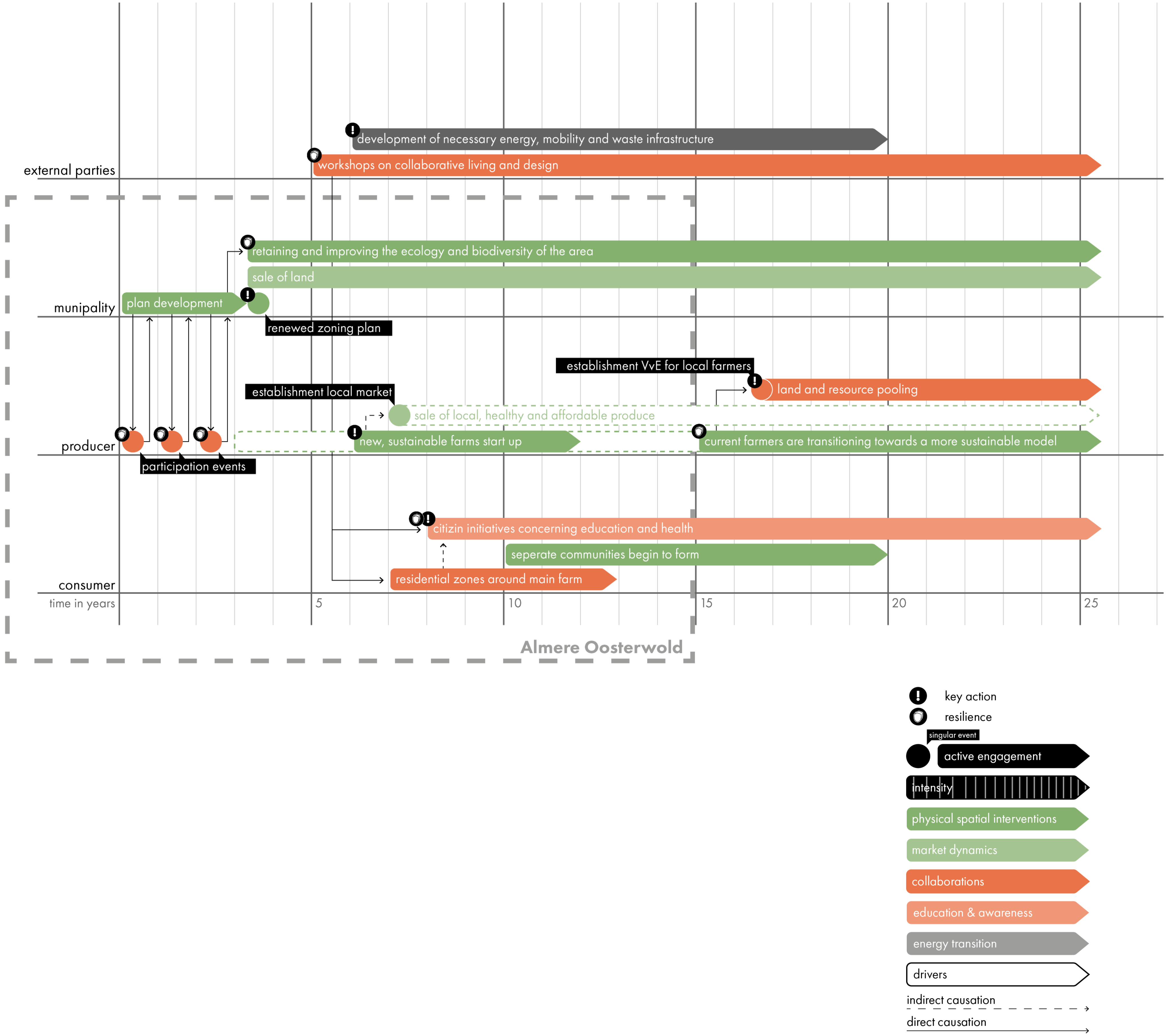
Gewas	Productie in Flevoland (1.000 ton)	Aandeel dat in Nederland blijft (%)
Pootaardappelen	12,5	70
Consumptie aardappelen	34,5	50
Winterpeen	61	20
Uien	52	30
Pompoen	4.5	25
Bloemkool en broccoli	14	30
Sluitkool	4	50
Overige koolsoorten		50
Rode Bieten	16.5	35
Appels en peren		40
Melk en zuivel		90

Bron: Eigen berekeningen en inschattingen op basis van interviews.

Dekking et al. (2020, p. 7)

APPENDIX D

Complete timeline of Oosterwold pilot case.



April 2025