ECOFLOWER TO POWER

Opening up Westland into a resilient energy landscape by transforming Westland's flower industry, using the energy transition as a catalyst

ECO FLOWER

Eco flower to power
09-04-2025

Delft university of Technology
Faculty of Architecture and the Built Environment
MSc Architecture, Urbanism and the Buildings Sciences
Track Urbanism

Authors

Evelien Breit	5309301
Julia van der Velde	5464412
Nikki van der Klaauw	5024109
Pol Bardet	5263344
Shifra van Houwelingen	5463106

Supervisors
AR2UO86 R&D Studio: Spatial Strategies for the Global Metropolis
Ir. Francesca Rizzetto
Dr. Diego Andres Sepulveda Carmona

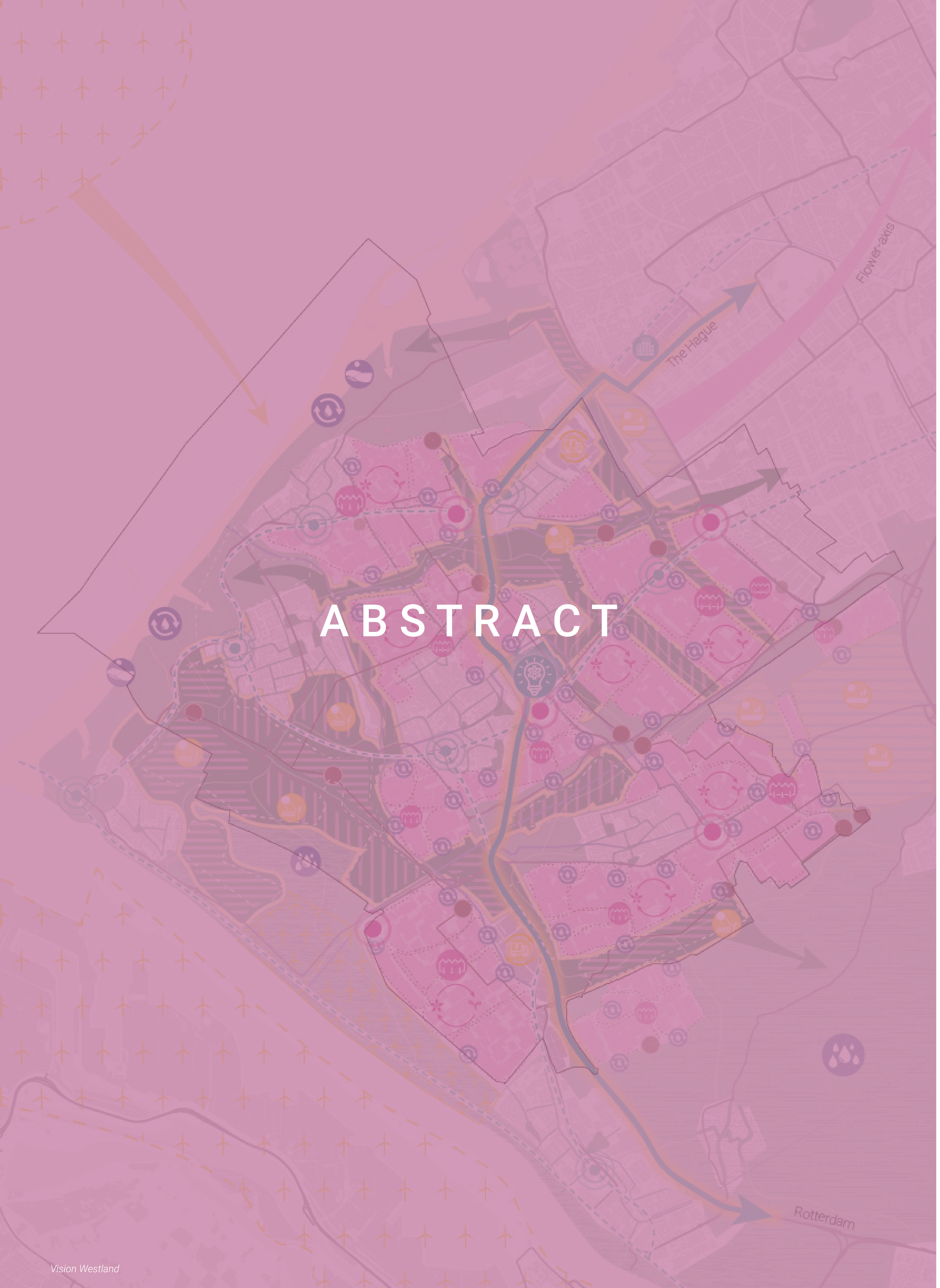
AR2U088 Research and Design Methodology for Urbanism
Roberto Rocco
Juliana Goncalves

Please note: if there is no source listed, we made the figure ourselves.

TU Delft BK Bouwkunde

Opening up Westland into a resilient energy landscape by transforming Westland's flower industry, using the energy transition as a catalyst

TO POWER



ABSTRACT

Vision Westland

Keywords: energy transition, floriculture, greenhouse, Westland, community driven design, organic, regeneration

To meet the United Nations' target of global energy neutrality by 2050, a fundamental shift is needed in how we produce and consume energy (United Nations, n.d.). Though governments currently focus mainly on adapting, while mostly maintaining systems as they currently are, it becomes increasingly more clear that adaptation alone will not suffice. A systemic, structural transformation that redefines systems and industries is needed.
In the Netherlands, the energy transition is stuck, with political and private actors pointing fingers at each other. This is particularly evident in the horticulture sector, where environmental cost and energy consumption have long reached unsustainable levels. Westland, a municipality where nearly a quarter of Dutch horticulture is located, serves as the focal point in this research project. Within this theme, the focus lies on floriculture in particular, as it represents almost half of the greenhouses in Westland.

This project critically examines the current floriculture system and proposes a future-oriented alternative: a vision in which flower and energy production go hand in hand. In collaboration with conventional greenhouse owners and organic farmers, the project explores how these communities can be brought together to form one unified community of fully organic, energy-positive floriculture.
Methods used in this project include literary review, spatial analyses using QGIS and PDOK, interviews, and research by design. The energy transition is used as an opening for reimagining the floriculture landscape.

The analysis reveals three guiding themes: spatial quality, energy landscapes, and organic floriculture. These were linked to overarching goals of decentralisation, integration, identity and spatial and systematic openness. These inform two visions: one for Westland and one for the province of South Holland. A strategy in three phases outlines the implementation of the vision through policy, funding, agreements and key processes.
By 2060, the envisioned future sees Westland as a global pioneer in innovative and regenerative organic floriculture, where sustainability is not just a goal, but a lived reality.

TABLE OF CONTENT

INTRODUCTION

Photo birdsview Westland (Vullings, 2019)

Our task as an urban designer

The vision and strategy for organic floriculture outlined in this report entitled 'From Eco flower to power', are centred on a community-focused energy perspective. The energy transition is a prominent subject in today's world, usually implemented through top-down policies. These policies have led to a hard to parse through system for the affected communities. This report explores how communities affected by the energy transition can be brought into the implementation and evolve into resilient and sustainable pioneers.

The energy transition can be categorised into the following domains: production, distribution, storage, and consumption. This report focuses on the dichotomy between production and consumption. In the contemporary context, the majority of energy production is characterised by substantial complexity and large-scale infrastructure, such as solar parks and (offshore) wind parks. Involving low-power stakeholders into this transition will restructure the socio-economic dynamics of energy production. Energy consumption transitions tend to be placed solely on the shoulders of these low-power stakeholders. Therefore, this report focuses on a community-perspective on the energy transition in relation to production and consumption.

As urban designers, we are responsible for designing the connection between policy and people. This design process needs to be more complex than just aesthetics. It connects stakeholders with innovative strategies through envisioning and strategizing. The act of designing these connections is incredibly delicate. What appear to be insignificant changes on large, regional vision maps can impact people's lives tremendously. It is imperative to design for different sensitive communities, in order to make a design function properly.

This report highlights the connection between policy and spatial interventions. When working with a community's perspective, it is crucial to clearly explain design choices (see chapter 3). Urban designers should demonstrate why change is necessary, and this should be done in an accessible, understandable manner, because it is the community that needs to change with the environment to create a safer future.

Team 6.2

An urgent call for action

This report is based on the urgency of climate change. This global problem affects many people. In order to prevent climate change, the Sustainable Development Goals (SDGs) were signed in 2015 by 193 countries of the United Nations (UN). These sustainability goals have been described as an urgent call for action. A global partnership is required to shape international policy and transform the world into a place with peace and prosperity for people and the planet, both now and into the future (United Nations. n.d.-2).

The present assignment, pertaining to the energy transition, is grounded in the 7th goal, which stipulates the necessity of ensuring reliable, sustainable, and modern energy for all. Achieving this transition is imperative for the adoption of a novel, non-polluting energy system. Achieving this transition necessitates the active involvement of communities (Goal 11). The energy transition can be subdivided into the following categories: production, circulation, storage and consumption. The community (goal 11) can be used to effect changes in production and consumption (goal 12). (United Nations. n.d.-2)

A clash between energy consumption and production

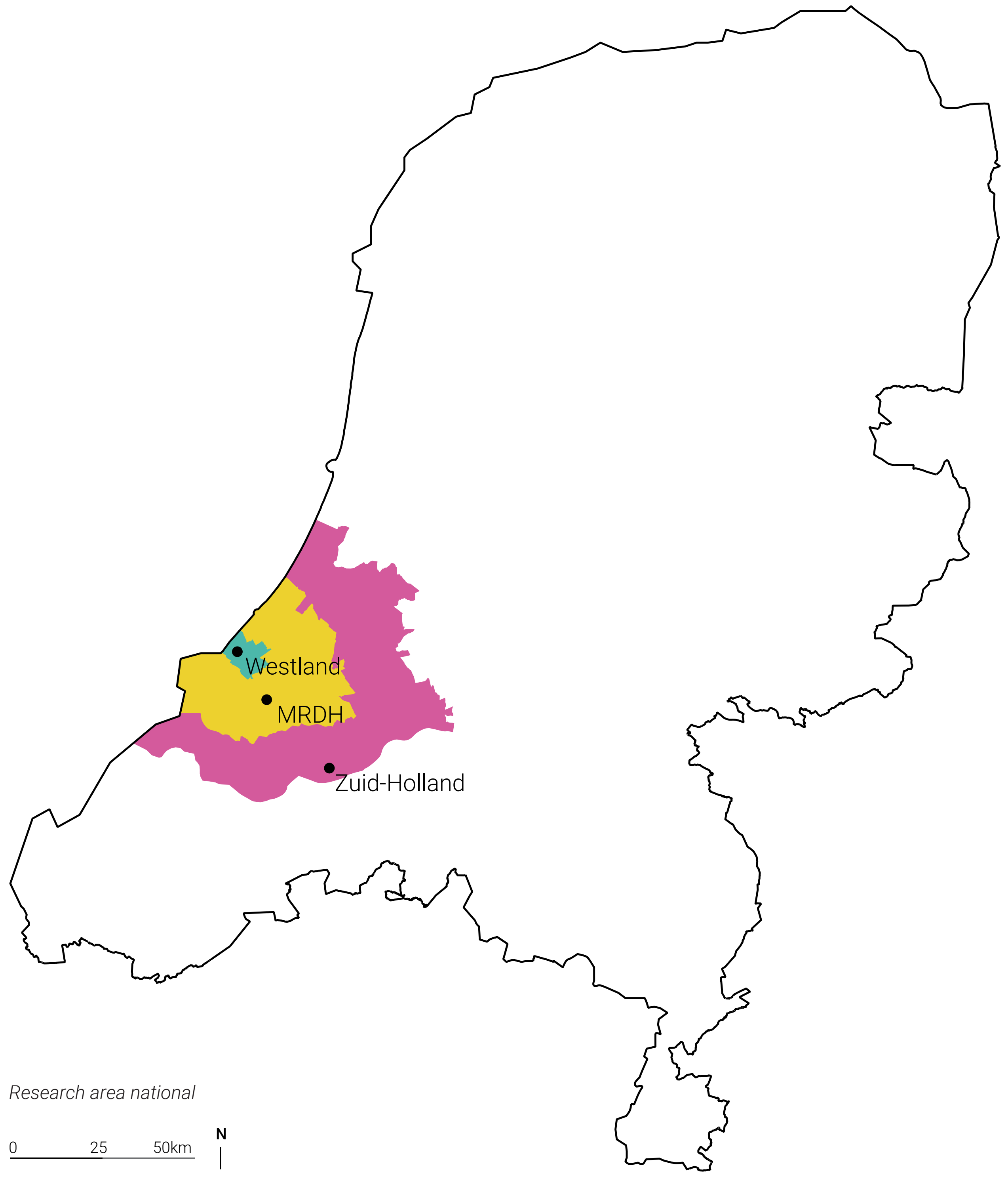
The energy transition is one of the most important spatial challenges of our generation. The Netherlands has benefitted from access to fossil fuels for more than a century. Now, the country and its citizens are experiencing catastrophic consequences in the form of an accelerated climate crisis (Sijmons, 2014). In response to this crisis and following the Paris Agreement (2016), the European Green Deal (2019), and the European Climate Law (2021), which all target climate neutrality by 2050, the Netherlands introduced the National Climate Agreement, or Klimaatakkoord, in 2019 (Rijksoverheid, 2019). The aim of this agreement is climate-neutrality by 2050 at the latest, and a 55% reduction in CO_2 emissions by 2030 compared to 1990 levels (Balz & Katsikis, 2025).

These ambitious agreements call for large-scale spatial restructuring. A region, where the challenge of emissions and climate-neutrality is expressed strongly, is Westland. This municipality is known for its large scale horticulture industry, where energy consumption is excessive. Westland lies north of the port of Rotterdam, an energy producing area with, among other energy sources, five power plants (Port of Rotterdam, 2023). The port is one of the most polluted areas of the Netherlands (NOS, 2022). The Metropolitan region Rotterdam The Hague, surrounding Westland, is one of the most densely populated areas in The Netherlands with nearly 2,4 million people (MRDH, n. d.). These combined factors put a large pressure on the landscape, impacting the environment greatly.

Reshaping Westland, an energy consuming landscape, ties in with Dutch governmental aims of making agriculture climate neutral by 2050 (Balz & Katsikis, 2025). This opens up avenues for reorganising the area spatially and tackling other environmental challenges. This makes Westland an interesting case for this energy-focused project.

(Sustainable Development, n.d.)

In order to establish an environment in which affordable and clean energy are the norm, it is essential to establish sustainable communities as the foundation for a responsible consumption and production system.



Research area national

Research area regional (Google, 2023)

The current political vision on agriculture

The Dutch agricultural, horticultural, and fishing sectors are world leaders. It is the government's ambition to maintain this position, even in 50 years' time. Simultaneously, the country faces numerous major societal challenges. For instance, soil, a crucial resource for agriculture, is at risk of depletion, and biodiversity is concurrently decreasing. The Netherlands has signed into the aforementioned climate agreement. To meet these aims, Carola Schouten, former Minister of Agriculture, Nature and Food Quality pressed for a transition towards circular agriculture by 2030 in 2018. This vision was elaborated upon in the report Agriculture, Nature and Food: valuable and connected (2018). Circular agriculture is to minimise waste and emissions of harmful substances, and to utilise raw materials with minimal losses (Ministry of general affairs, 2018).

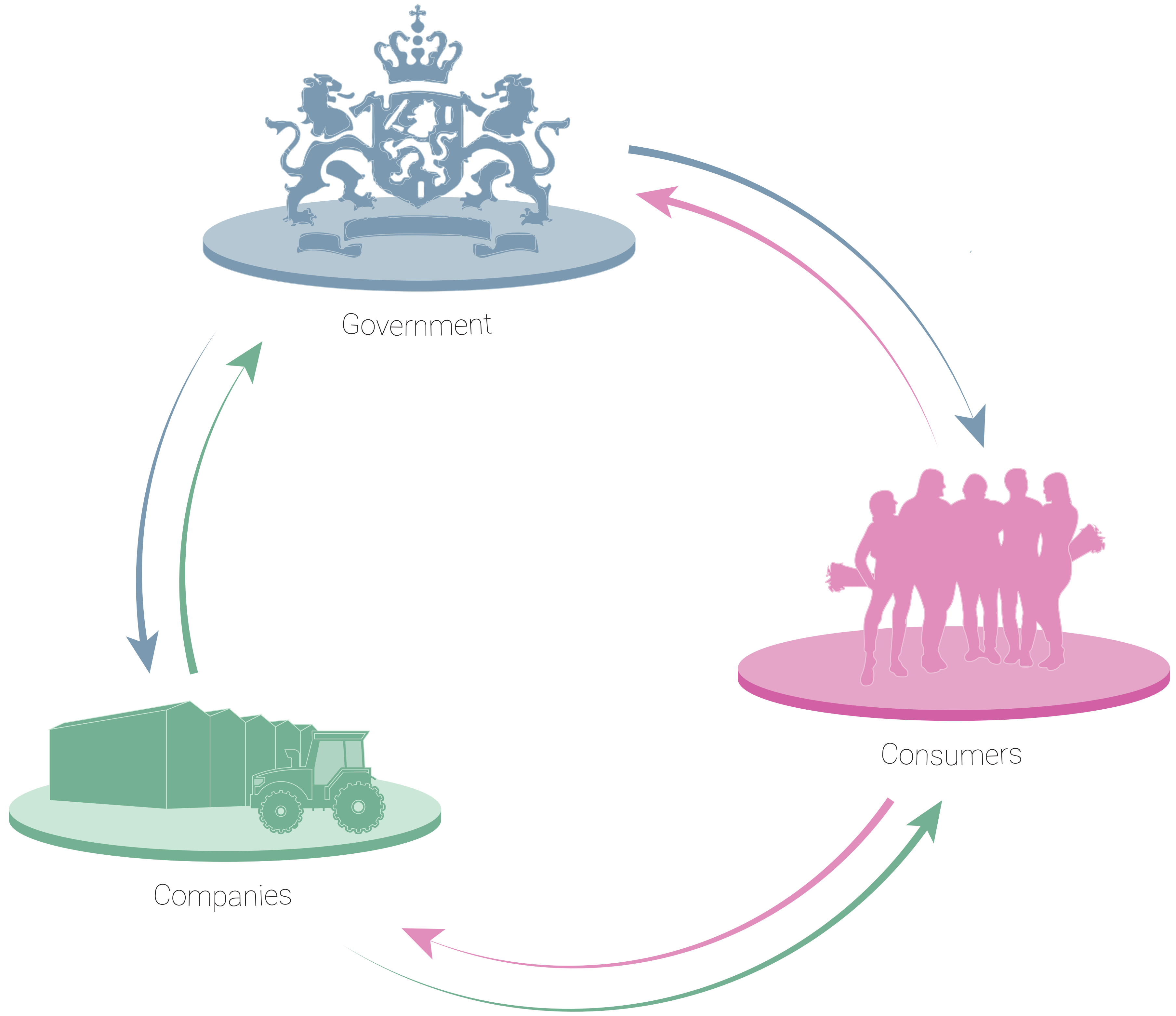
This project explores the imbalance between consumption and production within the agricultural system of the Netherlands. A close analysis of the system reveals a pervasive focus on achieving the lowest possible costs and the highest possible yields. This has resulted in the emergence of a systemic problem. The prevailing paradigm in the Netherlands is based on the pursuit of economic profit. The system exhibits numerous deficiencies, including inefficiencies, waste dumping, among others. The system is often not examined as a whole, as current policies tend to focus on small parts within it.

This approach, which is based on too narrow of a focus, is unsustainable and lacks the necessary resilience to ensure long-term viability. It is imperative to recognise that there is only one Earth, and this alone should make restructuring intensive agriculture an obvious step towards protecting the planet. The current production chains are exerting excessive pressure on the ecosystem regarding biodiversity, air pollution, soil, and water (Ministry of Agriculture, Nature and Food quality, 2018).

Carola Schouten (Van Der Meulen. 2021)

'This has to change. We have to transition away from continuously reducing the cost price of products and transition into circular agriculture, with reduced use of raw materials through more efficient cycles.'

(Ministry of Agriculture, Nature and Food quality, 2018)



The current system is stuck

"Companies think: I can produce something, but people don't want to buy it. Governments think: I can't implement a climate policy, because I don't find any support for it, then I won't be re-elected. Consumers think: I want to, but the government and the business community do nothing,"

- Linda Steg Universiteit Groningen (NOS, 2022)

Fieldtrip in Westland

In the second week of our project, we visited our project. Traveling by car, we stopped at Naaldwijk, the beach near the Maasvlakte and Hoek van Holland.

The transition from one spatial expression to the next was notable and interesting to observe whilst driving through the landscape. From the urban environment of Delft, we transitioned to the expanses of the green Midden-Delfland area, arriving afterwards at a mono-functional greenhouse landscape. An interesting note is that, for most of the journey, the view was limited to roads and greenhouse infrastructure. The polder system, however, remained a constant presence.

When entering Naaldwijk the industrial monotone atmosphere as seen on the road, was replaced by a historic, small-scale village. The absence of greenery remained a factor. Hard borders created a more monotonous experience. Moving towards the coast, the landscape opens up into dunes. From an elevated perspective, the sheer expanse of the greenhouse industry becomes clear. The expansive infrastructure of the port of Rotterdam is also clearly visible from the beach. Offshore wind turbines could be seen on the horizon.

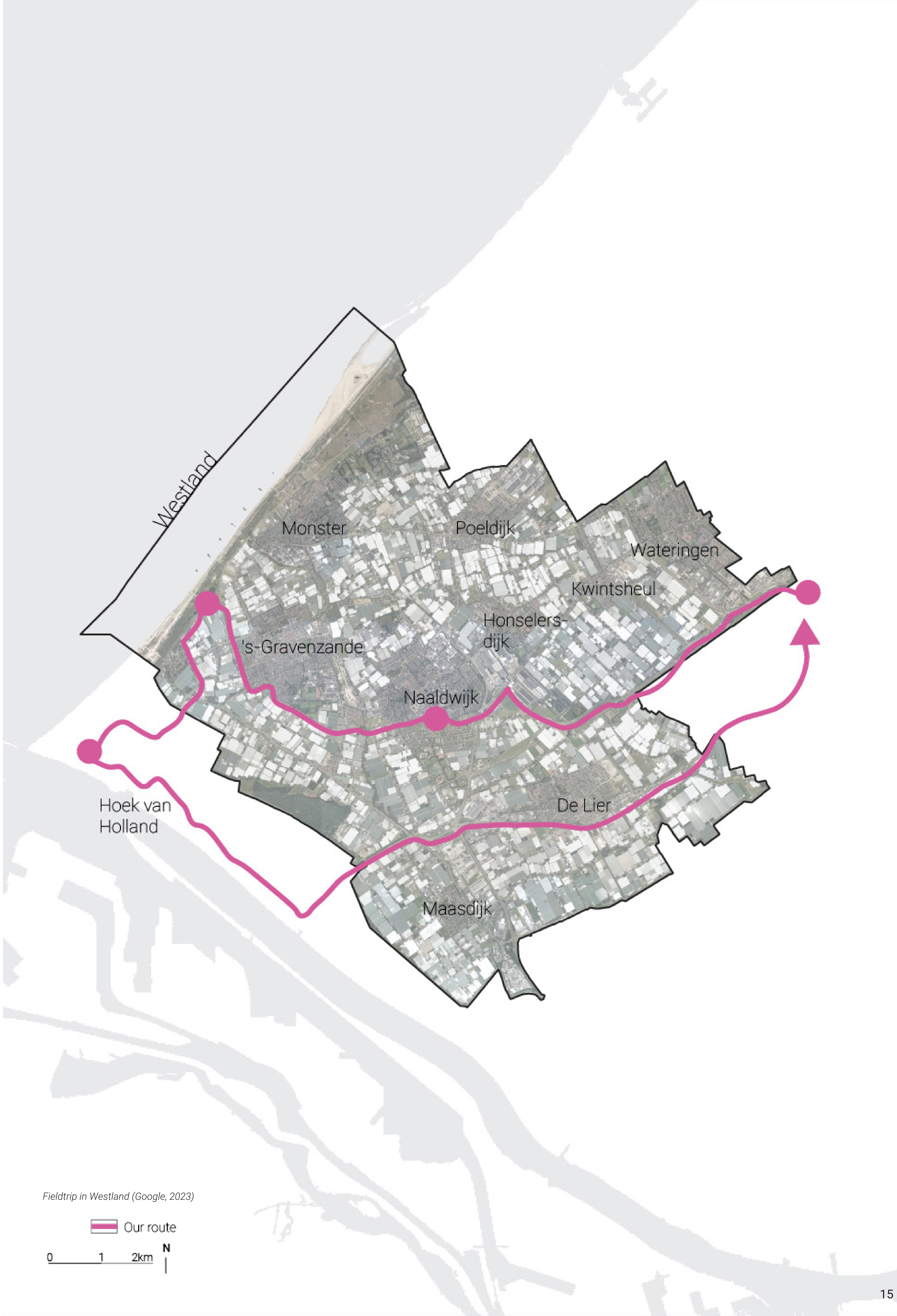
The field trip illustrated how, though the area has different spatial typologies, these typologies do not interact much with each other. This results in monotony. The coast, seas and Rotterdam's industrial skyline serve as a backdrop to the greenhouse infrastructure. The area feels tight and dense, but also gives off the feeling of different monofunctional boats drifting in a sea of greenhouses.


Greenhouses connected to the polder system


Greenhouses and water bassins


Greenhouses and windmills


Te beach with a view on Hoek van Holland

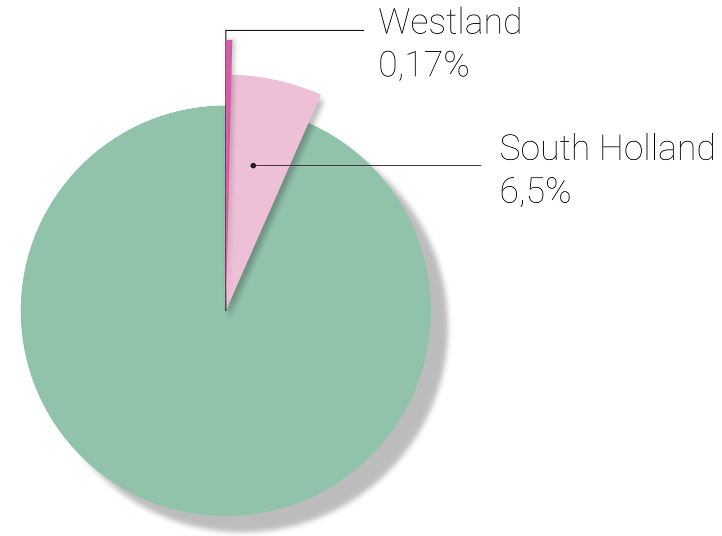


Fieldtrip in Westland (Google, 2023)

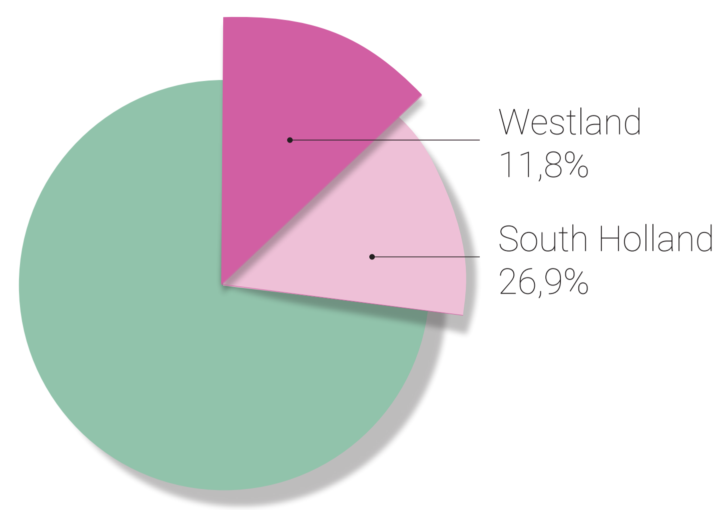
Greenhouses in the Netherlands

The Netherlands is one of the world's largest exporters of flowers, vegetables, and plants. This success is largely driven by its extensive and highly efficient use of greenhouses. Greenhouses allow Dutch farmers to produce crops year-round, independent of the weather. With controlled climates, irrigation, and advanced technologies, the greenhouse sector has become a model of innovation and productivity. These systems maximize output, with a minimal spatial footprint. The country's strong infrastructure and proximity to major European markets make the sector very lucrative.

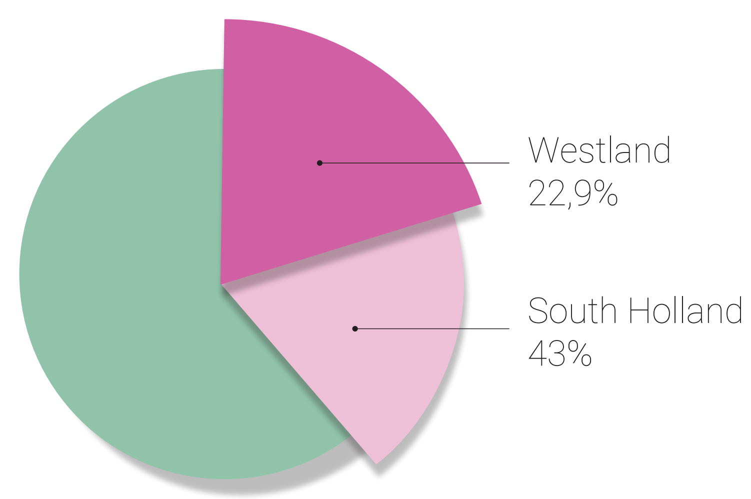
Westland is the most greenhouse-dense region in the Netherlands. Although it covers just 0.2% of the country's total land area, it hosts approximately a quarter of all Dutch greenhouses (CBS Statline, n.d.). The environmental impact of this high-production agricultural system is significant. Horticulture consumes vast amounts of energy, contributing to regional emissions. The province of South Holland, where Westland is located, has the highest agricultural CO_2 emissions in the Netherlands—Westland being one of the main contributors.



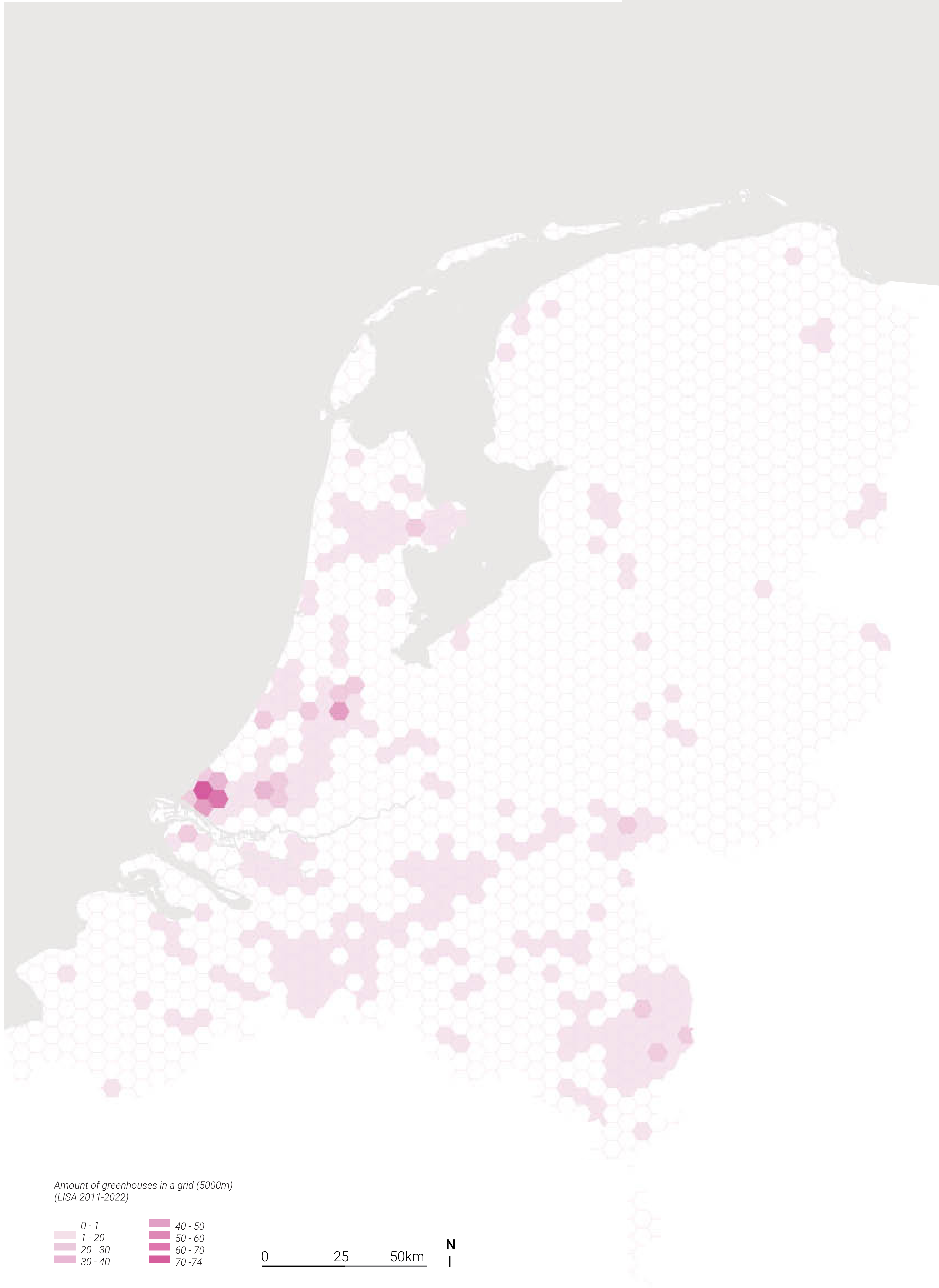
Agricultural area in the Netherlands
Total: 1.169.064.800 m^2
Klimaateffectatlas (2025)



CO_2 emission from electricity in agriculture
Total : 5624,45 Kton
Klimaateffectatlas (2025)

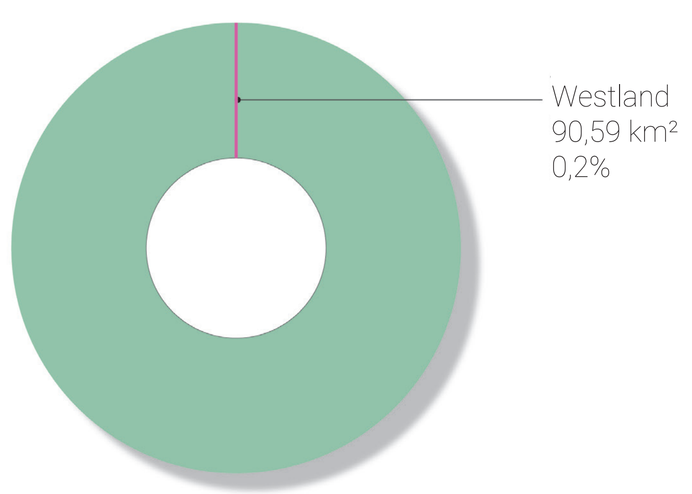


CO_2 emission from gas in agriculture
Total : 1039,45 Kton
Klimaateffectatlas (2025)

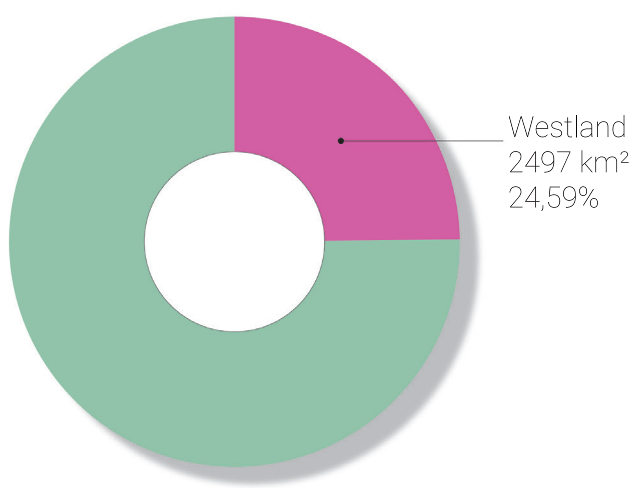


Introduction of Westland

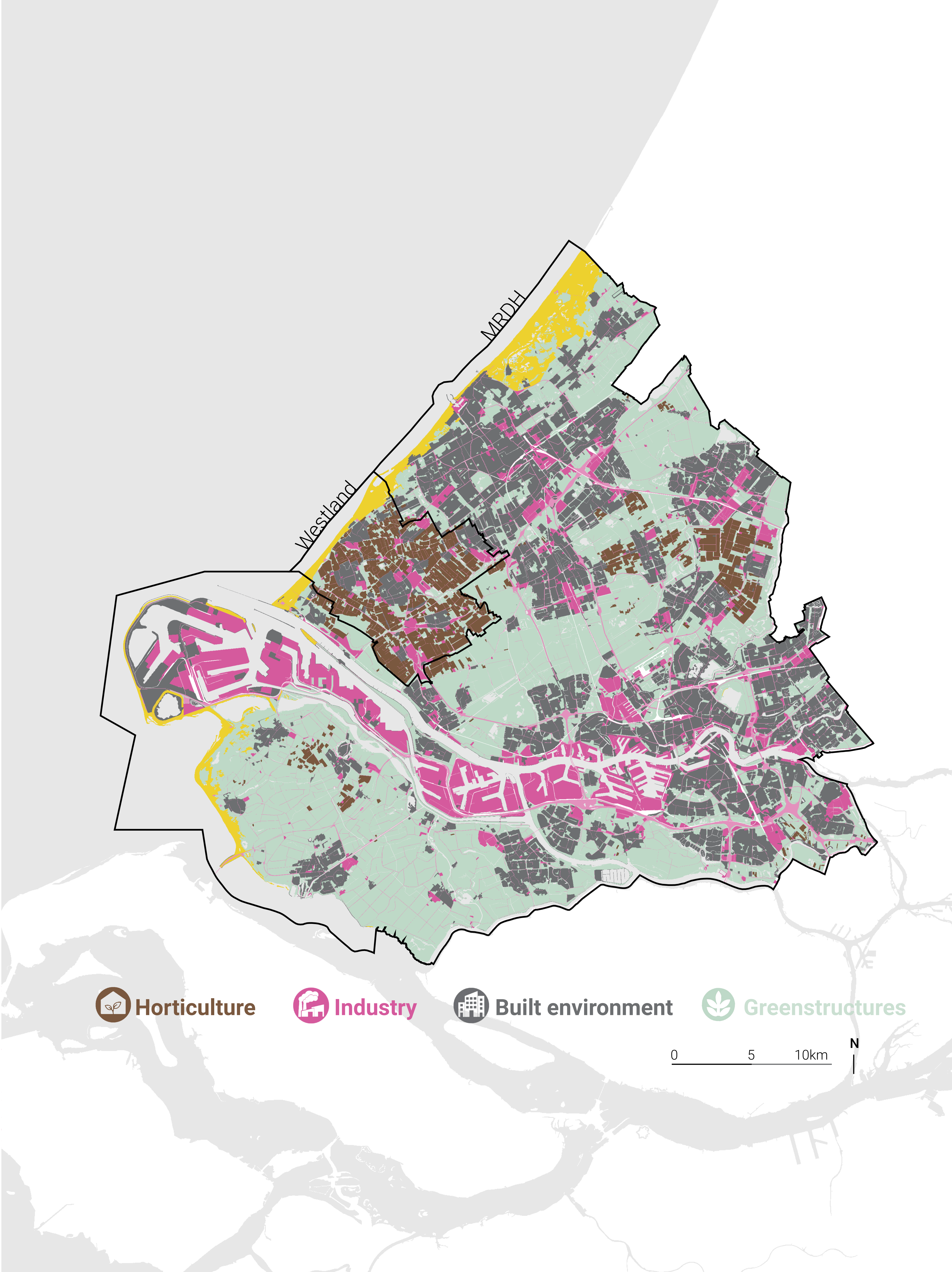
The intensive land use present in Westland places enormous pressure on the landscape. Aside from its agricultural function, the area is also home to over 100.000 residents (Westland in Cijfers - Gemeente Westland, n.d.). This coexistence exists within a relatively small space, creating complex spatial challenges.
The world's largest international floriculture marketplace, both in trade volume and physical size is also located in Westland (Royal FloraHolland, 2025). It serves as an auction for global trade in flowers and plants, reinforcing Westland's position as a key player in the international horticultural economy.
However, this intense level of activity makes the energy transition in Westland a particularly pressing issue. Greenhouse horticulture is an energy-intensive sector, heavily reliant on fossil fuels for heating and electricity. The urgency of transitioning to renewable energy sources—such as geothermal heat, residual heat, or solar power—is widely acknowledged, but implementing these solutions at scale remains a significant and complex task.



Surface area of Westland in NL
Total: 41.553 km²
CBS Statline (n.d.)



Surface area of greenhouses in NL
Total: 10.153 km²
CBS Statline (n.d.)



Spatial lay-out of region Westland (Klimaateffectatlas, 2023)

History of greenhouses in Westland

Westland was once a green dune landscape filled with castle and country estates. These estates often featured large gardens and orangeries—glass structures used to grow exotic plants. However, by the early 19th century, the estates had disappeared, and their lands were divided and sold as agricultural plots (Geschiedenis van Zuid-Holland, n.d.).

As demand for fruit and vegetables grew throughout the 19th century, Westland's horticulturists adapted by improving their soil. They excavated sand from the dry geest soils (ancient beach ridges) and mixed it with clay, creating a fertile subsoil for cultivation (Bezoek Westland, n.d.).

Gardeners were looking for ways to protect their crops. They initially built walls to shield grapevines and fruit trees from the elements. By 1850, they began using loose frames with heavy stained-glass windows to cover vegetable plants. These were soon replaced by lighter glass panels in wooden frames, making the structures more practical (Bezoek Westland, n.d.).

By 1900, Westland had already developed 200 hectares of glass-covered horticulture. The breakthrough came when growers discovered that heating their greenhouses significantly boosted production, allowing them to cultivate a greater variety of crops year-round (Bezoek Westland, n.d.). Several factors contributed to the rapid expansion of greenhouse horticulture specifically in Westland: the moderating influence of the nearby sea, abundant sunlight, proximity to large urban populations, and continuous innovations in greenhouse construction. These advantages helped Westland develop into the world's largest and most concentrated greenhouse horticulture region (Bezoek Westland, n.d.).

During World War II, Westland's greenhouses suffered significant damage, with 1,7 million square meters of horticultural glass being broken or destroyed (Van Doesburg, et al., 1999). In the post-war years, greenhouse farming evolved due to several key factors such as increased market demand and export opportunities, and rising labour costs, prompting the need for efficiency.

Shifts in government policies affected the sector (Berkers, E., & Geels, F. W., 2011). Oil-fired heating was introduced in the early 1950's, replacing coal as a cheaper and more efficient energy source. This extended the growing season, allowing Dutch farmers to compete with those in southern Europe. The adoption of artificial lighting further enabled year-round cultivation (Berkers, E., & Geels, F. W., 2011). In the 1980's artificial light became the widespread norm for flower growing (Van Doesburg, et al., 1999) .

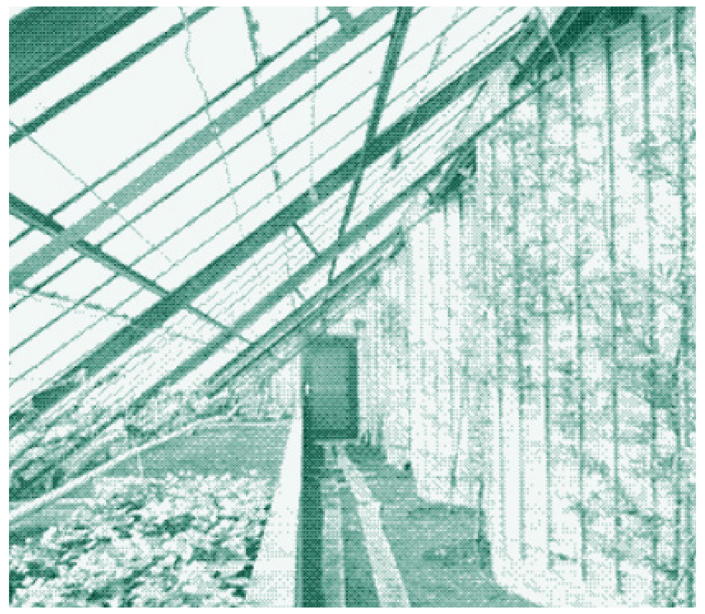
Technological advancements continued to transform the industry. Artificial watering systems significantly reduced manual labour, eliminating the need for watering by hose or bucket. Pipes, chimneys, and larger glass-covered areas also became status symbols, reflecting a grower's success (Berkers, E., & Geels, F. W., 2011).

The horticultural community in Westland developed strong social networks, forming an economic cluster. Farmers established cooperatives to strengthen their bargaining position with consumers. These cooperatives expanded to include interactions with suppliers of seeds, fertilizers, and equipment. The collaborative spirit also fostered a willingness to share knowledge among greenhouse owners (Berkers, E., & Geels, F. W., 2011).

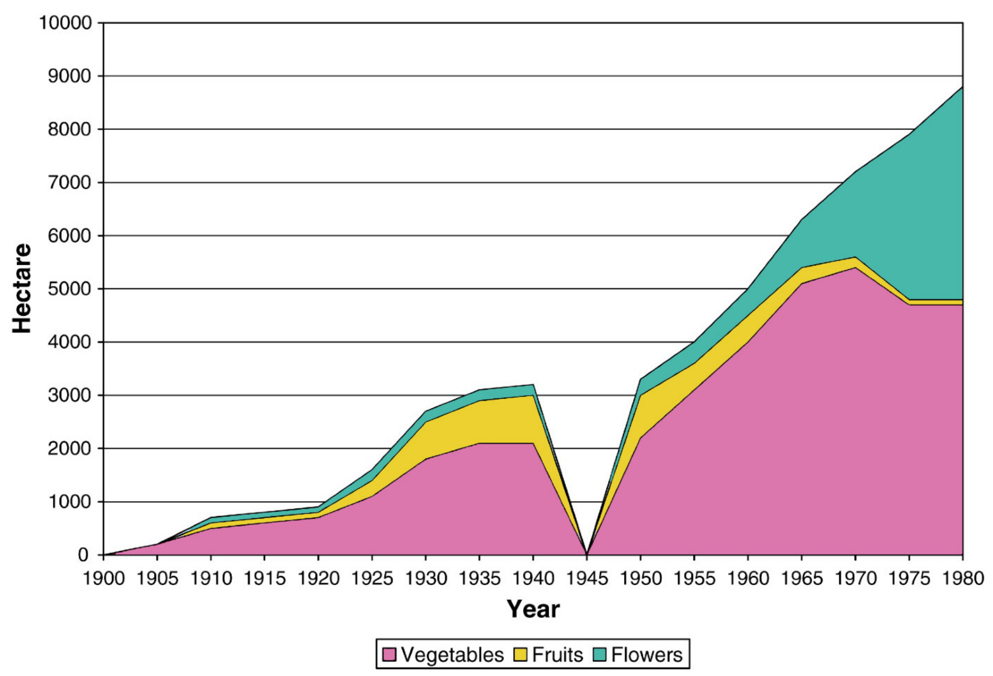
This eagerness to learn led to the creation of horticultural study clubs. These groups invited researchers to give presentations, incorporated external expertise, and even conducted their own experiments to improve cultivation techniques (Scholten, G., and C. Sonneveld, 1999).

A shared commitment to learning and collaboration, rooted in a long history of cooperative practices, technological advancements, and knowledge exchange, fostered a culture of collective innovation within the Westland horticultural cluster, still reflected in the sector it is today.

Waterbassin by greenhouse (De Decker, K. 2015)

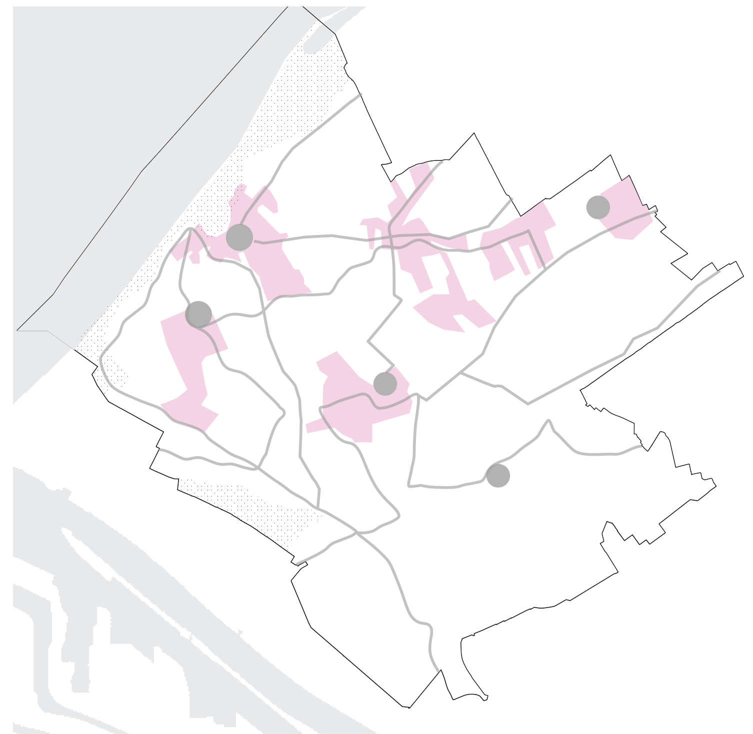


Greenhouses (De Decker, K. 2015)

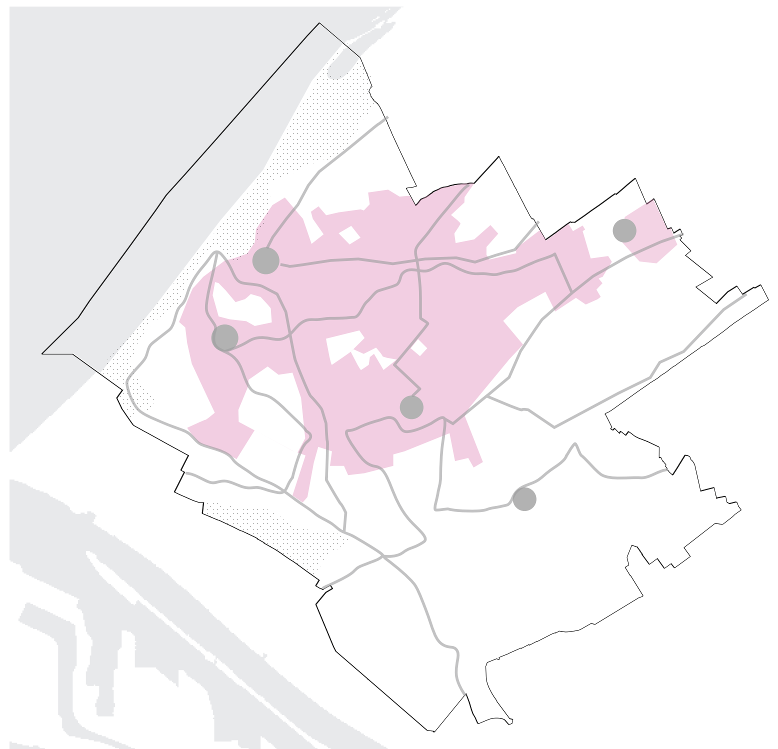


Production in Westland(Berkers, E., & Geels, F. W., 2011)

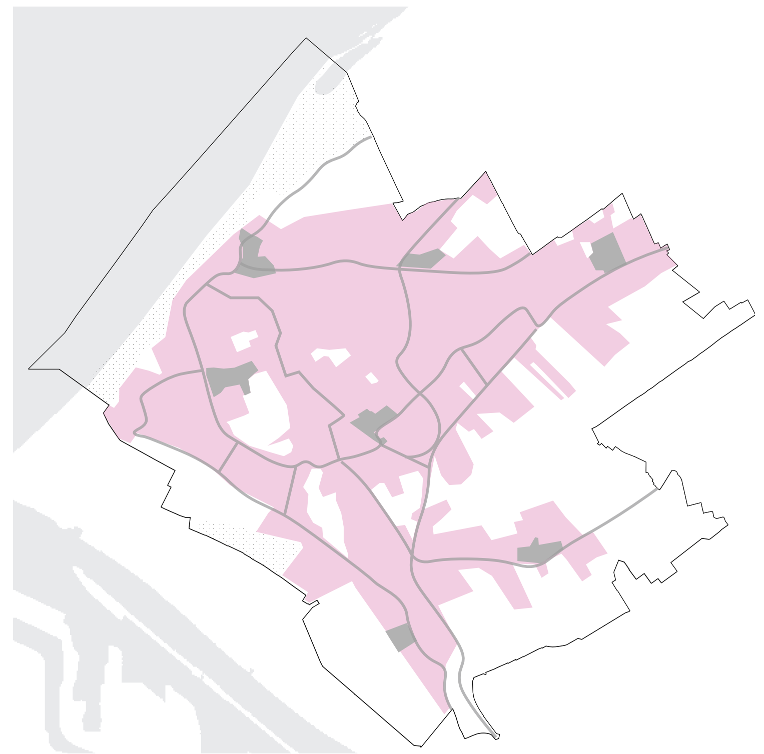
Westland in 1815



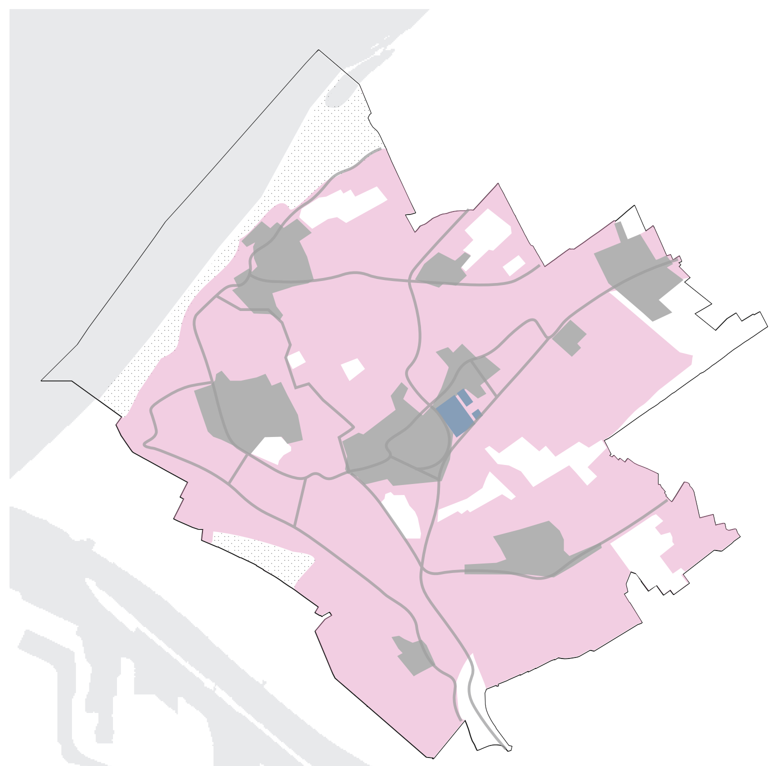
Westland in 1850



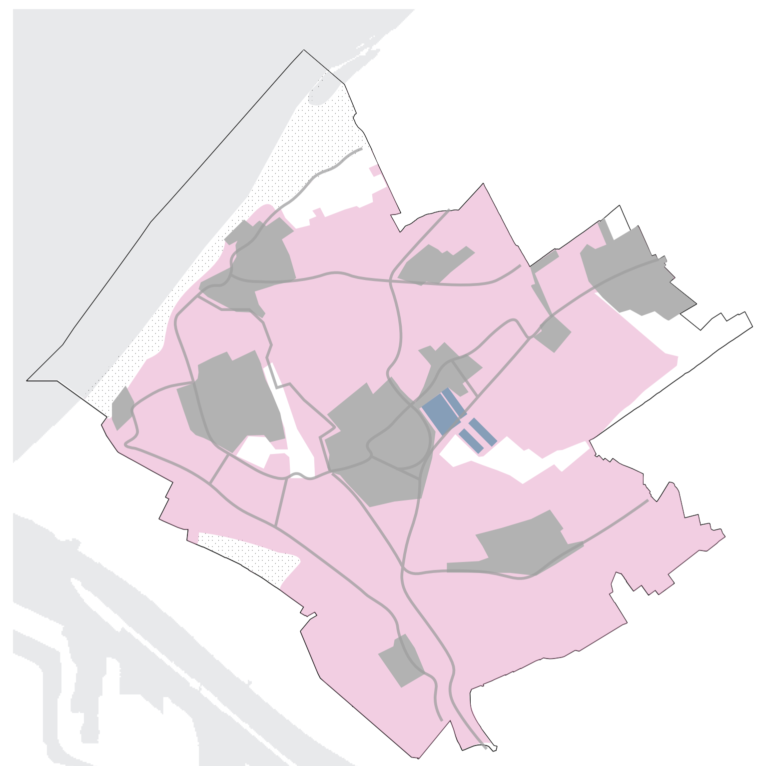
Westland in 1940



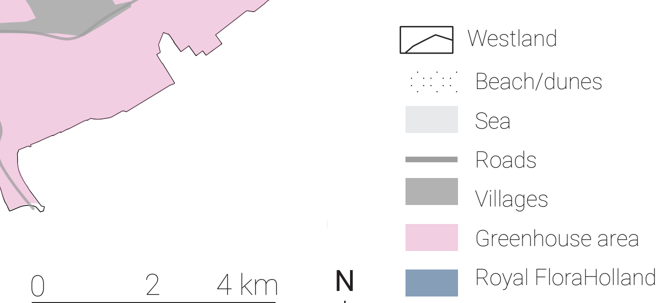
Westland in 1965



Westland in 1999



Westland in 2021



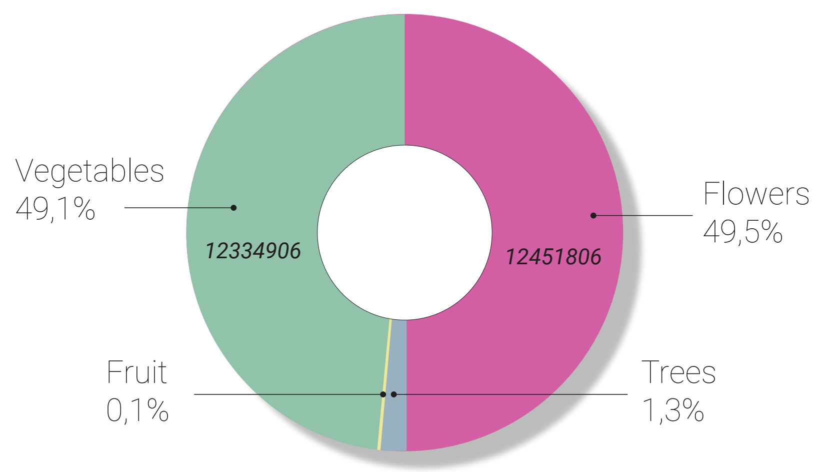
(Topotijdreis, n.d.)

Focus on floriculture

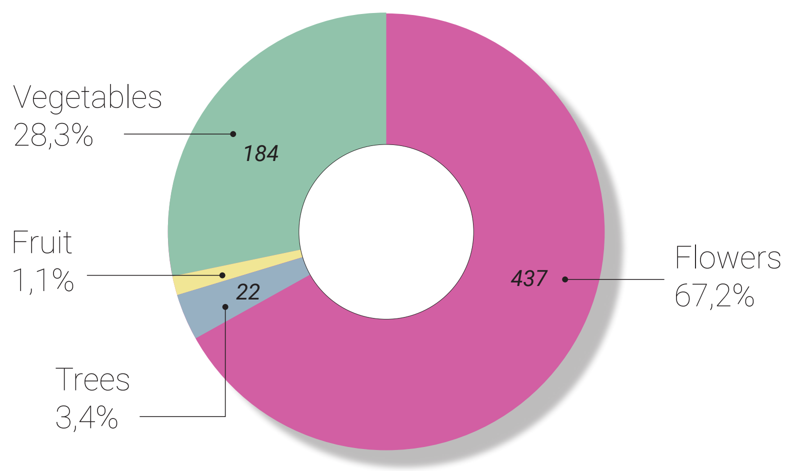
A substantial part of Westland's horticulture sector consists of flower production. This floriculture sector occupies nearly half of the greenhouse companies there, while covering close to 70% of the surface area of Westland's greenhouses, as seen in the graphs below. The floriculture sector consists of both cut flowers and flower bulb cultivation.

This raises questions about efficient land use and resource allocation. Flowers serve aesthetic, symbolic and cultural purposes, but no nutritional purposes. Still, they dominate the greenhouse landscape in Westland. This production is driven by high international demand and a well-established trade infrastructure centred around Royal Flora Holland.

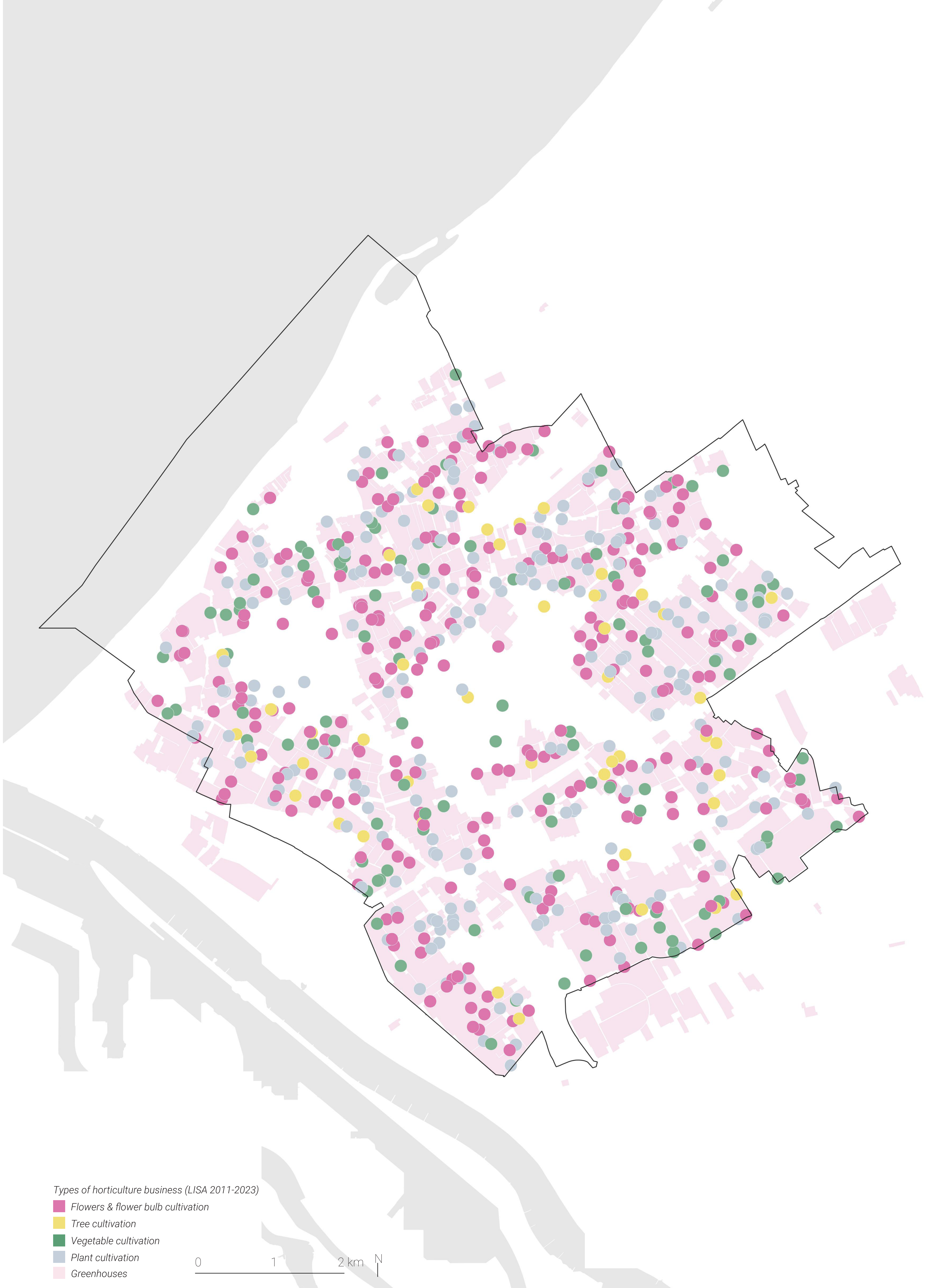
While the floriculture industry contributes significantly to the economy and labour market, its dominance in such a dense and energy-intensive area raises concerns. The fact that non-essential products like flowers occupy such a large share of greenhouse space highlights the focus on economic success in Westland. In the context of the energy transition and increasing environmental pressures, this wrongly placed focus is the start of this project's vision.



Greenhouse companies in Westland
Total 633
CBS Statline (n.d.)



Greenhouse area in Westland
Total 25.132.671 m²
CBS Statline (n.d.)



Community introduction: The greenhouse owners

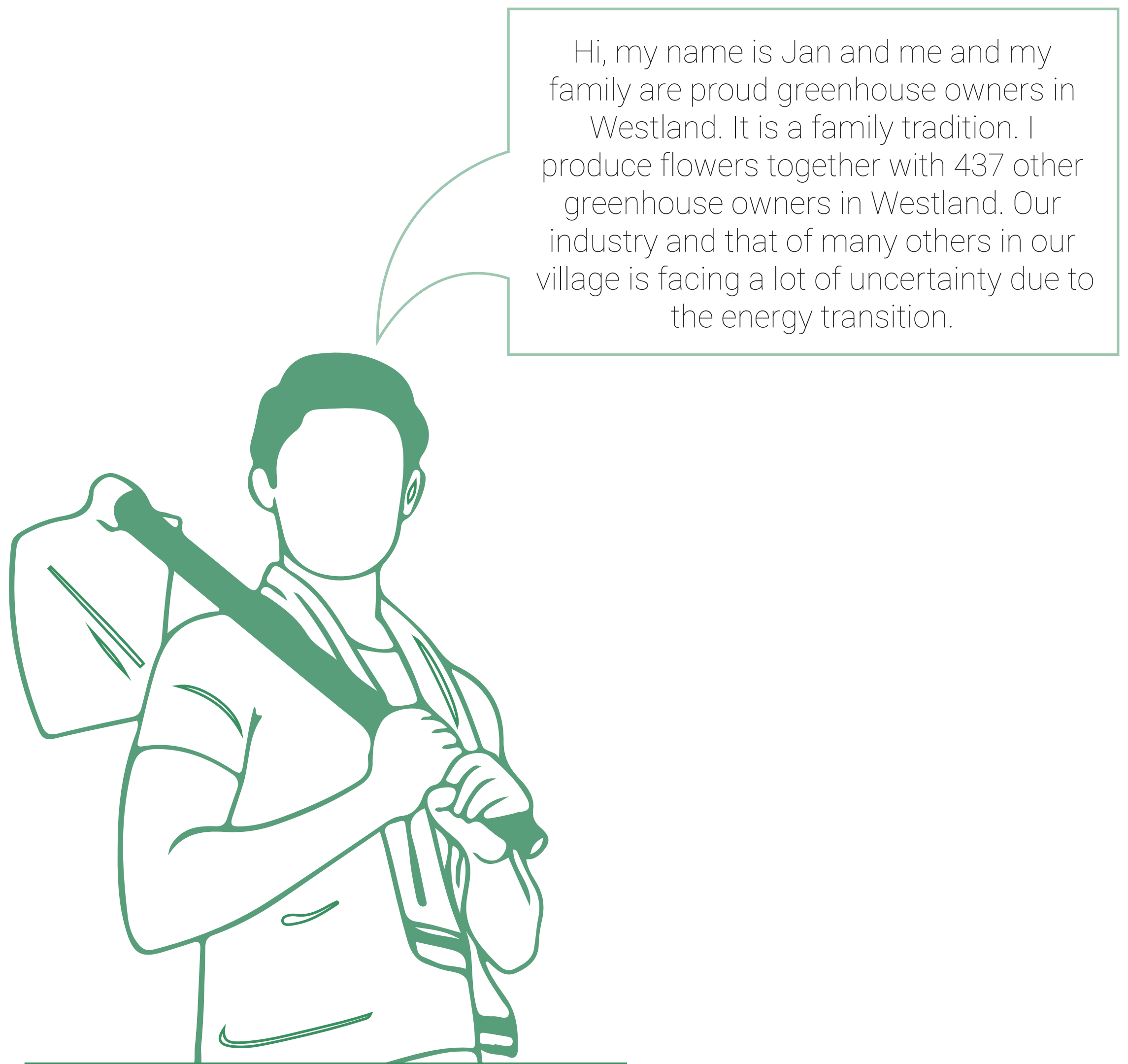
Involving Westland's greenhouse owners is imperative to the needed transformation in this area and sector. The focus in this project lies on floriculture, therefore the involved community is specifically the flower greenhouse owners. These owners play a key role in shaping the region's landscape, economy and its environmental footprint.

Currently, their primary focus is economic success; by maximizing production they can remain competitive in (inter)national markets. Though this has contributed to the global leadership that Westland has in the flower trade, the greenhouse owners have placed a considerable burden on local resources.

To create meaningful change, it is crucial to align the interests of these greenhouse owners with broader societal goals such as reducing CO_2 emissions, optimizing land use, and increasing the sector's contribution to sustainable development. This involves incorporating them in the vision making process. This is especially important, as this community is a part of the private sector and often owns the land they cultivate. Thus, transforming this landscape requires collaboration.

In the history of Westland, the greenhouse owners were characterised as cooperative and connected. A literature analysis using Atlas.ti highlights that this is still the case (Appendix 1). The sector is focused on collaboration, culture and politics. Though less pronounced, sustainability is also present in the zeitgeist, showing that the community has a desire to move with the energy transition instead of against.

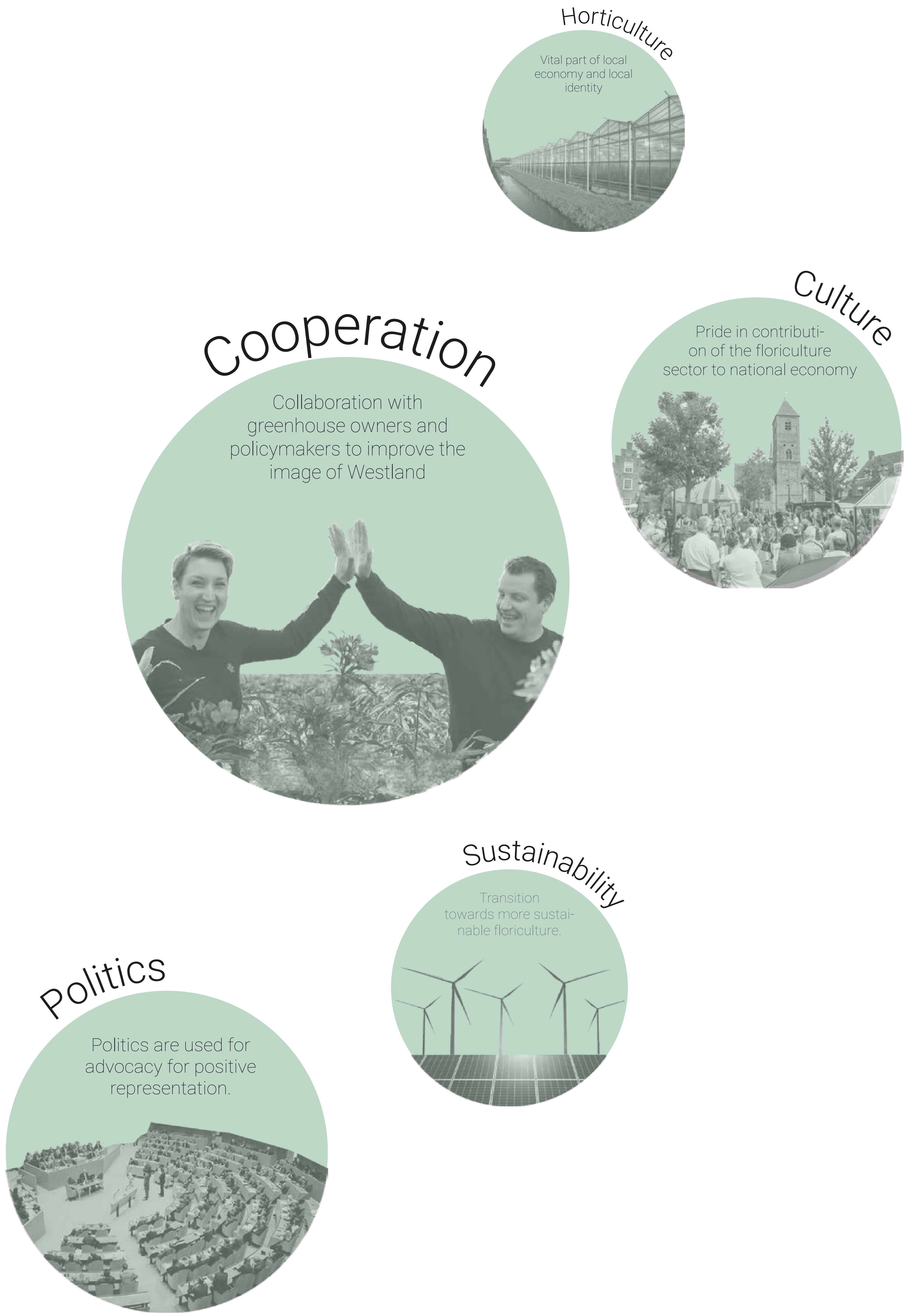
By acknowledging their expertise, and co-creating viable pathways for change, a more future-proof greenhouse sector in Westland could contribute to the region's ecological health, the energy transition, and spatial quality.



Greenhouse owner Jan

Market	●●●●●
Regional connection	●●●○○
Sustainability	○○○○○
Innovation	●●●○○

Greenhouse owners (Atlas.ti, appendix 1)



Current themes in floricultural sector (Atlas.ti, appendix 1)

Greenhouses Westland (Admin, 2024)

The succes of Westland

This chapter expands on the global success of the floriculture sector, demonstrating how this can be viewed in relation to its drawbacks. Westland's success impacts regional spatial quality significantly. To change this, a variety of stakeholders are implementing policies, steering the future of the horticulture system.

The Netherlands, together with three other countries, is the world's largest exporting country of cut flowers with a market share of 80% in 2017. In this year 1,7 million tonnes of cargo were transported to and from Schiphol Airport. Air cargo transport of flowers amounts to 25% of the total annual tonnage of goods through Schiphol Airport. The sector also contributes to the employment opportunities in the region, providing structural employment to 83,000 people yearly, and up to 134,000 during peak periods.

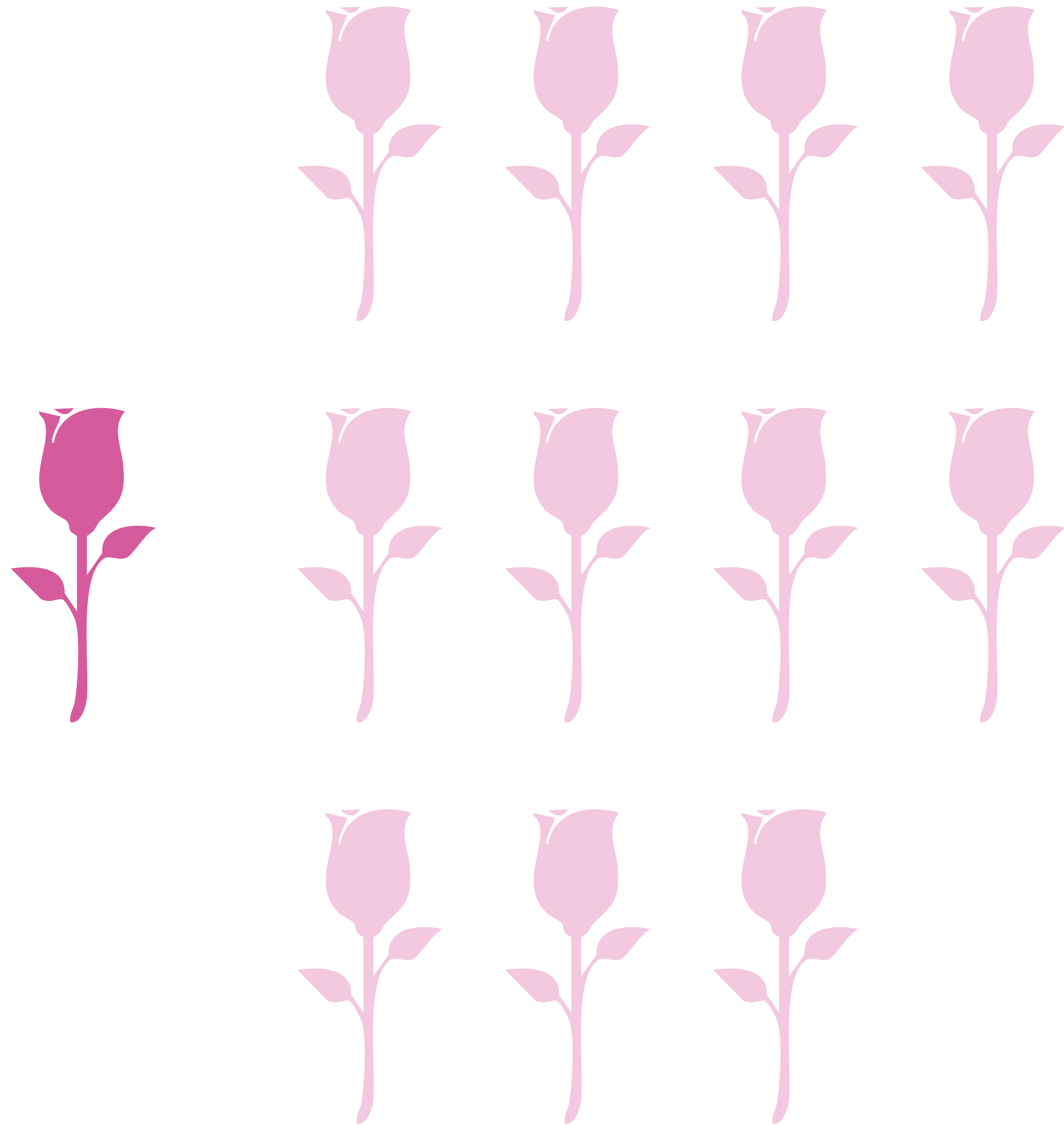
The region has become a global hub for floriculture. Its expertise, efficiency, and ability to continuously innovate have positioned Westland as a leader in the international flower market.

Economic impact of flowers (DutchHorticultureNL, n.d.)

Global distribution of flowers (El Makhloufia, et al. 2018)

The downside of Westland

Greenhouse production in Westland is characterised by a significant energy consumption. To maintain optimal growing conditions throughout the year, greenhouses are reliant on artificial lighting, heating, and ventilation systems. This enables continuous production cycles, allowing flowers to grow day and night, regardless of seasonal or weather conditions. A comparison of carbon footprints has revealed that the growth and transportation of 11 roses from Africa by air has a lower climate impact than the production of a single rose in a Dutch greenhouse (Hortileads, 2019). Although African roses are transported by air, they are cultivated relying on natural sunlight and need no artificial heating.
Energy costs account for the second largest share of production costs in greenhouse horticulture, only surpassed by labour (Greenport West-Holland, 2024). This includes the cost of heating to maintain optimal temperatures during the winters, as well as the electricity needed for high-intense lights, especially during the winter. On top of that, dehumidification systems, CO_2 enrichment to stimulate plant growth, and water pumping systems all add to the total energy demand.
Efforts are being made to transition the sector towards more sustainable energy systems. However, this transition is complex, capital-intensive, and not yet widespread.



11 roses from Africa equate to 1 rose from the Netherlands in terms of the climate burden

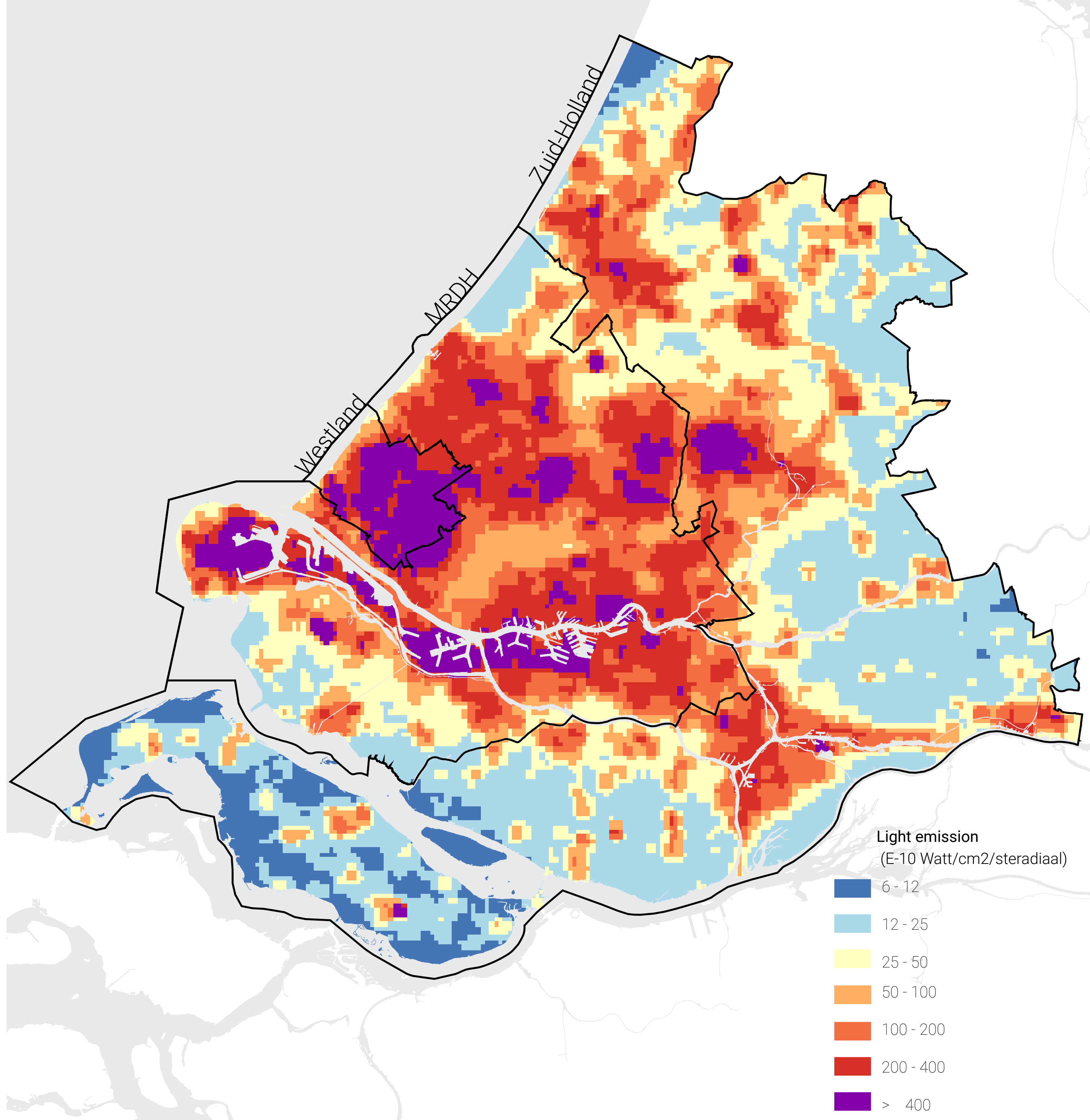
(Hortileads, 2019)

Spatial downside of Westland

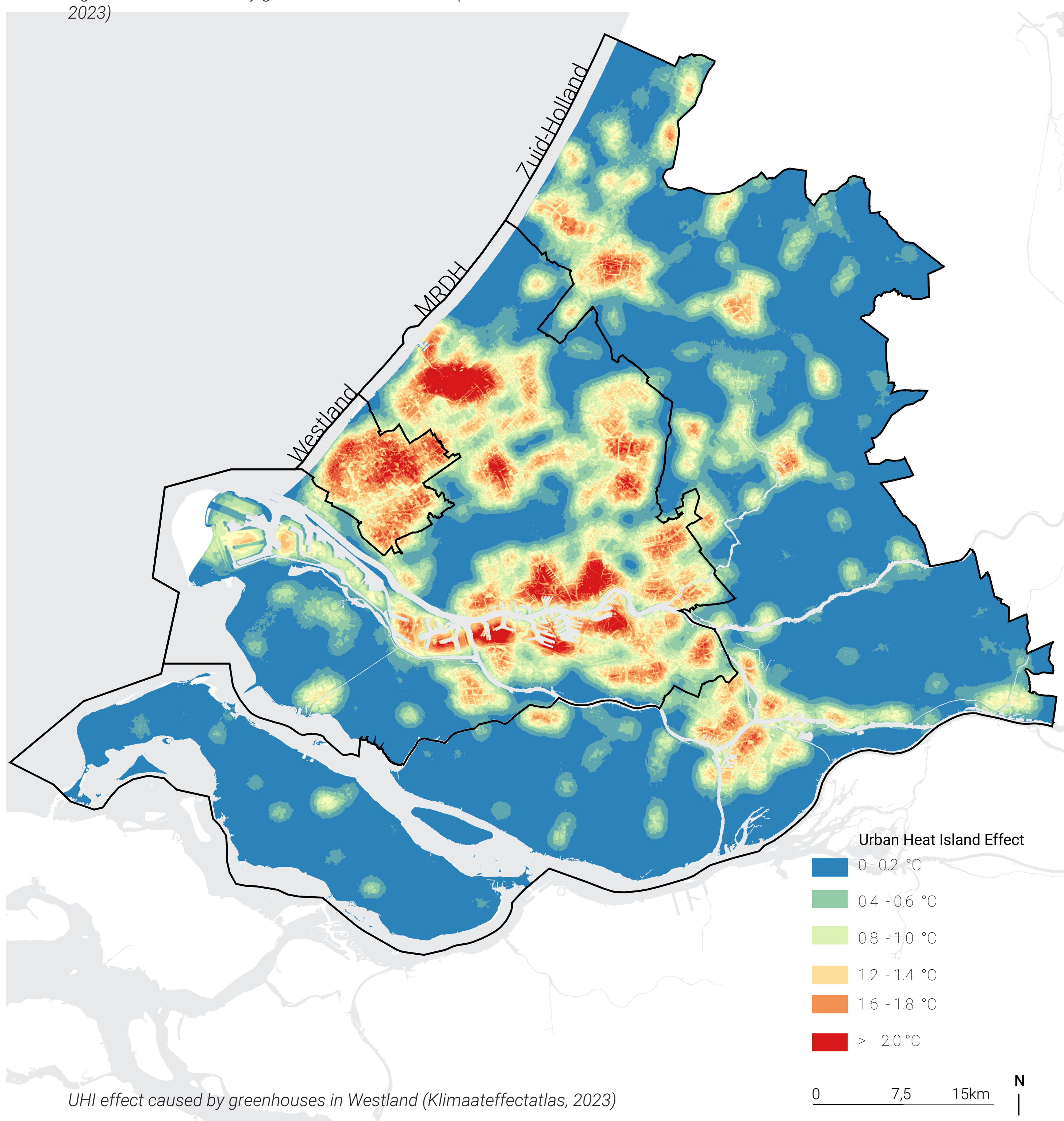
One of the most notable environmental impacts of extensive horticulture is light pollution. The artificial lights, shining through the glass structures, contribute to excessive light emissions across the region. The map on the right clearly shows that Westland emits significantly more light than surrounding areas.

This continuous glow doesn't just impact the aesthetics of the night sky—it has tangible effects on local ecosystems. Light pollution is a known driver of insect decline. A study by Owens et al. found that artificial lighting can significantly increase insect mortality rates, with up to 30% of insects dying under artificial lighting (2019). Moreover, light interferes with insect reproduction by disrupting scents used to find mates. As a result, essential pollinator species are declining in population.

In addition to the use of lighting, greenhouses are also heated to create optimal growing conditions year-round. This heat is released onto the surrounding environment, contributing to another phenomenon: the Urban Heat Island effect (UHI). This refers to the localized warming of areas due to human activities and infrastructure. The UHI-map shows that Westland stands out as a major hotspot, alongside large urban centres The Hague and Rotterdam. Remarkably, while those cities are more than five times the size of Westland, the greenhouse region shows equal or higher temperatures.



Light emission caused by greenhouses in Westland (Klimaateffectatlas, 2023)



UHI effect caused by greenhouses in Westland (Klimaateffectatlas, 2023)

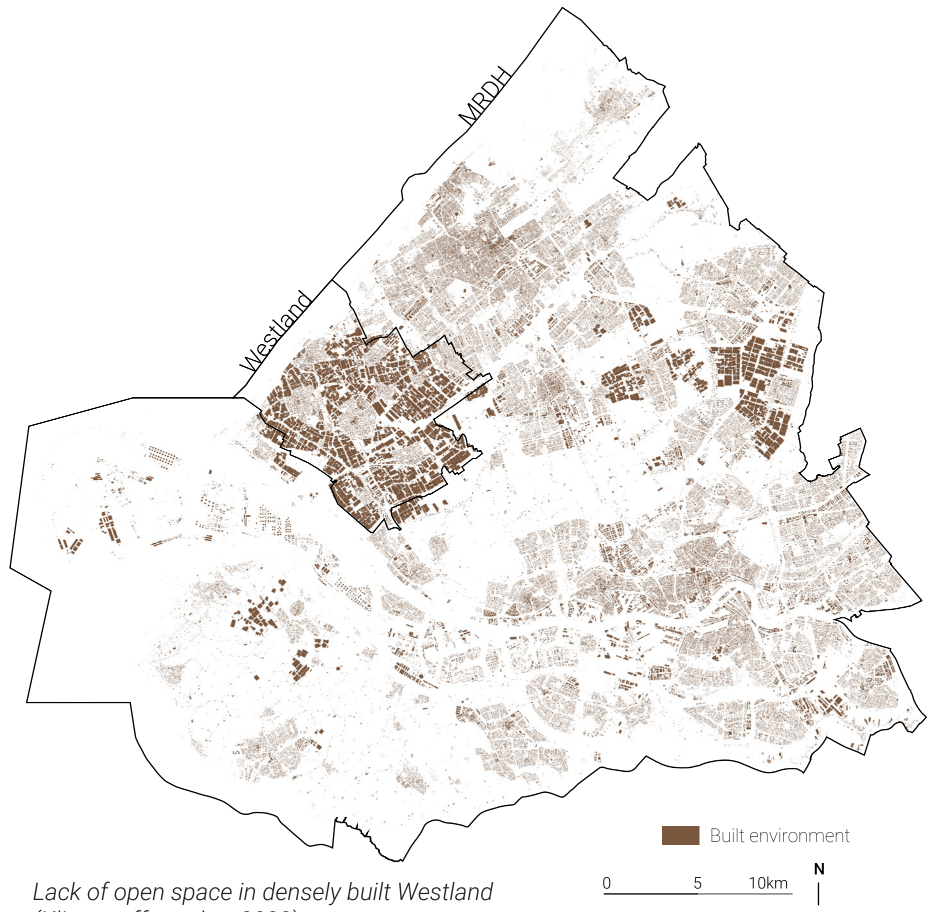
Spatial downside of Westland

Besides contributing to light pollution and the emission of excess heat, the greenhouses in Westland also significantly impact the region's soil and water quality. The physical scale of the greenhouses themselves is immense, often stretching over multiple hectares. In Westland, every available patch of land is optimized for productivity, which means there is little room left for open, undeveloped space. The dense network of greenhouses is closely interwoven with infrastructure—roads, transport hubs, and paved service areas—all needed to keep the industry functioning efficiently. As a result, Westland is noticeably more paved compared to surrounding cities and rural villages.

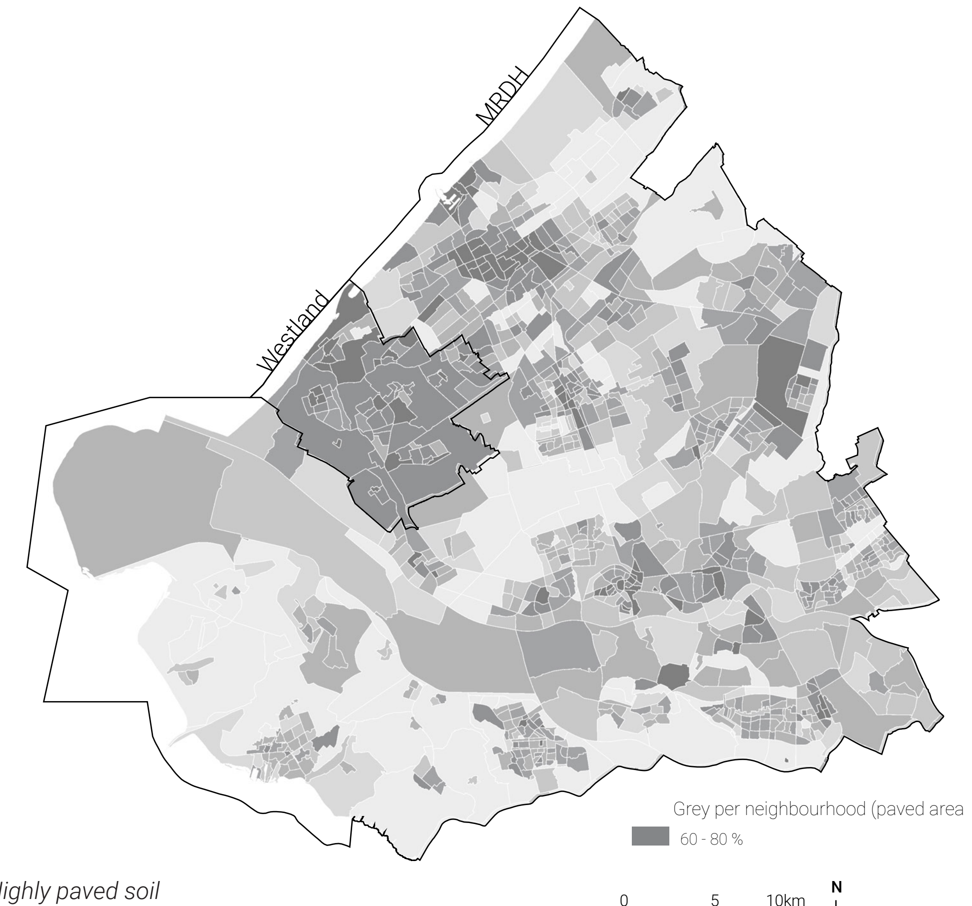
Although many of the crops are grown hydroponically—without soil—the production process still involves large quantities of fertilizers, pesticides, and nutrient-rich water. These substances often find their way into the surrounding environment, either through runoff or accidental leakage, leading to the contamination of local waterways and soil systems. This pollution can disrupt aquatic ecosystems, contribute to the growth of harmful algae blooms, and make it more difficult to maintain clean water for both agricultural and residential use. Such intensive use of water and nutrient solutions puts increasing pressure on water purification infrastructure and the availability of clean, high-quality water.

The lack of open green space limits the region's capacity for natural water absorption, cooling, and biodiversity. Rainwater, instead of seeping into the ground, runs off the extensive paved surfaces, putting additional stress on drainage systems and increasing the risk of flooding. Moreover, the absence of natural habitats leaves little room for native flora and fauna, further reducing biodiversity in the area.

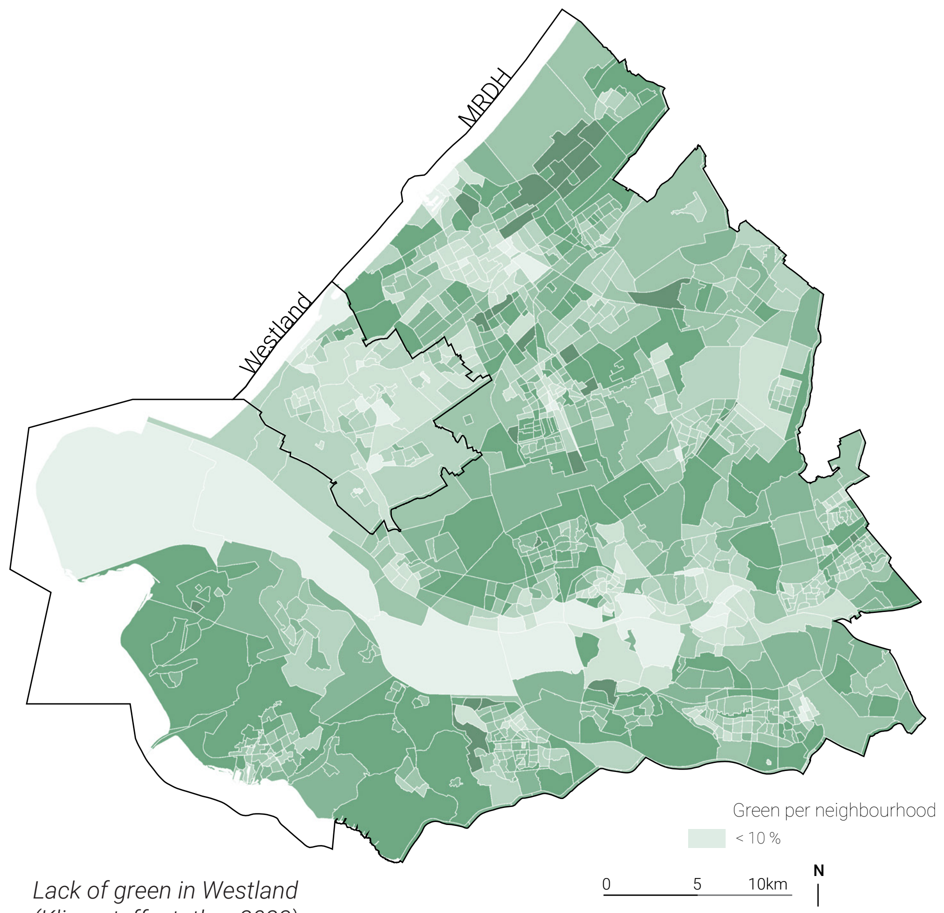
In this way, the dominance of greenhouses in Westland shapes not only the economy but the entire spatial and ecological character of the region.



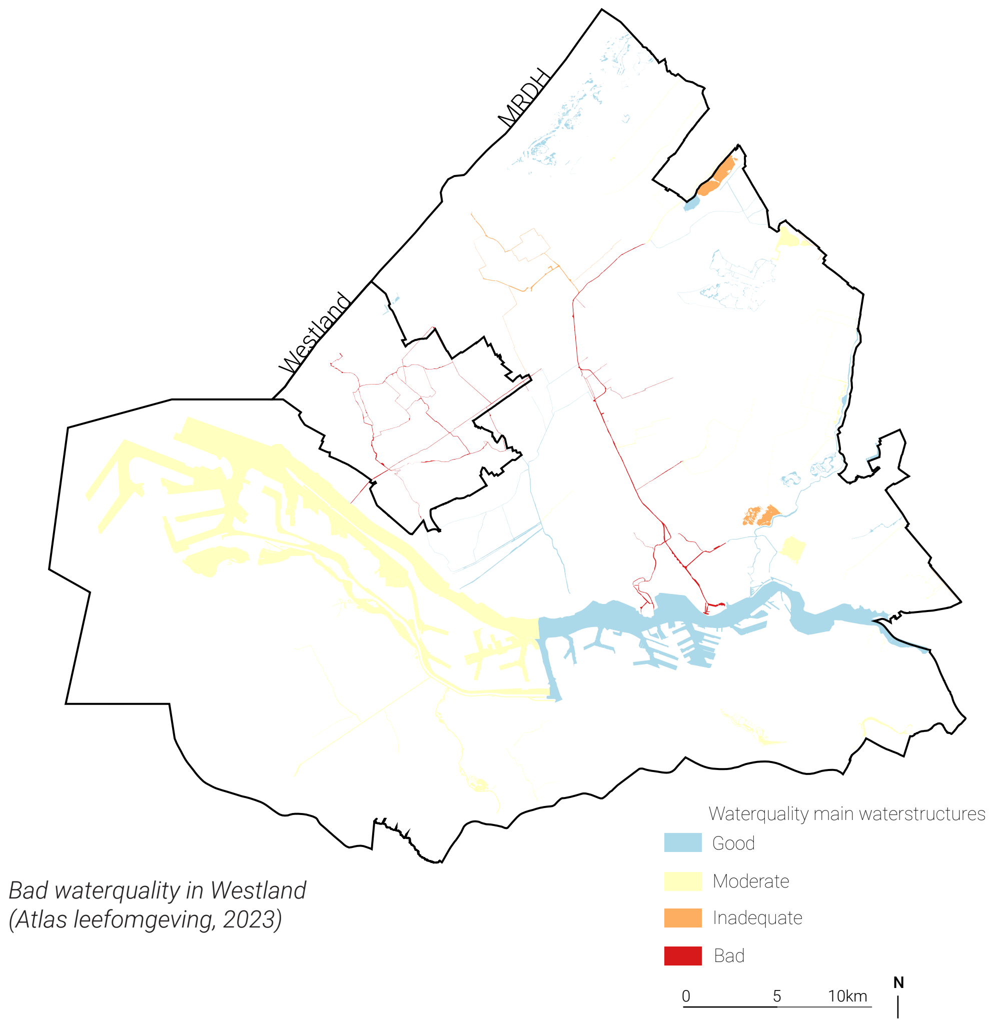
Lack of open space in densely built Westland (Klimaateffectatlas, 2023)



Highly paved soil (Klimaateffectatlas, 2023)



Lack of green in Westland (Klimaateffectatlas, 2023)



Bad waterquality in Westland (Atlas leefomgeving, 2023)

Energy consumption system

As previously mentioned, greenhouses require a substantial amount of energy to maintain the controlled environments needed for flower production. However, the entire flower production system in Westland is much more complex than just energy consumption within the greenhouses. It is part of a highly optimized industrial chain, all designed to ensure the cheapest and most efficient production of flowers.

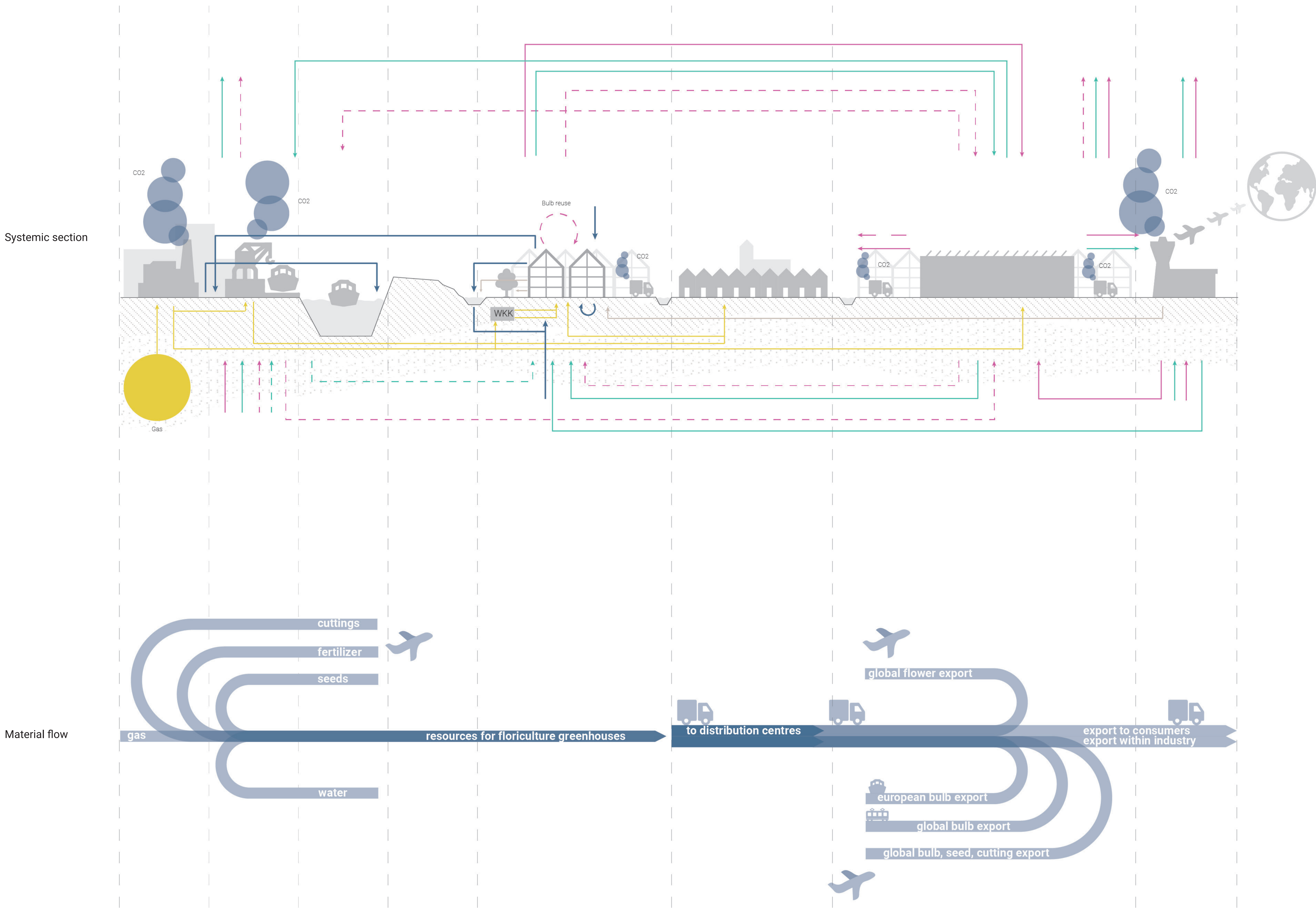
In the systemic section, the process begins on the left with the extraction of natural gas. Most of this gas originates from countries like Norway and Germany (Centraal Bureau voor de Statistiek, 2022). Norwegian gas is transported to the Netherlands through international pipeline networks. This imported gas forms the primary energy source for heating the greenhouses in Westland.

Further along the systemic chain lies the port of Rotterdam. This is a major node in the Dutch import and export infrastructure. In the context of the floriculture sector, the port facilitates the global trade of seeds, bulbs, flowers, and cuttings (BRON). A portion of these imports is used directly in the greenhouses of Westland, while the rest is destined for the Dutch consumer market. The seeds and bulbs produced in the Netherlands are exported via the port.
The port of Rotterdam is itself a significant energy consumer and source of emissions. However, part of the waste heat generated by industrial processes in the port is captured and redirected as residual heat (BRON). Some of this residual heat is used by nearby greenhouses, though the majority of greenhouse heating still depends on natural gas from international pipelines.

Water use is another essential part of the system. Greenhouses require large amounts of clean water for irrigation and nutrient delivery. However, because fertilizers and pesticides are heavily used in greenhouse farming, much of this water becomes contaminated and is not reused. Most greenhouse operators rely on extracting fresh groundwater to ensure the purity needed for optimal plant growth (BRON). This practice puts additional pressure on local water resources and purification systems, leading to salinization (BRON).

After cultivation, the next step in the system is distribution. Westland has developed a dense and highly specialized infrastructure to support this. Trucks are used to transport flowers from the greenhouses to Royal Flora Holland (Royal FloraHolland, 2025). Here, flowers, bulbs, and seeds are auctioned and distributed to both domestic and global markets. Products from Dutch greenhouses are auctioned alongside flowers imported from other countries, reinforcing the global nature of the industry.

Following the auctions, products are exported worldwide, often via large cargo planes departing from airports such as Schiphol. Because of the short life-span of the product, flying is the most viable option. It is fast but energy-intensive, adding another layer to the environmental footprint of the flower industry.

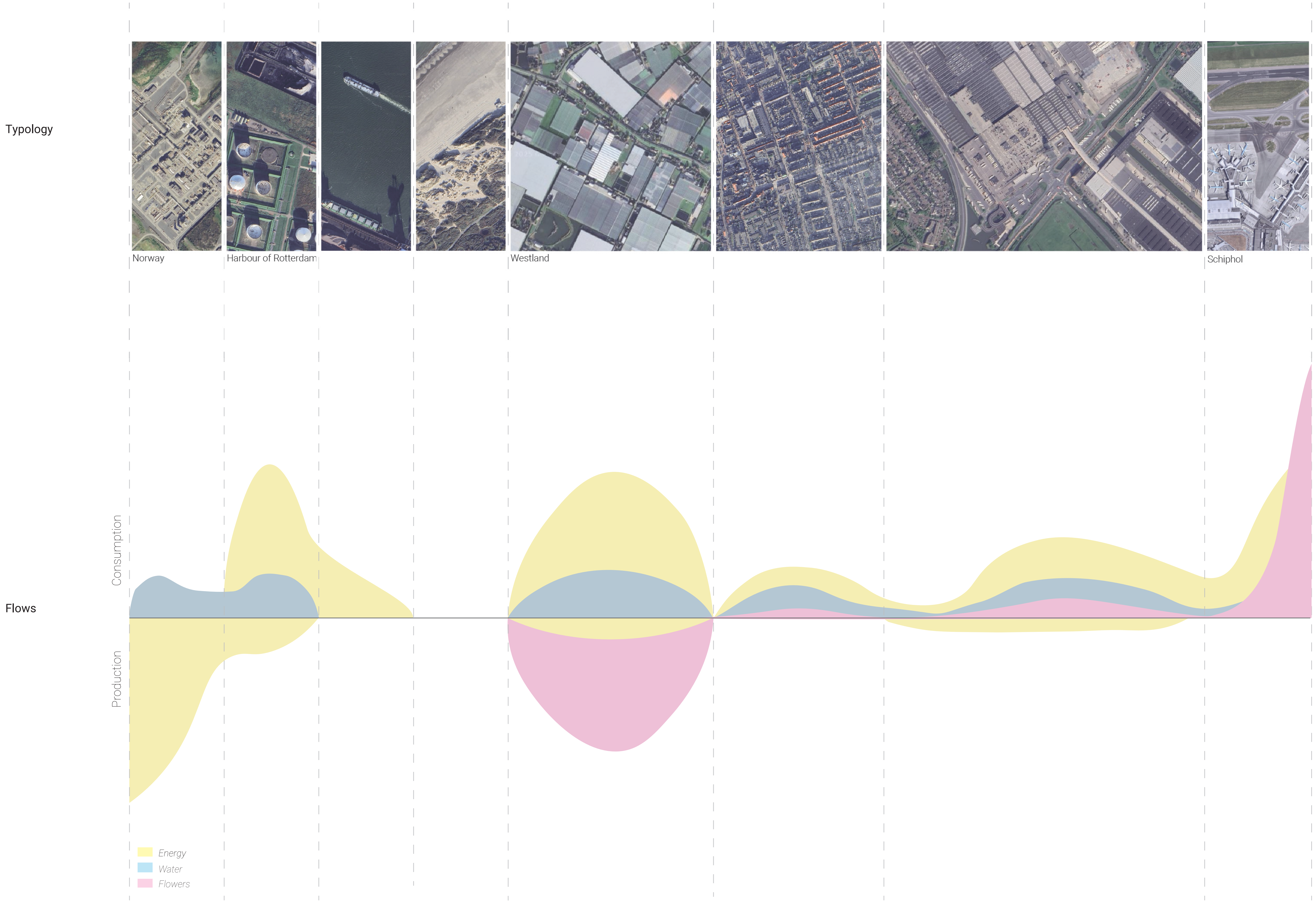


- Seeds
- Cuttings
- Flowers
- Bulbs
- Energy
- Water

Energy consumption system

The flow section on the right shows the energy production and consumption of the whole floriculture system. The consumption and production of energy are completely misaligned. Energy production only occurs in a few parts in the system, not integrated throughout the process.

The greenhouses purely consume energy, leading to a clash between energy consumption and flower production.



Systemic section floriculture

Energy demand of the floriculture

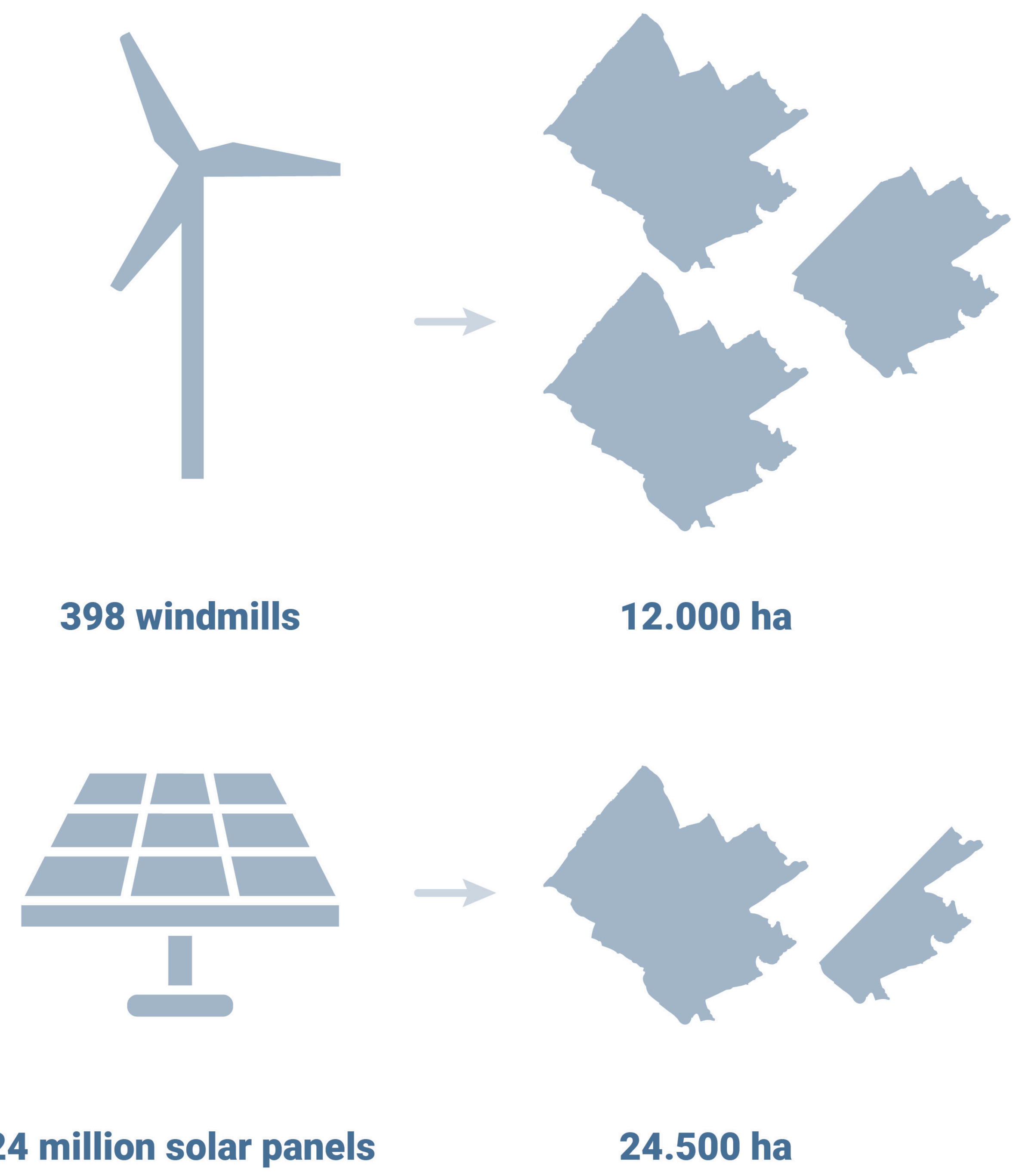
The current energy use of the floriculture industry in Westland is extremely high and, in many ways, inefficient. Greenhouses run day and night, relying heavily on artificial heating and lighting to maintain constant growing conditions. This results in a continuous demand for energy, most of which is still supplied by fossil fuels. As the Netherlands—and the world—moves toward a renewable energy future, a pressing question arises: can the current model of energy use in Westland's floriculture sector be sustained using clean energy?

Due to Westland's flatness and its position near the North Sea, renewable energy potentials are high in the area. The map on the right illustrates this, showing that different energy sources are viable in the region.

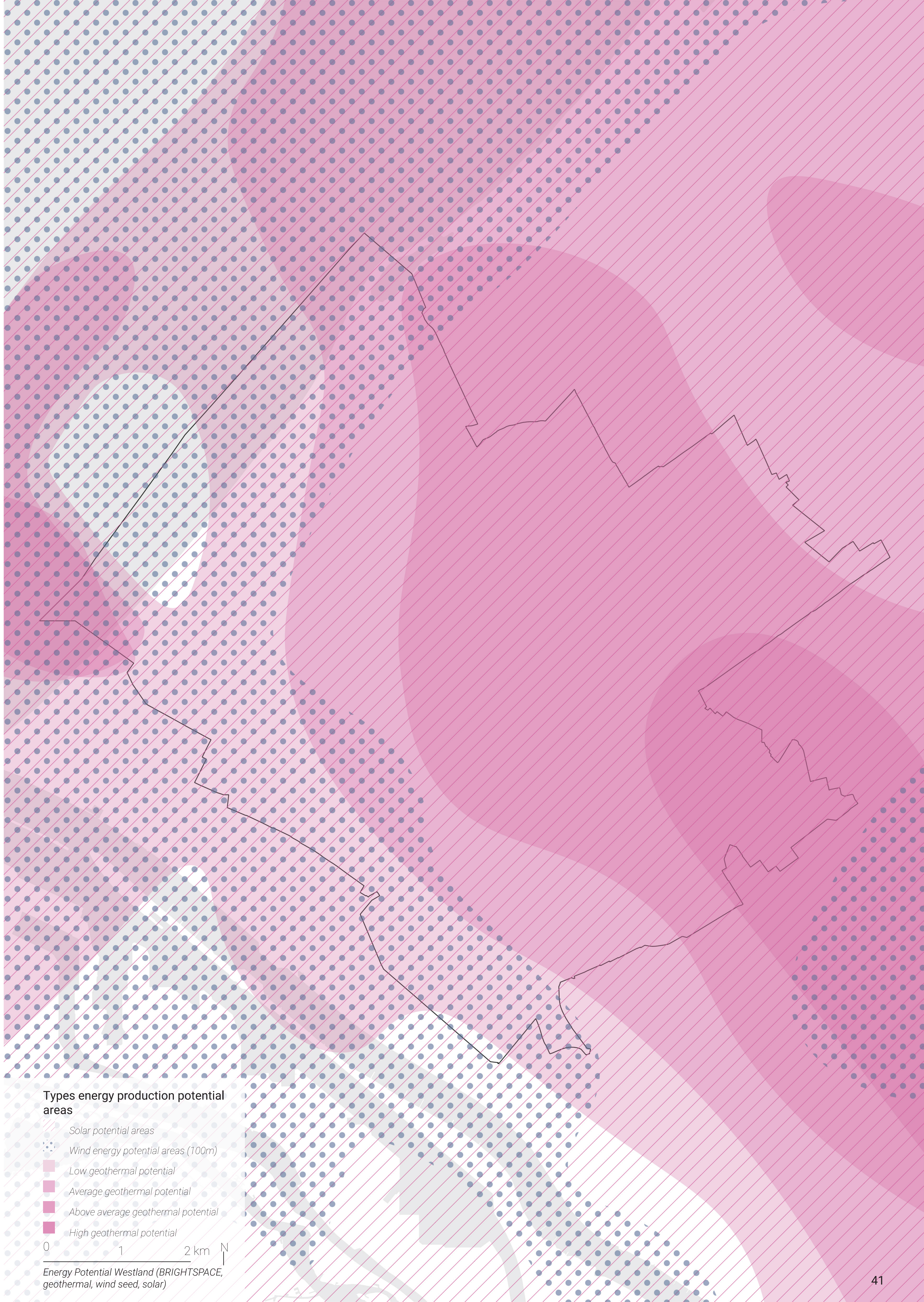
To meet the existing energy demand of the sector entirely with renewable sources, the scale of infrastructure required is staggering. It would require 398 wind turbines or around 24 million solar panels to power the floriculture greenhouse sector alone.

To put that into perspective, installing 398 wind turbines would require a surface area nearly three times the size of Westland itself. Even using solar panels would demand an area equivalent to one and a half times the total surface of Westland.
These figures highlight the sheer intensity of energy consumption in the region and raise serious questions about the long-term sustainability of the current production model. Though renewable energy is a necessary step towards climate neutrality, merely adapting the current system to one that relies on renewable energy is not enough. A fundamental shift in the design and operation of the greenhouse sector is necessary—one that prioritizes energy efficiency, circularity, and a reduction in total energy use.

To sustain the current energy use of the floriculture industry in Westland, we need:



Quantifying energy need floriculture sector (Appendix 2)



Energy Potential Westland (BRIGHTSPACE, geothermal, wind seed, solar)

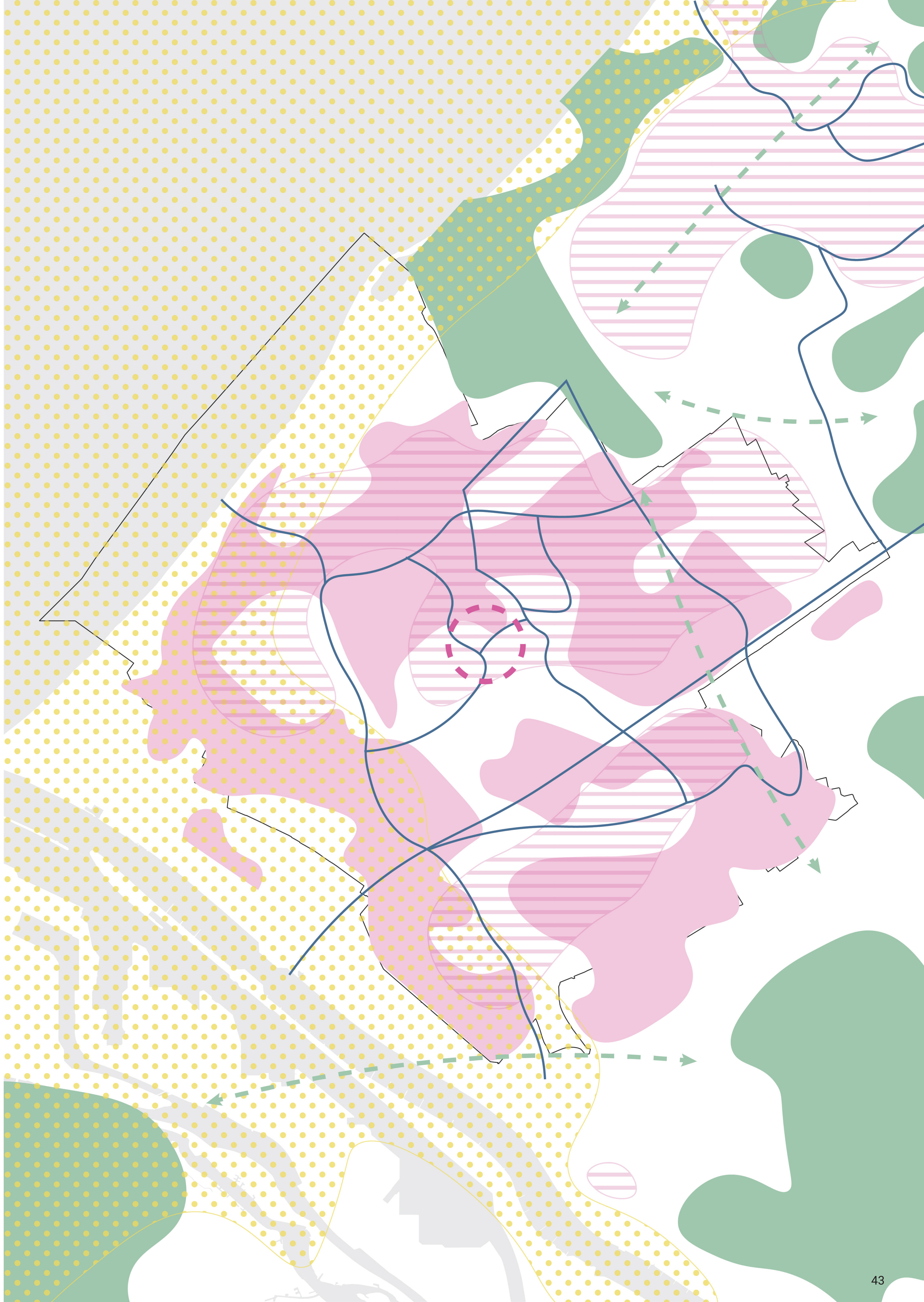
Spatial conclusion

The spatial analysis of Westland revealed that Westland has several issues, such as urban heat island effect and poor water quality. The area is surrounded by green spaces and has a high energy production potential, making it ideal for spatial transformation. The conclusion map on the right illustrates the combination of possibilities and complications, that informs the vision spatially.

Conclusion map; analysis

- *Flora Holland*
- *High Urban Heat Island effect*
- *Wind energy potential areas (100m)*
- *High green percentage*
- *Greenhouses*
- *Water with poor quality*
- *Potential green connections*

0 1 2 km N



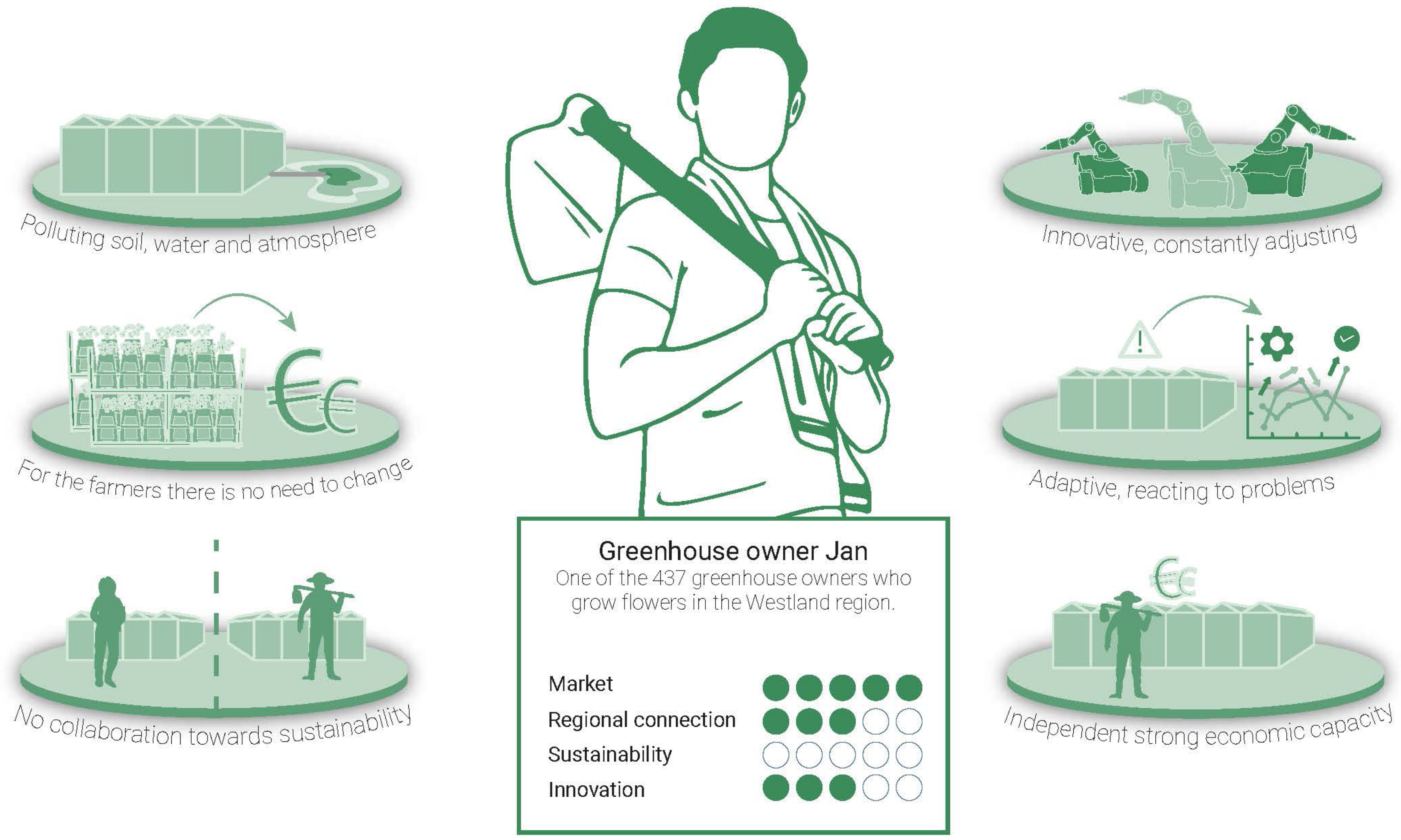
Community powers and problems

Westland's greenhouse owners are competent business owners. Through constant adaptation, strategic investments, and the integration of innovative technologies, they have optimized growing processes to achieve maximum output and efficiency.

These business owners are not only growers—they are innovators. Many have pioneered the use of data-driven cultivation systems and automated logistics. Their willingness to experiment with new methods has led to the foundation for the sector's reputation as a global leader in high-tech horticulture.

However, the same drive for high productivity and economic performance causes issues. The widespread use of pesticides and fertilizers has led to pollution of soil and water systems. Runoff from greenhouses can carry chemical residues into nearby ecosystems, affecting soil, water and with that biodiversity.
In their eyes, pesticides and fertilizers are solely beneficial. There is no incentive to change, as these polluters increase profit and decrease labour. This project faces the challenge that there is little accountability between farmers to change sustainably.

Without collective investment or shared learning, efforts toward sustainability remain fragmented and slow. This lack of collaboration makes it difficult to scale up sustainable solutions or share the risks and benefits of innovation.



Problems and powers greenhouse owners (conclusion from community analysis)

Community wants & needs	Environment wants & needs
Low energy prices	No pollution
High yields	Healthy soil & water
Clear regulations	No light emission

Community wants & needs

Transition community

A systemic shift in the way greenhouses operate must be done urgently. Greenhouse owners must begin to rethink the future of floriculture—beyond short-term profits—towards more sustainable, future-proof practices.

Organic farmers represent a potential path forward, showing that cultivation can still exist with fewer external inputs and lower environmental impact. However, they are still a minority in the Netherlands. To understand why that is the case, an interview was conducted with Geert op 't Hof, the chairman of the association for organic flower production in the Netherlands. He also owns the biggest organic flower farm in the country. He outlined several key issues with the current system.

The transition to organic flower production faces several challenges, but also shows promising opportunities. At the core of the issue lies the Skal certification system, a certificate awarded to organic farmers (for a price). This currently presents significant barriers for growers. While it is technically possible to obtain the certification for greenhouse cultivation, strict requirements—such as phasing out natural gas and implementing crop rotation—make the process inaccessible. Many farmers find the rules overly restrictive and impractical, especially in high-output systems like Westland. The use of pesticides and fertilizers is deeply embedded in current practices, and although some growers claim that up to 85% of their practices are already "biological," this often refers to reduced pesticide use rather than full organic compliance. Government policy could play a key role in initiating change. One potential strategy is increasing public purchasing of organic flowers—municipalities already stimulate organic cultivation in tree nurseries by committing to sustainable purchases. A similar strategy could help kickstart the organic flower market. The Dutch government has committed to reaching 15% organic agriculture by 2030, but achieving this goal will require both financial support and regulatory reform. Subsidies for certification help lower the barrier for growers to make the transition.

The market dynamics also present obstacles. Traders and consumers tend to point fingers at each other: customers say there is no organic supply, while traders claim there is no demand. Supermarkets and auction houses can help break this cycle by actively promoting organic products and allowing them greater visibility. A good example is the 'bioklok' (organic clock) auction system used at Plantion in Ede, where organic flowers are sold in a separate auction, allowing producers to see real-time demand and consumers to clearly identify organic products. In contrast, at Royal Flora Holland, organic flowers are mixed with conventional ones, making them invisible to buyers.

Currently, Westland has virtually no certified organic flower producers. The Skal certificate is not focused on greenhouses, so the regulations for this sector are vague. Greenhouse growers are largely focused on maximizing output, and many are reluctant to transition out of established practices. This is further complicated by a cultural factor—many growers have been using the same methods for decades. A generational shift may be needed to spark innovation and openness to change.

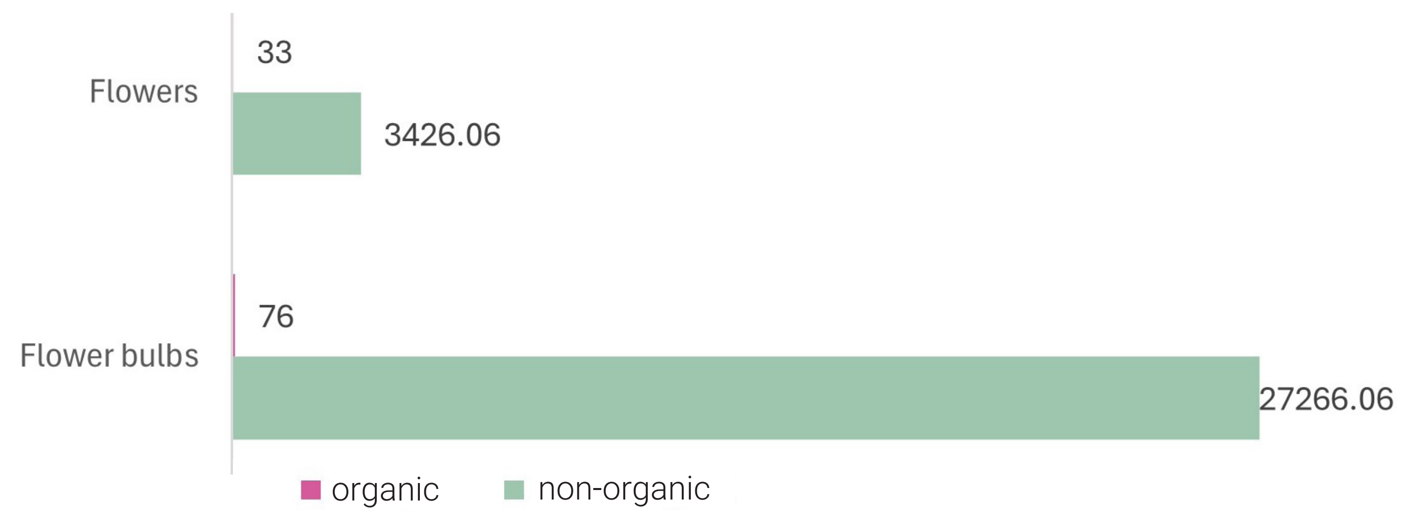
A systemic shift requires effort from all sides:
- Consumers must become more aware of emissions and be willing to pay fair prices.
- Retailers and auction houses like Royal FloraHolland should promote organic flowers more.
- Government must support the transition through subsidies and more flexible regulations, such as easing the crop rotation requirements under Skal.
- Producers need to adopt a new mindset—focusing on diverse, sustainable production with renewable energy sources.

As outlined in Geert's three-point plan: 3-point plan for organic floriculture in the Netherlands from 2024:

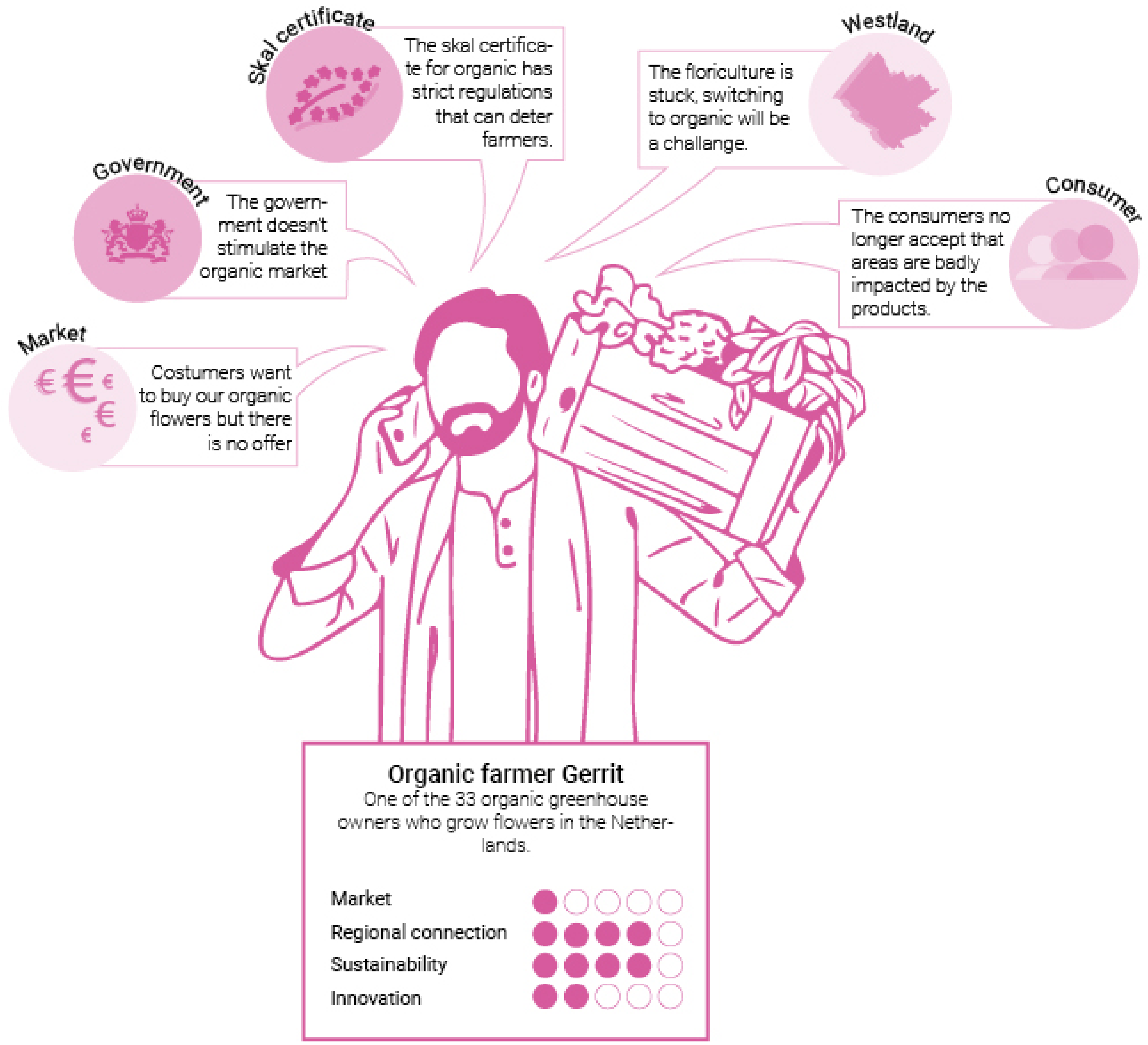
- Production:
Compensate all certification costs for organic growers to create a level playing field.
- Supply chain:
Reward certified growers with financial incentives, such as lower water board levies and support through sustainable procurement and green financing.
- Market:
Let the government lead by example as a launching customer, increasing its share of organic flower purchases.

These coordinated efforts could help unlock the future of truly sustainable floriculture in the Netherlands (Biologische Sierteelt Nederland, 2024).

Areas use organic and non-organic floriculture in the Netherlands



organic and non-organic floritculture (CBS, 2024)



Organic farmers (profile based on the interview with Geert op 't Hof)

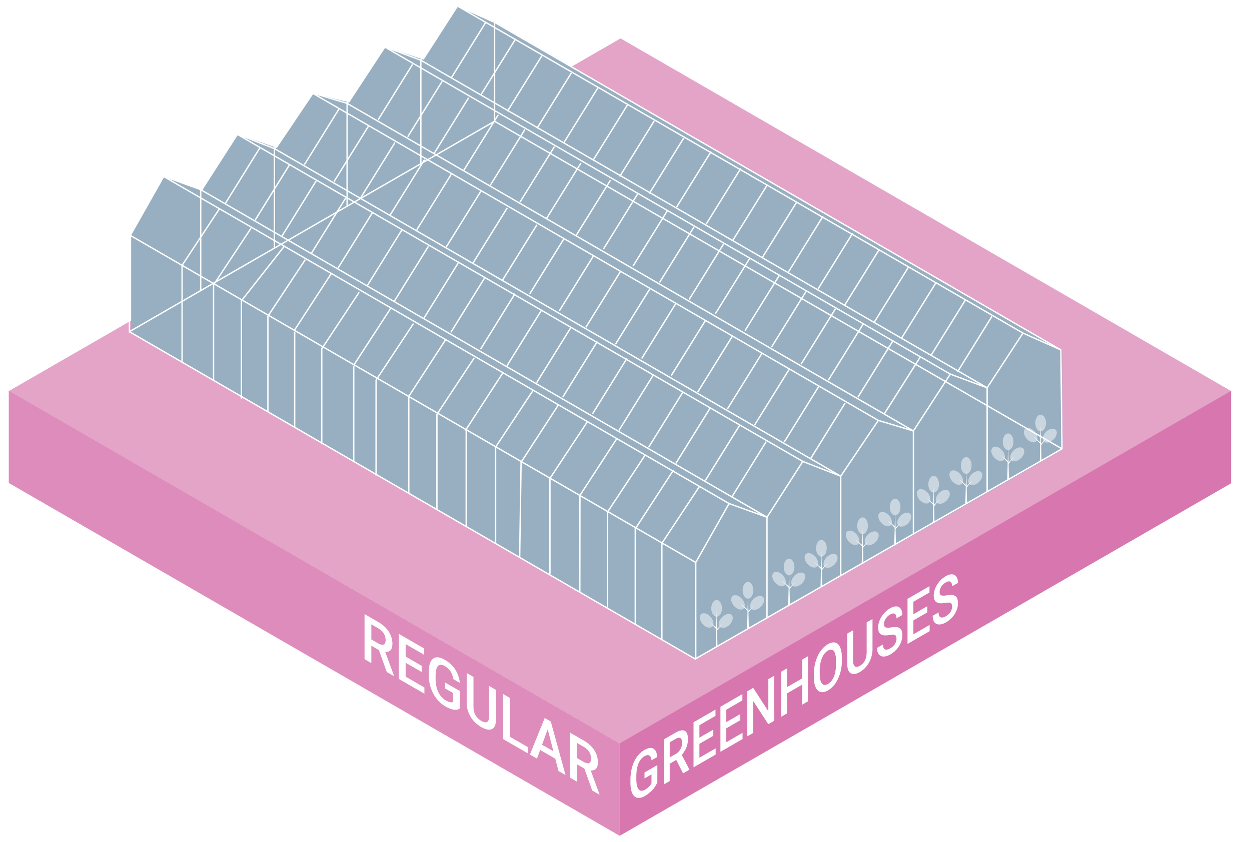
Current floriculture cultivation types

The flower industry in the Netherlands can be divided into two types. Flowers grown year-round inside greenhouses and flowers grown seasonally in open soil. Floriculturists in Westland belong to the first type, while the transition community belongs to the second.

Current greenhouses

Current greenhouses create an optimal climate for the crops growing inside. Plants, unsuitable for open soil growth in the Dutch climate, are able to thrive year-round under this glass. By perfecting the amount of light, water and heat, production is optimized (Van Vliet, 2022). The most common flowers grown in Dutch greenhouses are the chrysanthemum, rose and lily (Glastuinbouw Nederland, n.d.). These have a purely ornamental function. Most greenhouse owners are specialised in growing one specific crop (Enviroliteracy Team, 2024). This simplifies management and increases short-term profit. However, the long-term consequences on soil fertility are detrimental. To combat that, farmers currently utilise harmful pesticides and chemical fertilisers.

This soil health depletion explains why 80% of greenhouses are disconnected from the soil and instead use substrate to grow their crops. Mats made of rock wool of pots with potting compost or coconut are used to supply nutrients to crops (Glastuinbouw Nederland, n.d.-2). This manner of cultivation makes determining the amount of water a plant needs simple and allows for efficient growth. However, in order to comply with Skal certification, organic farming does not allow for this way of farming (Skal biocontrole, 2025).



Regular greenhouse

Open floriculture

Outdoor open soil cultivation includes bulbs, arboriculture products and flowers. Tulips, lilies, hyacinths and narcissuses are the main products in bulb cultivation. Together with the other aforementioned crop-types they consist of more than 20.000 varieties. The outdoor cut-flower cultivation sector is relatively small (De Beuze et al., 2005).

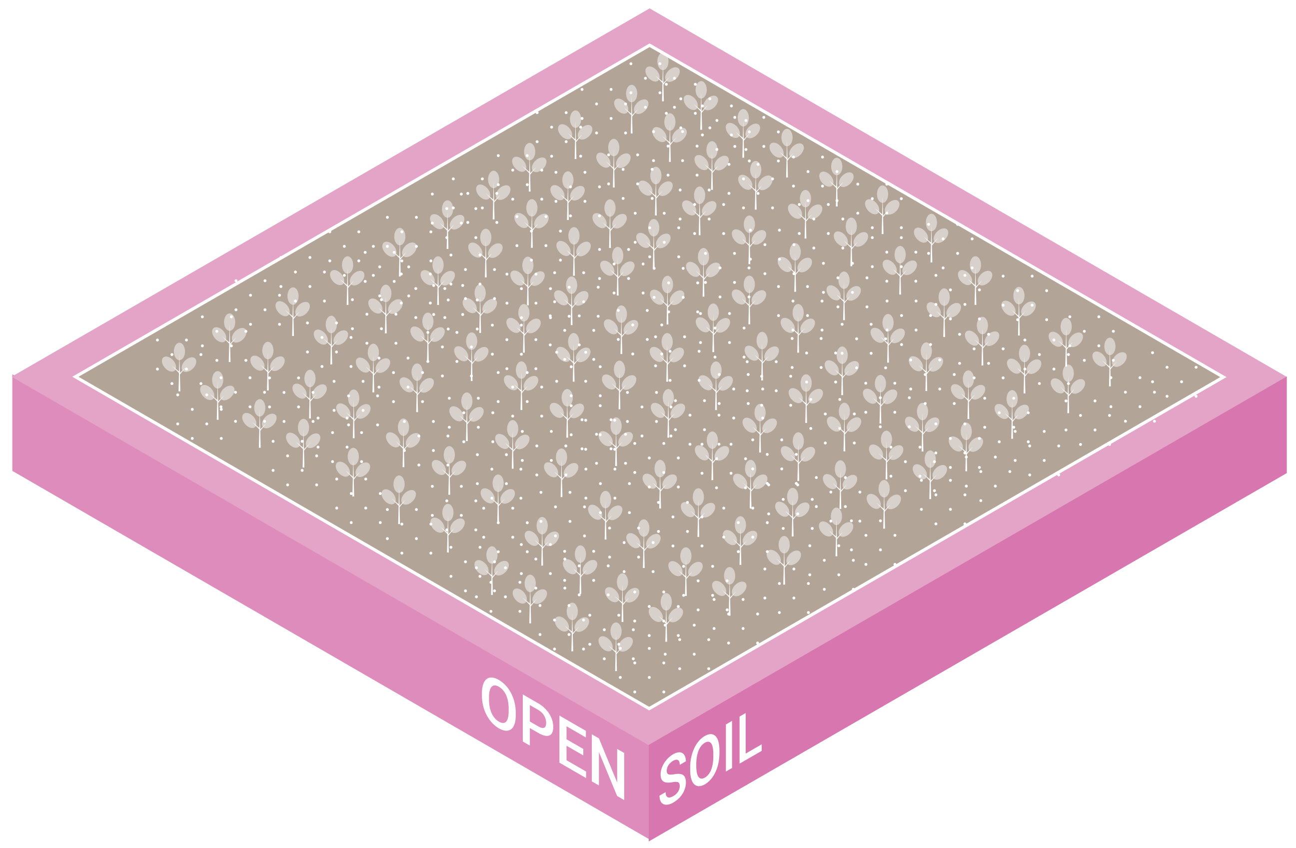
Even in open soil farming monoculture has become the norm for large scale production, because it increases profits. As previously stated, long-term monoculture leads to a depletion of the soil and a loss of nutrients, which then have to be artificially added using fertilisers and pesticides. This increases the negative impact of farming on the environment (Balogh, 2021).

Growing the same crop year in year out leads to a depleted soil, losing nutrients, which have to be replaced by using chemical fertilisers and pesticides, causing a big impact on the environment and biodiversity.

Regenerative soil

Regenerative agriculture also cultivates in open soil. Contrary to conventional open soil cultivation, it aims to create a self-sustaining system, by prioritising soil health. Producing high quality flowers can therefore coexist with improving the land, instead of depleting it (Sahu and Das, 2020). This type of agriculture captures more carbon than it emits and is more resilient to extreme weather, driven by natural productivity of an agricultural ecosystem, rather than an artificial efficiency machine (SystemIQ & Soil Capital, 2020).

The most common techniques for regenerative farming are crop rotation, year-round cover crops, minimal tillage, and controlled grazing. By using drones and robots chemical pesticides can be avoided. Finally, regenerative farming can also be done by mimicking natural ecosystems through permaculture, leading to low-maintenance, resilient agriculture (IJsenbrand, 2021).



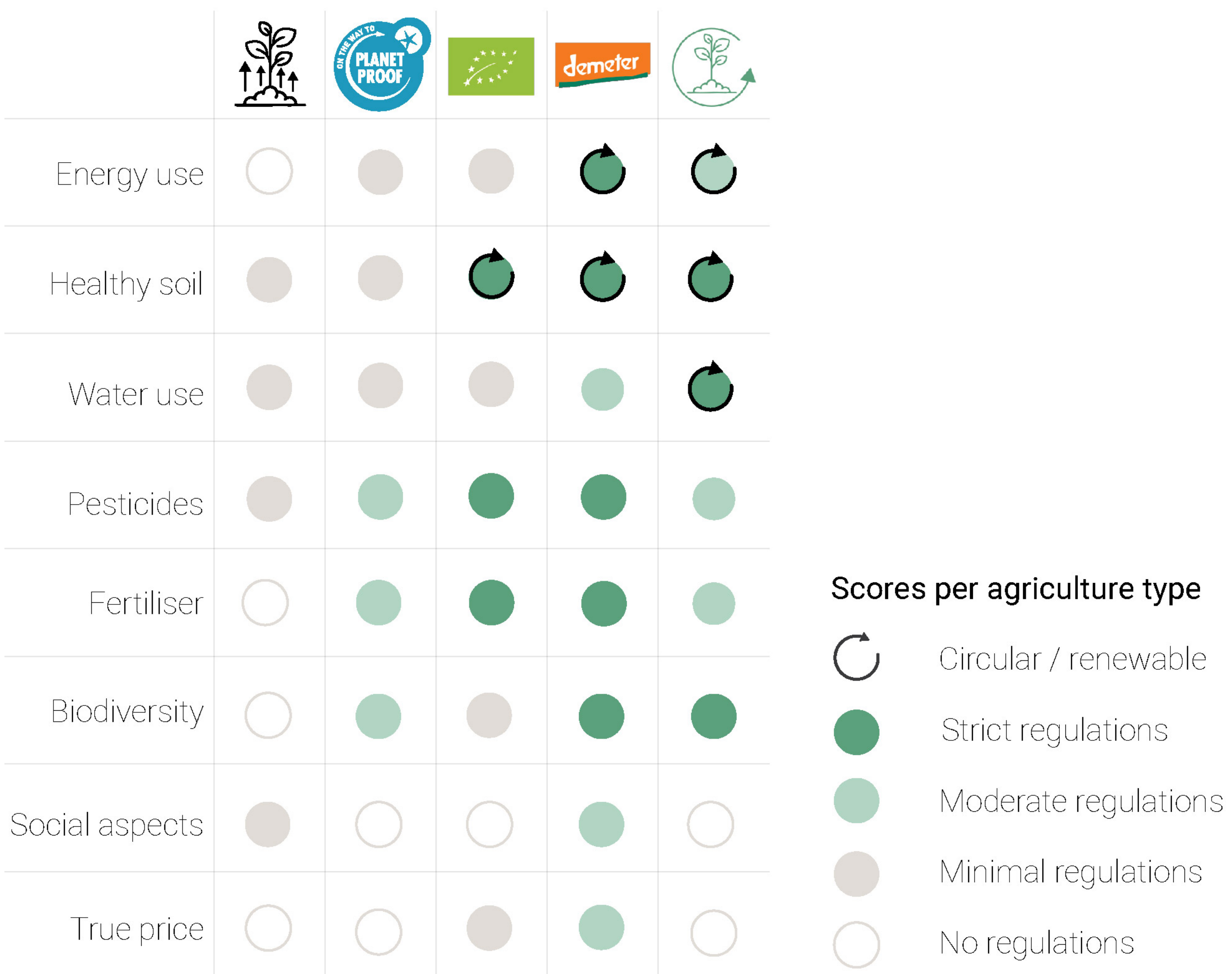
Open soil floriculture

Agriculture methods and regulations

There are many agricultural philosophies and methods for producing flowers. All have a different impact on the environment and are recognizable by different certificates. To make the differences between these explicit, with factors like social and labour circumstances, Milieucentraal created a website to compare them (Milieucentraal, n.d.). Ten certificates are distinguished, divided by production type, but also to which flower shop they are sold.

Five different agricultural methods are specified on the right, with three of them having their own certificate. The table below illustrated how strict the methods score in terms of regulations. The first shows conventional agriculture, which has no official certificate. The last shows circular agriculture, once again without an official certificate.

As is clear, there are many certificates, making it difficult for consumers to understand the implications of their purchase. For example, while the Skal certificate appears to signal a good purchase for the environment, the certificate does not prohibit fossil fuel use.



Intensive agriculture

Conventional agriculture

Conventional agriculture has clear environmental and climatebased impacts: climate change, resource scarcity, soil depletion, reduced biodiversity, environmental pollution, and a water shortage.

Regulations

Products from conventional agriculture need no certification.

There are laws on animal manure use and water quality, among other aspects of agriculture, but there are no strict requirements pertaining to sustainability (Milieuregels in Boerentaal, 2025).

Planet proof

(On The Way to PlanetProof, 2024)

Integrated agriculture

Integrated agriculture states that farming intensity should be in balance with the Earth's bearing capacity. Resources cannot run out, therefore it focuses on lessening the use of resources from elsewhere. Production is combined with landscape management, restoring soil quality, biodiversity, and the natural resistance of crops and production systems. Products are certified as 'On the way to PlanetProof'.

On the way to planet proof certificate

- Use of chemical pesticides and artificial fertilisers must be limited and attention needs to be paid to the prevention of diseases and pests.
- Various crops are planted in the fields and/or the farmer creates strips of flowers around field edges to attract beneficial insects.
- Water should be reused.
- Use of renewable energy sources is encouraged, as is more efficient energy use.

Organic farming

(Skal Biocontrole, 2025)

Organic farming

Organic farming combines environmentally conscious practices with high levels of biodiversity, conservation of natural resources, and high animal welfare standards. Floriculture products certified with the EU label get an organic certificate from Skal.

Skal certificate

- Crops grow in open fields.
- To prevent diseases and pests, crops are rotated and hoeing and weeding is carried out. Pesticide use is limited.
- Prohibition of the use of genetically modified organisms.
- Only animal manure is allowed. Excess manure goes to other organic farmers.
- There are no requirements in terms of water or energy use.

Demeter

(Keurmerkenwijzer Milieu Centraal. n.d.)

Bio dynamic agriculture

Biodynamic farming is a holistic approach to farming based on concepts by Rudolf Steiner (BRON). It integrates organic practices, astrological planting calendars, and natural soil enhancements to create a self-sustaining and biodiverse ecosystem. This farming method complies with EU regulations for organic farming, applying even stricter rules. Therefore, all the SKAL rules also apply. Demeter Foundation is responsible for the procedure and regulations for Dutch farmers.

Demeter certificate

- Green electricity is mandatory.
- Only biological means of plant protection are allowed. No pesticides are allowed.
- Requirements for energy and water use in cultivation, transport, waste management and packaging use.
- At least 10% of the area must be available for local biodiversity, crop rotation is mandatory.
- Social requirements such as combating child labour, discrimination and right to fair payment.

Circular agriculture

Circular agriculture

In circular agriculture, farming is done in a way that diminishes waste production. All raw materials and any residual flows are utilised and reused within the cycle as much as possible. This does not have to be limited to one farm, but can be achieved in collaboration with others. A farm does not have to achieve this alone, but may also do so in cooperation with other farms. The Dutch Ministry of Agriculture Nature and Food Quality (LNV, 2018) created a vision for circular agriculture. However, there is no certificate to signal this to consumers yet.

Vision on circular agriculture

- Agriculture and horticulture use residues and waste from each other's farms and from the food industry.
- Energy use is as low as possible and mostly from renewable sources.
- As little use of fertilisers as possible, by paying close attention to soil quality and fertility.
- Farmers prevent diseases and pests by choosing resistant plants and supporting biodiversity, with flower beds, crop rotation and the use of natural enemies of pests.

Innovations in floriculture greenhouses

Westland plays a key role in the innovation and transition of greenhouses to a future proof and sustainable sector. Some key innovations for the upcoming 25 years are highlighted in the greenhouse sector shown on the right. The focus therein lies on the automation of the production chain and the shift towards a regenerative and circular system. Importantly, for these innovations to become accessible on a larger scale, they must become more affordable. Otherwise, the aforementioned shift will remain out of reach.

Automatisation

The Dutch greenhouse sector aims for a 2050 where manual labour is largely redundant, thanks to robotisation, digitisation and artificial intelligence. The use of robots particularly offers a solution to many issues the sector currently faces rising labour costs, reliance on migrant labour and increasing pressure to operate sustainably. Utilising robots for repetitive and intensive tasks allows for people to focus on value-added work (WOS, n.d.).

Ethic use automatisation

There are currently no regulations pertaining to the use of automated machines in organic agriculture (European Commission, 2025). However, there are rules in place for the use of machines. The European Union has introduced a new Machinery Regulation, set to replace the 2006 Machinery Directive, with enforcement beginning on January 20, 2027 (BKT Tires, 2024). This regulation aims to ensure that the integration of emerging technologies such as AI in agricultural machinery enhances efficiency and productivity, whilst maintaining high safety and security standards.

Energy and CO²

Through the use of geothermal energy, renewable energy, and by using this energy more efficiently, horticulture is transitioning towards being climate neutral by 2040, as stated by the Greenhouse union Glastuinbouw Nederland in the booklet 'Gaan met die circulaire kas (2022).

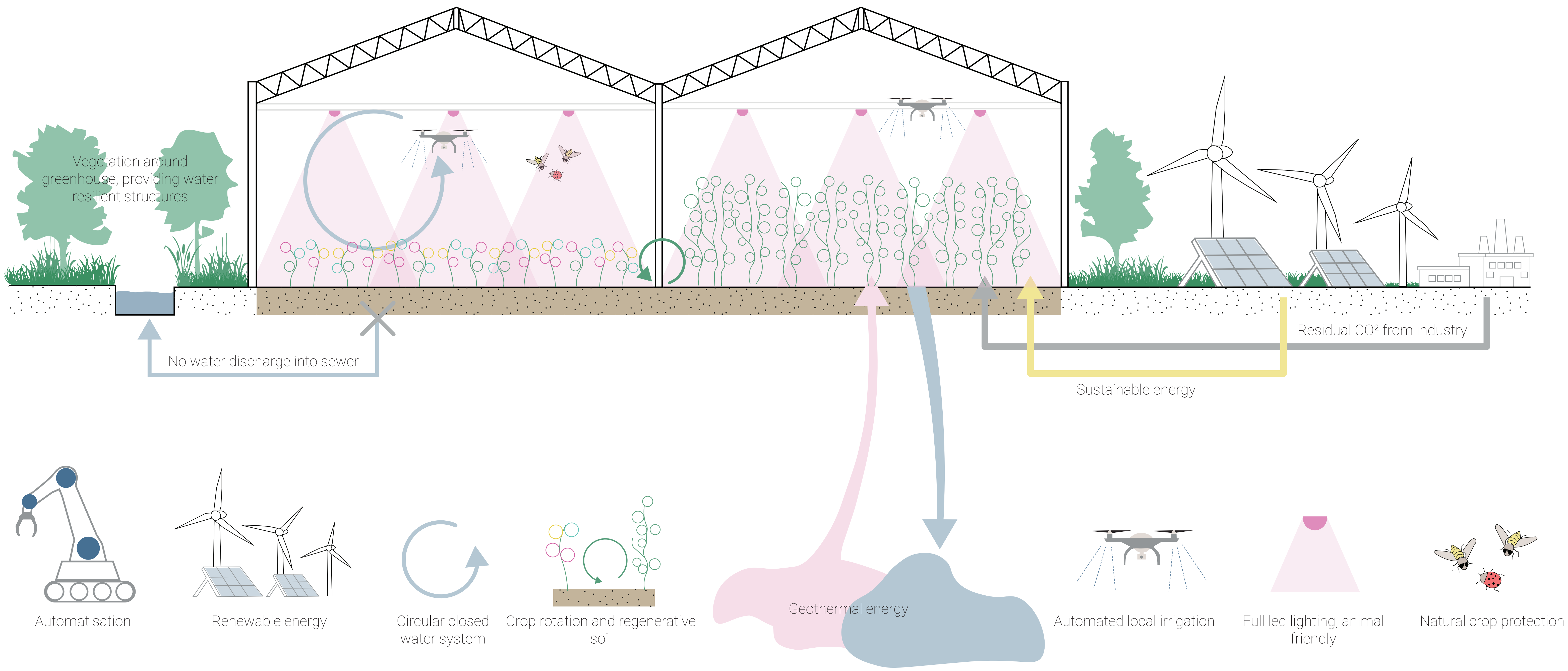
Geothermal energy could produce half of the current heat needs of greenhouses. This heat is extracted from water from deep underground. After the water is cooled, it returns to the ground, creating a closed cycle of heat production and consumption. These sources can also provide for other functions. To increase the efficiency of greenhouses, energy-saving techniques are being assessed, such as: dehumidification, application of low-grade heat, heat storage and adapted deck material (WUR, 2014).
With these renewable energy sources, horticulture could in the future become climate neutral. Important to note is that greenhouse owners need to be able to purchase or produce enough CO2 for their crop growth.

Water use and crop protection

Innovated greenhouses will no longer need to discharge water into drainage systems, as everything will be reused. Therefore, nutrients are no longer lost, the water is used optimally and no products that serve as crop protection end up in surface water. Irrigation drones would make watering plants locally possible. Ozone is used to disinfect water, making it safe to reuse in cultivation. Crop protection should become fully integrated, using natural enemies wherever possible (WUR, n.d.).

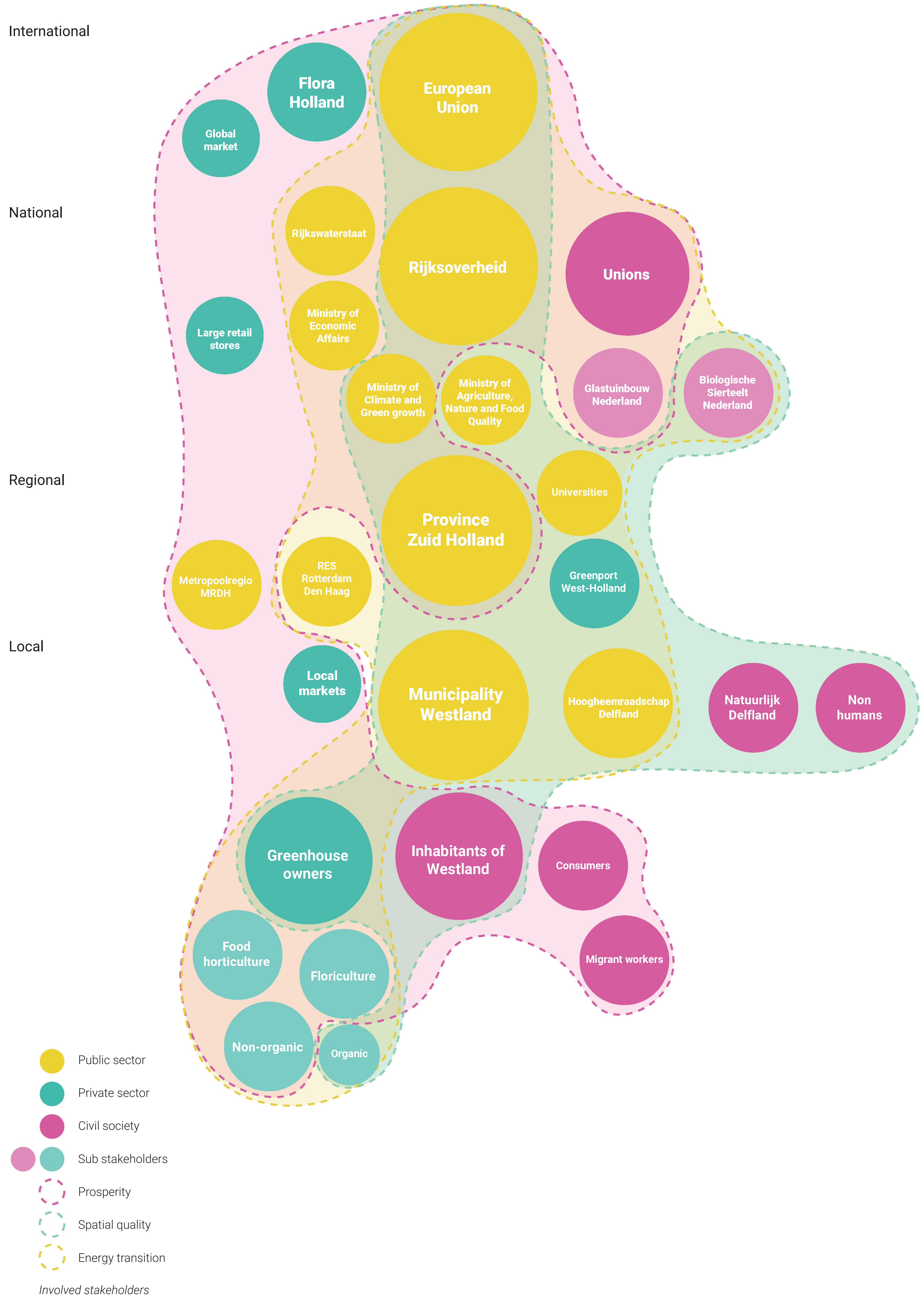
Regenerative soil and crop rotation

Through regenerative agriculture, greenhouses could return to tilling in soil. This would lead to a self-sustaining system that prioritises soil health, while still producing high quality crops. Ultimately, this would result in productive farms and healthy communities and economies (Sahu and Das, 2020). Regenerative organic techniques could be employed even on indoor crops, such as cover cropping, reduced soil cultivation, use of on-farm inputs, recycling of nutrients, use of plant and animal-based inputs, and increasing diversity in their crop rotation (Dick, 2022). Crop rotation is the most effective and cost-beneficial way to improve crop efficiency and soil fertility (Boincean & Dent, 2019). However, this would call for a systemic change in greenhouse use that would need time to grow. Therefore, it is necessary to phase in this transition with other ways of attaining a regenerative soil.



Stakeholders

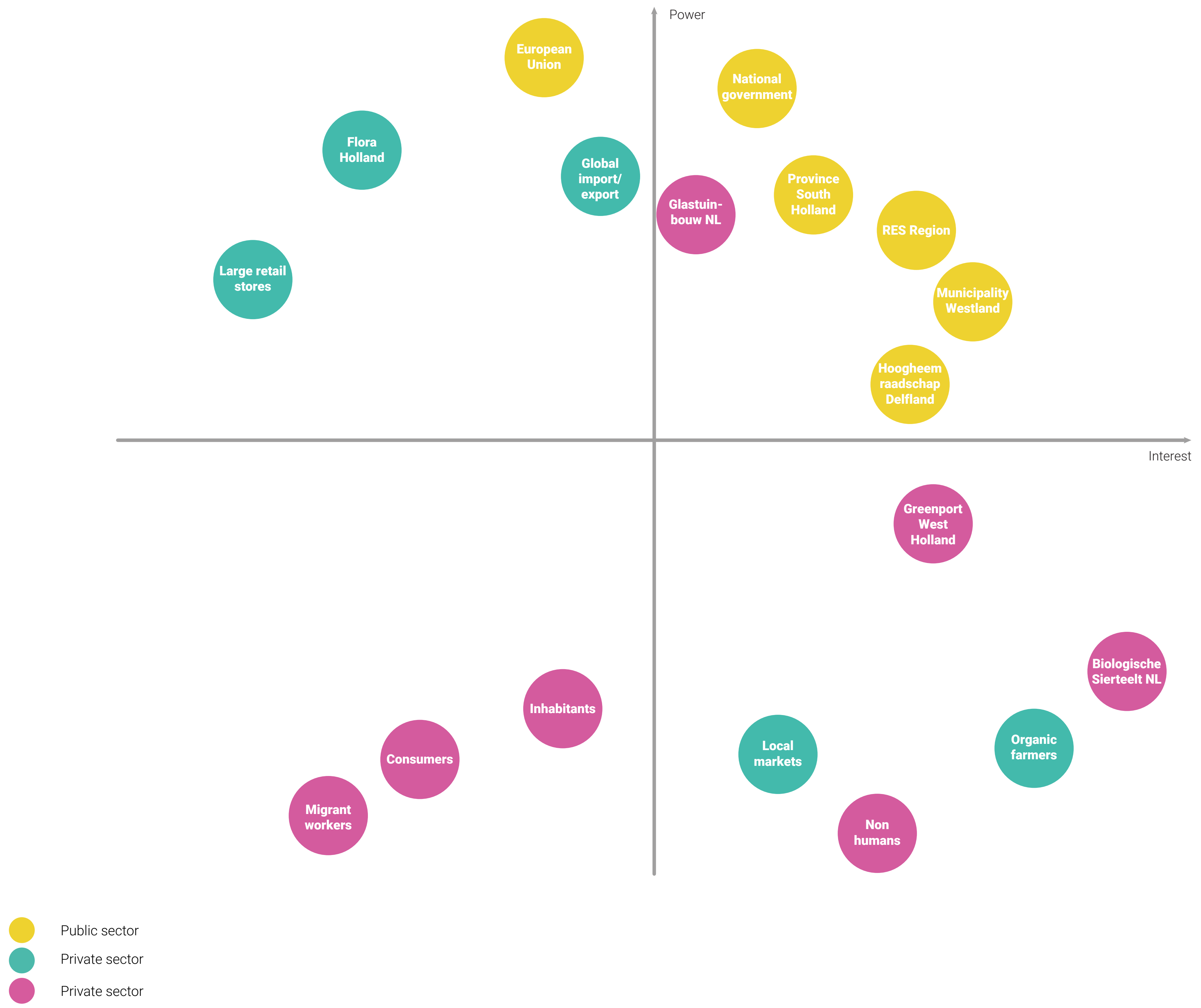
The floriculture sector in Westland is embedded in a complex network of stakeholders—ranging from local residents and municipalities to international trade platforms and European policy makers. Each of these actors has its own interests, priorities, and degrees of influence over the future direction of floriculture. In the diagram shown on the right, the main stakeholders involved in this system are visualized, from the local to the global level.



Stakeholder interest

In Westland and the broader floriculture system, a diverse range of stakeholders can be identified. The list on the right highlights some of the most critical ones, outlining their key interests in relation to the energy transition and the shift towards organic floriculture. These stakeholders hold varying degrees of power and interest in our project, which is illustrated in the power-interest index below.
This project challenges the current top-down management of the floriculture industry as it is now, by amplifying the voices of underrepresented stakeholders and reducing the dominance of large powerhouses.

To provide clarity, the stakeholders have been categorised into three sectors: public, private and civil society. The public sector consists of governmental, non-profit organisations such as the European union. They shape policy, law and regulation. The private sector includes for-profit organisations that drive economic activity. They hold power in the form of blocking plans. Finally, civil society represents social groups and public, non-governing organisations (European Commission, n.d.). They again hold power mostly in the form of blocking plans.
Each sector wields different resources, influencing the industry differently as well.
Currently, big companies and government institutions largely align in maintaining the status quo, introducing only incremental changes in energy policy. However, this slow, gradual approach no longer suffices. To achieve significant goals, the voices of smaller stakeholders need to be heard, and these incremental steps must give way to bold and decisive action.



Power interest matrix

Public Sector

European Union
Interests:
Reaching climate neutrality, Upholding economic connections

National Government
Interests:
Reaching climate neutrality in 2050, global market share in production

Province South Holland
Interests:
broad prosperity and selective growth

RES Region
Interests:
Making greenhouses more energy efficient.

Municipality Westland
Interests:
Improving the image of greenhouses and Westland, big global production to be proud of

Hoogheemraad-schap Delfland
Interests:
Cleaner water, water safety, sustainablee water use

Private Sector

Flora Holland
Interests:
Maintain competitiveness of Dutch floriculture, innovating the industry, reaching energy neutrality

Large retail stores
Interests:
Retaining low import prices, sourcing more sustainably, supplying growing demand

Global import / export
Interests:
Continuing global bonds, market regulations

Greenhouse owners
Interests:
Lower energy prices, more land, constant and easier policies, sustainable production

Organic flower farmers
Interests:
A sustainable way of cultivating flowers, better certifications, financial support

Local markets
Interests:
Supplying local products, sustainable floriculture system, investment in local distribution

Civil Society

Glastuinbouw Nederland
Interests:
Innovation, energy neutrality, low costs

More-than-humans
Interests:
Diverse ecology, a place to breed safety, connection, no more pesticides

Greenport WestHolland
Interests:
Improving knowledge and connection between greenhouse clusters and further innovation

Migrant workers
Interests:
Good labour conditions, social safety

Inhabitants of Westland
Interests:
A liveable Westland, profitable floriculture, less dependency on fossil fuels (due to costs)

Biologische Sierteelt NL
Interests:
Supporting organic floriculture, getting a more prominent plac in the zeitgeist

Consumers
Interests:
More clearly labeled organic flowers, transparancy in the environmental cost of flowers

Knowledge institutes
Interests:
Advancing knowledge, collaborate with other sectors

Stakeholders interests

Connected policies

The stakeholders from the public sector have policies pertaining to the energy transition and agriculture on a Westland scale. The image on the right outlines the key policy trajectories and corresponding challenges and goals at three levels: national, regional, and municipal.

At the international level, the Paris Climate Agreement provides the overarching ambition to reduce global greenhouse gas emissions (Ministerie van Economische Zaken en Klimaat, 2024). In response, the Netherlands has committed to becoming climate neutral by 2050, leading to the development of the National Energy Structure (Ministerie van Economische Zaken en Klimaat, 2024). This strategy emphasizes the expansion of renewable energy, infrastructure development, and technological innovation, while also identifying major challenges such as space limitations, intermittency of renewables, and competing land use.

Building on this, the Regional Energy Strategy (RES) translates national goals into regional action. In the Westland region, the RES aims for climate neutrality in the greenhouse sector by 2040 (Res Regio Rotterdam Den Haag, n.d.). It focuses on the development of heat networks, increased use of renewable energy, and collaboration between stakeholders. Yet, the region still struggles with issues like high energy consumption, uncertainty about future energy demand, and a lack of financial viability for sustainable solutions.

At the local level, the Municipality of Westland has committed to achieving greenhouse energy neutrality by 2040, with substantial CO_2 reductions already planned for 2030. The municipal strategy supports sustainability through subsidies, feasibility studies, and infrastructure investments. However, the local greenhouse sector faces additional problems, including high energy prices, aging infrastructure, and continued dependence on fossil fuels.

To accelerate change, alignment and stronger collaboration across all levels—national, regional, and local—will be essential.

Nationaal programma
RES Regionale Energie Strategie

GEMEENTE WESTLAND

The Paris climate agreement

National Energy Structure

Climate Change: The primary driver for the transition is the urgent need to reduce emissions to combat climate change.

Climate neutral by 2050: Which will require significant changes in energy production and consumption patterns.

Problem

Space constraints: The transition to a climate neutral energy system requires more physical space than current fossil fuel-based system.

Infrastructure needs: There is a significant need for new infrastructure to support renewable energy sources, such as wind and solar energy.

Intermittency of renewable energy: Renewable enerhy sources like wind and solar are weatherdependent, leading to fluctuations in energy production supply.

Competing land use: The energy transition coincides with other spatial demands such as housing and nature conservation.

Expansion of renewable energy: Plans include increasing offshore wind capacity, which will contribute to both domestic energy and export capabilities.

Infrastructure development: New infrastructure including high-voltage cables, pipelines , and energy storage is needed to implement the energy transition.

Technological innovation: There is an emphases on fostering technological innovation that enhance energy efficiency and safety, such as hyrdrogen and storage technology.

Regulatory framework: The government is modernizing regulation to facilitate the development of energy infrastructure while balacing the envionmental and community interest.

Goal

Regional Energy strategy

Problem

Intermittency of renewable energy: Renewable enerhy sources like wind and solar are weatherdependent, leading to fluctuations in energy production supply.

Uncertainty in future demand: After 2030 the energy demand for greenhouses is uncertain due potential changes in cultivation techniques.

Labor market issues: There is a structural shortage in the labor market for technicians, which poses a risk to the succesful implementation of energy in the transition plans.

Regulatory challanges: Existing regulations do not provide sufficient tools for municipalities to manage the local heat transition effectively.

Energy consumption: The region is currently using a significant amount of energy. There is a pressing need to reduce this energy demand.

Financial viability: The transition to sustainable energy sources, such as heat energy networks and electric heating is currently not financially viable.

Climate neutral by 2040: The greenhouse sector aims to become climate neutral by 2040, which involves significant energy savings and a shift towards renewable energy.

Development of heat networks: Within the greenhouse sector there is a strong willingness to transition to heat networks, which reduc individual energy consumption.

Increased use of renewable energy: Plans include utilizing water basins for solar panels and exploring wind energy, contributing to national energy targets.

Collaboration and local ownership: Future plans emphasize collaboration amoung stakeholders and aim for 50% local ownership of new renewable energy projects.

Regulatory and financial support: The development of regulations and financial instruments is crucial for the transition. This includes exploring subsidies and other mechanisms.

Goal

Municipality of Westland

Problem

High energy prices: The greenhouse sector is facing challanges due to extremely high energy prices. Which make the operations less profitable.

Aging infrastructure: 60% of the greenhouses was built before 2000, making them less efficient in energy use.

Dependence on fossil fuels: The reliance on natural gas and electricity for heatingand lighting is problematic.

Environmental regulations: The need to comply with environmental regulations and the transition towards more sustainable practices adds pressure on the greenhouse sector.

Energy transition: The goal is to achieve energy neutrallity in geenhouses by 2040, with signigicant reductions in CO2 emissions planned for 2030.

Support for sustainability initiatives: The municipality plans to support greenhouses trough subsidies and feasibility studies to encourage the energy-saving measures.

Infrastructure development: The RES aims to create sustainable energy supply for greenhouses. Including the development of a collective heating network.

Investment in renewable energy: There is a strong focus on renewable sources such as solar panels and geothermal energy, to reduce dependence on fossil fuels.

Innovative technologies: The sector is looking into innovative technologies such as heat-cold storage systems and further electrification of heating processess.

Goal

Policies European to regional (Ministerie van Economische Zaken en Klimaat, 2024 & Res Regio Rotterdam Den Haag n.d. & Gemeente Westland 2023)

Connected policies

On a regional scale, the regional water authority, Hoogheemraadschap Delfland addresses growing concerns about groundwater use, land subsidence, drought-related water scarcity, and declining water quality. These policies reflect growing awareness of the impact that greenhouse farming has on regional ecosystems. Delfland emphasizes the need for sustainable water management, including better integration between urban and agricultural water systems. Other goals include increasing green space, improving climate resilience, and reducing flood risk by restructuring urban water infrastructure.

Hoogheemraad van Delfland

Hoogheemraadschap Delfland Watervisie

Problems

- **Groundwater extraction and land subsidence:** Continuous groundwater extraction leads to land subsidence
- **Increased water demand during drought:** There is a growing demand for water during drought periods, with insufficient sources to meet this demand
- **Heat Island Effect:** The increase in impervious surfaces contributes to the heat island effect, exacerbating urban heat
- **Flooding and water quality Issues:** The rise in impervious surfaces also leads to increased floodingrisk, and the chemical quality of water is deteriorating
- **Fragmentation of agricultural practices:** The fragmentation of agricultural areas leads to individual initiatives that put pressure on soil and water resources

Goals

- **Sustainable water management:** Implementing off-bottom greenhouses to stop groundwater extraction and improve water reuse during droughts
- **Integration of urban and agricultural systems:** Creating an integrated system where excess heat and water from greenhouses can be reused
- **Enhancing biodiversity and green Spaces:** Increasing green spaces to mitigate the heat island effect and improve biodiversity
- **Improving urban Infrastructure:** Restructuring urban areas to enhance water retention and reduce flooding risks, including the creation of new water channels
- **Climate resilience:** Developing climate-resilient urban designs that incorporate green roofs, water storage systems, and improved drainage

Policies spatial quality (Hoogheemraadschap Delfland, n.d.)

Connected policies

South Holland's spatial economic vision promotes a sustainable and future-proof greenhouse sector that is both economically viable and environmentally responsible by 2040. This includes innovation in automation and sustainable practices, resource management to reduce reliance on fossil fuels, and safeguarding production capacity to ensure food security. The province also aims to strengthen regional clusters by stimulating cooperation and knowledge exchange, and aligning greenhouse locations with ecological and water system planning.

The Greenport Westland initiative imagines a fully circular and innovation-driven greenhouse ecosystem by 2040. The vision positions the region as a hub for smart collaborations between entrepreneurs, policymakers, and researchers. Key components include the development of zero-waste production systems, modular and future-proof greenhouses, and a shift toward sustainable water and energy use. Spatial planning is emphasized, with a focus on efficient land use and transport, as well as maintaining a strong knowledge and innovation ecosystem.

Glastuinbouw Nederland, the greenhouse owners' union, is working to support all its members in transitioning to more circular and climate-resilient production systems. Their focus includes collecting rainwater to mitigate droughts and flooding, promoting automation to reduce labour intensity and improve working conditions, and pushing for greater energy efficiency through investments in technologies like LED-lighting and geothermal systems. While many innovations are underway, the union highlights the need for further support to ensure that future-proof greenhouses are within reach for all farmers—not just the richest or most advanced.

provincie Zuid-Holland

Glastuinbouw Nederland

GREENPORT West Holland

Regional economic perspective

Goals

- **Zuid-Holland Spatial Economic vision:** The goals specifically related to greenhouses, particularly in the context of the horticultural sector, include:
- **Innovative development:** Encouraging technlogical innovations in the greenhouse sector, such as automation and sustainable practices, to enhance productivity and reduce environmental impact.
- **Sustainable transition:** The province aims to accelerate the transition to a sustainable and future-proof greenhouse sector that is climate-neutral, circular, and economically viable by 2040.
- **Resource management:** Addressing the high consumption of fossil resources, pesticides, and plastics in the greenhouse sector while ensuring the availability of freshwater.
- **Maintaining production capacity:** Ensuring sufficient space for primary production companies within the greenhouse cluster to secure the entire horticultural chain, which is vital for food security.

Perspective on the greenhousessector in Westland

Goals

- **Greenport ambitions:** In 2040, Greenport is an innovation ecosystem of businesses, policy makers and knowledge institutions.
- **Fully circular by 2040:** -Zero-waste production - Greenhouses are circulair built - innovative and natural watersystem - circular production packaging
- **Spatial economic cluster:** - Renewable energy and efficient use - More sustainable transport, using hubs - Future proof greenhouse location based on ecology and water
- **Knowledge and innovation:** - Collective cooperations - individual innovations - Export of knowledge and solutions. - Sustainable knowledge and innovative ecosystem
- **Maintaining Production Capacity:** Ensuring sufficient space for primary production companies within the greenhouse cluster to secure the entire horticultural chain, which is vital for food security.

Perspective on the change in greenhouses

Goals

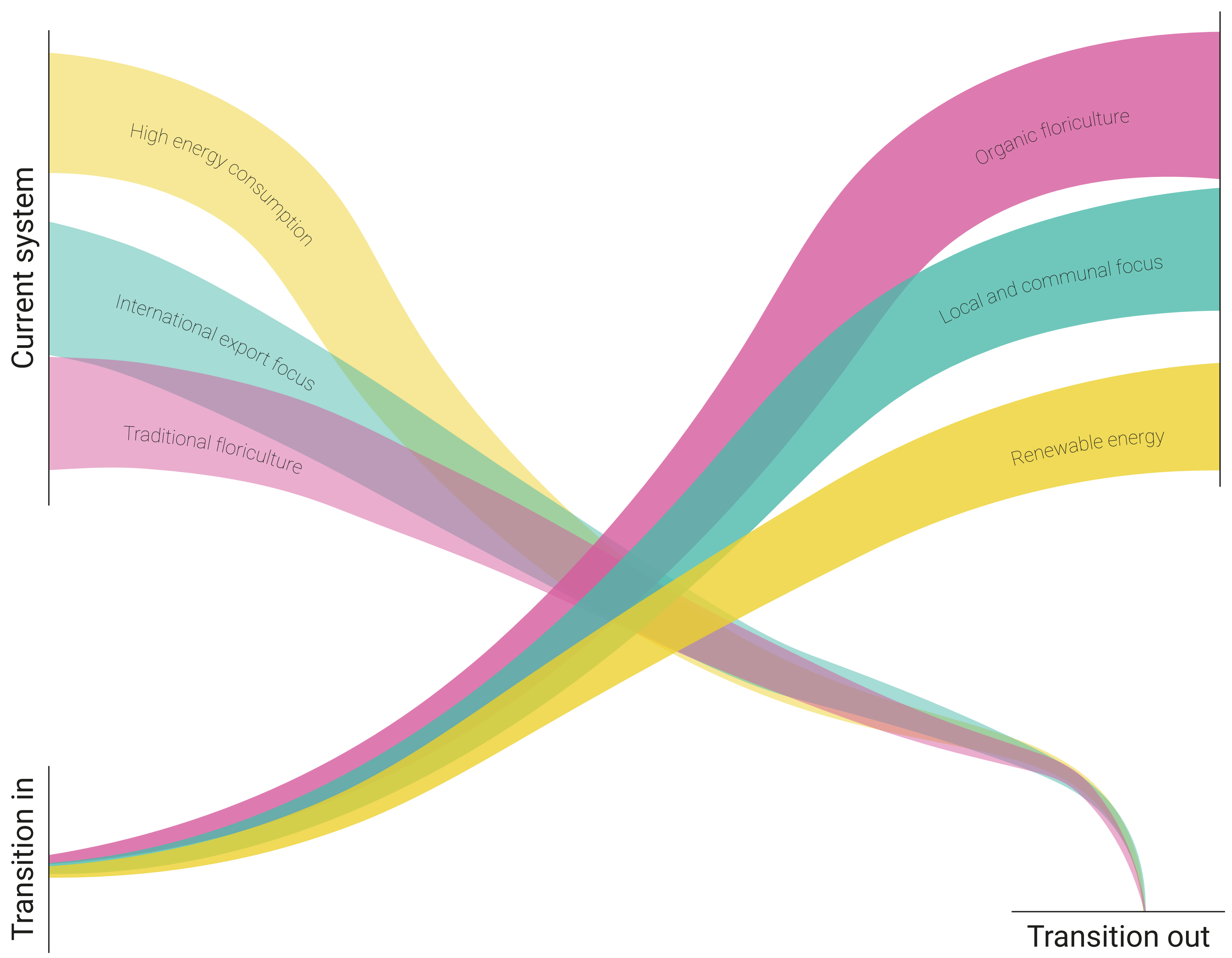
- **Glastuinbouw Nederland:** The union (including 3300 companies) is working on creating the circular greenhouse for every farmer
- **Geothermal energy:** Horticultural entrepreneurs are investing in heat from the ground. Geothermal energy can be used not only to heat greenhouses, but also houses, swimming pools and schools.
- **Collecting rainwater:** Greenhouses collect rainwater to prevent flooding during periods of extreme rainfall.
- **Automation:** Automation and robotics make the greenhouse future-proof: less monotonous manual work and more interesting technical functions.
- **Energy savings:** Innovations in energy and growing light (including LEDs) are important for greenhouse horticulture entrepreneurs, but also for entrepreneurs investing in greening and sustainability.

Policies greenhouses (Provincie Zuid-Holland n.d. & Greenport West Holland, 2018 & Glastuinbouw Nederland, n.d.)

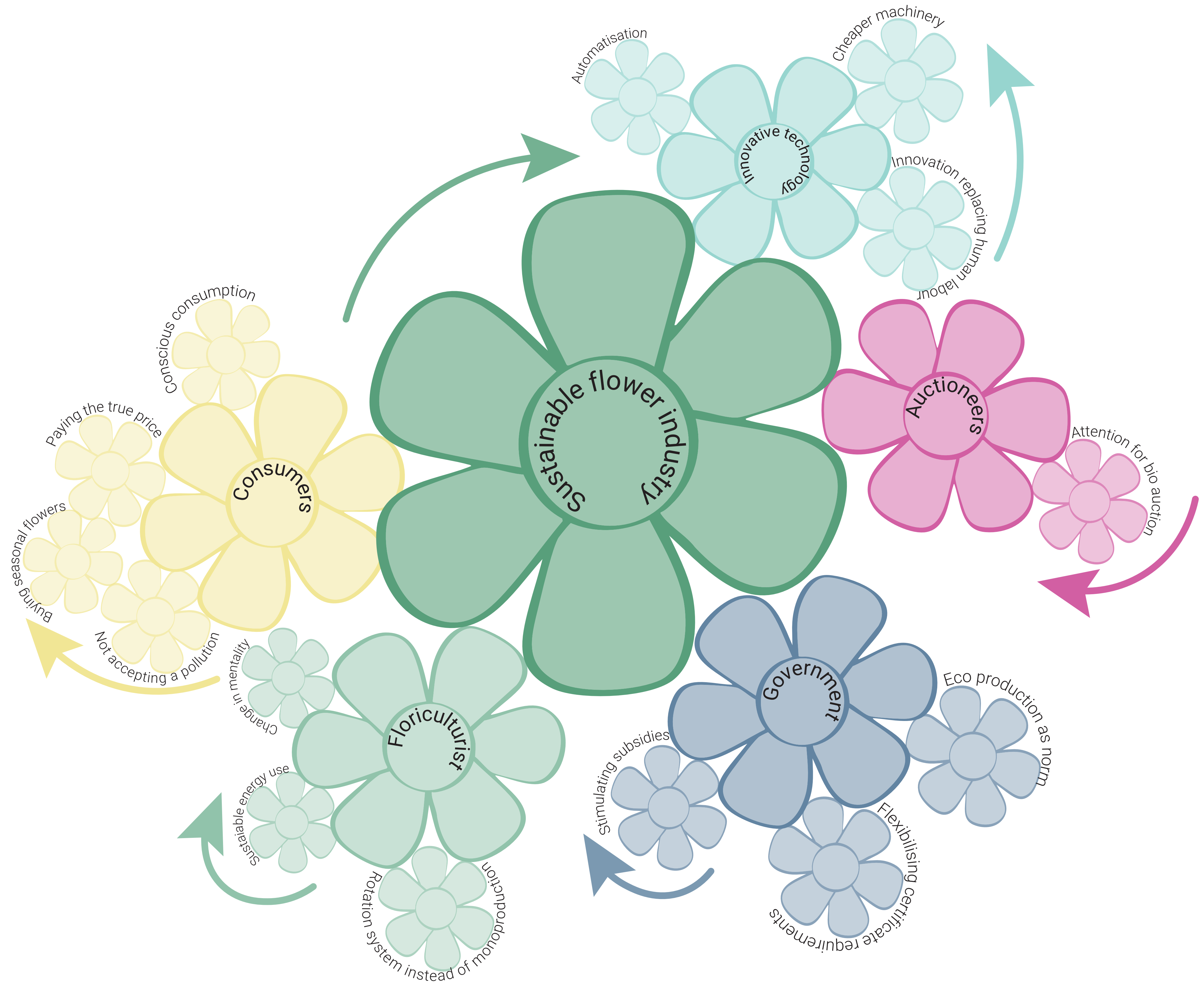
Conclusion

The current greenhouse system needs to change. As it stands, the model is not efficient in terms of resource use, revolving almost entirely around maximizing production and revenue. This results in excessive energy consumption and environmental degradation. Transitioning to renewable energy is essential, but it will not be enough if overall energy demand remains as high. As calculations show, maintaining the current energy use levels of only the flower industry with renewables would require far more space than Westland can provide.

A more sustainable and efficient system must be built—one that reduces energy use, limits environmental impact, and supports long-term resilience. Policies are already pointing in this direction, but change will only be possible if all actors work together. To truly transform the floriculture system, every stakeholder must act.



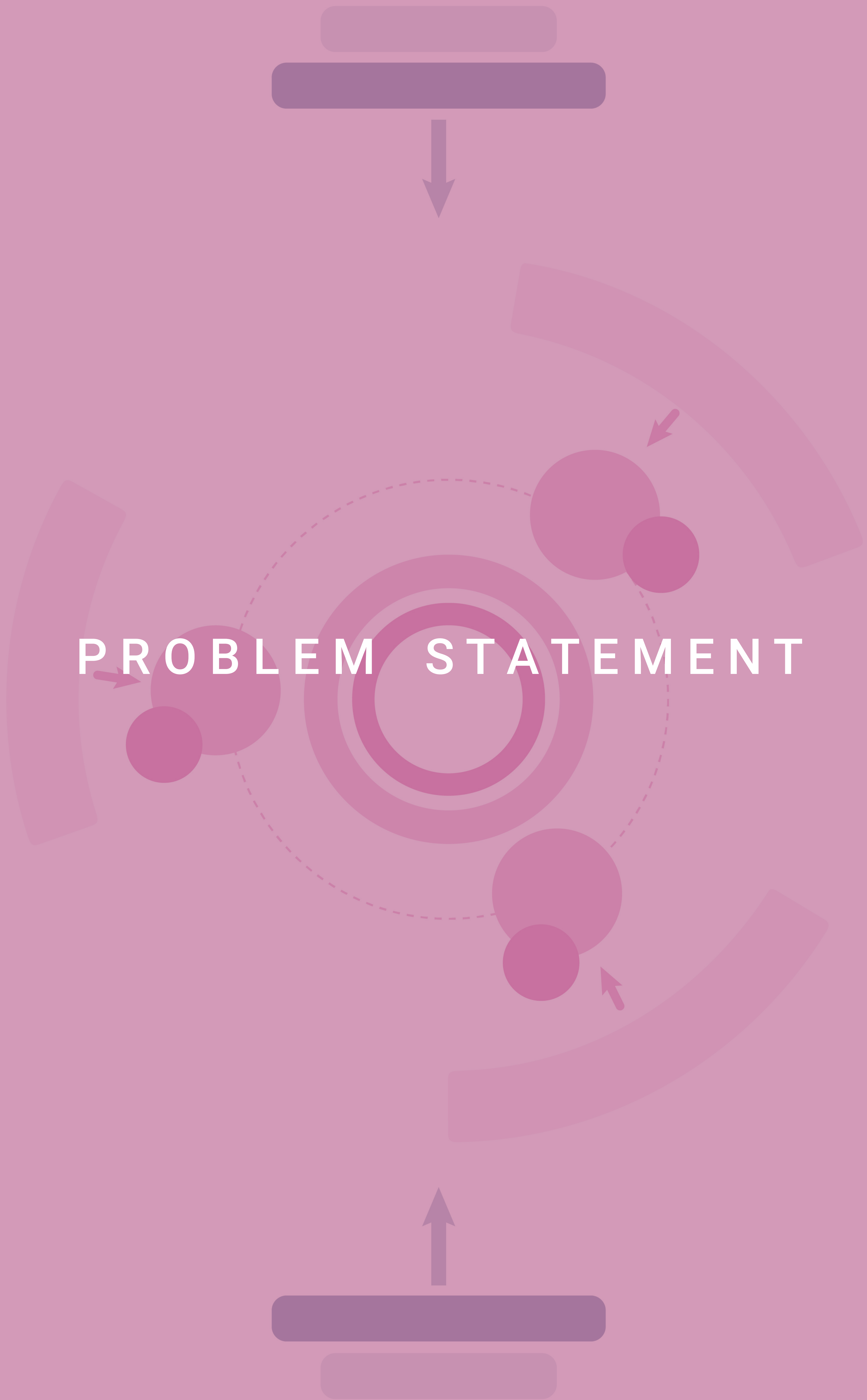
Transition in, transition out diagram



Every gear must turn for the system to change

Gear turning system

PROBLEM STATEMENT



Research questions

Main question

How can we use the energy transition as a catalyst to transform the flower industry in Westland into a circular organic industry, therefore enhancing the spatial quality?

Sub questions

The sub questions have been divided into three categories in which the vision is also categorised. The main question per category is highlighted.

Energy landscape: How to turn the greenhouse landscape of Westland into an energy producing landscape?
- How much energy is needed currently in Westland?
- What is the spatial implication of this energy demand?
- How to optimise the energy consumption in the flower industry?
- How can this energy production be implemented in the landscape?

Eco floriculture: How can the flower industry be reshaped to remain feasible, while being organic and fully circular?
- How can regenerative farming be implemented in Westland's flower industry?
- How to stimulate the collaboration between knowledge institutes for the innovation of the floriculture sector?
- What new cultivation types can influence the future of flower production?
- How to convince the involved stakeholders in Westland to make the transition to an organic circular production?

Spatial quality: What changes need to be made to sustain Westland's prominent global identity in terms of horticulture?
- How to add value to floriculture products?
- How can a reshaped flower industry improve the spatial quality of Westland?
- What concepts/spatial interventions could support the future organic floriculture in Westland?
- What interventions are needed in Westland to adapt to climate change?

Problem statement

Westland, a municipality in the Netherlands, is famous globally for its intensive horticulture industry. Housing almost a quarter of Dutch horticulture, it contributes significantly to the national conomy, with 85% of its produce being exported across the globe . In total, the industry accounts for around 1% of the Netherlands' GDP (CBS Statline, nd.;DutchHorticultureNL, n.d.). The flower industry, making up nearly half of the green-house area within Westland, is a large part of this success. However, behind this economic success lies a growing environmental crisis.

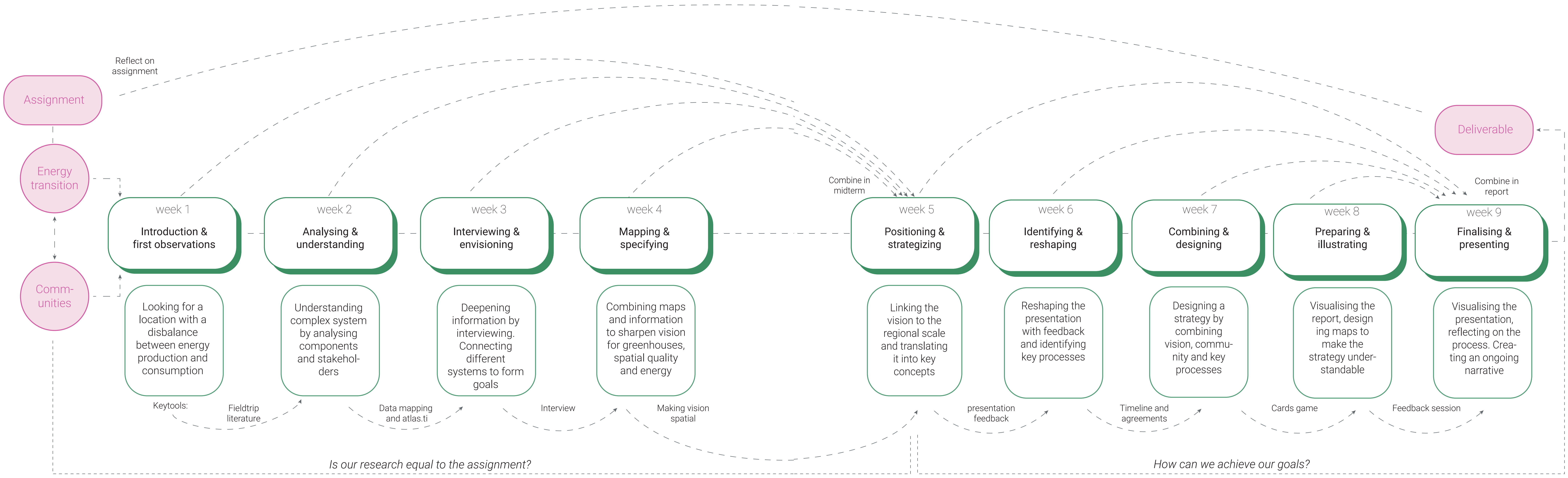
The floriculture industry, though lucrative, comes at a high environmental cost. The area suffers from salini-sation due to constant groundwater extraction, declining soil health, and biodiversity loss (SOURCE). On top of that, in comparison to imported flowers, Dutch floriculture results in a greater environmental burden due to the use of pesticides and the energy use. As the industry has a high energy demand, it relies heavily on fossil fuels. Rising energy prices due to shifting global alliances further expose the industry's vulnerability. The union Glastuinbouw Nederland aims for climate neutrality by 2040, which is an ambitious goal, especial-ly seeing the current transition strategy (SOURCE).

The current spatial configuration of Westland leaves no space for the needed scale of energy infrastructure. To restore the ecosystem in the area, even more space is needed. The challenge is no longer how to sustain the floriculture industry, but how to fundamentally transform it.

This research seeks to explore how the necessary energy transition can serve as a catalyst for transforming the flower industry in Westland into a circular, organic industry, while also improving the spatial quality of the region. This needs to be done in connection to current greenhouse owners, as this private sector holds such power in the area. Shifting interests and perspectives in the community is essential. The project aims to contribute to the field of complex system design, of community-based transformation and sustainable devel-opment. The project aims to identify structural and systemic changes needed to achieve ambitious sustain-ability goals and how to start the process of this change. A focus lies on innovation and systemic change is present throughout the project.

Methodology

This scheme shows the methodological approach that guided our project. It outlines the assignment, along with the necessary tools and methods for each week. In addition, it highlights two overarching reflections. During the first half of the project, we continuously evaluated whether our research remained aligned with the core assignment. Once that connection was firmly established, the focus of reflection shifted towards assessing the feasibility of our goals in the second half of the project.
This schedule is an approximation of our approach, topics are not covered strictly per week. As with most research and design projects, the process is inherently iterative, resulting in the need for a more flexible approach.



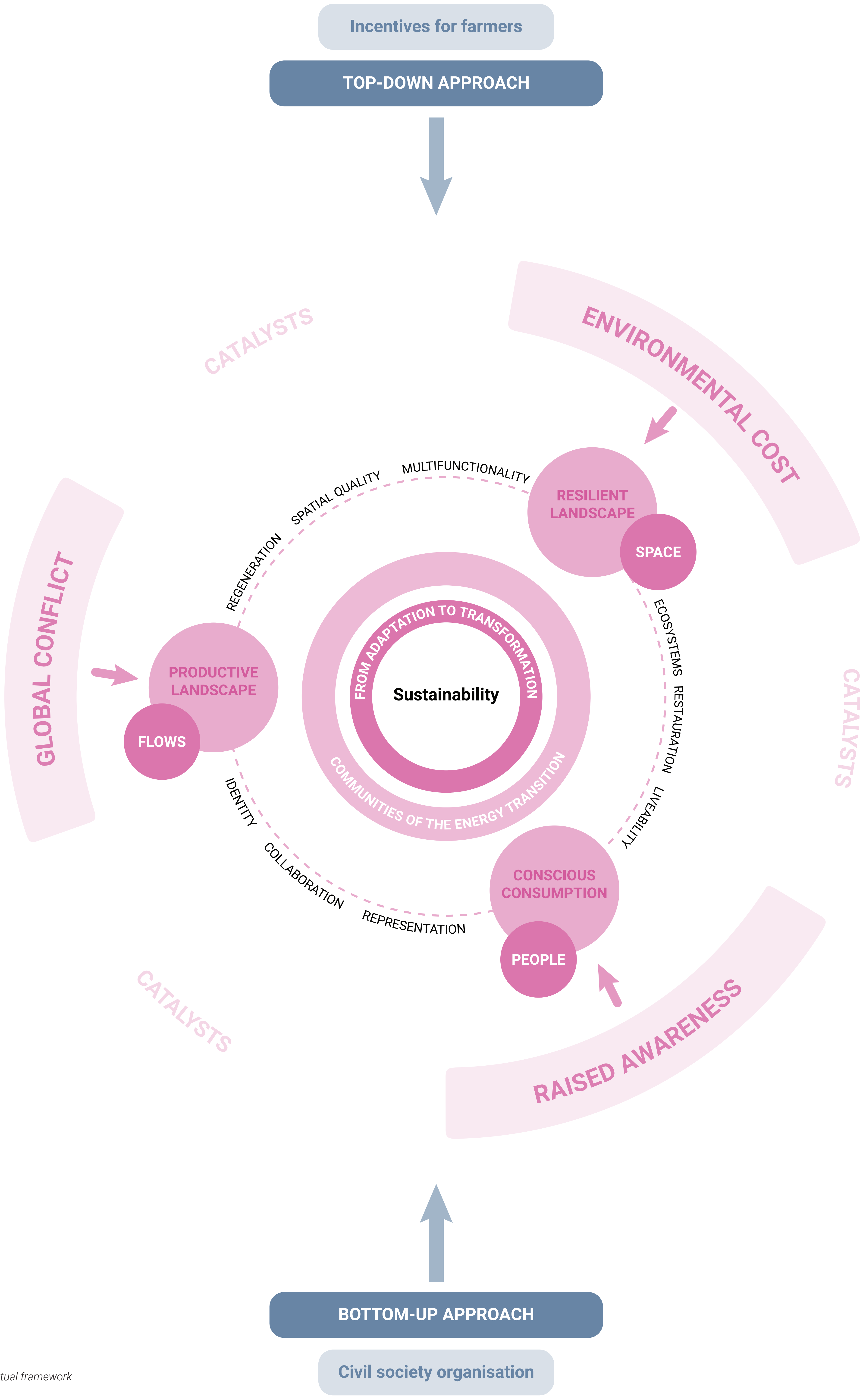
Methodology framework

Conceptual framework

The conceptual framework outlines the foundation upon which our vision is built. At its core lies the overarching goal of sustainability, surrounded by the societal shift that must occur: a move from mere adaptation towards total transformation. Encircling this shift are the communities of the energy transition, involved as a key perspective for whom this vision was made.

The framework combines three pillars of urban design: space, people, and flows. Each pillar is connected to a unique principle, and these principles are in turn connected through shared values. The outer ring shows the catalysts, current processes that create urgency for transformation. Each is linked to a design pillar, with space, people, and flows all having different urgencies.

Finally, the blue arrows show the combination of a top-down and bottom-up approach. The top-down strategy consists mainly of incentivizing farmers into adopting sustainable practices. Meanwhile, the bottom-up approach focuses on civil society, fostering collaboration between organisations and communities. Together, these elements form a framework that informs our vision towards a sustainable future.



Conceptual framework

Theoretical framework

To form a coherent and well-informed vision, several theories were collected that fit the conceptual focus of sustainability. To maintain a focused research, the theories are based on the sharpened theme of sustainable development. Four main theories were collected: the natural step theory, the transition theory, the planned behaviour theory and the paradigm shift. These theories, with their main concepts are outlined in the figure on the right. Many concepts are intertwined, shown in the connecting lines in between the concepts. All theories will be further expanded upon below.

Natural step theory

The natural step theory is a sustainable development framework that proposes, explicitly and implicitly, that continuous economic growth is no longer feasible (Upham, 2000). The framework outlines four system conditions that need to be met to work sustainably as a society. The conditions state that nature will not be subject to:
- an increasing level of extraction of substances from the earth's crust,
- an increasing level of production of substances by society that are not decomposable,
- an increasing level of degradation by society's hand,
- and that human needs are met worldwide (Everard, 2001).

It is a theory one must critically analyse, as it aims more to appeal widespread, rather than use scientific reasoning (Upham, 2000). The message is based largely on assumptions that lack strong backing. However, the principle is one that fits this project, and the four conditions stated above have partially informed the vision for Westland.

Transition theory

Often, research surrounding energy and design challengers are limited by their notion that social processes and dynamics are linear principles. Transition theory strays from this, and sees these transitions as born from the alignment of processes between and within three scales: the niche, the regime and the landscape (Fraser, 2021). This multi-scalarity and non-linear factor is imperative. A 'multilevel perspective' to the transition theory offers more understanding of not only the multiple scales, but also the multiple actors and dynamics present (Geels et al., 2017).
The multilevel perspective transition theory acknowledges four major challenges. First, transitions involve a wide range of actors, guided not only by cost-benefit calculations, but more so by values, interests and unequal social relations. Secondly, the energy transition should go further than just technological innovation; changes in consumers, culture and broader politics are necessary. Thirdly, transitions require complex negotiations between goals and constraints, like social acceptance, feasibility and cost-effectiveness. Finally, this multilevel perspective sees transitions as goal oriented in addressing the climate crisis. (Geels et al., 2017) Climate protection is a public good, making private sectors less interested in addressing it, since their own benefits to them outweigh the need for this transition. In response to this, the public sector must balance this out with policy and taxing.
In this project, multi-scalarity and complexities with the private sector are interwoven with the vision. As was seen in the conceptual framework on the previous page, a top-down approach must be used to incentivize the private sector. This is based on the multilevel perspective on transition theory. As transitions need to challenge current economic positions of the floriculture industry, disruptiveness and dispute are inevitable.

"Transitions are therefore not tame, but disruptive, contested, and non-linear processes. Disruptive, because they threaten the economic positions and business models of some of the largest and most powerful industries (e.g., oil, cars, electric utilities, agro-food), which are likely to protect their vested interests. Contested, because actors disagree about the desirability of different low-carbon solutions and often resist their implementation (e.g., onshore wind turbines, carbon capture and storage). Non-linear, because climate change policies and low-carbon innovations can experience setbacks, accelerations, or cycles of hype and disappointment (e.g., current climate policies in the UK, USA, and Australia)." (Geels et al., 2017, p. 2).

Sustainable agriculture theory / theory of planned behaviour

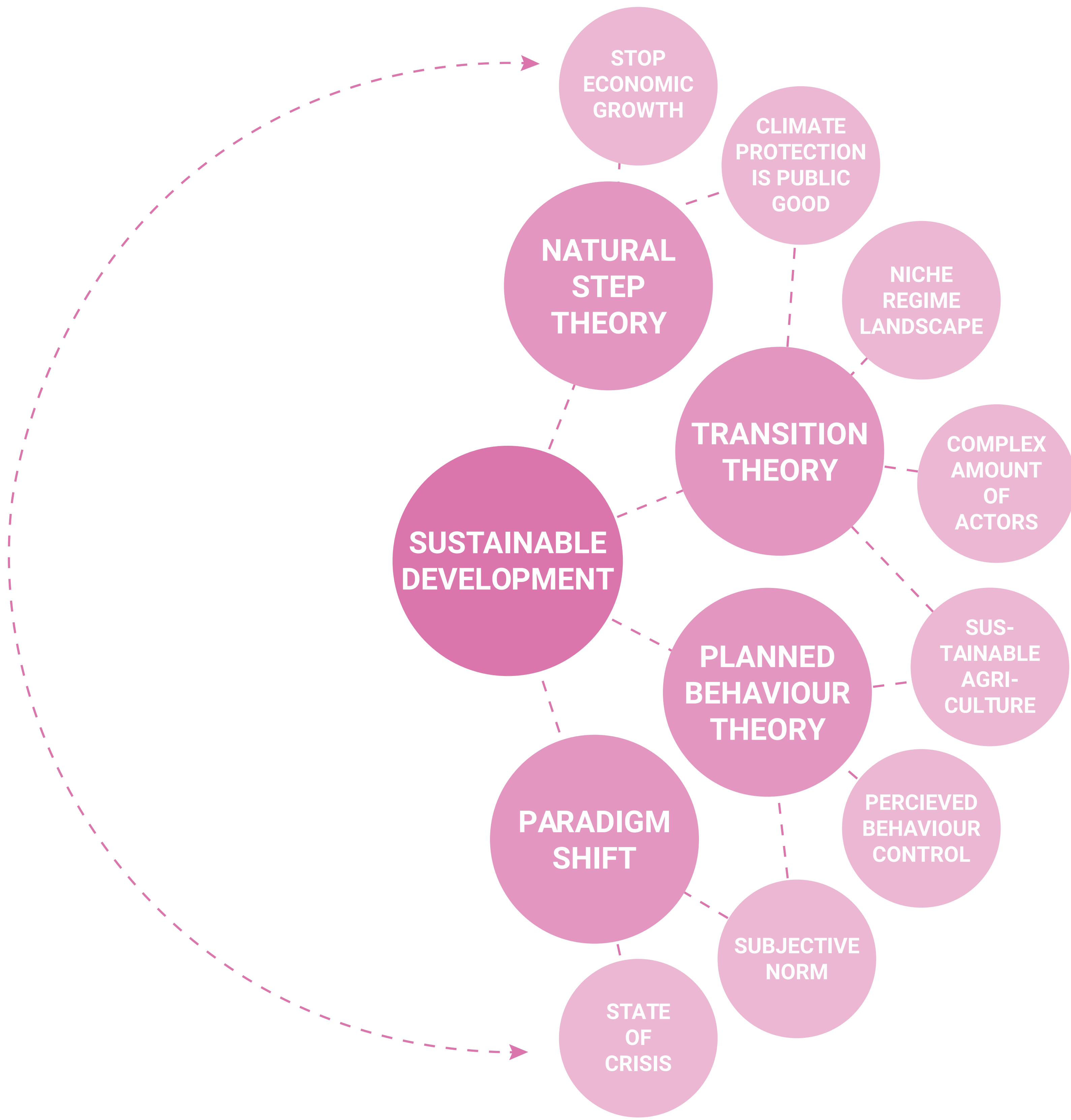
Sustainable agriculture is a system of adopting organic agricultural practices while also reducing emissions. That this is necessary follows from the sustainable development goals. These state that food production (no hunger) is essential, while emphasizing healthy, thriving land and water (United Nations, n.d.). However, the move towards sustainable agriculture is a complicated one, as the private agricultural sector must change. An approach used in this research project was the theory of planned behaviour.

This theory illustrates that attitude, the subjective norm and the perceived behavioural control guide intentions and thus behaviour (Ajzen, 1991). Farmers own their land, and thus cannot always be made to transition into this sustainable agriculture. The theory of planned behaviour, or TPB, informed by several studies, indicates that attitude was the main factor that led to the adoption of organic agriculture (Ansari & Tabassum, 2018). Perceived control is of higher psychological effect than may be expected: it pertains to the perceptive ease or difficulty of performing the behaviour of interest. By increasing this ease through flexible certifications and phasing of policies, the intended behaviour, that of transitioning towards sustainable agriculture, will be more successful and adopted large-scale.

Paradigm shift

The term paradigm was first introduced by Thomas Kuhn (1970). A paradigm can be defined as a network of theoretical and conceptual commitments shared by the scientific community of any field. A paradigm shift occurs when many unsolvable problems are encountered, resulting in a state of crisis (Hall, 1993). More innovative ideas can crop up in this period, leading towards a new paradigm, one that is most likely contested by followers of the previous one. These shifts, though not political in content, tend to be political in tone, as they propose a new way of thinking regarding the field of science (Filippi, 2022).

Because these shifts from one collection of theories to another are immeasurable, the transition between them cannot happen one step at a time, in a neutral way (Kuhn, 1970). Instead, this shift will happen either all at once or not at all. The paradigm shift that this project wishes to incur is a drastic one, with a powerful, lucrative private sector as a key actor and a topical political viewpoint. That this shift will be contested is inevitable, which is why the drastic, enormous scale and impact are critically explored.



"Transitions are therefore not tame, but disruptive, contested, and non-linear processes. Disruptive, because they threaten the economic positions and business models of some of the largest and most powerful industries ... Contested, because actors disagree about the desirability of different low-carbon solutions and often resist their implementation ... Non-linear, because climate change policies and low-carbon innovations can experience setbacks, accelerations, or cycles of hype and disappointment."

(Geels et al., 2017, p. 2).

VISION

Vision statement

The flower industry, as it exists today, cannot be sustained. In regions of high floriculture production soil health has deteriorated, biodiversity continues to decline and water quality is consistently poor. Meanwhile, this industry demands enormous amounts of energy, almost entirely derived from fossil fuels. Rising gas prices due to shifting global alliances further underscore the urgency for change.

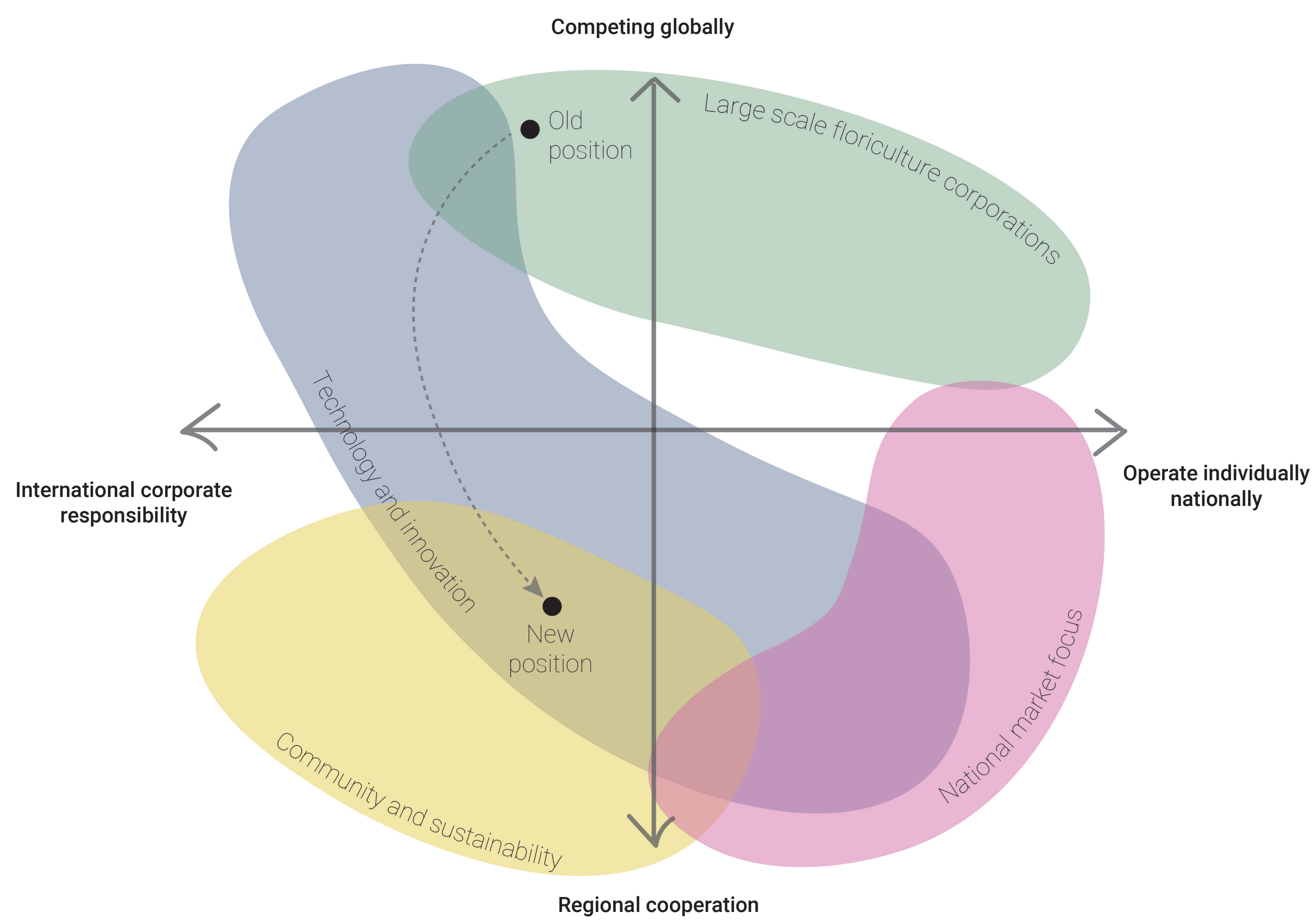
Westland epitomizes the modern greenhouse industry. The area is currently taking gradual steps towards climate neutrality in 2050. However, gradual steps are not enough. We propose a different, radical transformation: a fully integrated floral and energy industry that operates as a resilient, innovative, producing collective. Our vision, Eco flower to Power, reimagines Westland as a global model of sustainable floriculture and decentralised energy production.

One of Westland's main challenges is the current density of the land. By opening up the landscape, we can restore soil health, enhance green-blue resilience, and create more enjoyable, multifunctional environments for farmers, residents and nature. Energy production must also be decentralised, reducing the dependency on an unpredictable global market, while strengthening local connections. Our vision fosters a collaboration between the energy and flower industries, ensuring that both energy production and consumption become more community-driven.

In this future, producing energy alongside flowers will become as natural as riding a bike. Westland will no longer be just a greenhouse hub: it will be a pioneer of knowledge, innovation and circularity. The greenhouse owners will largely contribute to this position of Westland. Flora Holland, currently a European powerhouse in flower distribution, will lead this movement, together with the farmers, transforming into a centre for sustainable innovation implementation and knowledge exchange. This shift will serve as a global inspiration, proving that energy demanding, high producing industries can thrive sustainably.

Realizing this vision requires a combination of top-down and bottom-up approaches. The Dutch government must take the lead in funding and incentivizing sustainable horticulture, by subsidizing farmers transitioning to organic floriculture and by supporting large-scale renewable energy projects. Simultaneously, farmers must collaborate through crop rotation, shared resources and clustered investments in renewable energy sources.

With these strategies, we envision a flower industry that does more than grow plants: it inspires change, resilience and growth towards a sustainable future. Westland, together with the greenhouse owners, will not only transform itself, it will spark a global movement toward organic, circular and energy-producing floriculture.



Greenports Nederland (2020)

Goals and objectives

The objectives in the vision are based on the policies discussed in the analysis chapter. The policies from the different scales can be categorised into the 3 sustainability goals. The first goal is energy, we want to use the energy transition,making Westland a highly productive landscape. Using eco floriculture to reduce the impact on the ecological system and reducing energy consumption. The final goal is to create a sustainable landscape for Westland with improved spatial quality.

GEMEENTE WESTLAND

provincie Zuid-Holland

Nationaal programma RES Regionale Energie Strategie

7 AFFORDABLE AND CLEAN ENERGY

Energy landscape
Increase Westland's energy production by transitioning to a renewable energy industry. Various forms of local renewable energy sources; geothermal, wind and solar energy will provide energy for the greenhouse industry.

Glastuinbouw Nederland

GREENPORT West Holland

11 SUSTAINABLE CITIES AND COMMUNITIES

Eco floriculture
Reducing consumption through transition in organic floriculture. Organic farmers will start the energy transition. This new sector will be known for innovation and sustainability.

Hoogheemraad van Delfland

GEMEENTE WESTLAND

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

Spatial quality
Responsible consumption and production is linked to the quality of the landscape. By creating a resilient, future-proof and sustainable living and working environment in Westland, the landscape will be healthy for all Westlanders.

Policy and goals (United Nations, n.d.)

Organic greenhouse owners Westland
All greenhouse owners will be organic and innovative in the future. Clusters will ensure that greenhouse owners work together.

Market	●●●●●
Regional connection	●●●●●
Sustainability	●●●●●
Innovation	●●●●●

Future community of Westland

Vision framework

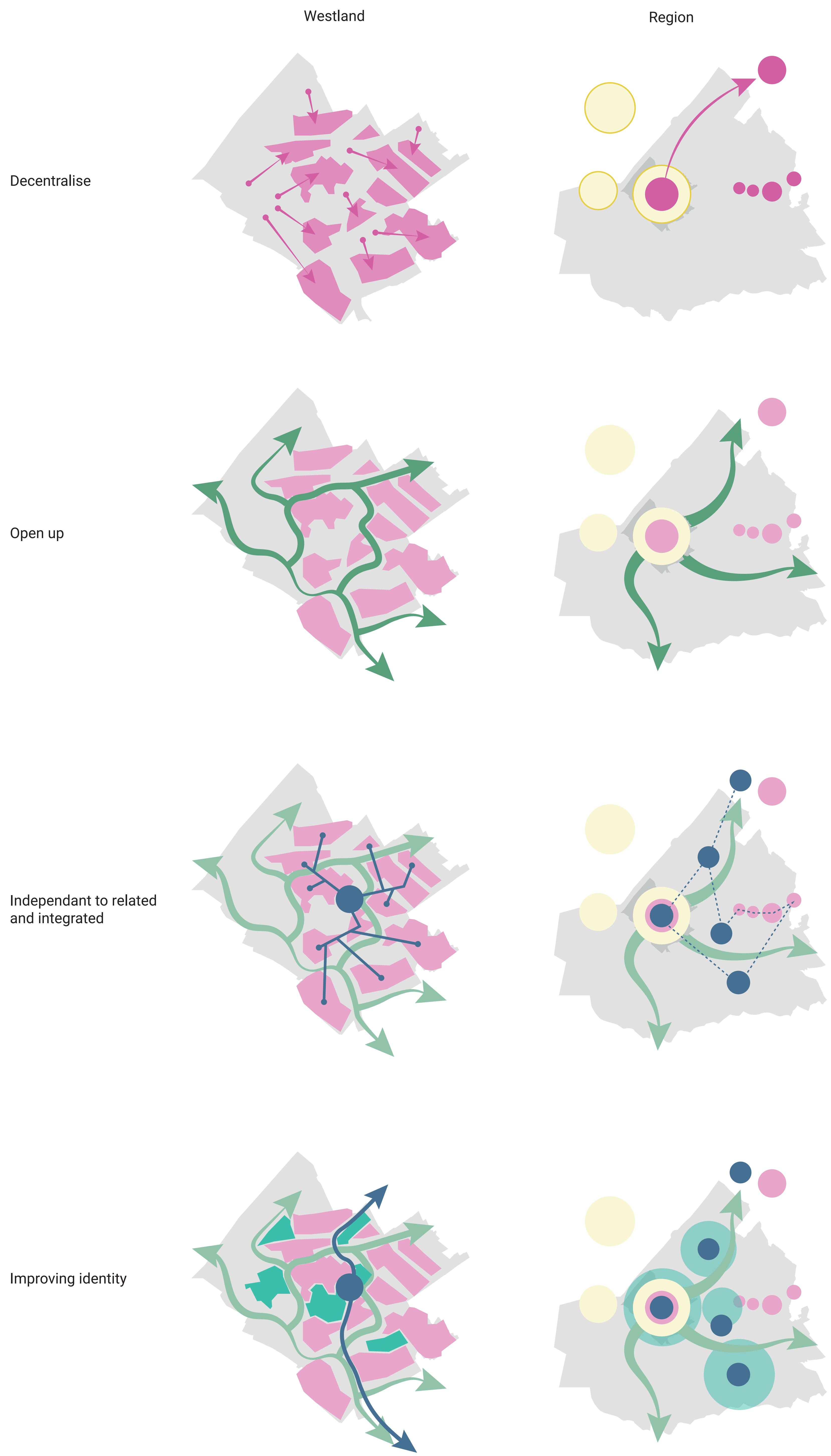
As mentioned above, the vision framework is divided into three goals: energy landscape, eco-floriculture and spatial quality. These three goals are linked to four key concepts. The key concepts describe how the system will change. The first key concept 'Decentralise' describes how the current system will be reorganised into new clusters, optimising the efficiency and creating space for a new spatial layout of the area. This leads to the second key concept: 'Open up', which describes how the landscape will be partly reopened. 'Independent to related and integrated' outlines how this new landscape will be used in a multifunctional way, instead of the mono functionality it is currently characterised by. The last key concept 'Improving identity' concerns the new focus on innovation in Westland. Not only inhabitants will be involved in this key concept, it will also reflect Westland globally.

The vision maps that follow are divided by the three different goals: energy landscape, eco-floriculture and spatial quality. They have been made on two different scales, Westland and the metropolitan region Rotterdam The Hague.

OPENING UP WESTLAND INTO A RESILIENT ENERGY LANDSCAPE BY TRANSFORMING THE FLOWER INDUSTRY, USING THE ENERGY TRANSITION AS A CATALYST

GOALS	ENERGY LANDSCAPE	ECO FLORICULTURE	SPATIAL QUALITY
ECO FLOWER TO POWER	Increase energy production by transitioning in the renewable energy industry	Decrease consumption by transitioning in the organic floriculture	Creating a resilient, future proof and sustainable living and working environment
KEYCONCEPTS			
DECENTRALISE	Local energy clusters	Clustering local farmers Regional cooperation More local distribution	Local water filtration in clusters Local quality of greenspace
OPEN UP	Creating space for energy production in Westland	Floriculture on open ground More efficient land use	From closed to open landscape Healthy soil system
INDEPENDENT TO RELATED AND INTEGRATED	Connecting renewable energy infrastructure with greenhouses Integrated renewable energysystem Synergy in the floriculture and energy transition	Floriculture reconnected to the soil Crop rotation system between greenhouses Exchange of knowledge between biofloriculture farmers From mono greenhouses to mixing of functions	Connected greenblue structure Water safety projects in natural landscape Enhanced regional connection Adding recreational functions Improving infrastructure and public transport
IMPROVING IDENTITY	Pride in the energylandscape Westland as pioneer and catalyst for sytemic change	Focus on innovation and education Westland as pioneer and catalyst for paradigm shift Creating added value to flowers	Strenghten connection with existing spatial qualities No more pollution of the living environment Safeguarding Westland's culture, identity and pride

Vision framework



Keyconcepts

Vision Westland; Energy

In Westland greenhouse clusters will be organized for local energy production and distribution. These clusters will be connected to a geothermal source within the area. The greenhouses will generate electricity on their own land, using wind turbines and solar panels. Some of the greenhouses will open up, this land can be used for agro-voltaic fields, areas where energy production is combined with flower cultivation.
On the southern side of Westland, where the wind potential is highest, windparks will be placed. Solar fields will be installed on the eastern side and together with the windmills, these measures will help meet the local energy demand.
Off the coast, a large-scale offshore wind farm is already in operation, with plans for further expansion in the coming years. This energy can also be used in Westland.
A new innovation is "the energy motorway", a future technology that generates power from transport that uses the road. Together with the wind park on- and off-shore and the harbor of Rotterdam, Westland will be a large energy production landscape.

Vision Westland energy

- Recreational network
- Motorways
- Buildings

Open up

- Clustered greenhouses
- Open soil floriculture
- Windmill park large scale

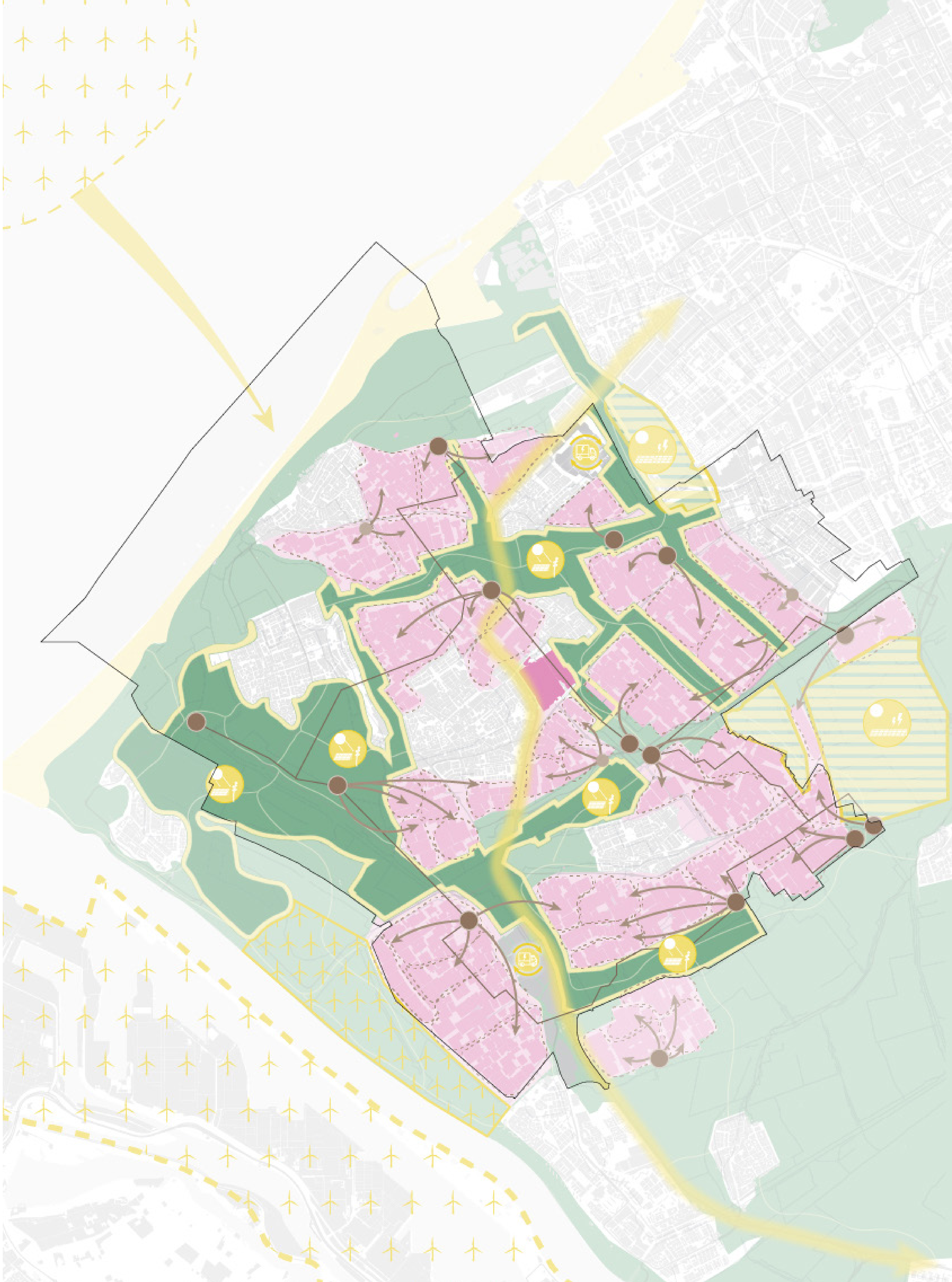
Independent to related

- Open flowerfield with solar energy
- Energy neutral distribution
- Geothermal clusters
- Energy motorway

Decentralise

- Current geothermal energy
- New geothermal energy
- Backbone geothermal energy
- Solar field
- Solar panels around flower fields
- Solar panels
- Windmill park small scale

0 1 2km N



Vision Westland Energy

Vision Regional; Energy

On a regional scale, various energy production areas are added. Geothermal installations will be installed at locations with high potential. In the future, solar and wind energy will be combined with recreational areas. Because of the busy transport system, the energy motorways will be extended in the Randstad.
In the region, renewable energy sources, solar/ wind parks, will be added to create a circular region In addition, various transport hubs will be used to combine transport of products . This will also reduce costs for greenhouse owners and be more efficient.

Vision Regional Energy

- Dunes
- Buildings
- Green structure

Open up

- Greenhouses Westland
- Other greenhouse clusters
- Clustered greenhouses

Independent to related

- New green-blue structure

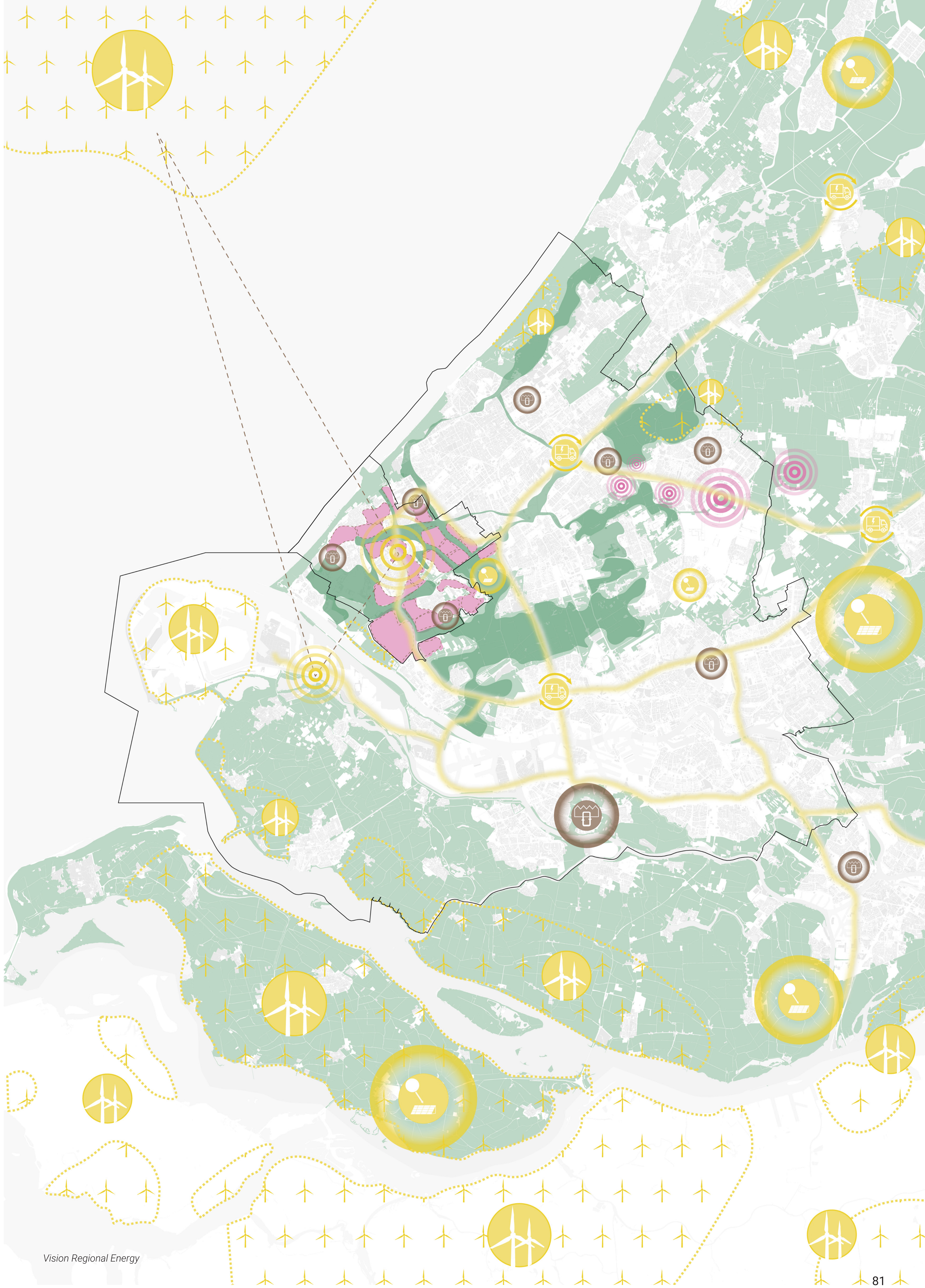
Independent to related

- Connection between Rotterdam, North Sea and Westland; Large energy production areas
- Energy motorway

Decentralise

- Local sunparks
- Local geothermal source
- Local wind parks
- Solar fields

0 5 10 km N



Vision Regional Energy

Vision Westland; Floriculture

The greenhouse clusters will ensure cooperation between greenhouse owners. Within the clusters, crop rotation and other material exchange will be possible. A quarter of the greenhouses in a cluster will transition to an open flowerfield. This will be in a way that regenerates the soil. These flower fields connect the regional greenstructure, enhancing biodiversity.
Between the clusters, there is crop rotation to maintain the healthy soil. Vertical farms will be used for production and new innovations, knowledge institutes can use the vertical farms to do research and implement innovations.
Flora Holland will be at the forefront of these innovations. The Flora Holland campus will be expanded to accommodate more knowledge, education and innovative systems. The organic flowers produced in Westland will also be sold on local markets in the connected villages.

Vision Westland eco floriculture

Recreational network
Motorways
Dunes
Buildings
Green structure

Open up

Open flowerfields
Connecting flowerfields
Previous greenhouses
Clustered greenhouses
Vertical farming locations

Independent to related

Open soil greenhouses
Crop rotation
Connecting flower-axis

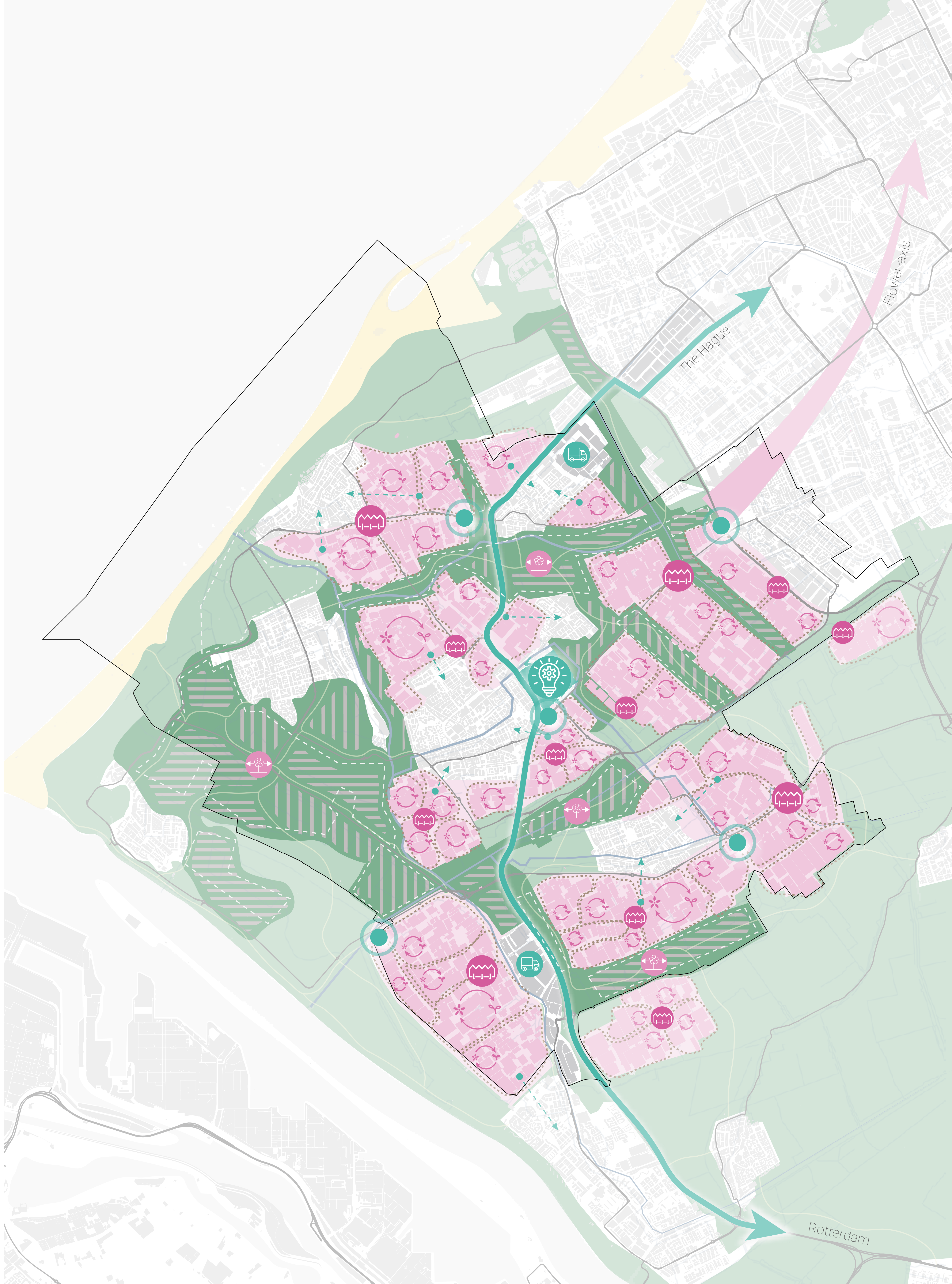
Improving identity

Flora Holland: innovation hub
Local distribution
Knowledge axis

Decentralise

Greenhouse cluster

0 1 2km N



Vision Westland Floriculture

Vision Regional; Floriculture

Westland will function as a catalyst for organic floriculture in the region. Connecting Westlands floriculture to other flower producing or researching areas. The knowledge and innovation gathered in Westland will be used in other greenhouses, for example in the Oostland. The Flora Holland campus will be linked to various universities, the universities will research new innovations for greenhouses and open field floriculture. The distribution of flowers will transition to more local rather than global. In the Netherlands, the flower axis (see strategy) will be used as a cooperation for flower production.

Vision Regional Floriculture

Dunes

Buildings

Green structure

Open up

Greenhouses Westland

Other greenhouse clusters

Clustered greenhouses

Independent to related

Bulb region in flower-axis

New green-blue structure

Independent to related

Knowledge institutes

Flower Axis

Improving identity

Flora Holland innovation hub

Decentralise

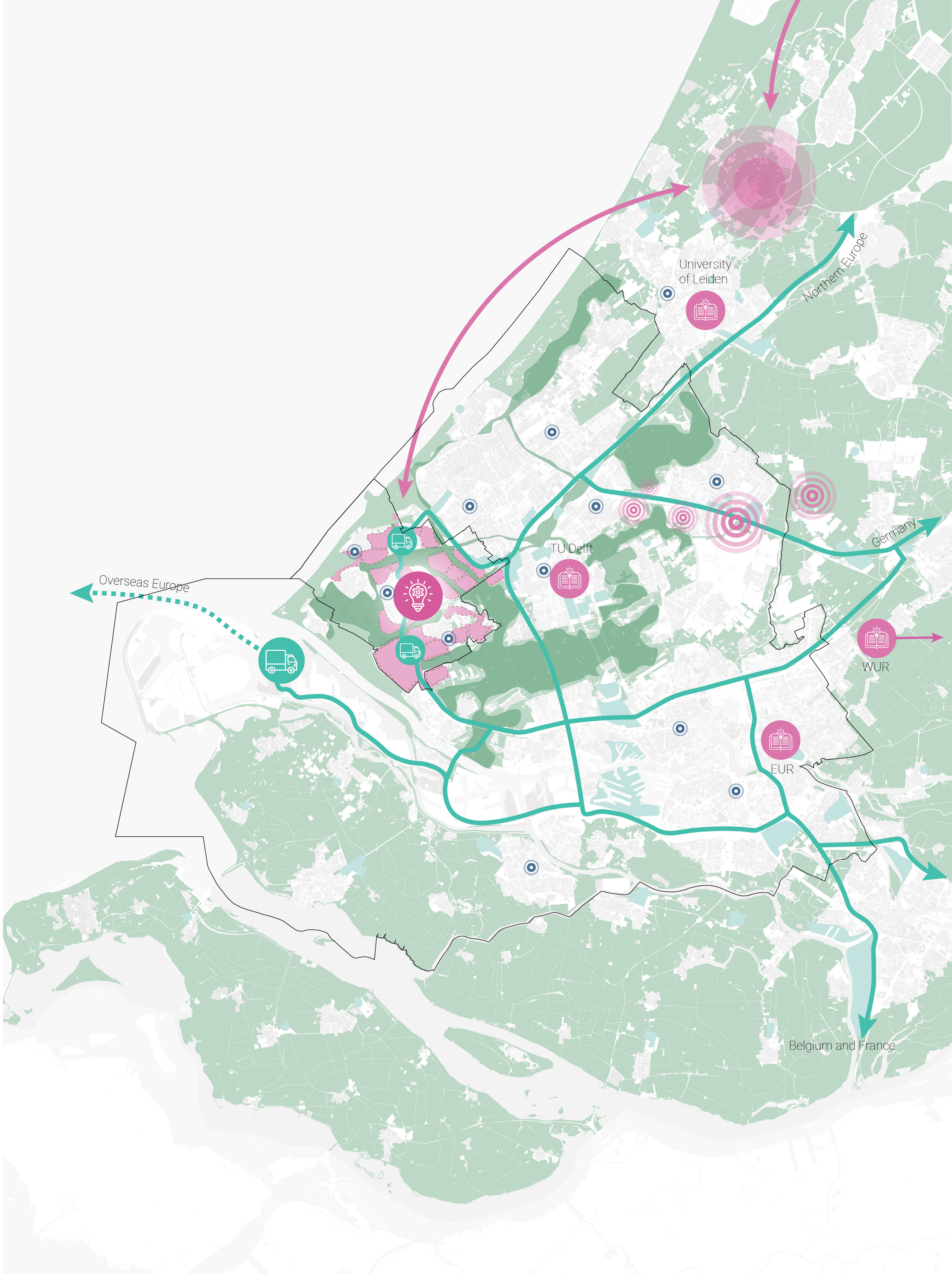
Mixed functions

Distribution

Localising export

Organic flowers on local markets

0 5 10 km N



Vision Regional Floriculture

Vision Westland; Spatial quality

The open floriculture fields will be used as a productive and recreational area. The fields are connected to the recreational green structure and will be connected to the regional green-blue structure. In the villages this green-blue structure will also be integrated. These connected green-blue structures will have a positive effect on the ecology of the region. Various low-speed roads will be added to connect the different regions.
The regional connection will also be improved by the new light rail link, a public transport connection. The greenhouse will have local water purification systems per cluster to ensure that the region will not be polluted. In areas of high salinity, water will be added, creating new wetlands. These areas could be used for recreation and new types of flower crops. The dunes will be extended for water security. The dunes will also be used for water purification in a natural way.

Vision Spatial quality

- Recreational network
- Motorways
- Dunes
- Buildings
- Green structure

Open up

- Open flowerfield
- Clustered greenhouses

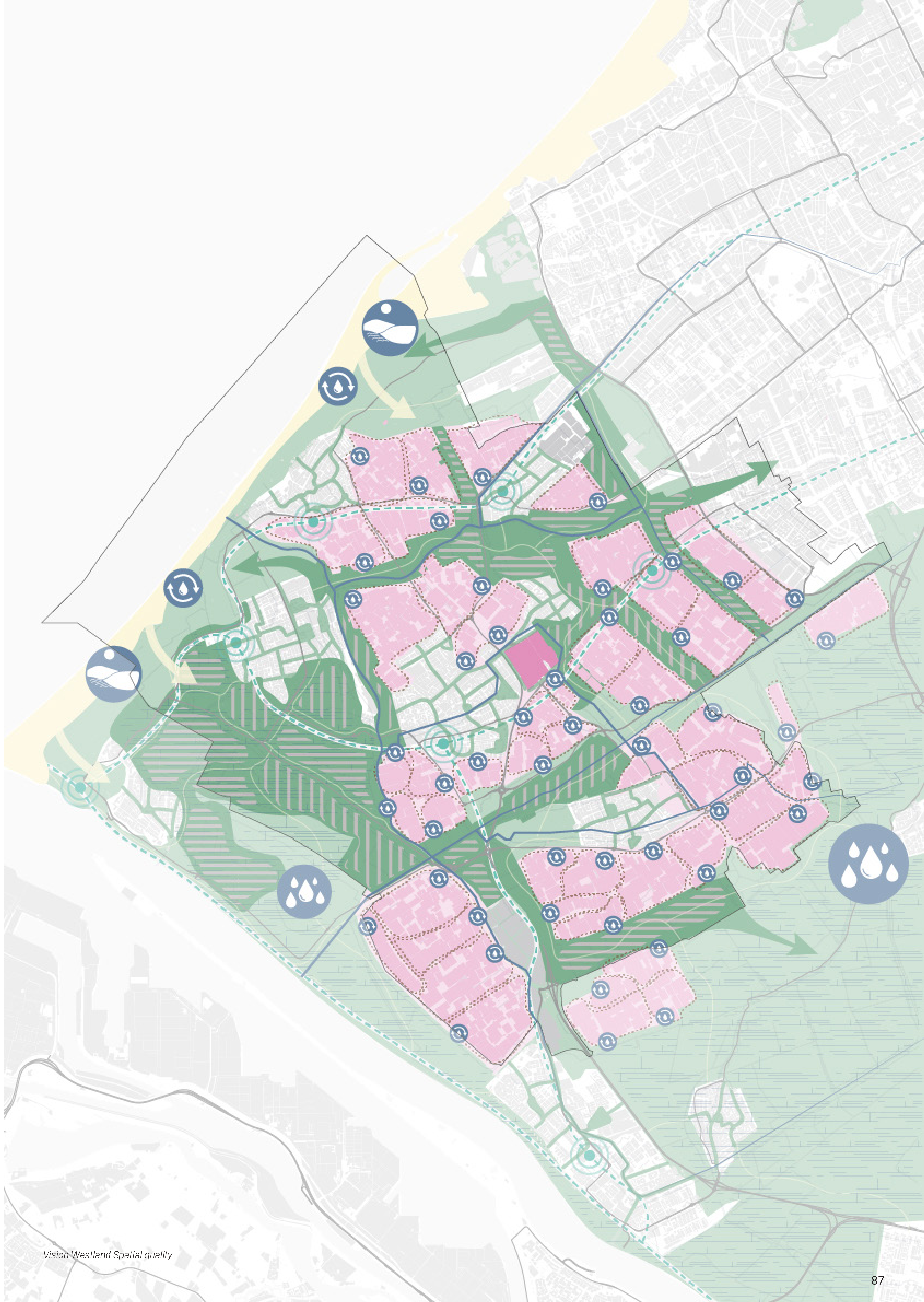
Independent to related

- Water purification cluster
- Westland lightrail
- Stations lightrail
- New green-blue structure
- Small scale green-blue structures
- Water retention
- Water retention area
- Water safety and storage
- Expanding dunes

Decentralise

- Water purification

0 1 2km N



Vision Westland Spatial quality

Vision Regional; Spatial quality

The new connected green-blue structure is visible on the regional scale. The light rail will improve accessibility, allowing more people to visit Westland while also strengthening connections between Westland and bigger cities in the Randstad. Along the coast, extended dune landscapes will be used in more locations to enhance water safety and support ecological restoration. Additionally, new wetlands will be developed to create a future-proof water protection zone, contributing to both climate resilience and biodiversity.

Vision Regional Spatial quality

Dunes
Buildings
Green structure

Open up

Greenhouses Westland
Other greenhouse clusters
Clustered greenhouses

Independent to related

Westland lightrail
Lightrail stops
New green-blue structure
Water retention
Water retention area
Water safety and storage

Independent to related

Regional connected green structure

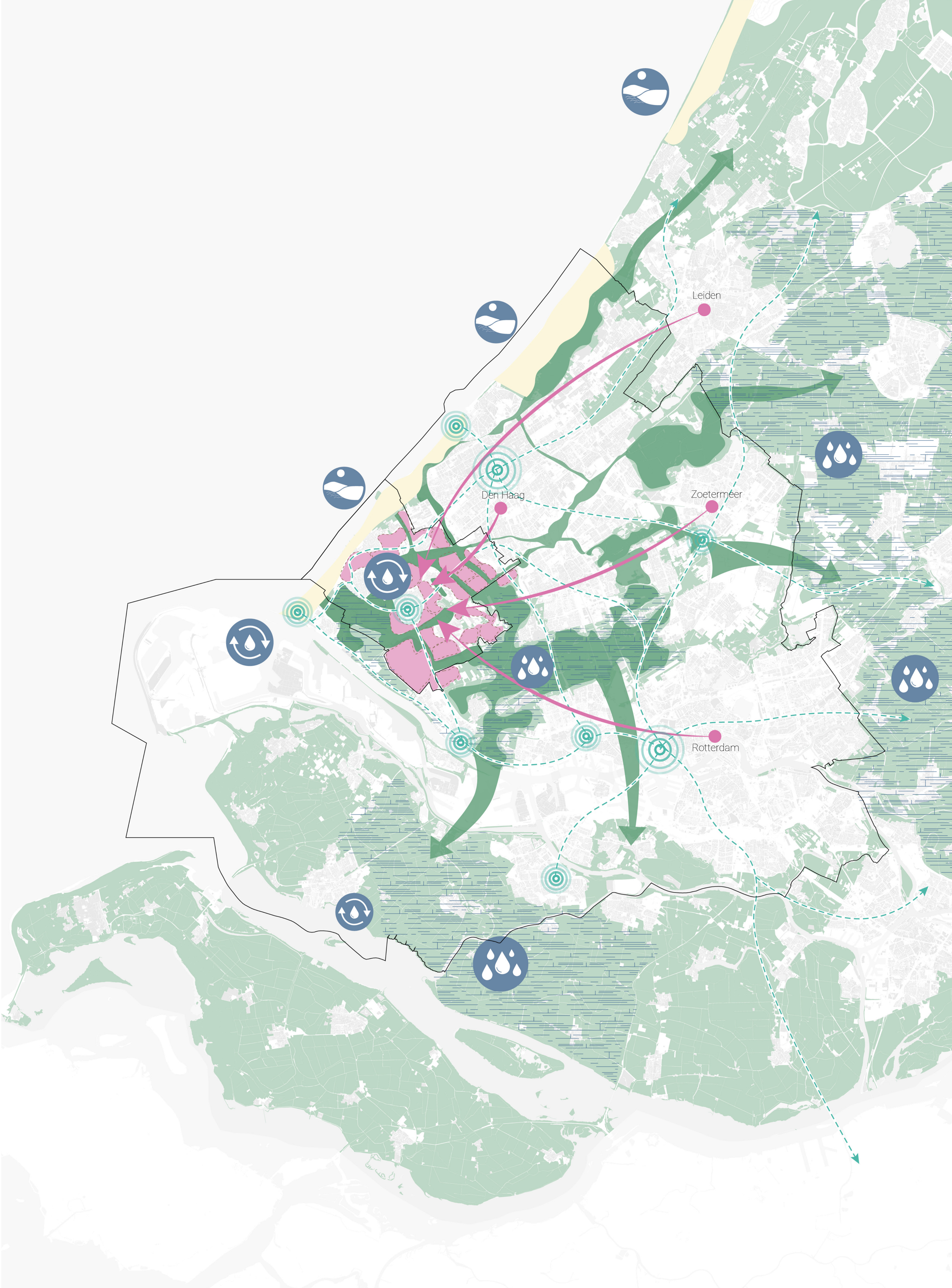
Decentralise

Water purification

Improving identity

Connections in the Randstad

0 5 10 km N



Vision Regional Spatial quality

Vision Westland

To transform Westland into an energy-producing landscape, large-scale systems must be decentralised. The new greenhouse clusters for energy and water will ensure local ownership, reduce pollution and increase resilience.

The introduction of open floriculture will help regenerate the soil. It will also open up the landscape for floriculture, recreation and energy production. Local distribution of flowers will decentralise the market and between the farmers it will improve knowledge of organic flowers.

Organic flowers are set to become the new standard. The organic flower community will be known for its innovative and sustainable character. The current independent monofunctional landscape will be transformed into an integrated and connected system. The greenhouses will be connected to local energy production. The system will be reconnected to the soil. Important will be the exchange of knowledge with Flora Holland, research institutes and greenhouse owners.

This new system will enhance Westland's identity. Westland will be known for its proud and innovative greenhouse owners. Residents of Westland will thrive in a sustainable, future-proof landscape.

Vision Westland

- Recreational network
- Motorways
- Dunes
- Buildings
- Green structure

Open up

- Connected green structure
- Clustered greenhouses
- New green structure
- Windmill park large scale

Independent to related

- Open flowerfield with solar energy
- Vertical farming locations
- Energy neutral distribution
- Open soil greenhouses
- Energy cluster
- Energy motorway
- Connecting flower-axis

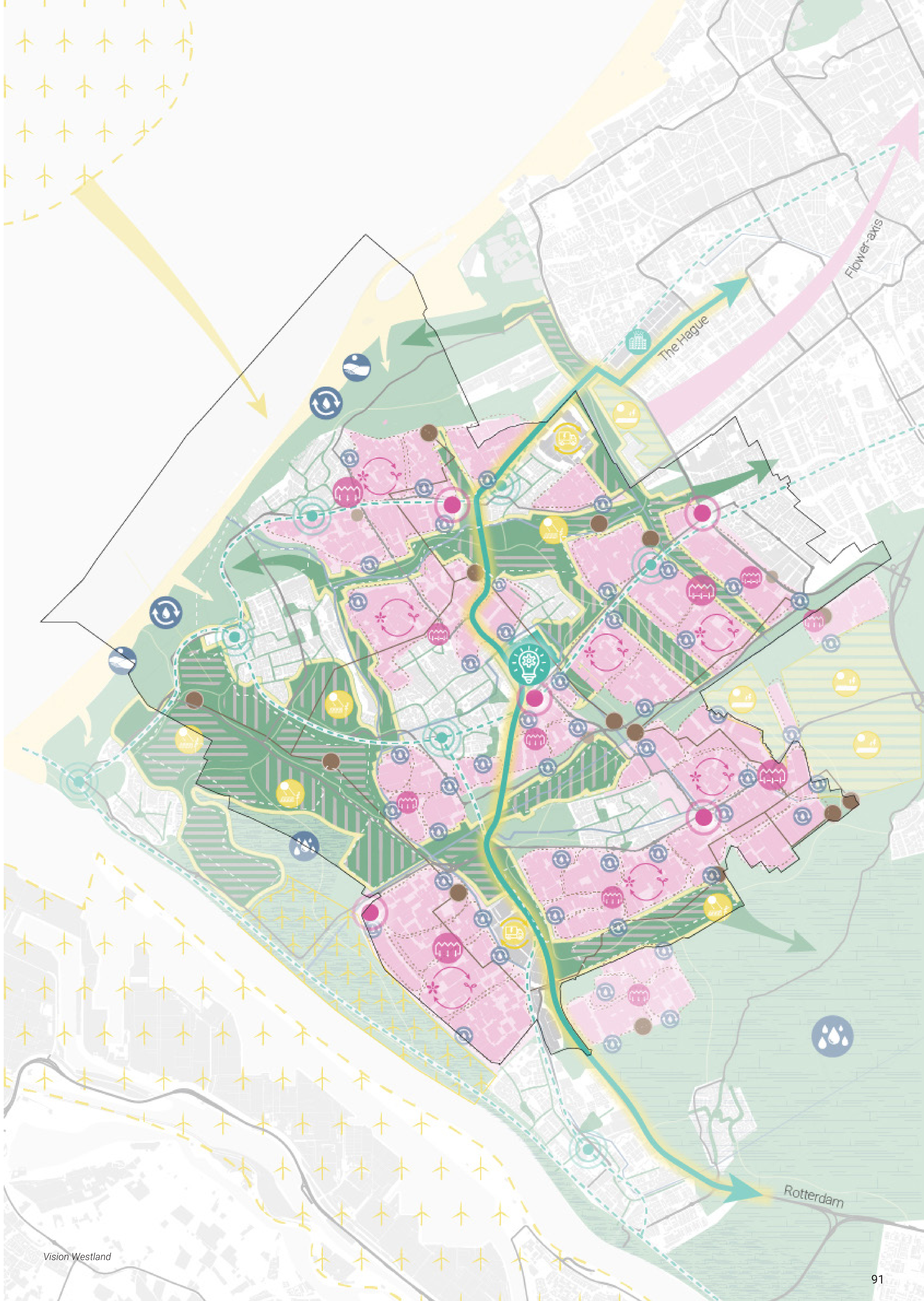
Improving identity

- Flora Holland innovation hub
- Westland lightrail

Decentralise

- Crop rotation in clusters
- Knowledge axis
- Water safety and storage
- Water purification
- Water retention
- Water retention area
- Current geothermal energy
- New geothermal energy
- Solar field
- Solar panels around flower fields
- Windmill park small scale

0 1 2km N



Vision Westland

Vision Regional

Together with the offshore windpark and the port of Rotterdam, Westland will become a highly energy-productive region, capable of sustaining its own energy needs. Regional cooperation in the Randstad, both in production and consumption, will be essential for building a sustainable system. Regional distribution of flowers will localise the market and strengthen this decentralisation.

Expanding the Randstad's public transport network through new regional light rail connections will improve accessibility for the residents of Westland. This opens up Westland to other cities.
Green connections are the start of a future-proof system for humans and non-humans. Different renewable sources will contribute to a local and resilient system. Ensuring water security, for example, is necessary for a future-proof system.

Various universities will collaborate with FloraHolland to drive innovation and research. Through cooperation with other flower regions, Westland will position itself as a pioneer—producing energy, growing sustainably, and advancing knowledge in the floriculture industry.

Vision Regional

- Dunes
- Buildings
- Green structure

Open up

- Greenhouses Westland
- Other greenhouse clusters
- Clustered greenhouses

Independent to related

- Bulb region in flower-axis
- Westland lightrail
- New green-blue structure
- Water retention
- Water retention area
- Water safety and storage

Independent to related

- Regional connected green structure
- Knowledge institutes
- Connected institutes
- Connection between Rotterdam, North Sea and Westland; Large energy production areas
- Energy motorway

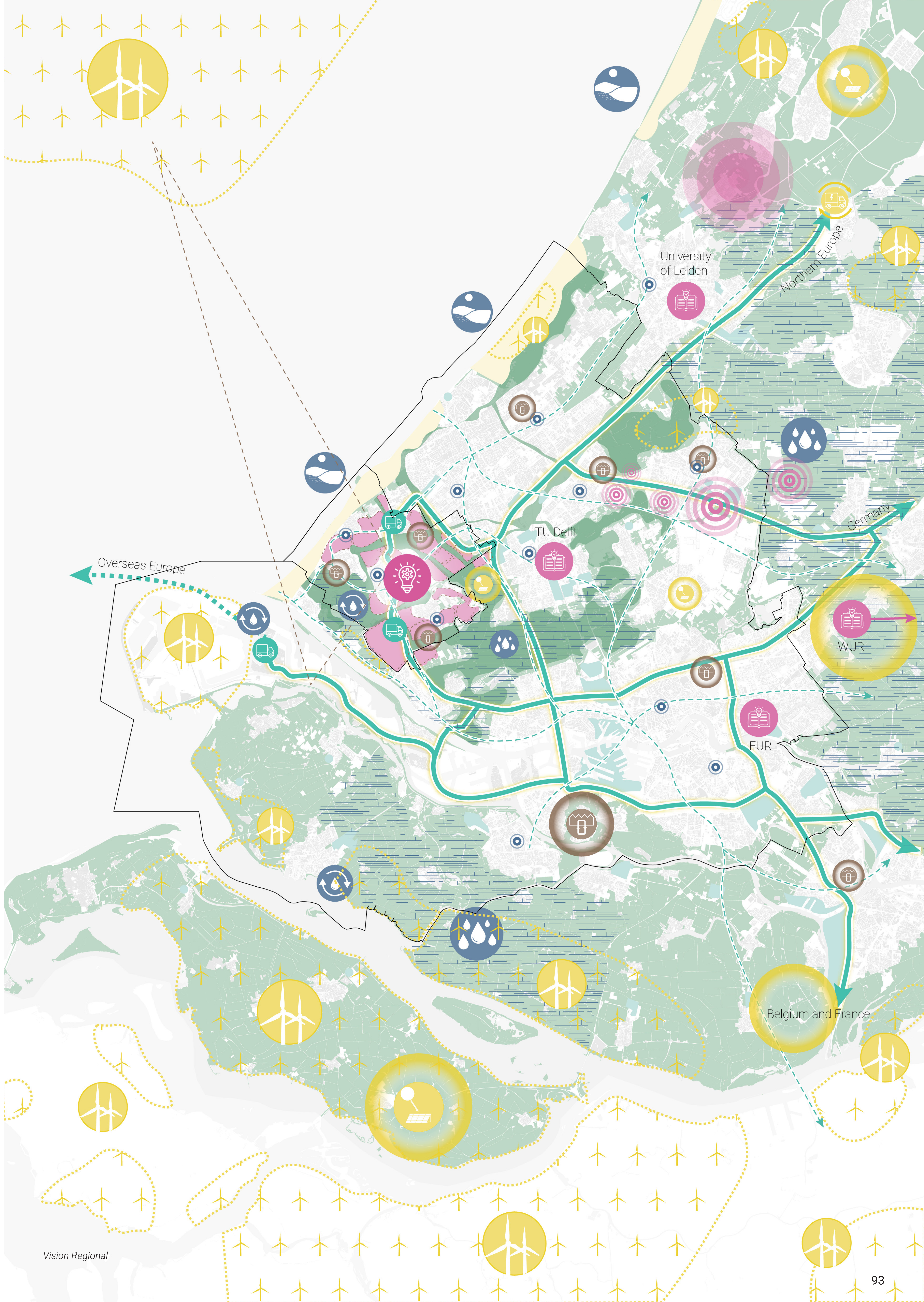
Improving identity

- Flora Holland innovation hub

Decentralise

- Water purification
- Mixed functions
- Distribution
- Localising export
- Local sunparks
- Local geothermal source
- Local wind parks
- Organic flowers on local markets
- Solar fields

0 5 10 km
N



Vision Regional

Vision: future flow section

The systemic section outlines the envisioned future of the floriculture sector, a system that is built around a more localized and sustainable approach. Energy will be produced nationally and is from renewable sources. Using geothermal sources to meet the heat demand and wind and solar energy to supply energy. Water purification systems per cluster will ensure healthy water systems and make it possible for the greenhouses to work in closed water loops, reusing their own 'waste' water.

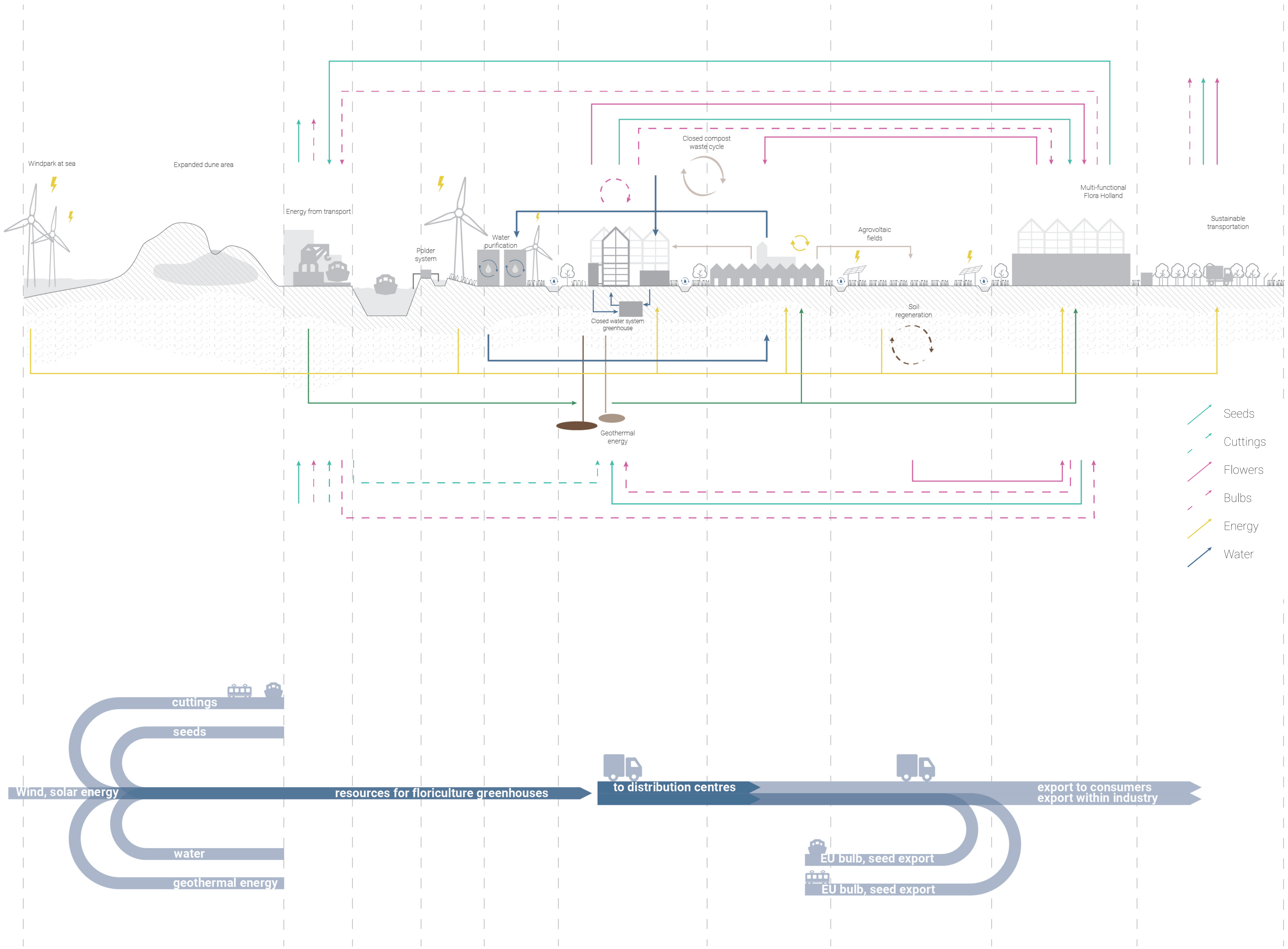
The village can also profit from these purification and energy systems. To close waste loops, the greenwaste of the villages will be reused to fertilise the soil in greenhouses and on open fields. On the open fields, the soil will be regenerated through organic floriculture.

The whole system operates on a smaller scale by changing the import and export system. Instead of relying on transport by plane, flowers will be transported by truck, train or boat. Electric trucks will be the main form of transport in the future system. This is possible because the market will focus on more local distribution.

In order to change the future demand for flowers in the Netherlands, we have to stop importing a large amount of flowers and prioritize selling the locally grown flowers.
Currently, the global export market is entangled in complex political dynamics. To create a more stable and sustainable system, the focus will shift toward the European market. This regional approach will help transform the sector while maintaining a strong and central role for flower growers in Westland.

Systemic section

Material flow

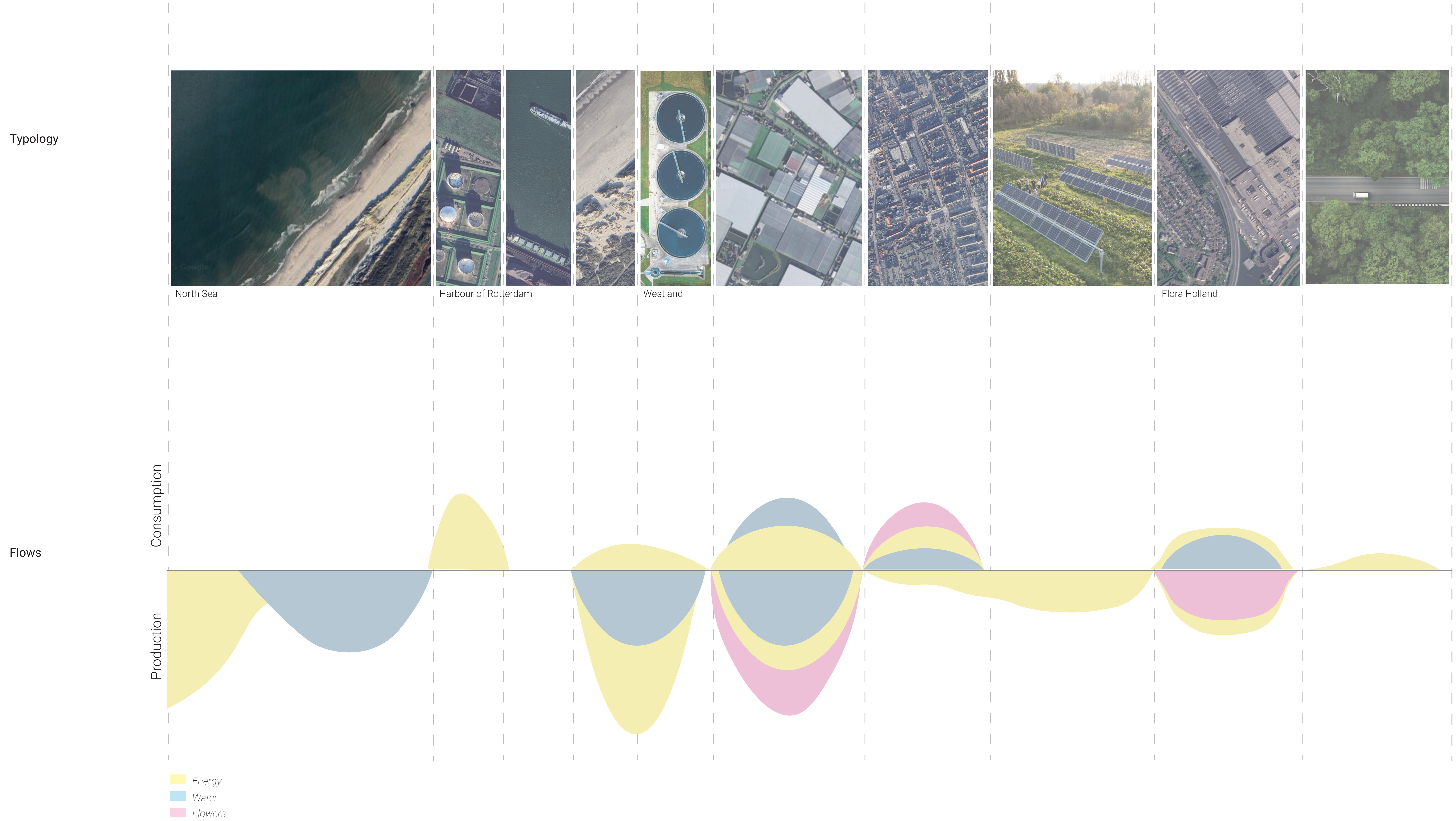


Future system flows

Vision: future flow section

This new system introduces a different spatial and functional typology, where energy production is integrated throughout the entire landscape. Greenhouses will serve as major energy producers, and their residual heat will be redirected to nearby villages, contributing to a shared, efficient energy network. Wind and solar parks surrounding Westland will supply a considerate amount of the region's energy demand.

Greenhouses will operate in closed cycles, for both waste and water. Rainwater will be collected, reused, and purified, ensuring a pollution-free system. Flower waste will be processed into natural fertilizer, reinforcing circular practices.
By localizing both energy and resource flows, this system lays the foundation for a resilient and future-proof energy landscape.



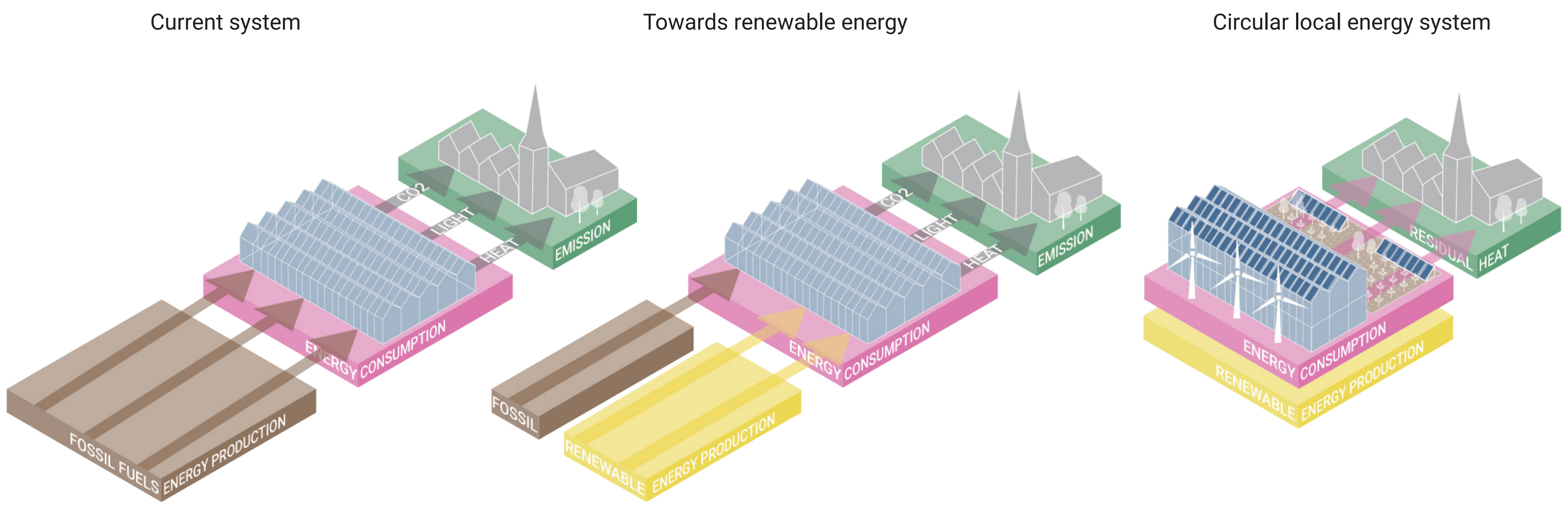
Future system flows

Vision: yearly energy use Floriculture Westland

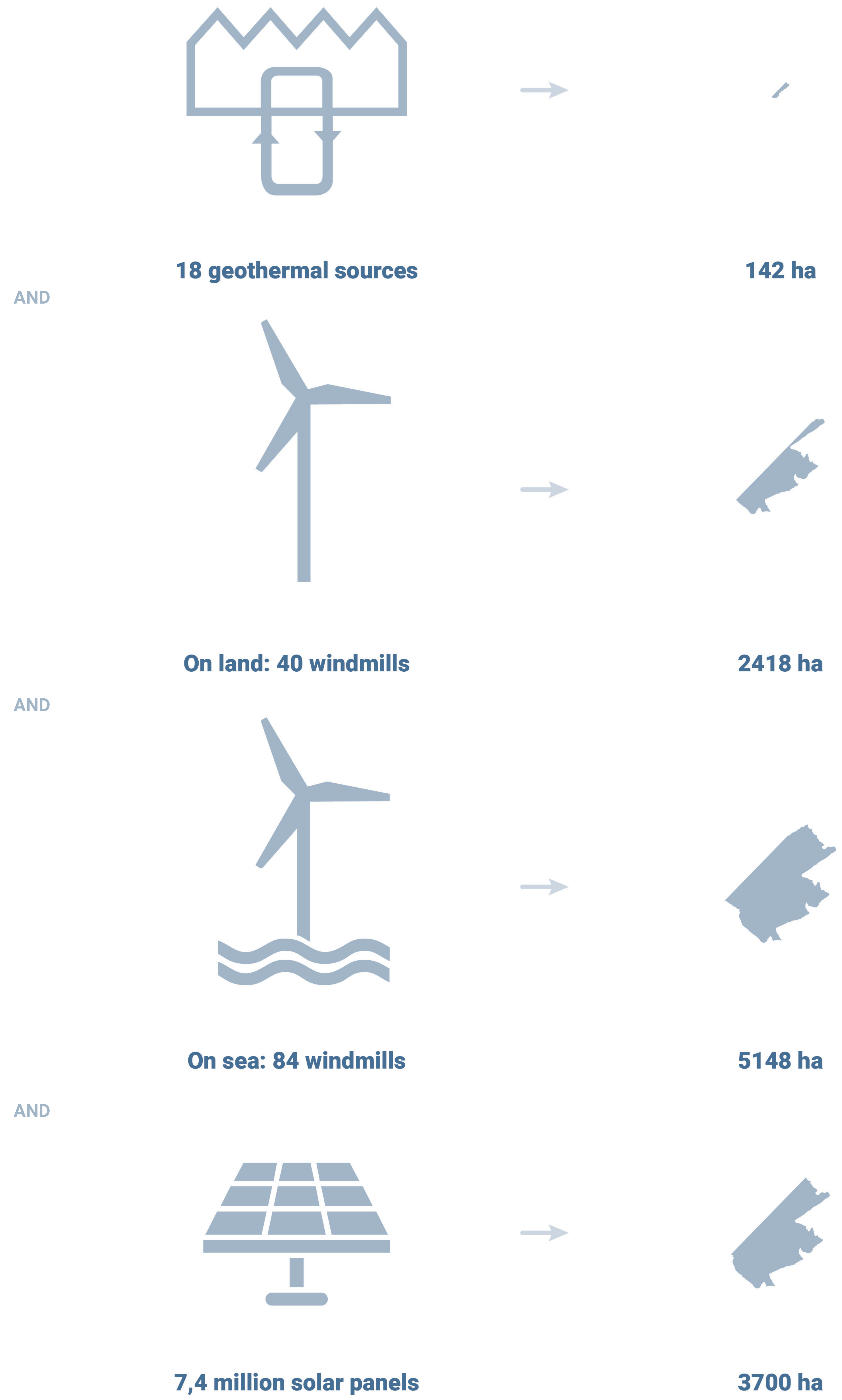
In Westland, 25% of the greenhouse area will be converted to open floriculture, which significantly reduces overall energy demand. Based on our calculations, the future system will require only 75% of the current energy consumption. While innovation and automation may initially increase energy use, we expect that continued technological advancements will ultimately lead to a decrease. To remain conservative, we have based our projections on 75% of today's energy demand.

The future energy system will rely entirely on renewable sources: geothermal, solar, and wind energy. Although the projected number of solar panels may seem high (7,4 million), most will be installed on rooftops, minimizing their impact on land use.

The transition to renewable energy will take place in several phases, beginning with a reduction in fossil fuel use. Fossil energy sources will gradually be replaced by renewables. In our vision, greenhouses and renewable energy production will be seamlessly integrated into a single, sustainable system.



Transformation of the energy system



Transformation of the energy system

New floriculture cultivation types

In the analysis chapter, two existing flower cultivation methods were outlined: greenhouse cultivation and open-soil cultivation. This chapter introduces three newly adapted methods, each designed to support a more innovative, multifunctional, and regenerative flower industry in Westland.

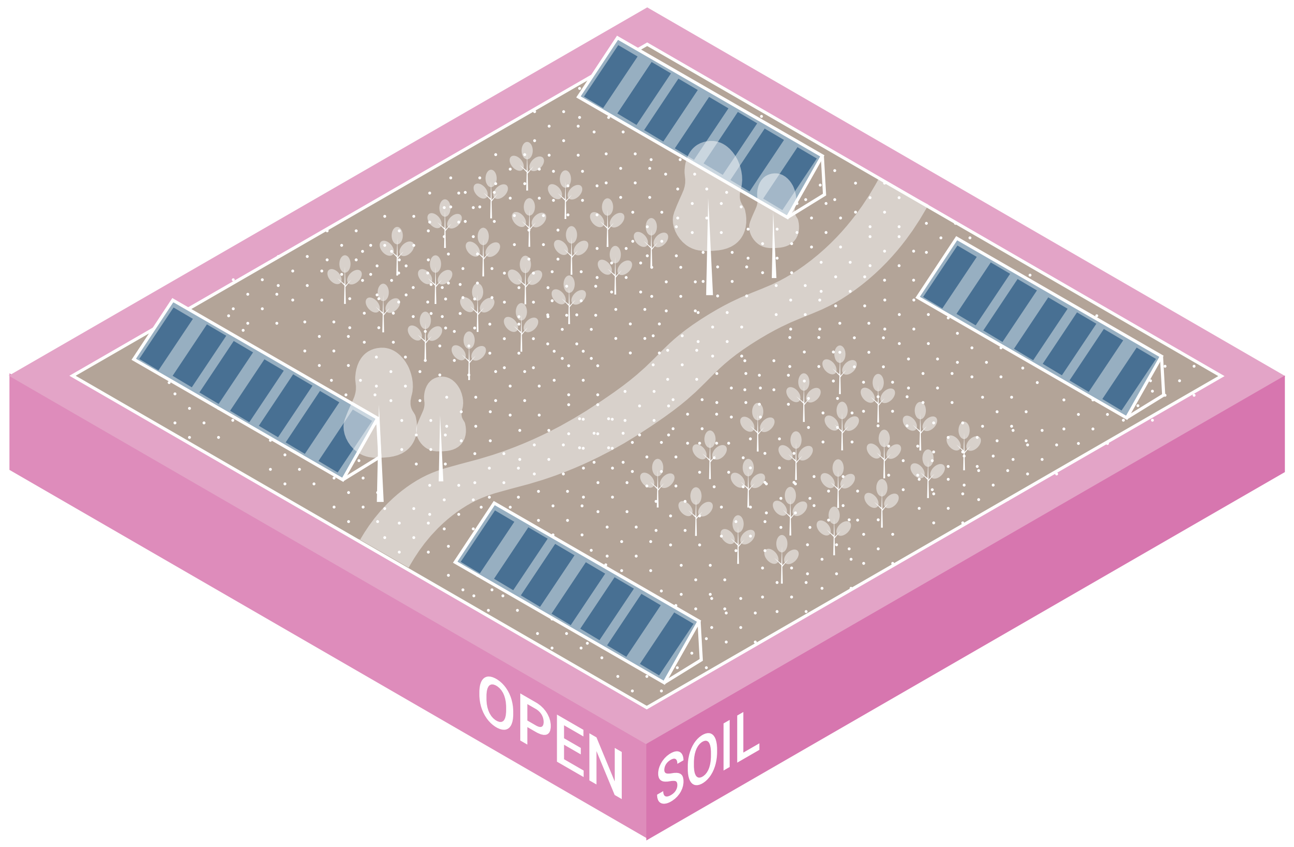
Open productive floriculture

An important added cultivation type in Westland is the reintroduction of open soil floriculture. 25 percent of the greenhouse area will become open soil. This approach allows for the regeneration of polluted soil, enables carbon capture that exceeds emissions, and increases resilience to extreme weather, issues previously discussed in the analysis. The open flower fields will be used within crop rotation systems that will be described later in the next chapter. The open landscape also creates opportunities for a multifunctional landscape. It enhances spatial quality, restores space for public recreation, and supports higher biodiversity in a pollution-free environment. In addition, it opens the door to combining floriculture with renewable energy production through the integration of agrivoltaic fields.

By giving back 25 percent of the greenhouse area in Westland to open soil, the soil can be regenerated, capture carbon and is more resilient to extremes of weather while it can be used multifunctionally

Agrivoltaic fields

Agrivoltaic fields enable the combination of space-efficient solar energy production with open flower cultivation, as is described in an interview by Statkraft with experts on this topic (Statkraft, n.d.). The solar panels are mounted on elevated, tiltable structures, allowing crops to grow underneath while still providing access for agricultural machinery. Currently experiments are determining what crop types perform best under the partial shade created by the panels. Applying these agrivoltaic fields on the edges of the open landscape creates a productive landscape, while also enhancing biodiversity.



Axo: open soil floriculture

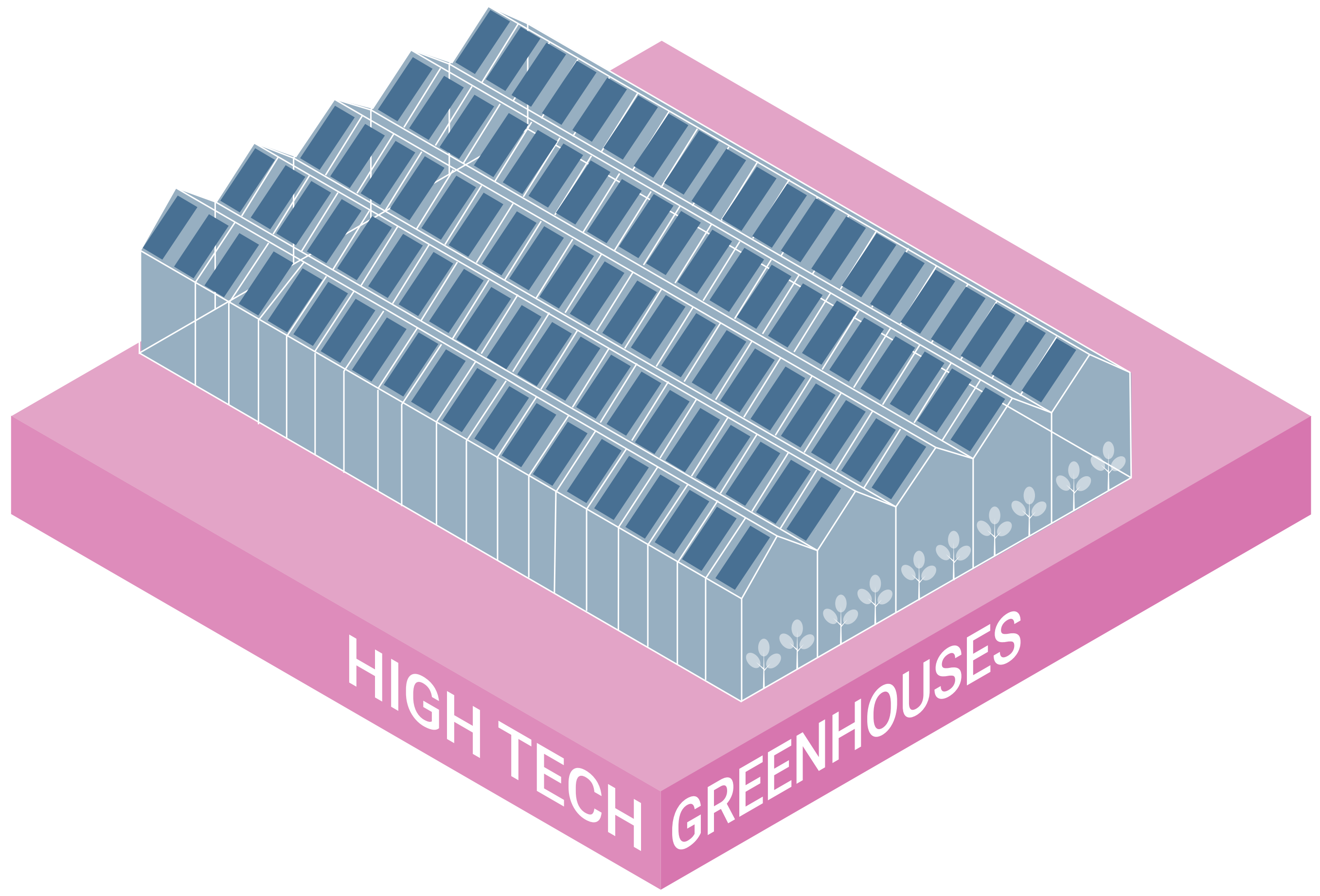
High Tech greenhouses

In the analysis chapter, several upcoming innovations in the greenhouse sector were introduced. Together, these innovations will form the basis of a High Tech greenhouse. This is a soil based, fully automated, regenerative, circular and efficient greenhouse, powered by renewable energy sources.

Greenhouse rotation system

A High Tech greenhouse will play a key role in the crop rotation model, allowing farmers with different crops to rotate between greenhouses. A High Tech greenhouse will be more universal and can easily adapt to different growing circumstances for different crops. This approach aligns with regenerative soil practices, enabling farmers to optimize nutrient cycles and growing environments while maintaining soil health.

A High Tech greenhouse is a soil based, fully automated, circular and efficient greenhouse, powered by renewable energy. The circumstances inside are easily adaptable to facilitate different crops to grow



Axo: High Tech farming

Vertical farming

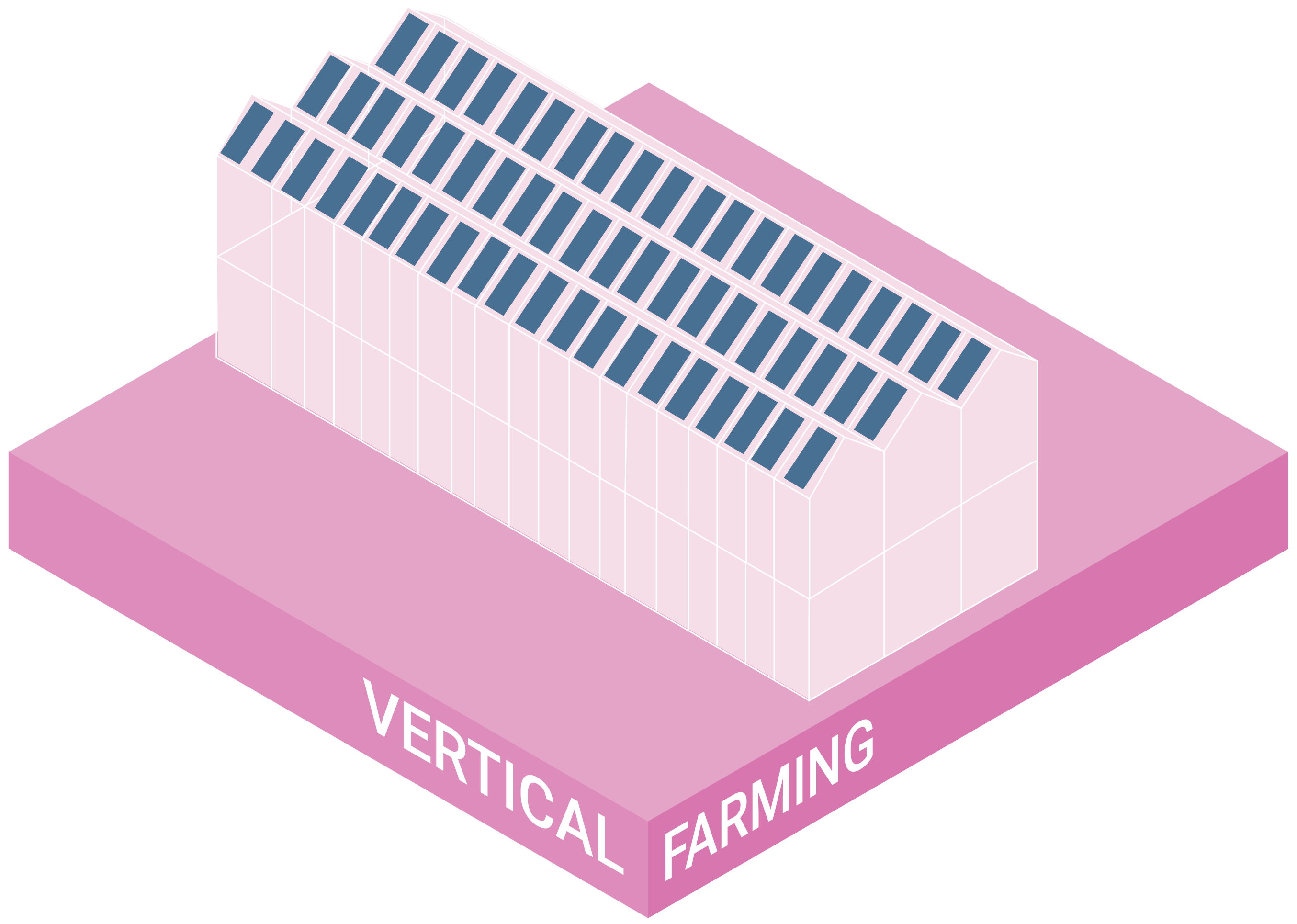
Vertical farming is the cultivation of crops in a closed off environment (WUR, 2024). The cultivation in vertical farms does not get in touch with the outside air or sunlight, unlike greenhouses which rely on natural sunlight. This method offers several benefits: it makes it possible to control the cultivation in a very targeted manner and cultivation in a vertical farm has several advantages for reducing damage to the environment: less crop protection is needed and water and fertilisers can be reused.
The crops in vertical farms are growing disconnected from the soil in vertical layers stacked on top of each other. Vertical farms can be located close to urban centers, which improves the freshness of produce and significantly reduces transportation costs (Stanghellini & Katzin, 2024).

Examples and challenges

Despite being a relatively new innovation, vertical farms are already operational. One example of this is located in the harbour of Amsterdam. In an interview with Dutch radio station NPO radio 1, Laura van der Kreeke tells about her experiences with her vertical farm Growy (NPO Radio 1, 2024). Currently they grow crops in a fully automated and controlled farm, the products are even in the supermarket for the market price. The controlled environment allows for precise input management, plants receive only the exact amount of water and nutrients they need, reducing waste.

However, vertical farming also faces significant challenges. Because it relies entirely on artificial LED lighting, energy consumption is high. Currently, vertical farms are about twice as energy-intensive as greenhouses (Stanghellini & Katzin, 2024). Stanghellini & Katzin state that about 4 square meters of solar panels would be needed for each square meter crop in a vertical farm. These solar panels can be partly placed on top of the farm, however for the system of vertical farms to be applied on a bigger scale, a more efficient energy use is crucial. Van der Kreeke from Growy sees potential for this in improvements for more efficient LED lights, optimising light use of the plants and for the farms to respond to peak hours of energy production on the network.

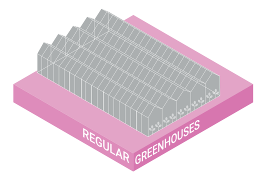
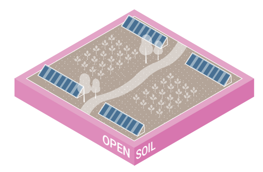
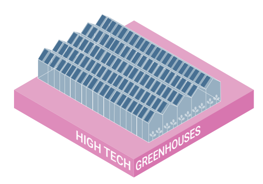
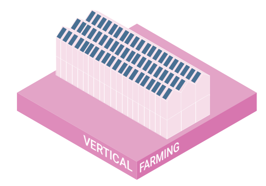
Vertical farms make it possible to grow crops in a fully controlled closed off environment stacked on top of each other, however this agriculture method still uses twice as much energy as High Tech greenhouses



Axo: Vertical farming

Comparison of cultivation methods

The table shown is based on a table used by Stanghellini & Katzin (2024). It ranks the different cultivation methods on different aspects. By analyzing these comparisons, strategic conclusions can be drawn about how each cultivation typology can best be applied in different contexts. For soil regeneration in Westland, open-soil floriculture proves to be the most effective method. To maintain the high levels of productivity, this approach can be complemented with high tech greenhouses. Vertical farms offer great opportunities to localise the growth of crops in urban environments, leaving fertile soil for regenerative agriculture outside of the city. Creating a healthy living environment. However this technology has to be optimised in terms of energy use. To make High Tech farming feasible also this cultivation method has to be largely innovated focussing on an increased productivity, to compensate for the productivity lost with parts of the cultivation in Westland going back to the outside open soil.

	 REGULAR GREENHOUSES	 OPEN SOIL	 HIGH TECH GREENHOUSES	 VERTICAL FARMING
Efficiency	●●	●	●●●	●●●●
Regenerative soil	●	●●●●	●●	○ (neutral)
Circular potential	●	●●	●●●	●●●●
Water use	●●●●	●●●	●	●
Energy use	●●●	●	●●	●●●●
Space use	●●●	●●●●	●●	●
Environmental impact	●●●●	●	●●	●●
Weather dependancy	●●●	●●●●	●●	●

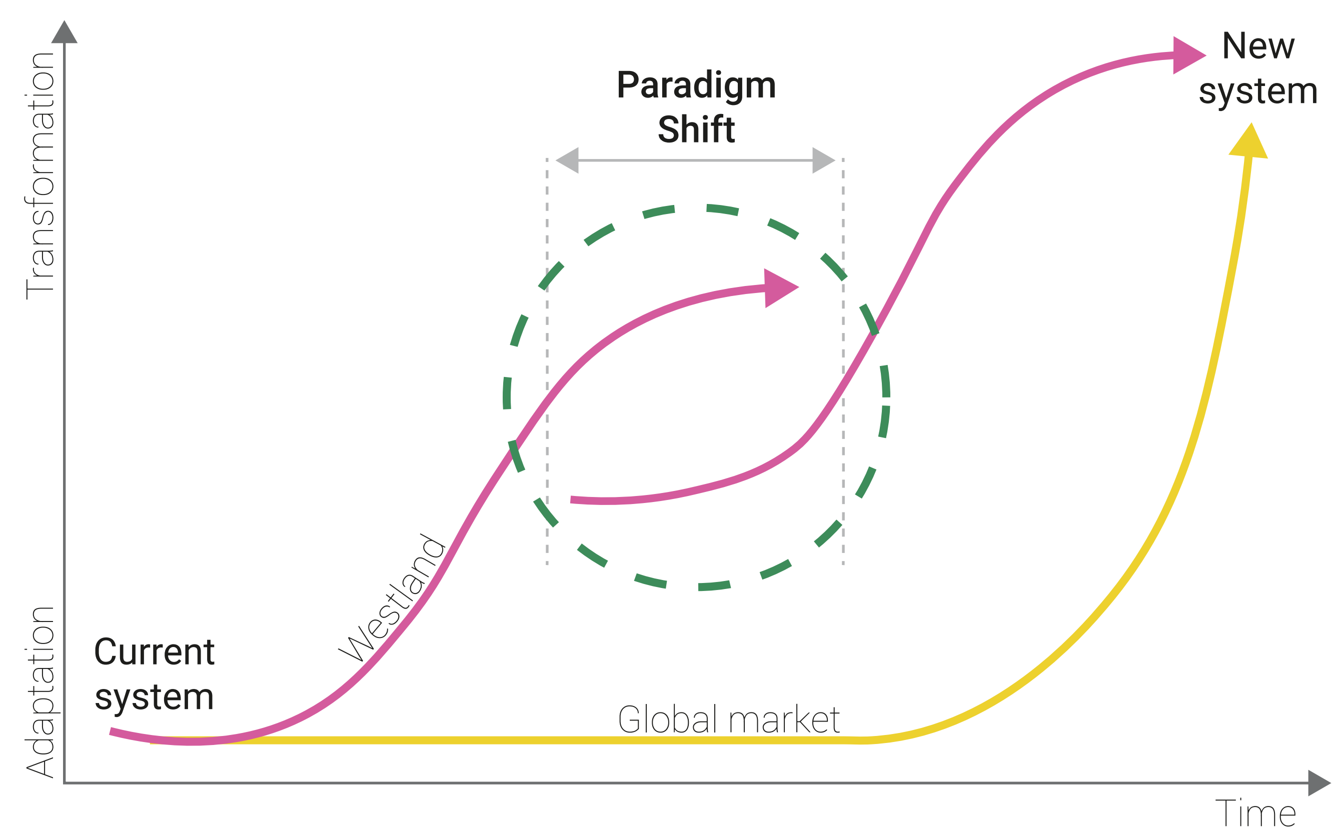
Positive impact
High ●●●●
●●●
●●
Low ●
Neutral ○
Low ●
●●
●●●
High ●●●●
Negative impact

Types of floriculture

STRATEGY

Paradigm shift

This project's paradigm shift will happen, once society can no longer accept the accumulation of negative effects caused by the current floriculture system. Westland feels these effects most. A new mindset must emerge, in which people put environmental impact before costs when choosing their products. This new mindset forces the industry and government to transition with it. The paradigm shift is also aligned with the vision of previous Minister Schouten of Agriculture, Nature and Food Quality (2018) for a transition into circular agriculture, as mentioned in the introduction of the report. At the point of the paradigm shift, a new system will take over the norm. Westland will be the pioneer of the transition in the flower sector. In the future, the global market will follow this new system and transform to a more sustainable one as visualised in the graph below.

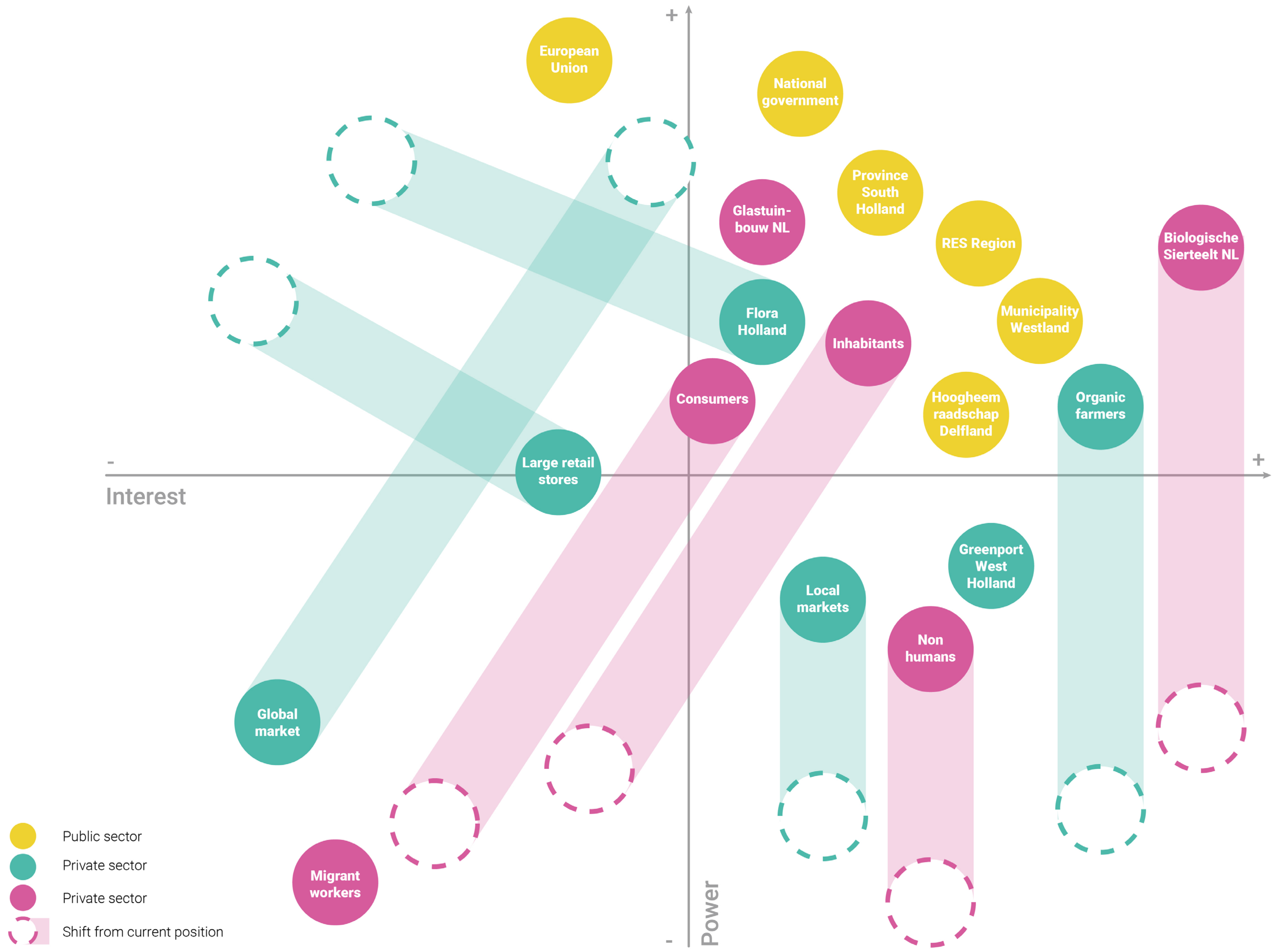


The paradigm shift (Kuhn, 1970)

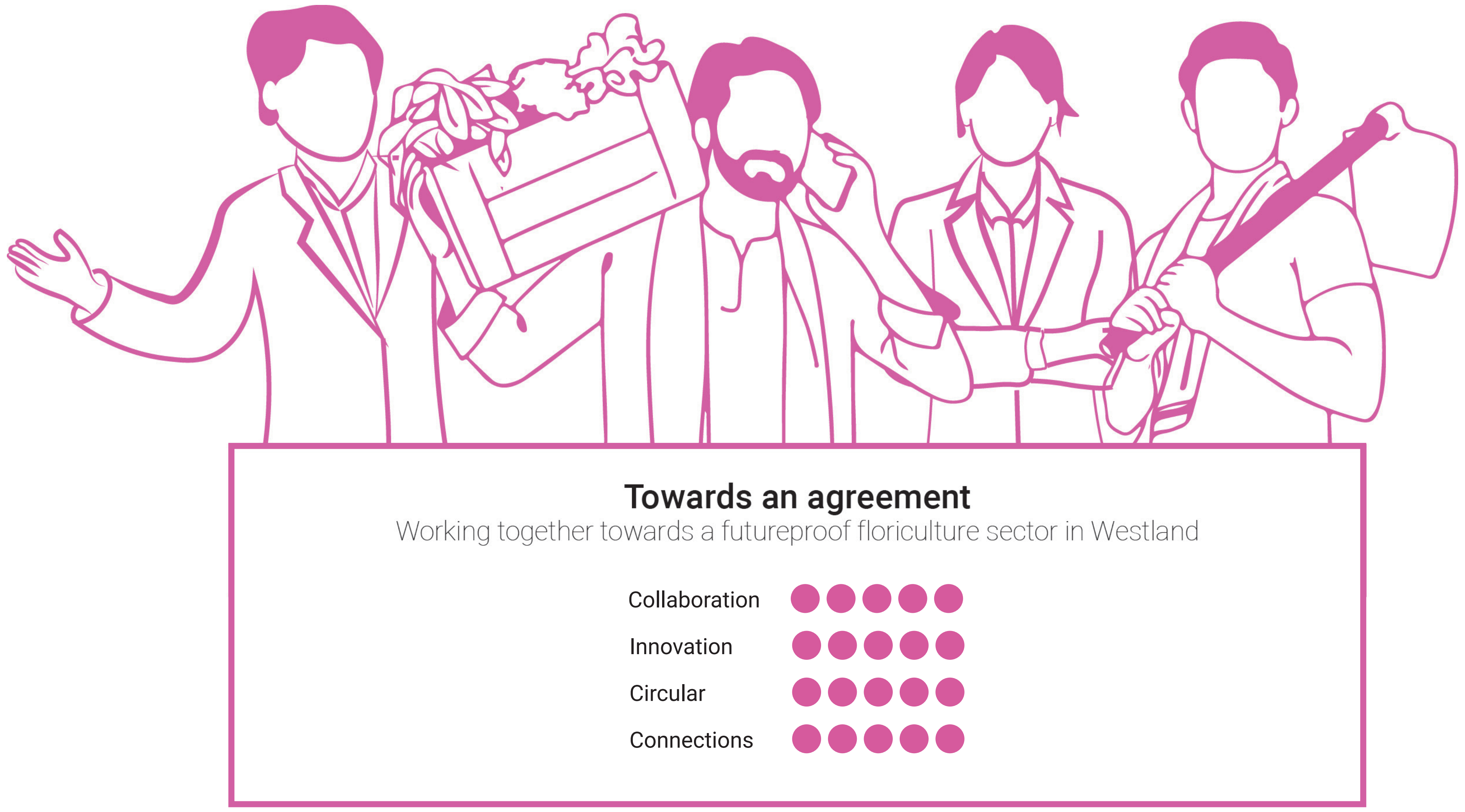
Stakeholder shift

The aimed systemic change needs the current community of flower farmers to transition into farmers of organic floriculture. The 'Regenerative Westland Agreement' is the beginning of this change. For this agreement to work, different stakeholders must cooperate. Current farmers and organic farmers need to work together to optimize their systems. They also need stakeholders who can invest and have the power to help with the transition.

In the transition, FloraHolland is an important stakeholder linked to innovation. As shown in the power-interest diagram, the global market will shift towards a new, more regional retail market. Due to the paradigm shift, consumers will enhance their power, influencing governments and companies to change. The union for organic floriculture will grow, because more farmers are incentivised to switch to the new method of organic agriculture.



Power interest stakeholder diagram



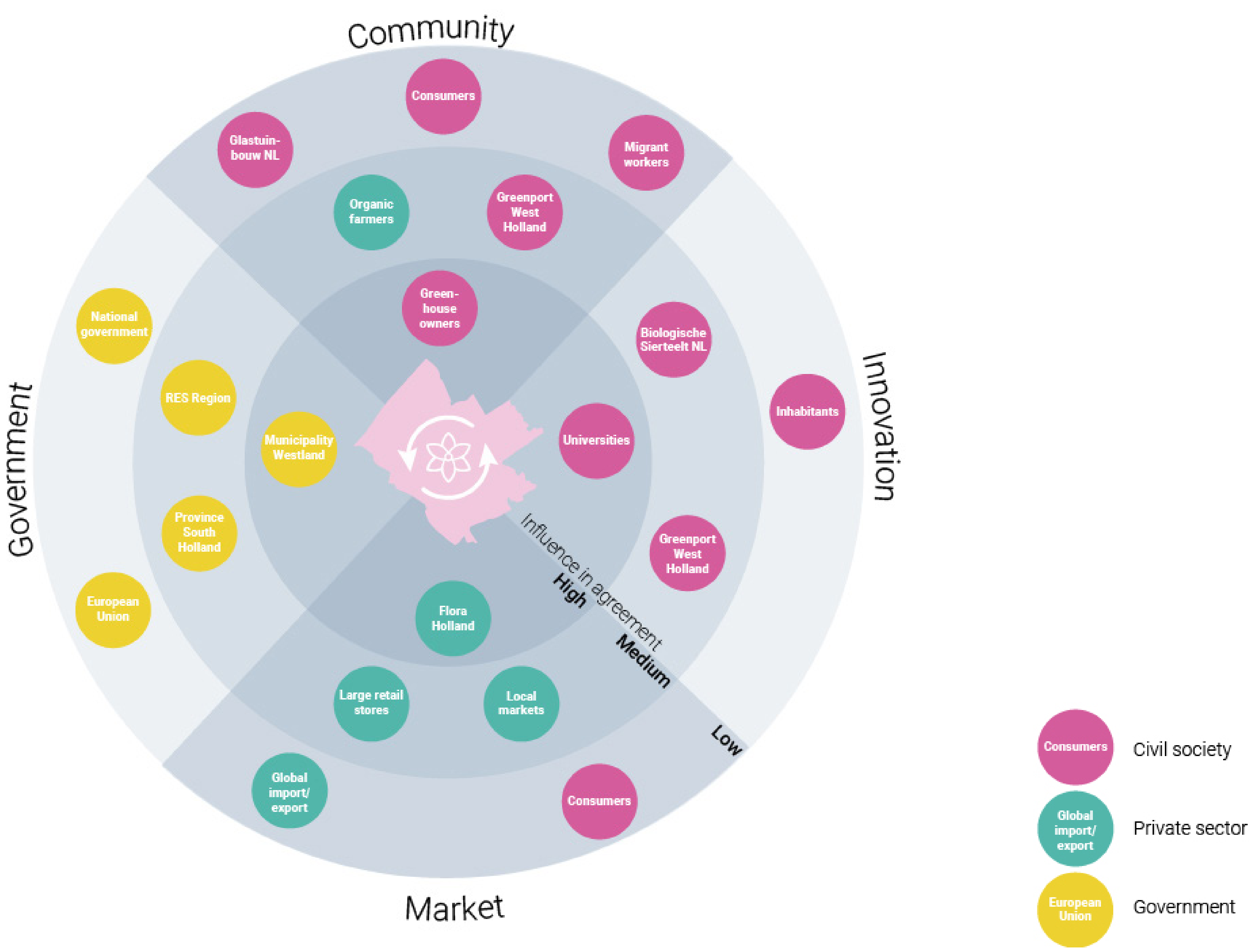
Collaboration between stakeholders

Regenerative Westland Agreement

Reacting to the societal switch in paradigm, Westland will take action to transition into a new form of floriculture. For this to happen, the 'Regenerative Westland Agreement' between the most important stakeholders will officially mark the transition into a future-proof flower industry in Westland. A Westland with healthy soil, healthy water and a resilient landscape, while retaining its leading and important position in the flower industry.

In the onion diagram shown below, the main stakeholders involved in this agreement are visualised: the government, the private sector, the innovation sector, and the local community. Key decisions between stakeholders from this agreement are noted on the adjacent page. There, it becomes clear that the government sees the energy transition as an important opening to break open the current system.

The 'regenerative Westland agreement' will officially mark the transition into a future proof flower industry in Westland. A Westland without soil depletion, a healthy water system and which is adapted to climate change. All while remaining its leading important and position in the flower industry.



Union diagram for stakeholders in the agreement

The government:
- Invest in large scale energy projects like: geothermal energy, solar, wind

With this create a fund to:
- Invest in the innovation of the greenhouse sector
- Compensate greenhouses, who have replaced a part of their greenhouses for open soil floriculture

In return:
Greenhouse owners:
- Will cluster and make place for 25 % of soil to be reopened and regenerated
- Go back to growing flowers in the soil
- In steps to a system where farmers rotate with their crops between High Tech greenhouses

Floraholland and the university cluster:
- Work together on innovation in a new 'Westland innovation centre'
- Start pilots for vertical farming and automatisation of greenhouses (High Tech greenhouses), to make a switch to a greenhouse rotation system possible

Glastuinbouw NL and Biologische Sierteelt NL:
- Play a key role in the adaption of a new organic label for consumers of flowers-
- Support greenhouse owners to make the switch to the new regulations

Consumers:
- Will be able to consume conscious with a new adapted organic certificate
- Pay a more true price for their products in terms of environmental costs, because the norm for flower production will go up in steps

Agreement per stakeholder

The new organic certificate

As concluded in the analysis, there are many different flower certificates, all with different criteria, which can be confusing for consumers. Therefore, a new label has been developed as part of the aforementioned agreement. It will combine the existing certificates, with strict and circular regulations in all categories, visible in the table below. The label will be named 'Ecoflora', with the logo shown on the right. The 'EcoFlora +' label will be an even stricter version. 'EcoFlora' is a flexible version of the current organic label. This will make it easier for farmers to adapt to the new rules, which will become the new norm by 2030. The 'EcoFlora+' will be the new norm in 2040, moving to a fully circular society. This transition can be seen on the right page.

The new eco-certificate gives clarity to flower consumers and farmers alike and stimulates the change into a circular and sustainable flower industry and society.

Eco Flora

Eco + Flora

EcoFlora and EcoFlora +

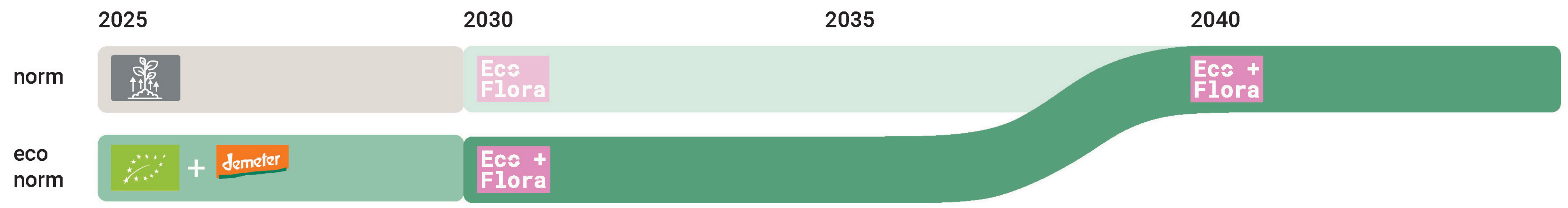
		PLANET PROOF		demeter		Eco + Flora
Energy use	No regulations	Minimal regulations	Minimal regulations	Circular / renewable	Circular / renewable	Circular / renewable
Healthy soil	Minimal regulations	Minimal regulations	Circular / renewable	Circular / renewable	Circular / renewable	Circular / renewable
Water use	Minimal regulations	Minimal regulations	Minimal regulations	Moderate regulations	Circular / renewable	Circular / renewable
Pesticides	Minimal regulations	Moderate regulations	Strict regulations	Strict regulations	Moderate regulations	Circular / renewable
Fertiliser	No regulations	Moderate regulations	Strict regulations	Strict regulations	Moderate regulations	Circular / renewable
Biodiversity	No regulations	Moderate regulations	Minimal regulations	Strict regulations	Strict regulations	Strict regulations
Social aspects	Minimal regulations	No regulations	No regulations	Moderate regulations	No regulations	Strict regulations
True price	No regulations	No regulations	Minimal regulations	Moderate regulations	No regulations	Strict regulations

New greenhouse production certificate

Scores per agriculture type

- Circular / renewable
- Strict regulations
- Moderate regulations
- Minimal regulations
- No regulations

Timeline towards a new norm



Current regulations

Currently there are rules for greenhouse owners to limit negative effects of this sector and to prevent the environment and the sector. The most important ones are:

- Energy and artificial lighting guidelines are in place to promote energy efficiency and reduce light pollution.
- The disposing of drainage water and other waste streams is regulated to minimise negative impacts on the environment.
- Regulations on the use of fertilisers and plant protection products to prevent soil and water pollution.

Flexibilised

Stricter

Ecological labels for greenhouses

Skal

The EU label for organic flowers ensures the reliability and integrity of organic farming. In the Netherlands it is certified by Skal.

- There are no extra requirements in terms of water or energy use.
- Only animal manure is allowed. Excess manure goes to other organic farmers
- To prevent diseases and pests, crops are rotated and hoeing and weeding is carried out. Pesticides are used as little as possible.
- Crops grow in the open field
- Prohibition of the use of genetically modified organisms

Demeter

Demeter is a biodynamic certificate, it goes further than Skal regulations, it has the same EU regulations and stricter ones.

- Green electricity is mandatory
- Requirements for energy and water use in cultivation, transport, waste management and packaging use
- Crop rotation is mandatory
- At least 10% of the area must be available for local biodiversity
- Social requirements as combating child labour, discrimination and right to fair payment.

Ecoflora: to a circular flower industry

A new ecolabel. A flexibilised and more outcome based version of the ecological regulations. A first step to a full circular flower industry as described at Ecoflora+.

- 50% renewable energy use and limiting energy use and light pollution
- Obligating water filtering inside greenhouse clusters
- Crops grow in soil. Keeping a high soil quality by exchanging soil between companies. No obligated crop rotations.
- Only using fertiliser or pesticides locally when there is no other natural option

Skal

Based on 'Kringlooplandbouw' by the Dutch ministry of Agriculture Nature and food quality (Milieucentraal, n.d.). This will combine the most strict rules of both the European Skal certificate and the Biodynamic Demeter certificate into a new stricter Dutch ecological certificate.

- 100% renawable energy use
- Strict rules against light pollution
- Only fossil free transport used for export
- Circular water use and obligating water filtering inside greenhouse clusters
- No soil depletion by obligated crop rotation
- Agriculture and horticulture use residues and waste from each other's farms and from the food industry
- No use of fertiliser, by paying close attention to soil quality and fertility.
- Supporting biodiversity, with 10% flower beds next to fields
- Social requirements combating child labour, discrimination and right to fair payment. Consumers pay the true rice of flowers
- Strict rules on packaging use

- Circular / renewable
- Strict regulations
- Moderate regulations
- Minimal regulations
- No regulations

Timeline in phases

The transition is divided into three phases, the first of which is the transition to a circular greenhouse system. The second phase is the transition to a circular floriculture industry. The third and final phase is the transition to a circular society in the Netherlands.

The Regenerative Westland Agreement is the beginning of this transition. The actors involved are shown in the timeline. The 2040 target of fully circular greenhouses is based on the policy of the Greenport West-Holland targets. The goal of 2050 of a climate neutral system in the Netherlands is based on the SDG's, which are shown in the national, regional and local energy policies.

Nationaal programma RES Regionale Energie Strategie

GREENPORT West Holland

THE START 'THE REGENERATIVE WESTLAND AGREEMENT'

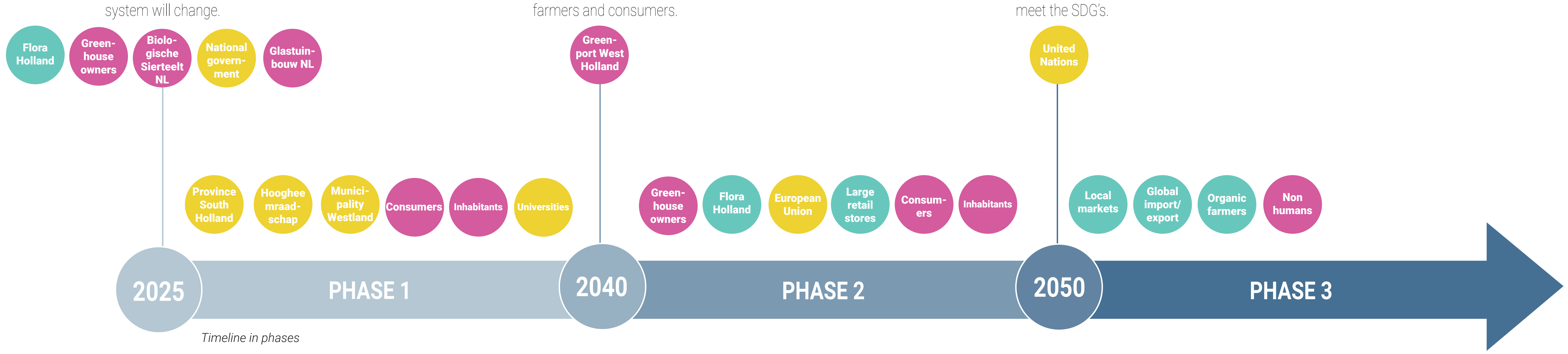
The new regulatory Westland Agreement is the starting point for the transition. It is known for innovation, cooperation and sustainability. When the agreement is signed, the system will change.

GREENHOUSES FULLY CIRCULAR

The current policy for national greenhouses is to be fully circular by 2040. We have achieved this by changing the system from within. Including a new of mindset of farmers and consumers.

SYSTEM CLIMATE NEUTRAL

According to the Sustainable Development Goals, the world needs to be transformed into a sustainable and equitable system. The whole flower production system must meet the SDG's.



Timeline in phases

TOWARDS CIRCULAR GREENHOUSES

The first phase focuses on creating a circular greenhouse system. Starting at the heart of the problem. This relates to water circulation, energy production and flower production.

TOWARDS A COMPLETELY CIRCULAR SYSTEM

The second phase is to make the whole system circular, including transport and the surroundings of the greenhouses. To create a circular system, the landscape must be future-proof.

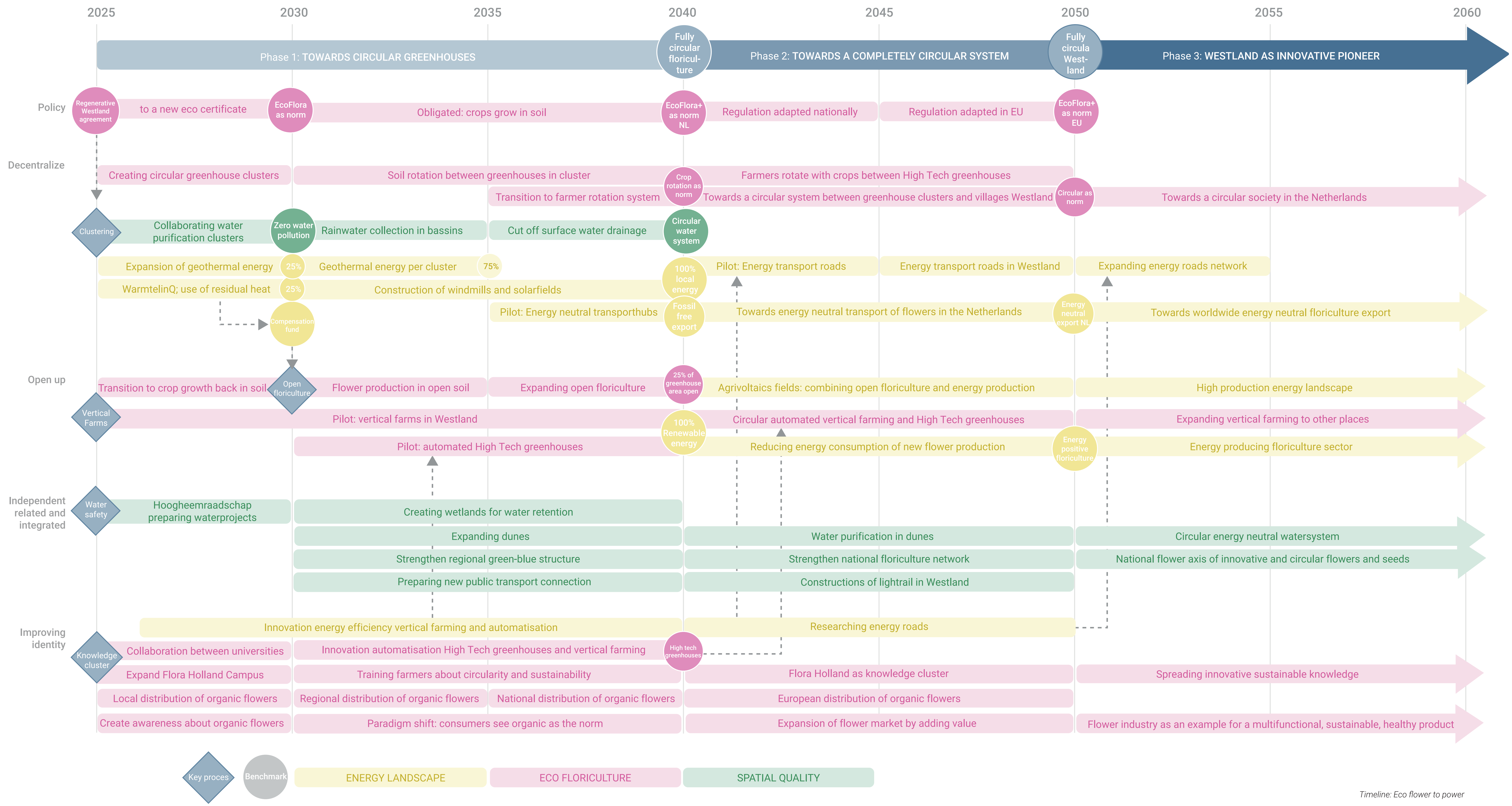
WESTLAND AS INNOVATIVE PIONEER

By transforming flower production into an energy positive and sustainable sector, Westland is acting as a pioneer for other agricultural sectors and locations.

Timeline

The complete timeline of the strategy towards a sustainable, resilient landscape and floriculture system is divided into three phases spanning from 2025 to 2060. On the left the key concepts are shown. The top row consists of policies from the 'Regenerative Westland Agreement'. The transition starts with different key projects, highlighted as diamonds. The key projects relate to key processes, expanded upon further in this chapter.

The essential benchmarks are indicated in circles, needing to be achieved before moving towards the following phase. The different colours in the timeline refer back to the goals dividing the vision maps: energy landscape, eco floriculture and spatial quality. The timeline ends with arrows, referring to the fact that this transition towards circularity is an ongoing process and will not definitively be accomplished by 2060.



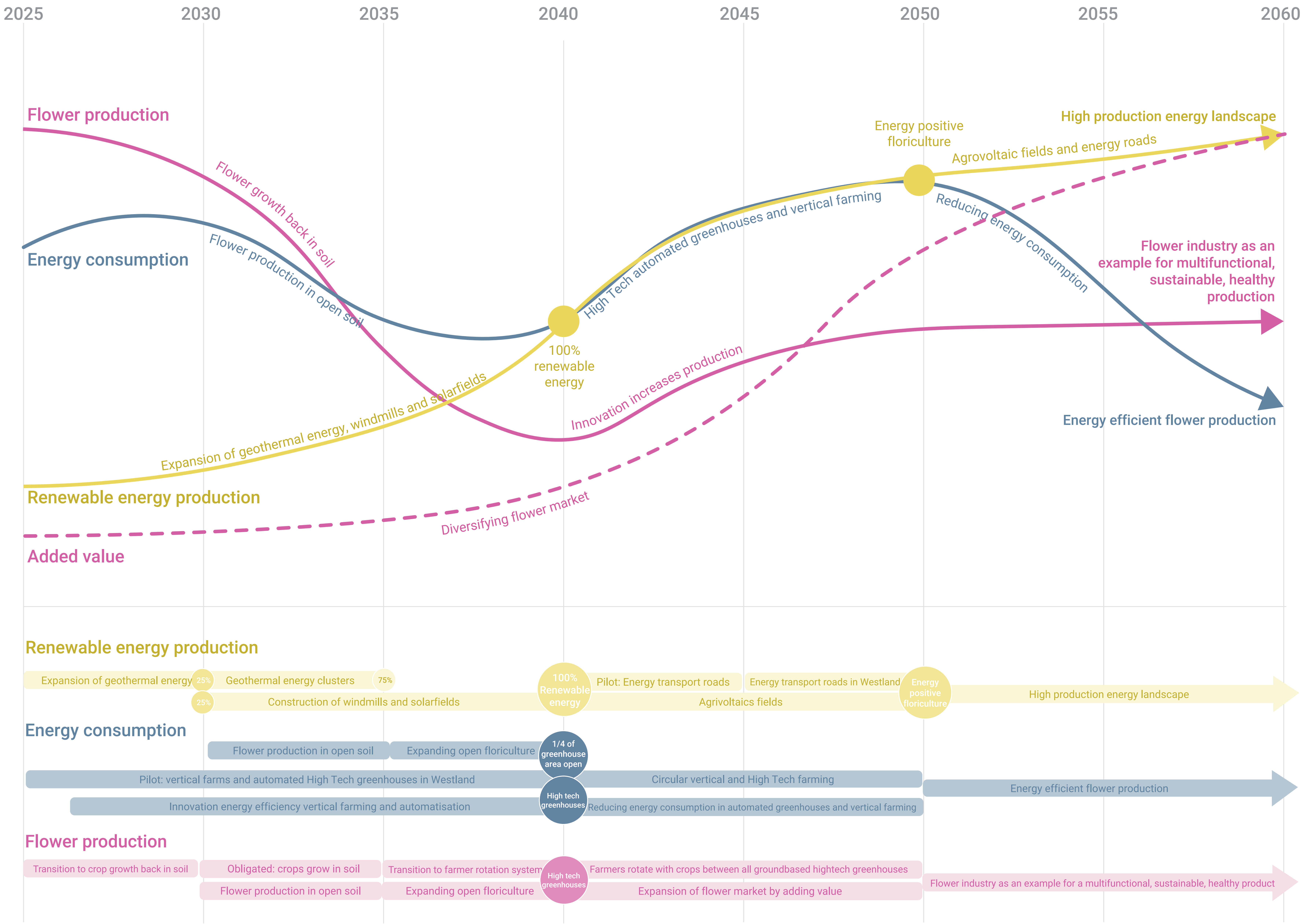
Timeline: Eco flower to power

Production and consumption timeline

This timeline shows the flows of flower production, energy consumption, renewable energy production and the added value of the flower market. These flows are all in relation to the strategic events previously shown.

Due to the Westland agreement, the government will invest in large-scale renewable energy production, to attain fully green energy production by 2040. Simultaneously, flower production and energy consumption will decrease in greenhouses, as 25% of current greenhouse surface area will return to open soil production.
From 2040 onwards, automated High-tech greenhouses will be developed, and this concept will be implemented in all greenhouses. The automated system will make the energy consumption and the production efficiency increase.
In 2050 the innovation for the greenhouse sector will increase the energy efficiency, resulting in an energy positive floriculture sector. Residual energy can be used for the surrounding urban areas.
The line with the diversified flower market with more added value for flower products rises steadily through the years. Flowers will be more than just ornamental, as will be explained further in this chapter.

The flows end up representing a balanced floriculture industry in Westland. With a high energy production and an energy efficient flower production, producing not just flowers, but products with added value. In this way the sector can serve as a world leading example for its innovative, sustainable and healthy production.



Production and concumption timeline

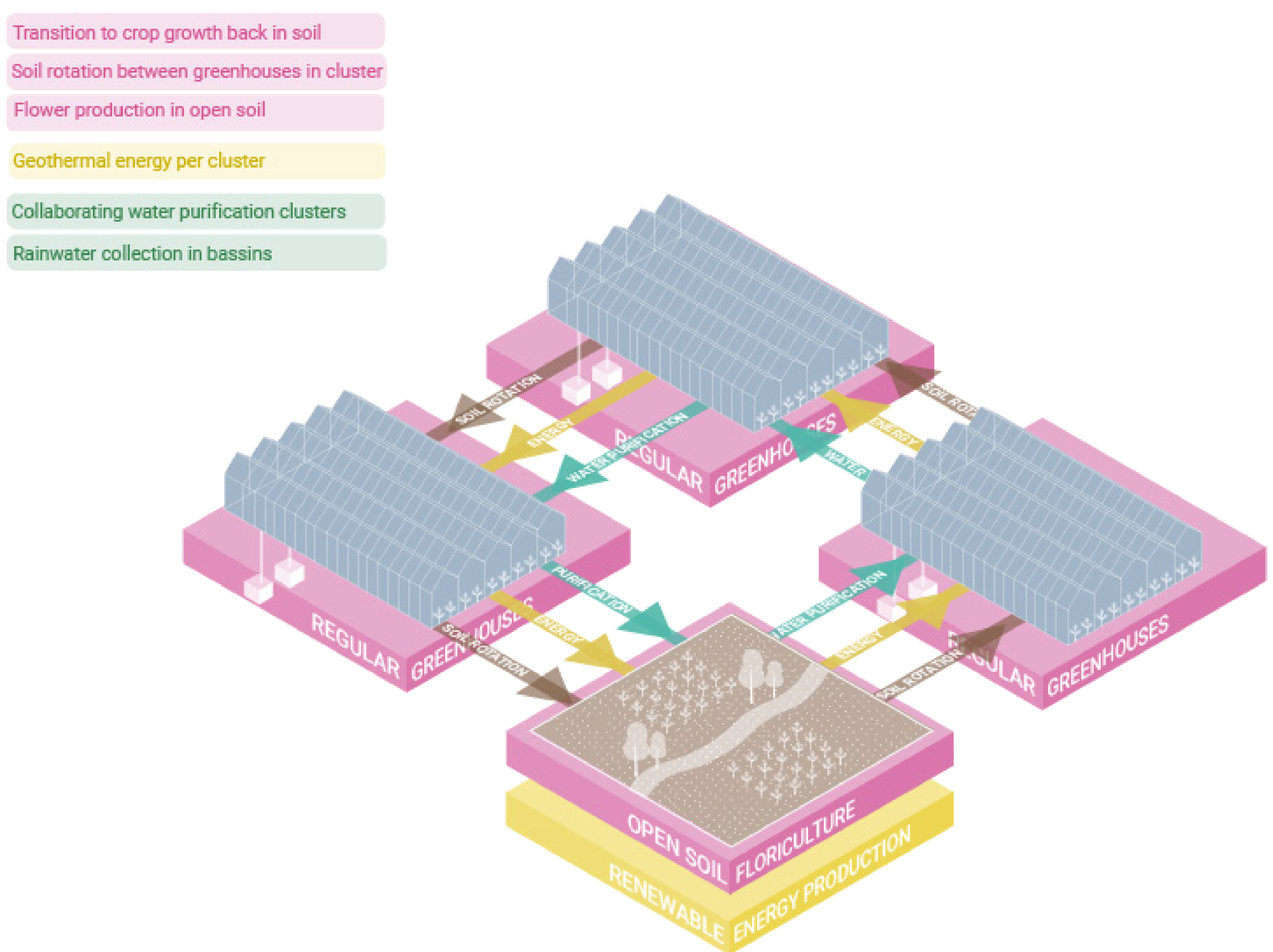
Spatial timeline

The different phases of the strategy have spatial implications for Westland. Each will be expanded upon, illustrating how Westland will transform into a new circular system. Per phase, the scale of the system will also increase, starting at the level of Westland in the first phase, to a regional level in the second phase, and ending with a national map, relating to the global place that Westland will hold. The most important events taking place in that phase are shown next to the spatial axonometries. More schematic axonometric zoom ins illustrate the principle of the clusters in each phase

Phase 1
The first phase starts with Hoogheemraadschap strengthening the main water structures in Westland. Westland will still be using the WarmtelinQ residual heat from the port of Rotterdam. Simultaneously, clusters of greenhouses will be formed, as visualised in the top drawing on the right page. These clusters will start to work together in energy use and production, water purification and soil rotation. Knowledge institutes will start an intensive collaboration, with a strong focus on a more efficient floriculture.

During the second part of the phase, all the greenhouse clusters will be formed. The clusters are moving towards 25 % reopened soil in Westland, to regenerate the soil, reduce the energy consumption and create room for water retention. Water retention projects are realised, such as expanding the dunes for a better coastal defence. The energy landscape starts to take shape, with the construction of solar fields and windmills and geothermal sources, connected to the new clusters.

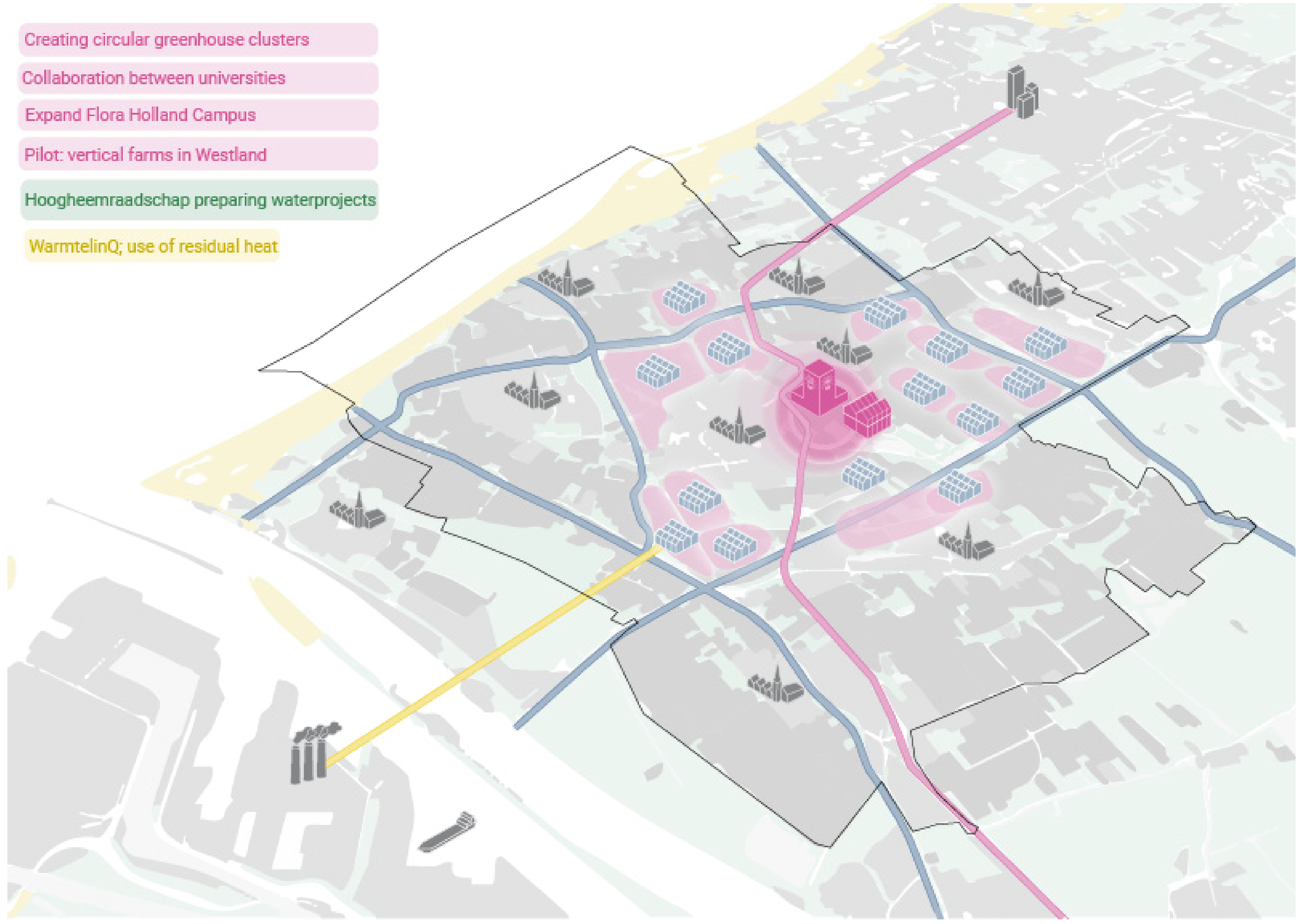
These clusters have returned to cultivation in open ground, due to the new EcoFlora norm. They are fully circular in the soil exchange, water purification and sharing energy. This is shown in the scheme below.



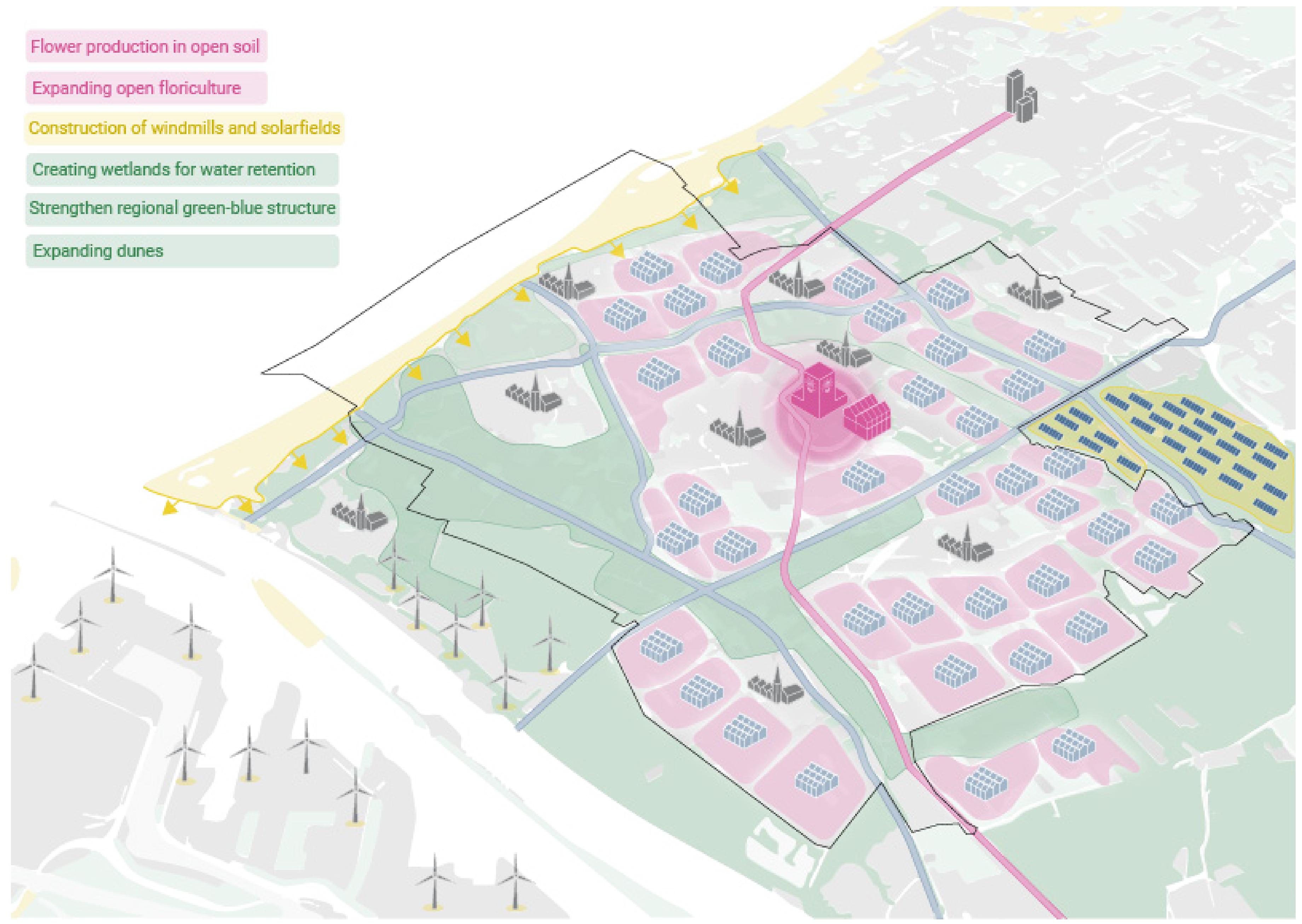
A circular greenhouse cluster

Phase 1 - Towards circular greenhouses

2025-2030



2030-2040

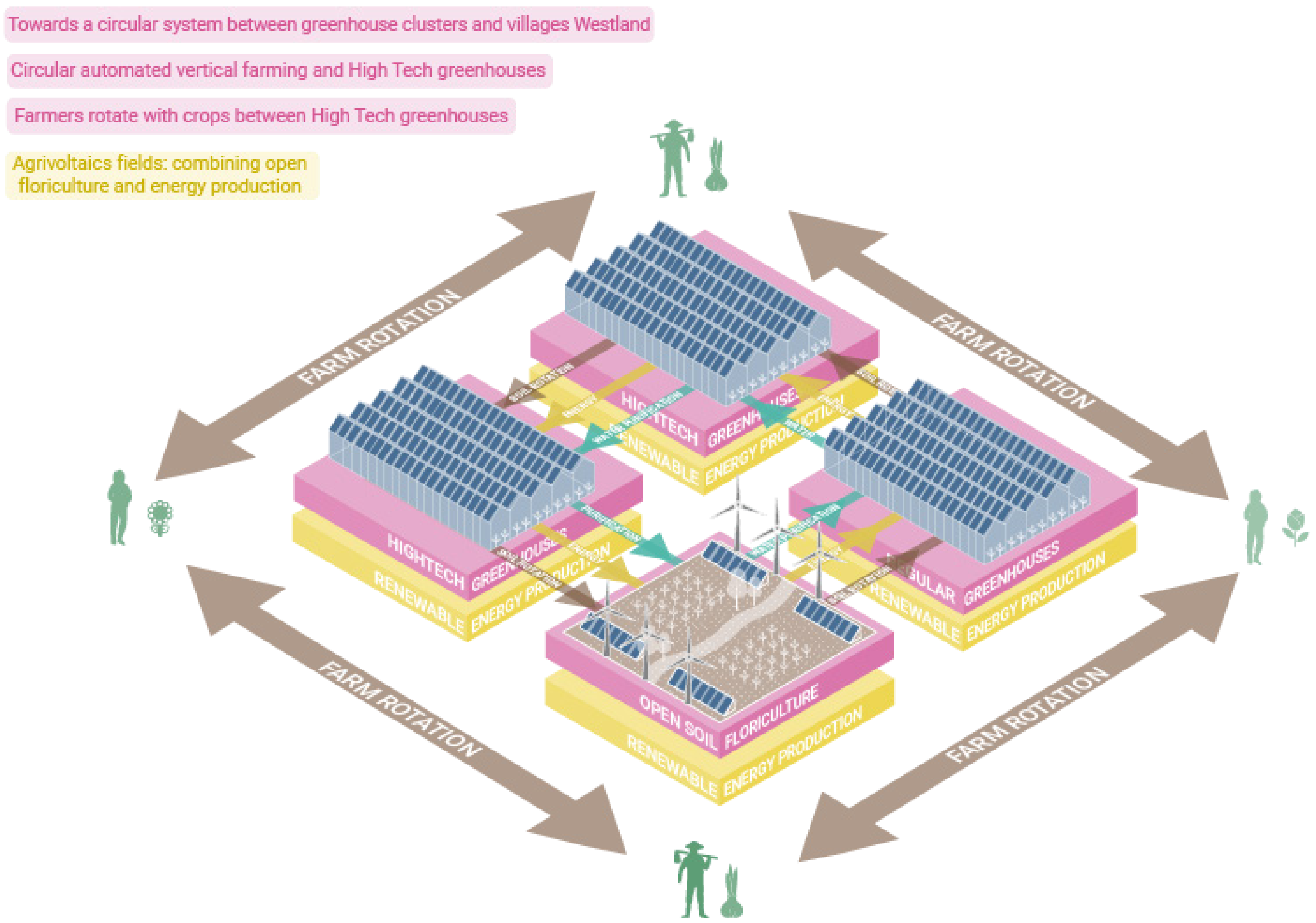


Spatial change in Westland

Spatial timeline

Phase 2
The second phase zooms out to the regional scale. The enhanced connections to the region of an opened up Westland are visible, with the open floriculture landscape connecting regional green-blue structures.

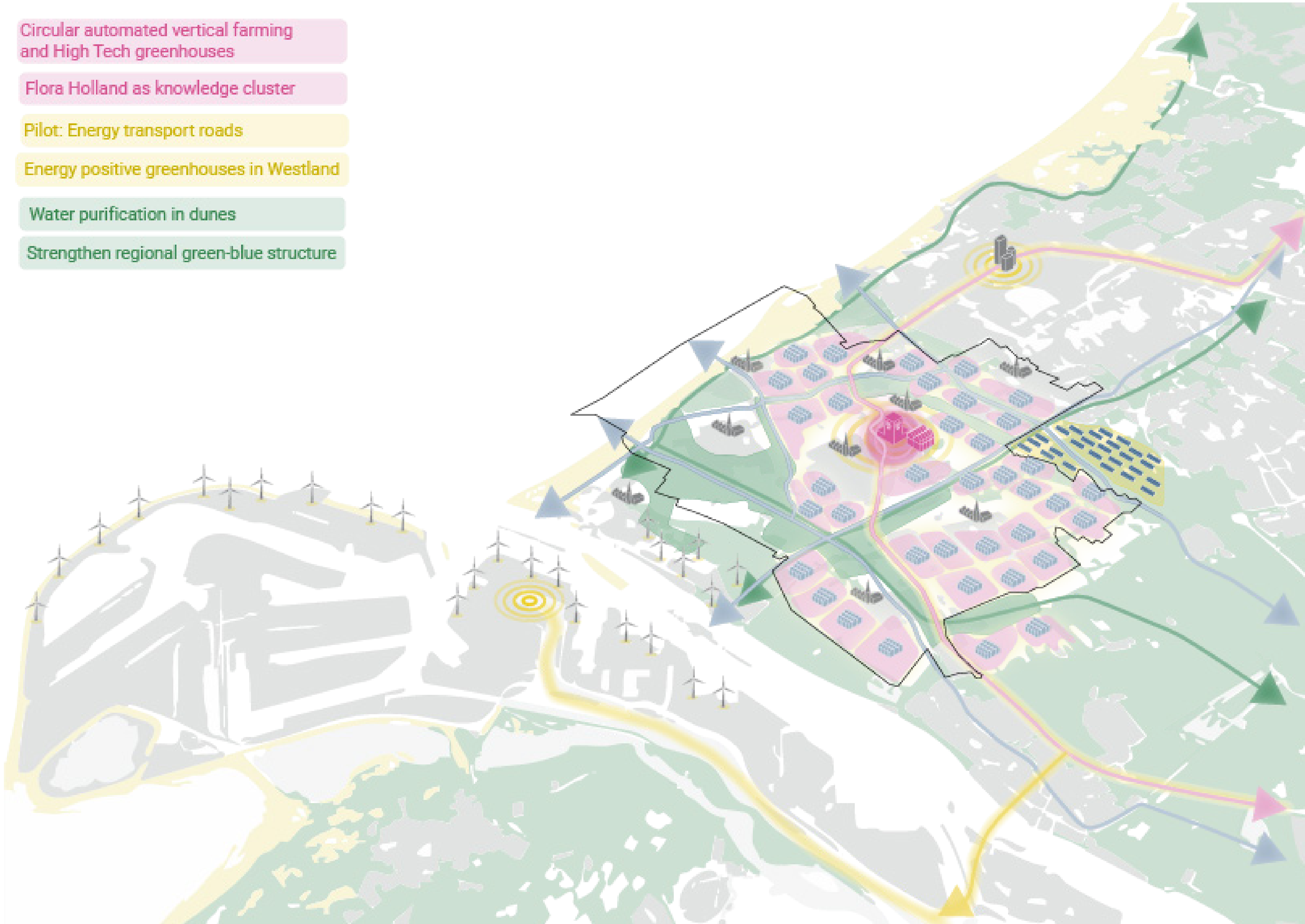
The innovation cluster surrounding FloraHolland has improved techniques in greenhouses and vertical farming, making it possible for clusters to become fully circular, with farmers with different crops rotating between High-tech greenhouses. This is in connection to the new norm of EcoFlora+ asking for regenerated soil. The clusters only rely on local energy production, feasible due to the growth in energy projects in the region. One of these projects is the implementation of agrivoltaic flower fields. The collaboration with the harbour in relation to residual heat use is replaced by a new collaboration of energy share from windmills. This makes all the energy sources renewable.



A High Tech greenhouse cluster

Phase 2 - Towards a completely circular system

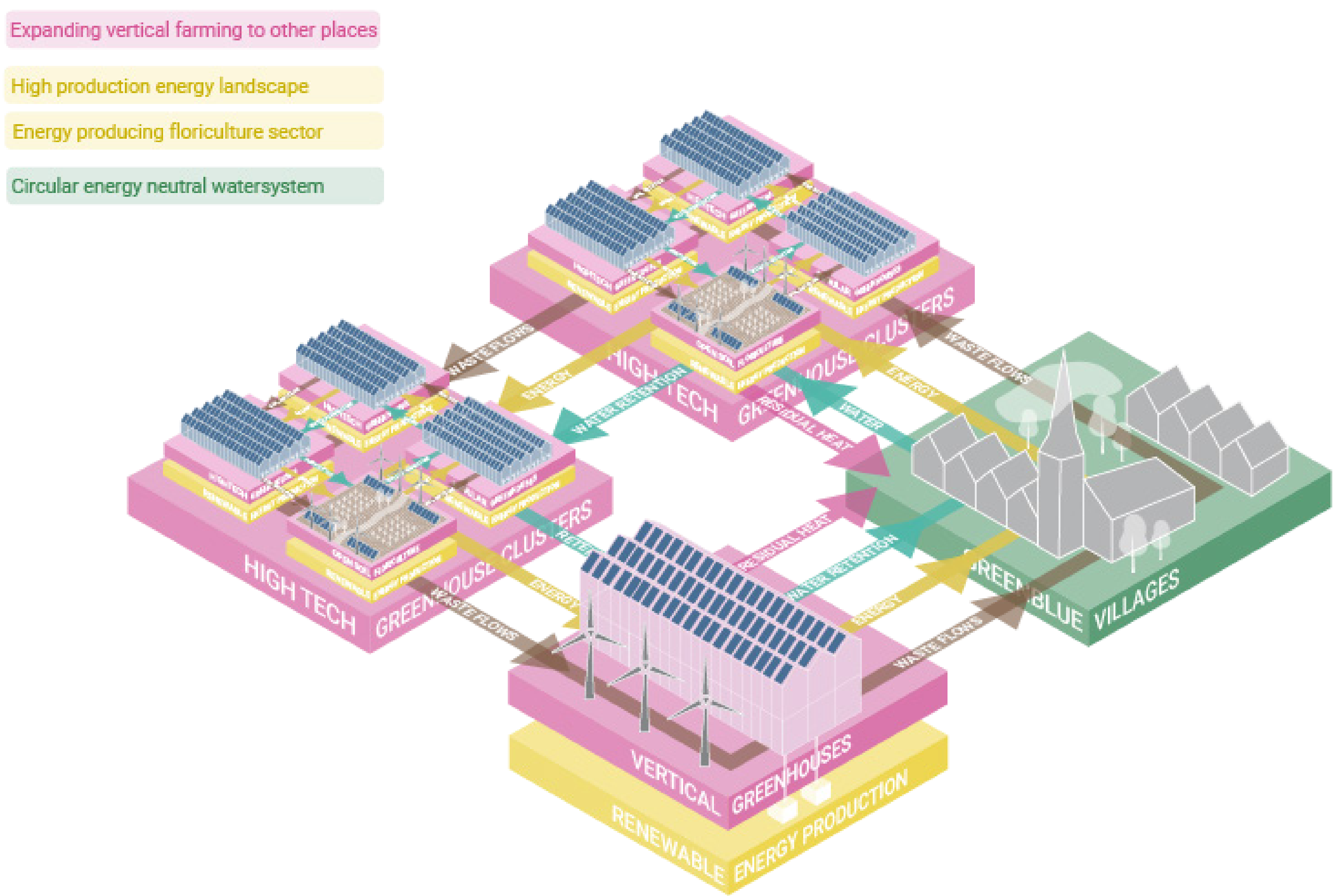
2040-2050



2040 - 2050 regional scale

Spatial timeline

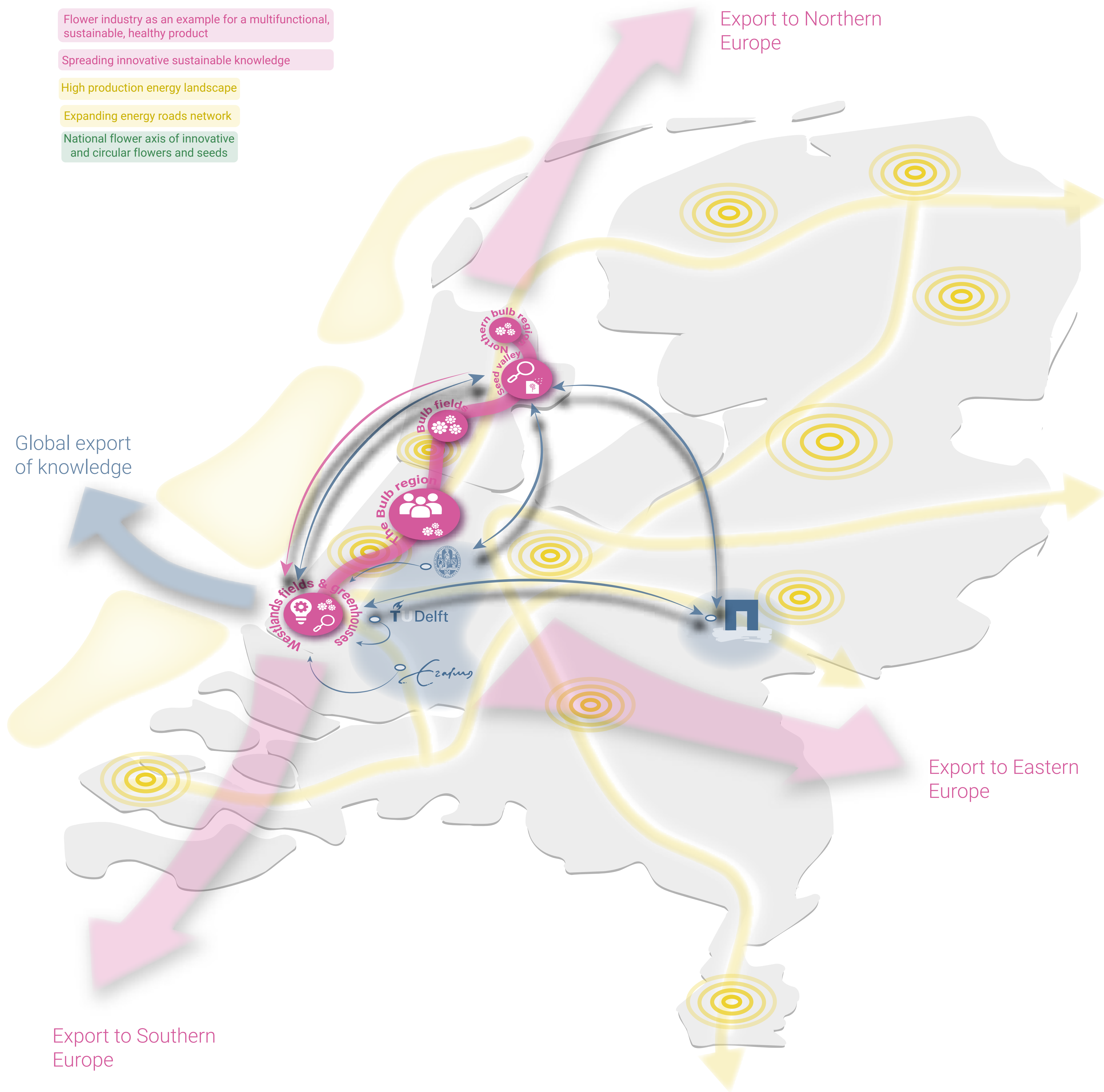
Phase 3
In the final phase, from 2050 onwards, High-tech greenhouses have started working together with urban areas and the newly developed vertical greenhouses, creating a fully circular Westland, where waste cycles are closed. The energy production in the cluster has surpassed the consumption, creating a surplus of energy which can provide for Westland's inhabitants.
On a national level Westland is connected to the floricultural system. The development of Westland leads to a collaboration between the complete floriculture sector of the Netherlands, sharing knowledge and creating circular, multifunctional, sustainable and healthy flower products. This concludes in a flower axis, connecting floriculture areas in the west. This new form of floriculture will be a global example. The energy network of the Netherlands has expanded, inspired by Westland, with energy roads present throughout the whole country. The end result is a flower industry where both production and distribution happens energy neutral.



A circular system between greenhouse clusters and villages

Phase 3 - Westland as innovative pioneer

2050-2060



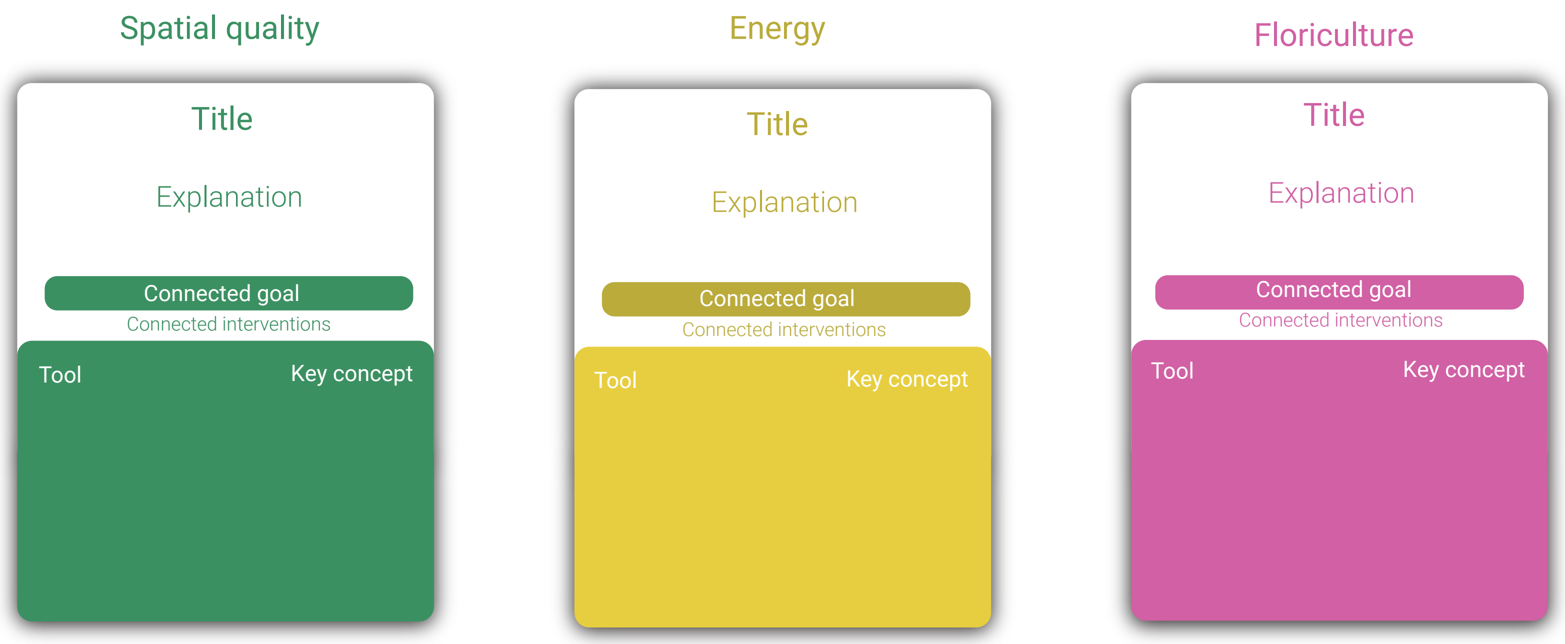
2050 - 2060 national level

Interventions cards

The transition is divided into interventions that are needed for full transformation of Westland. To make these interventions accessible and easy to understand for farmers and other stakeholders, a set of intervention cards has been developed. The interventions are linked to the main objectives through colour coding. The tools are also shown on the left side of the cards. The right side shows the associated key concept. By combining different cards, users can gain insight into the broader key processes that support the transition.

Farmers and other stakeholders can use the cards as a means of communication. The board game on page 142 shows the transition timeline, outlining important milestones for farmers. The cards can be used to discuss and group different interventions. Greenhouse owners working within clusters can use the cards to coordinate efforts, while also engaging with stakeholders through the 'Regenerative Westland Agreement'.

The energy intervention cards focus on reducing energy consumption and increasing renewable energy production. The Regenerative Westland Agreement, training and guidance will help farmers to navigate the transition step by step. The floriculture intervention cards emphasize cooperation between farmers, but also universities and Flora Holland, to support knowledge exchange and innovation. Finally, cards related to spatial quality highlight interventions aimed at shaping a healthy, sustainable, and biodiverse landscape.



Example intervention cards

Interventions: Energy

Legend

Key concepts:
D Decentralize
IR Indepent to related and integrated
O Open up
II Improving identity

Tools:

Greenhouseowners responsible
Municipality responsible
Government responsible
Money needed
Gaining money
Knowledge
Regulations

Interventions: Floriculture

Crop rotation
Rotation of different crops and farmers to keep the soil healthy
Healthy soil system
O.1, IR.4, II.5, IR.1, IR.5, IR.11, D.5, D.8, D.6, IR.13
D.5

Greenhouses on industrial buildings
Functions are mixed to open up the landscape
From mono to mixed functions
O.1, IR.4, II.5, IR.1, IR.5, IR.11, D.5, D.8, D.6, IR.13
D.6

Metropole distribution
Westland is known for distribution to regional scale
Enhanced regional connection
II.5, II.2, II,3, O.6, D.7, II.4, IR.6, IR.7
D.7

Sell on local market
Local distribution of organic flowers
Localize the market
O.1, IR.4, II.5, IR.1, IR.5, IR.11, D.5, D.8, D.6, IR.13
D.8

Ground lease
Municipal leasehold gives ownership of the land to the municipality
Floriculture as the norm
II.5, II.2, II,3, O.6, D.7, II.4, IR.6, IR.7
O.6

Bio farmer groups
Organic farmer groups are set up to communicate and learn from each other
Floriculture as the norm
O.1, IR.4, II.5, IR.1, IR.5, IR.11, D.5, D.8, D.6, IR.13
IR.1

Shared resources
Shared equipment for lower costs and better connections
Exchange between organic farmers
O.1, IR.4, II.5, IR.1, IR.5, IR.11, D.5, D.8, D.6, IR.13
IR.4

Material exchange
For example a cycle of seeds between greenhouses
Exchange between organic farmers
O.1, IR.4, II.5, IR.1, IR.5, IR.11, D.5, D.8, D.6, IR.13
IR.5

Flower axis
Westland is part of the larger flower axis in the Netherlands
Regional cooperation
II.5, II.2, II,3, O.6, D.7, II.4, IR.6, IR.7
IR.6

Adding value to flower market
New features such as edible flowers are produced in Westland
Westland as pioneer
II.5, II.2, II,3, O.6, D.7, II.4, IR.6, IR.7
IR.7

Open ground floriculture
25% of greenhouses are transformed to open up the landscape
Floriculture on open ground
IR.8, O.5, O.2, O.3, O.4, IR.9, IR.12, IR.14
IR.8

Shared landownership
Different farmers using floors in vertical farming
from mono to mixed functions
O.1, IR.4, II.5, IR.1, IR.5, IR.11, D.5, D.8, D.6, IR.13
IR.11

New crops on wetlands
Combination of flower production and energy in the open field
100% renewable local energy
IR.9, IR.10, D.9, O.8, D.10, D.11, D.12
IR.10

New skal certificate
Ecoflora and Ecoflora+ to create a more sustainable organic floriculture sector
Floriculture as the norm
O.1, IR.4, II.5, IR.1, IR.5, IR.11, D.5, D.8, D.6, IR.13
IR.13

Open greenhouse day
Create a sense of pride and awareness in Westland among residents
Focus on innovation/education
O.1, IR.4, II.5, IR.1, IR.5, IR.11, D.5, D.8, D.6, IR.13
II.5

Innovative Flora Holland
Flora Holland as a sustainable and innovative pioneer in Westland
Westland as pioneer
II.5, II.2, II,3, O.6, D.7, II.4, IR.6, IR.7
II.2

Collaboration between universities
New innovations are designed and tested in collaboration with universities
Westland as pioneer
II.5, II.2, II,3, O.6, D.7, II.4, IR.6, IR.7
II.3

Open greenhouse day
Create a sense of pride and awareness in Westland among residents
Focus on innovation/education
O.1, IR.4, II.5, IR.1, IR.5, IR.11, D.5, D.8, D.6
II.5

Legend

Key concepts:
D Decentralize
IR Indepent to related and integrated
O Open up
II Improving identity

Tools:

Greenhouseowners responsible
Municipality responsible
Government responsible
Money needed
Gaining money
Knowledge
Regulations

Interventions: Spatial Quality

Rainwater collection
Waterbasins and underground tanks for optimal rainwater use
Closed clean water cycle
D.1, D.2, IR.2, IR.3, D.3, D.4, II.1
D.3

Water purification
Filtering used water to prevent water pollution
Closed clean water cycle
D.1, D.2, IR.2, IR.3, D.3, D.4, II.1
D.4

Water filtration in dunes
Natural water filtration for a healthier water system
A future proof environment
IR.9, IR.10, D.9, O.8, D.10, D.11, D.12
D.10

Green borders between greenhouses
More recreation and biodiversity between greenhouses
From closed to open landscape
IR.8, O.5, O.2, O.3, O.4, IR.9, IR.12, IR.14
O.2

Slow traffic connections
Cycle and pedestrian paths through the new landscape for better connectivity
Enhanced regional connection
IR.8, O.5, O.2, O.3, O.4, IR.9, IR.12, IR.14
O.3

Biodiversity
Diverse flora and fauna for better ecology and biodiversity in the landscape
Local quality of greenspace
IR.8, O.5, O.2, O.3, O.4, IR.9, IR.12, IR.14

Recreational areas
Protected nature for recreation to create a healthy landscape
Local quality of greenspace
IR.8, O.5, O.2, O.3, O.4, IR.9, IR.12, IR.14
O.5

Expanded dunes
Creating a flood resilient landscape
A future proof environment
IR.9, IR.10, D.9, O.8, D.10, D.11, D.12
O.8

Waterlogging in the landscape
Creating wetlands for better quality of the soil
Local quality of greenspace
IR.9, IR.10, D.9, O.8, D.10, D.11, D.12
IR.9

Protected nature
Expanded protected nature areas for safety and biodiversity
A future proof environment
IR.8, O.5, O.2, O.3, O.4, IR.9, IR.12, IR.14
IR.12

Public transport
New lightrail for a better connection with the region
Enhanced regional connection
IR.8, O.5, O.2, O.3, O.4, IR.9, IR.12, IR.14
IR.14

Legend

Key concepts:
D Decentralize
IR Indepent to related and integrated
O Open up
II Improving identity

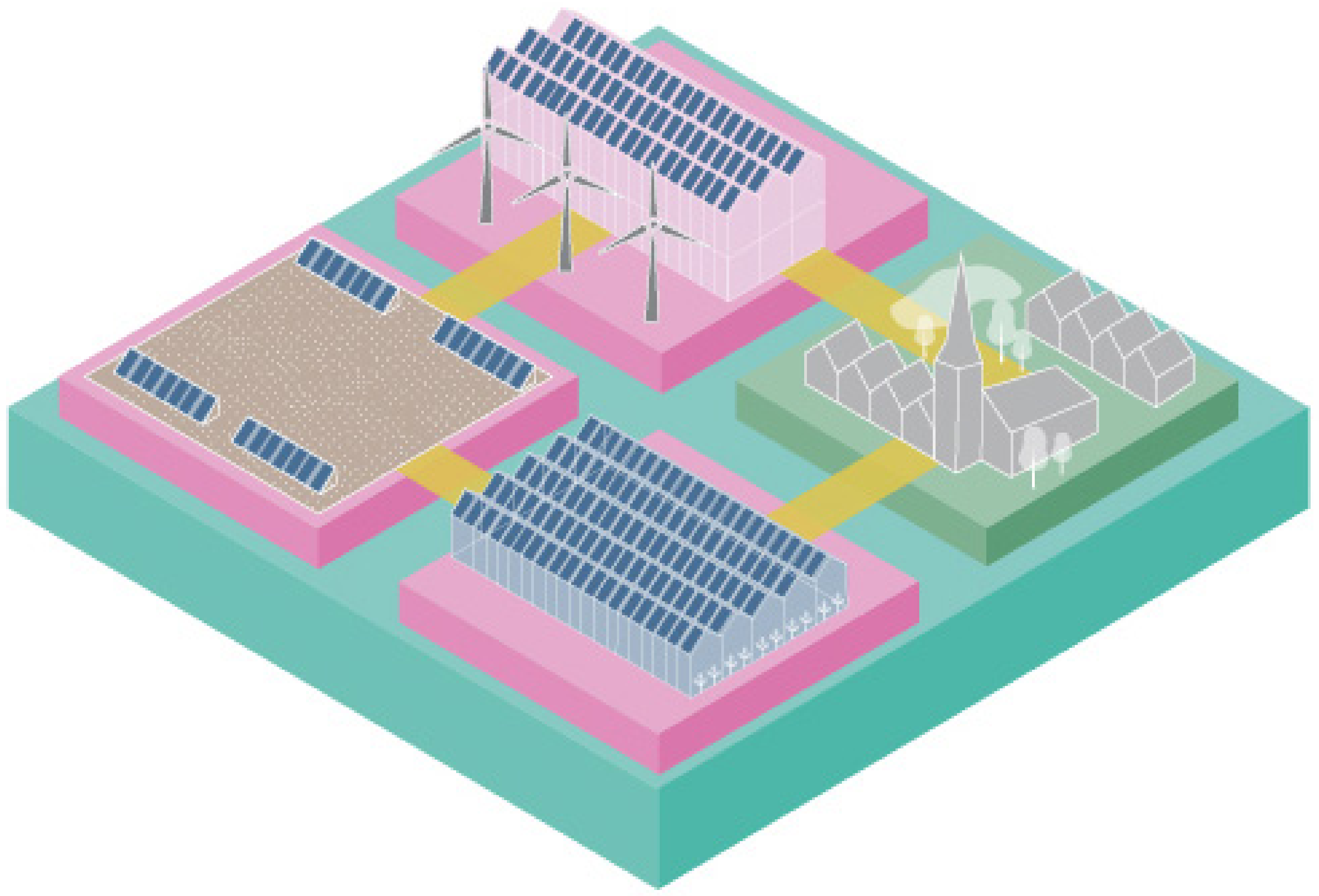
Tools:

Greenhouseowners responsible
Municipality responsible
Government responsible
Money needed
Gaining money
Knowledge
Regulations

Key process: Collaboration

Key process *Collaboration* → Key project *Clustering*

Collaboration plays an important first step in the transition toward a circular Westland. The process starts with the key project of clustering, which can be seen on the right page. Multiple greenhouses next to each other will join forces to share resources and optimize processes, such as energy production, water purification and exchanging soil. By working together costs can be reduced and the efficiency will be as high as possible within the clusters. Clustering serves as the start for a circular society in Westland and marks the starting point of a broader transformation. Its role and impact are further elaborated in the three phases of the spatial timeline.

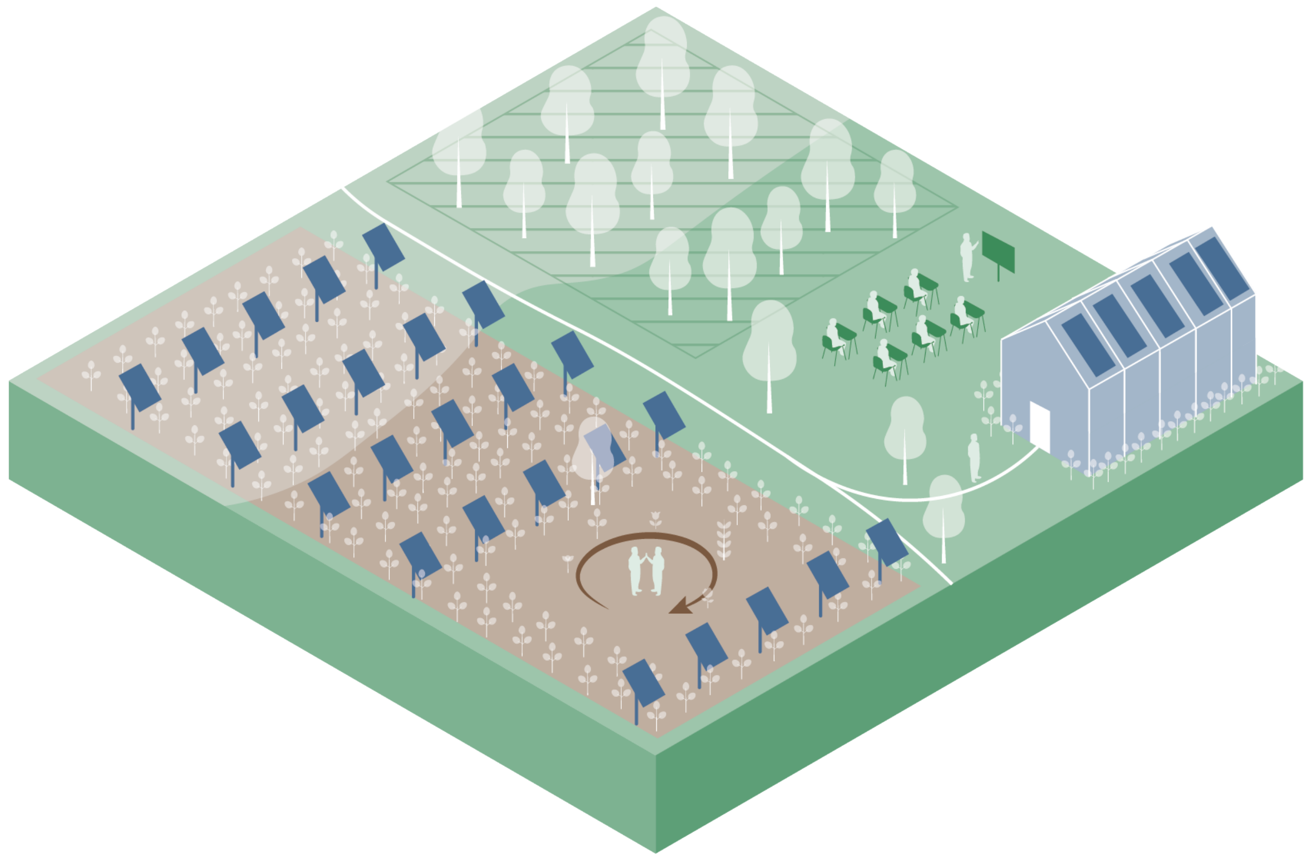


Axo greenhouse clusters working together

Keyprocess: Soil regeneration

Key process → Key project
Soil regeneration → *Open floriculture*

Open floriculture is used to regenerate the soil and reduce energy consumption. In Westland 25% of the existing greenhouses will be reopened. Various forms of cultivation can regenerate the soil for a sustainable Westland. The newly opened areas can be used in a multifunctional way. Connecting regional ecosystems with each other, while also creating space for recreation and enhancing the spatial quality of Westland. The open soil can also be used for water retention, adapting the area to climate change and to prevent salinization.
Various spots in the area will be used for agrovoltaic fields. These fields are a combination of energy production and flower production. New types of flowers and crops can be grown in the wetlands in open floriculture. Beyond their ecological and functional benefits, these open flower fields have the potential to attract tourism, giving Westland a renewed identity as a vibrant and sustainable landscape.



Axo open floriculture

Keyprocess: Innovation

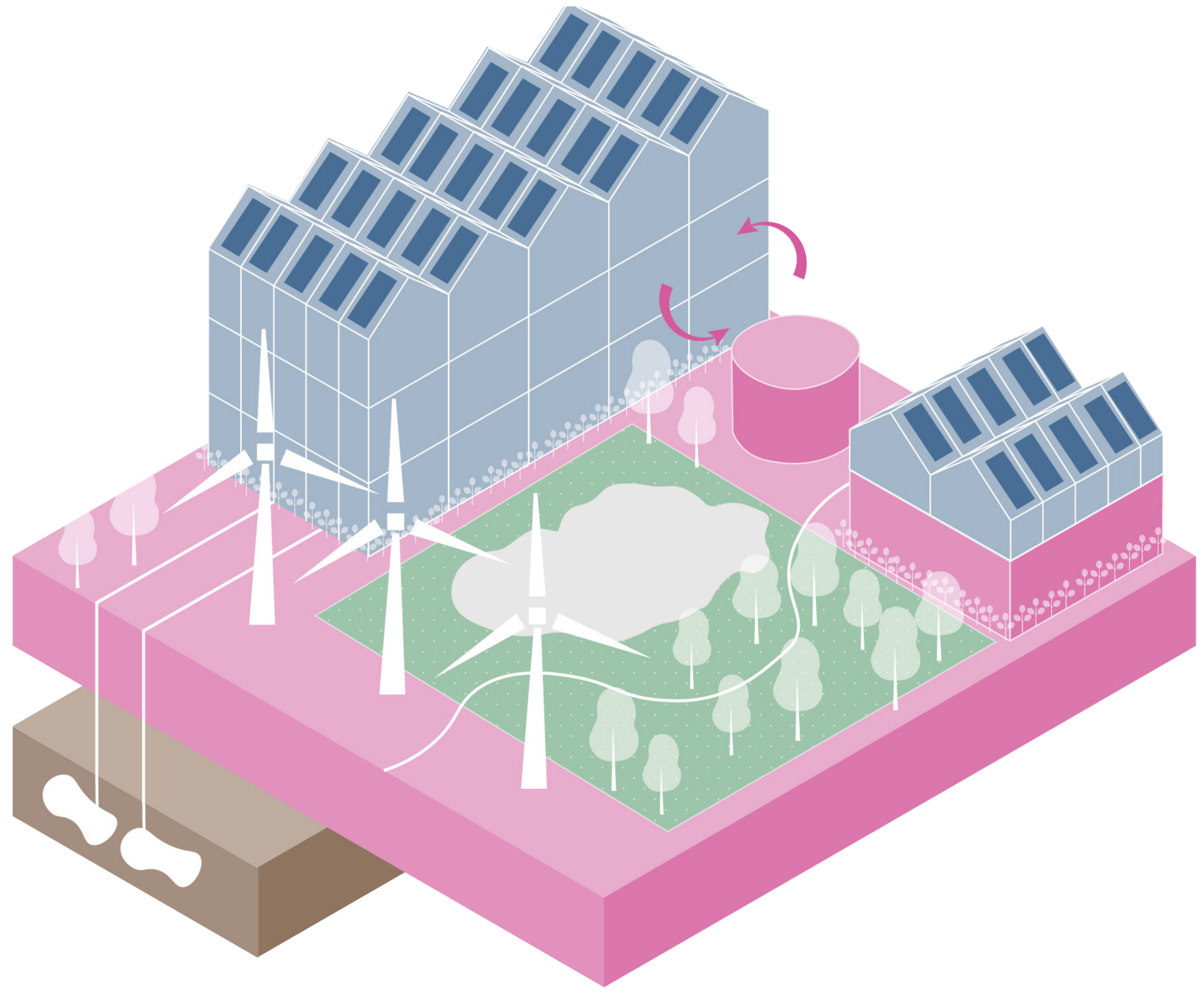
Key process
Innovation

→

Key project
Vertical farms

As explained at the end of the vision, new forms of innovative and efficient flower production are being developed, including High Tech greenhouses and vertical farms. Vertical farms will be high productive farms, detached from the ground. In Westland they will be tested and developed further, particularly in terms of energy and production efficiency. This development will be driven by the innovation cluster around Floraholland.
Because the farms are detached from the ground, they can be placed in urban environments, making it possible to localise the distribution of products. In Westland, vertical farms can create space to reopen and regenerate the soil, while still keeping a high production level in for example industry areas, where vertical farms can also for example be placed on top of buildings.

While the innovation will largely be developed and piloted in Westland, its broader implementation is envisioned in urban settings beyond the region. Within Westland itself, the focus will remain on ground-based production methods, such as open-soil cultivation and High Tech greenhouses, all contributing to soil regeneration and a healthier living environment.

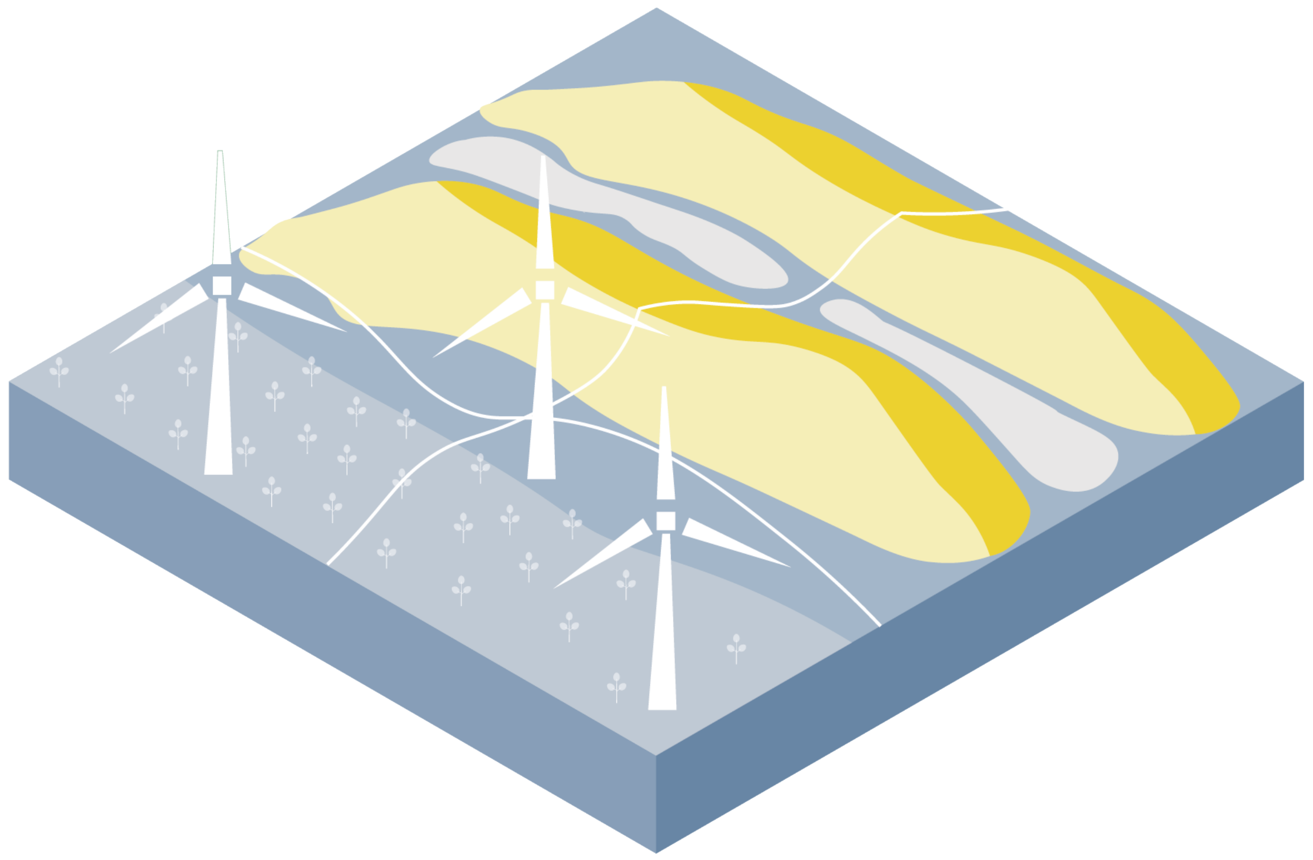


Axo vertical farming

Keyprocess: Watermanagement

Key process	→	Key project
Watermanagement		*Water safety*

Water management is an important key process linked to spatial quality and a sustainable landscape. The key project water safety is divided into several interventions. The dunes on the western side of Westland will be extended, to enhance coastal protection. The dunes can also be used as natural water filtration systems. Additionally, parts of the landscape will be waterlogged to create wetlands, which will help mitigate salinization and improve climate resilience.
These various extended green areas can be used as recreational areas. They will also enrich the ecological structure and biodiversity of Westland.

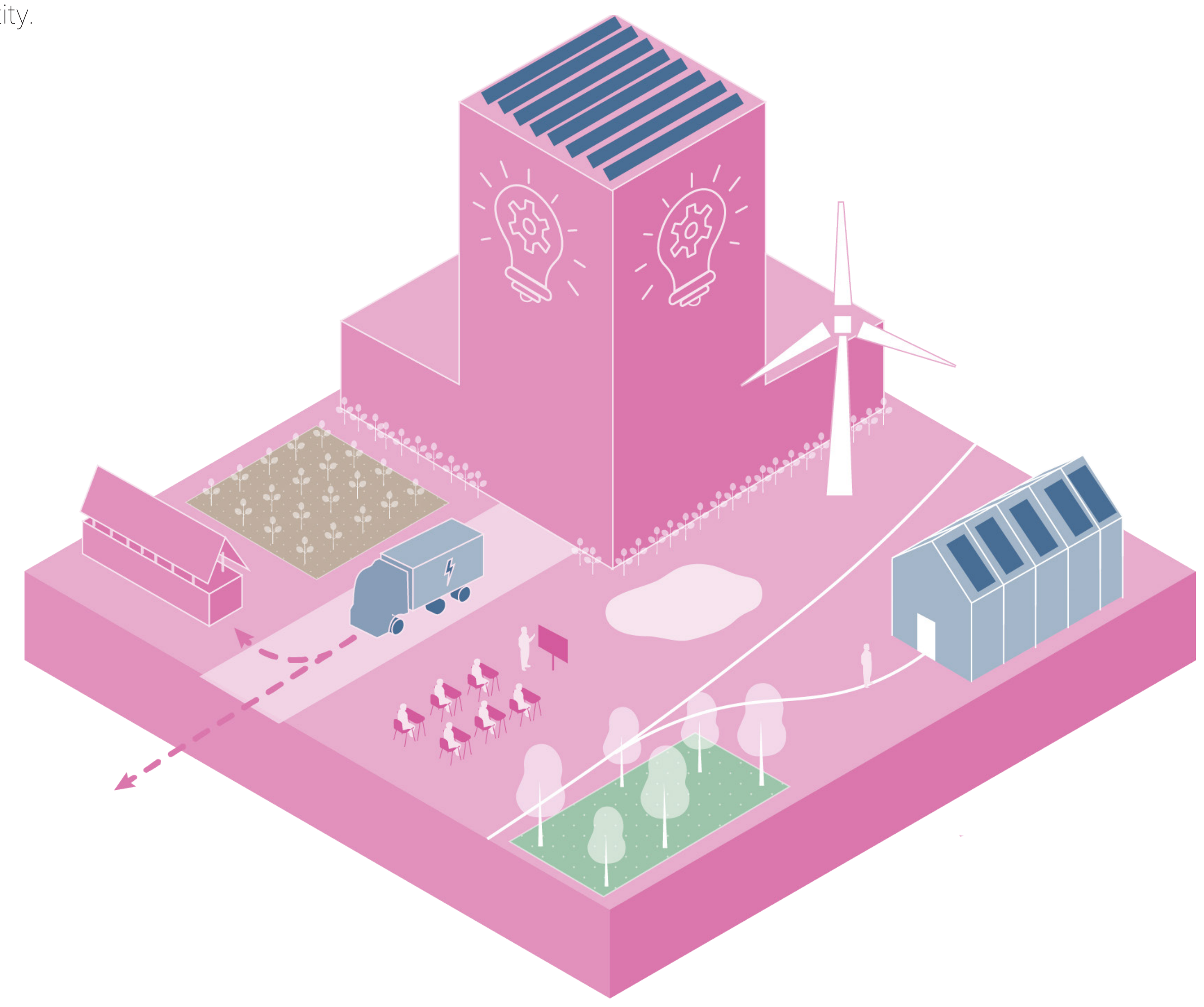


Axo water safety

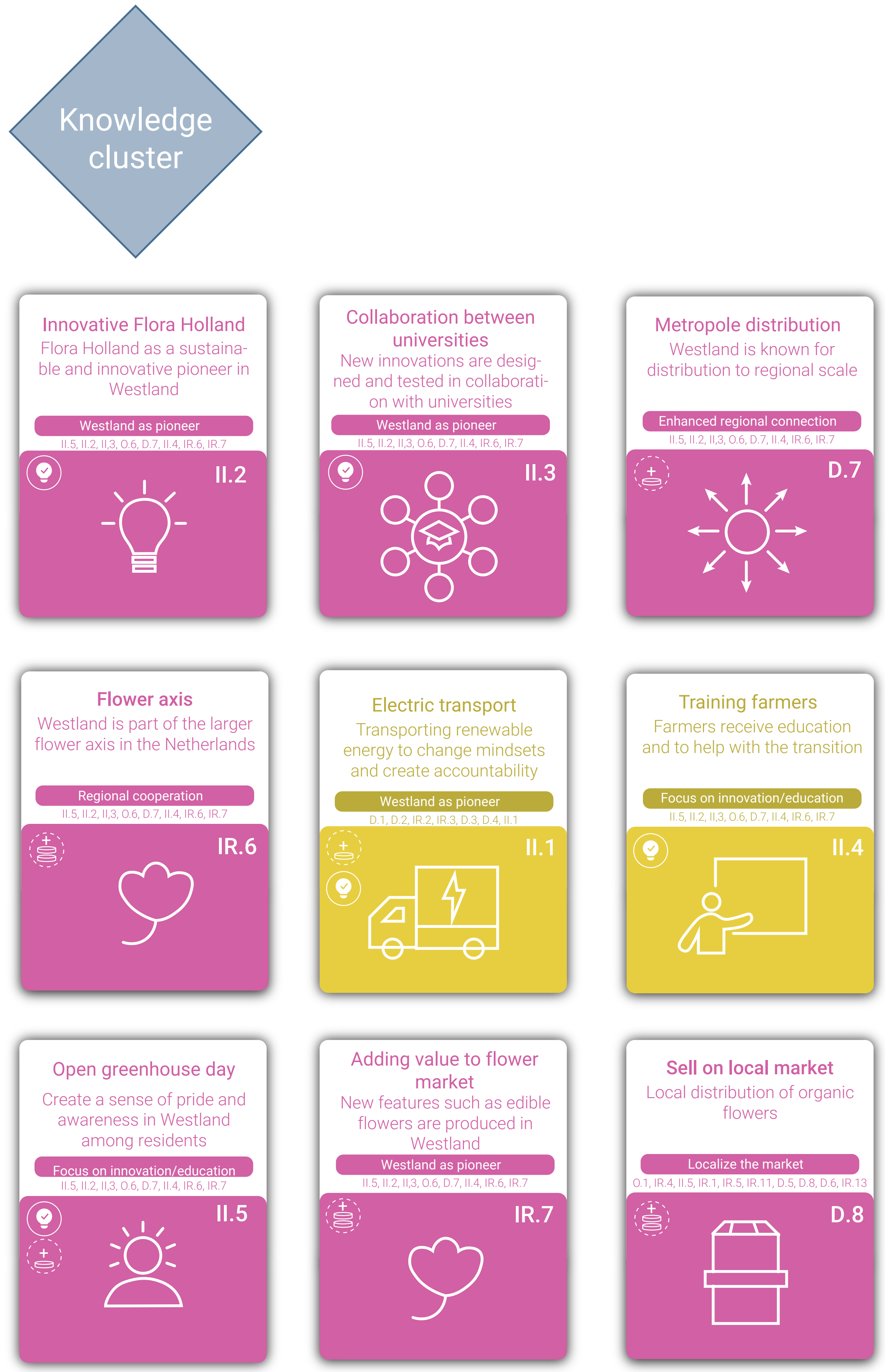
Keyprocess: Knowledge sharing

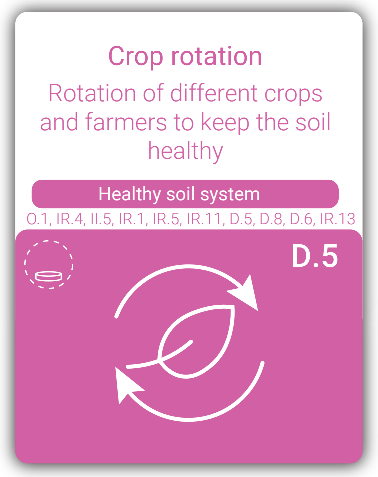
Key process
Knowledge sharing → Key project
Knowledge cluster

FloraHolland will combine its strong global market with the knowledge gained by nearby universities, creating a knowledge cluster in Westland. Investing in innovation is important in developing the new cultivation methods as mentioned in the key process innovation and to make the transition to a circular floriculture sector.
Farmers will be supported in this transition with FloraHolland's expertise. The organisation's role will evolve from a global position focused on the distribution of flowers to a position focused on innovation and cooperation.
Initiatives like open greenhouse days, local distribution systems, and training programs will help shift consumer perceptions toward organic and sustainably produced flowers. In addition, the flower axis and the added value of flowers will enhance Westland's identity.



Axo knowledge cluster

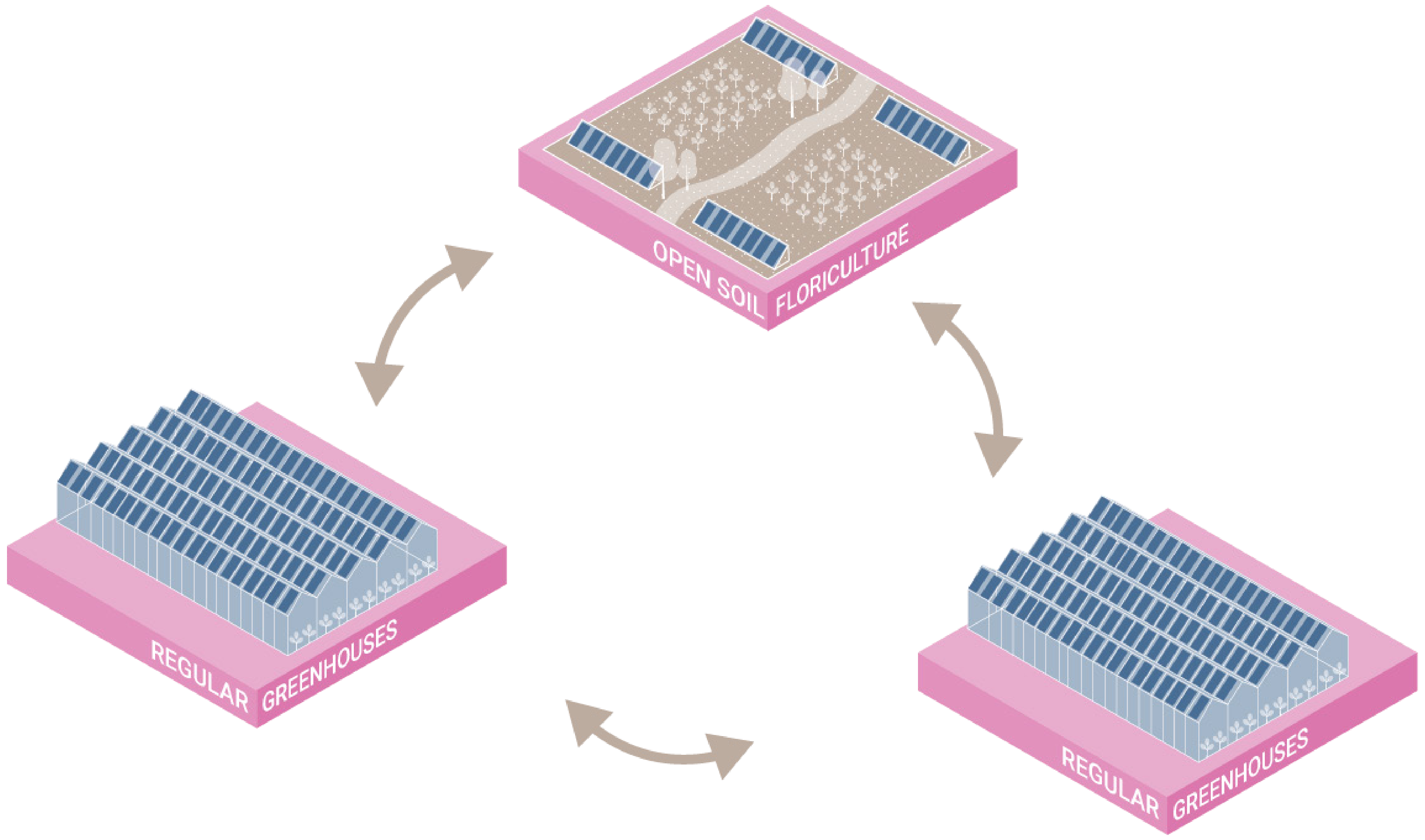




Intervention: Crop rotation

Keyprocess: Clustering

Within the clusters, floriculture farmers will return to soil-based cultivation, in line with the new 'EcoFlora' standards. To keep the soil fertile and regenerate the soil rotation of crops is necessary, however this system takes time for farmers to adapt to.
Initially, a transitional system will be introduced, where greenhouses within each cluster exchange soil among themselves. Over time, this will evolve into a more advanced system in which farmers with different crops rotate between High Tech greenhouses, allowing the soil to recover while maintaining efficient production. This gradual transition is further detailed in the phases of the spatial timeline. This approach fosters a more sustainable and resilient floriculture system for Westland, one that prioritizes ecological health alongside high-quality production.

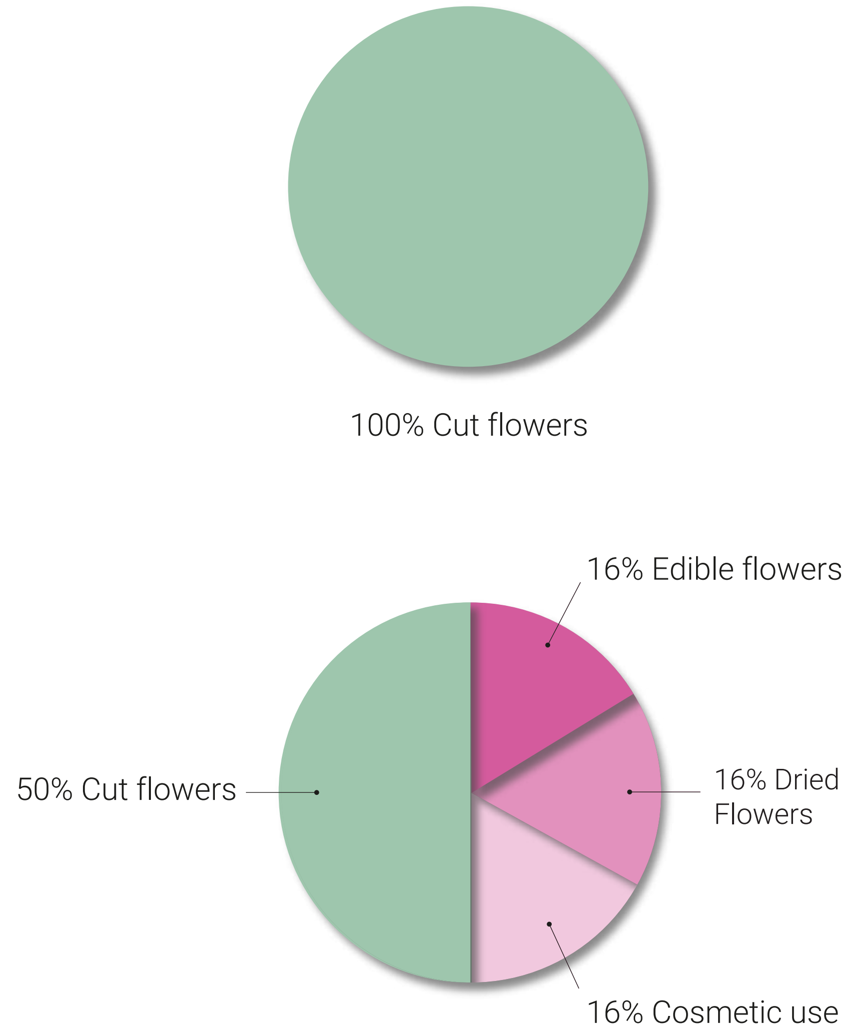


Crop rotation in floriculture sectors

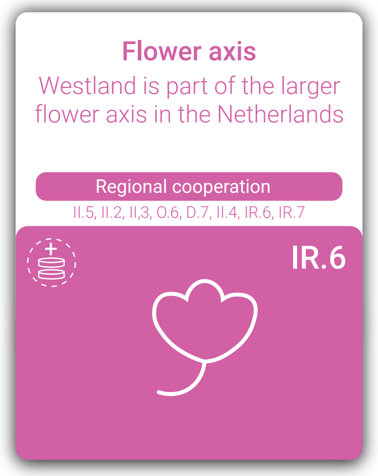
Intervention: Added value to the flower market

Keyprocess: Knowledge cluster

To create a large-scale market for organic floriculture, we need to add value to the flower market. At the moment the market is focused on selling cutting flowers. In the future this focus is not significant enough, the sector needs to have added value to continue to exist. The market can be used for edible flowers used in restaurants or for fancy dinners. Furthermore, the flowers can be used in cosmetics, which is already happening, essential oils and to improve skin. Westland can respond to this by creating local products for the cosmetic market. Another way to make flowers more valuable is by drying them, in this way they can be preserved way longer, and is it possible to increase the price. Different activities can be connected to the new organic flower market like, picking flowers in open floriculture fields, this could be linked to flower workshops. These activities will also help in enhancing the identity of Westland.



Adding value to the flowermarket

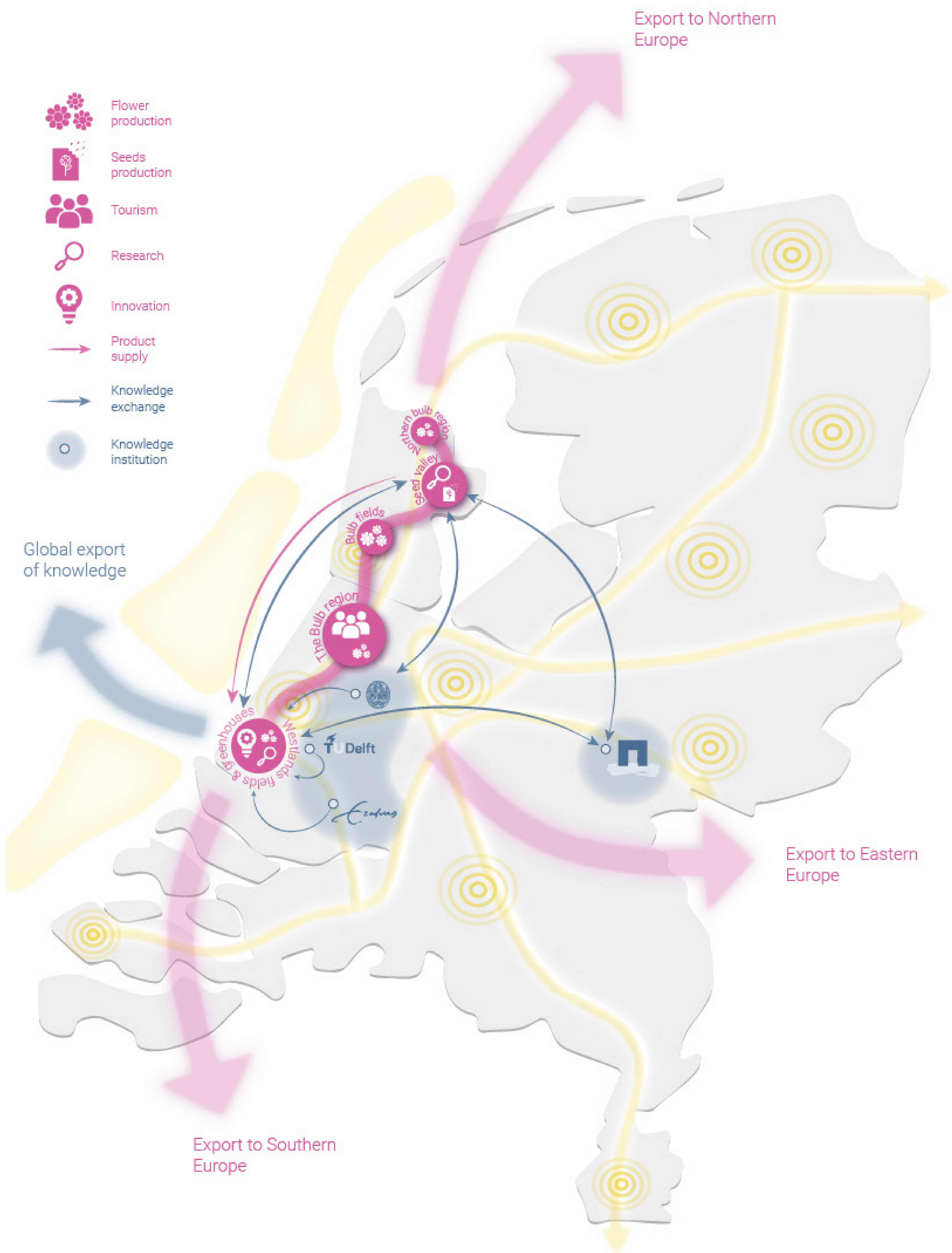


Intervention: Flower axis

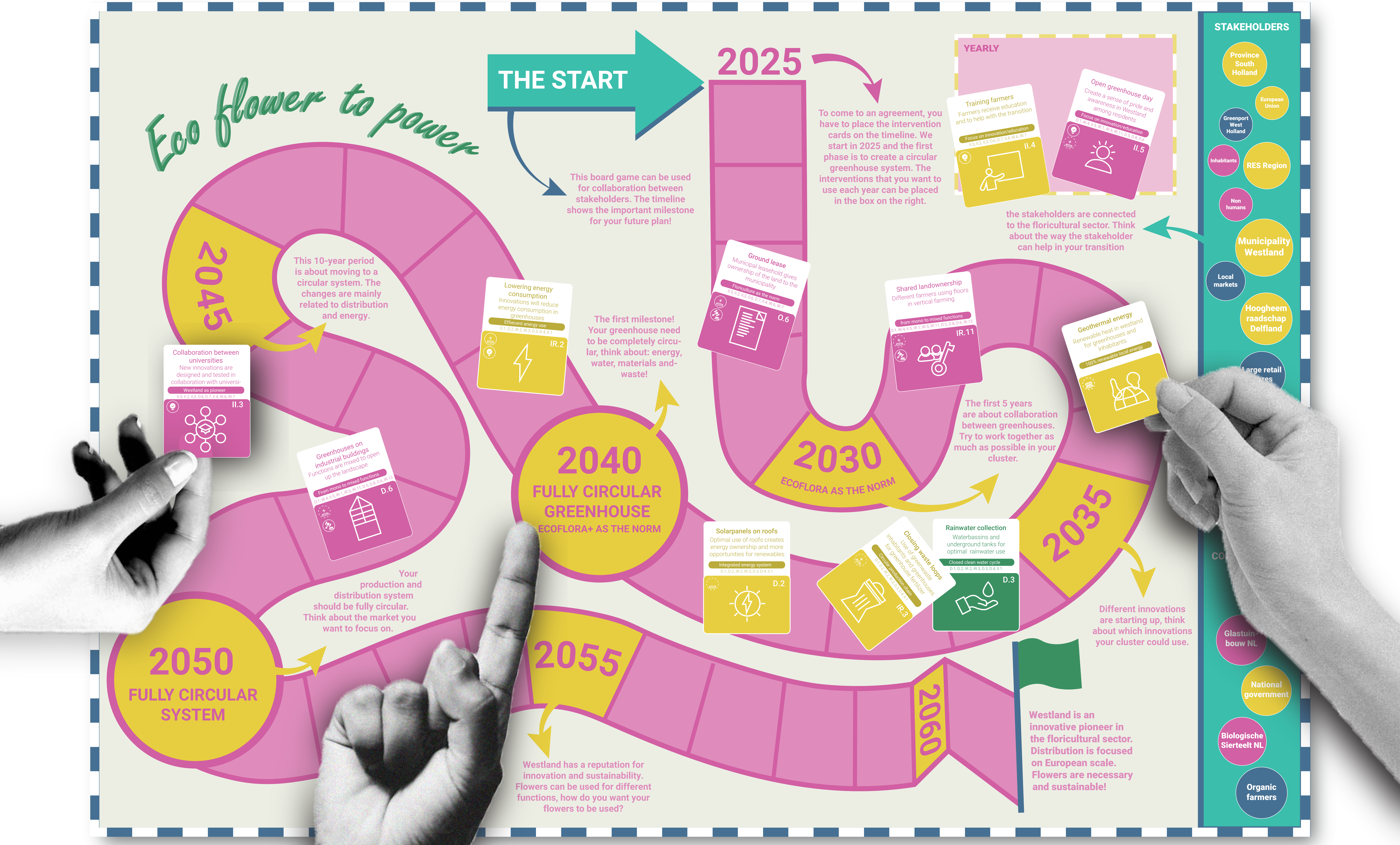
Keyprocess: Knowledge cluster

The Flower Axis is a collaboration between various flower regions across the Netherlands. The axis connects the Northern Bulb Region, the Seed Valley, other bulb fields, the Bulb Region and the floriculture in Westland. Together they form a complete localized system from seed to flower. This integrated approach limits the need for unnecessary import or export. Within this axis the different fields and regions can exchange resources, expertise and innovations. In addition, the Westland region will be connected to several universities. Wageningen University, TU Delft and Leiden University can help with knowledge for future improvements in the sector and exchanging knowledge between the sector.

With this flower-axis the Netherlands will be a global leader for a local production system.

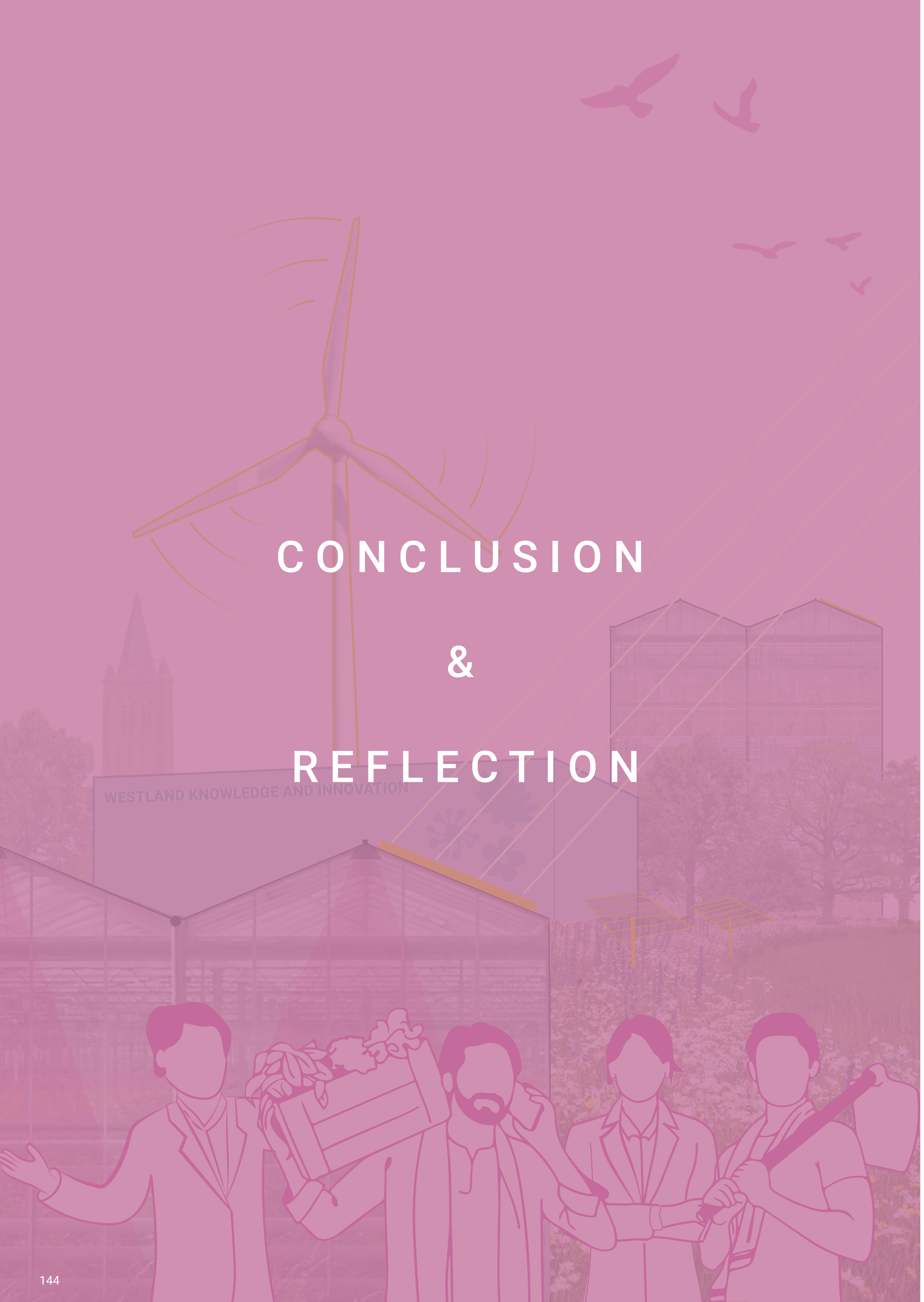


Westland's national position



Board game: Eco Flower to Power

CONCLUSION & REFLECTION



Ethical considerations

In this report, the ethical issue of imbalance between economic gain and environmental well-being was a key theme and an urgent challenge. Our vision aimed to restore this balance of social, environmental and economic sustainability, by removing the focus on the economic aspect and placing it instead on the environment and the social aspect. Rather than prioritizing short-term profit, we envision a regenerative system that acknowledges the diverse needs of all stakeholders, including non-human actors. Thus, the benefits and burdens are more equally distributed.

Through the Regenerative Westland Agreement, we promote inclusive participation and collaboration to enhance procedural justice. The transition may initially bring economic risks for greenhouse owners, by opening up their greenhouses and transforming to open soil, but we created funds from the energy projects to mitigate these harms. The greenhouse owners currently do not see much necessity in joining this transition, as a profitable company is a priority. We incentivize them by pointing out the current issues and creating a solution in the form of an agreement for them to join. There is room for discussion, but for the transition to start, they have to accept the agreement.

Our strategy takes a clear stance on both intra- and intergenerational justice. By addressing pollution, biodiversity loss, and spatial degradation now, we protect the rights of future generations to a liveable environment. Simultaneously, we recognize current inequalities and aim to listen to the community that is a big stakeholder in the region, giving them agency through collaborative decision-making and shared ownership of the transition.

Public goods, such as open flower fields, green-blue infrastructure and improved regional connectivity with public transport, are part of the key concept of 'Open up'. These key concepts strengthen community cohesion and resilience.
The strategy acknowledges uncertainty for the future and avoids rigid solutions. Five key processes are central in our strategy, pilot projects for these processes give space for feedback and adjustment over time. This allows for mutual learning and trust between planners, citizens and institutions.

The more-than-human stakeholders, such as birds, insects, fish, and broader ecosystems, are largely impacted in the current system. By addressing issues like light emission, pollution and the use of pesticides, these non-human stakeholders are considered, creating more justice in our design.
Ethically, we balance deontological principles, respecting the dignity and rights of all living beings, with consequentialist considerations, aiming to minimize long-term harm and maximize collective benefits. This opens the door to a sustainable and flourishing future for all living in Westland and the greater region.

Conclusion

The project "Eco Flower to Power: Opening up Westland into a resilient energy landscape by transforming Westland's flower industry, using the energy transition as a catalyst" began with a recognition of the urgent call for climate action. Meeting the United Nations' goal of global energy neutrality by 2050 requires more than incremental changes, it demands a structural transformation of the systems that define our economy and landscape. The current greenhouse-based floriculture in Westland epitomizes the challenges of this transition: it is energy-intensive, environmentally damaging, and focused on maximizing economic output rather than sustainability.

Through our analysis, Westland revealed itself as a region where the spatial pressures of the energy transition converge with deep-rooted agricultural traditions. Nearly 70% of the greenhouse surface in Westland is used for floriculture, an industry driven more by aesthetic and economic value than essential need. Despite its global success, the sector's reliance on fossil energy, high water consumption, and large-scale monoculture has led to significant ecological degradation.

Recognizing the historical, cultural, and economic importance of floriculture, the project's strategy does not reject the sector but reimagines it. The vision aims to transition Westland from a fragmented, profit-driven greenhouse landscape into a sustainable, regenerative, and community-oriented floricultural region. The key to this transformation lies in the community itself—specifically the greenhouse owners—who hold the knowledge, innovation capacity, and agency to lead the change.

To catalyze this shift, the Regenerative Westland Agreement was introduced: a collaborative framework developed with stakeholders to build trust, define shared goals, and begin the transition from within. This agreement forms the foundation of a broader vision that decentralises energy systems, connects floriculture with local knowledge networks, enhances the region's green-blue structure, and strengthens Westland's identity as a global pioneer in organic, energy-producing flower cultivation.

The strategy is shaped by five key transformative projects: clustering, open floriculture, vertical farms, water safety, and a knowledge cluster. These projects offer tangible spatial proof that the paradigm shift is taking place, motivating stakeholders and changing mindsets.
All of them are linked to a key process. These processes are designed to activate spatial and systemic change, each reinforcing the other. In this future, Westland becomes not just an energy-neutral region but a symbol of circular agriculture and social innovation.

This project demonstrates how regional design can go beyond spatial interventions to facilitate systemic transitions: bridging policy, community, and landscape. Westland's transformation is not just a regional ambition, but a global signal that intensive industries can evolve into regenerative systems that respect ecological limits, empower local communities, and inspire a sustainable future.

Future vision Westland

Group reflection

Our project, Eco flower to power, answered the main question: *How can we use the energy transition as a catalyst to transform the flower industry in Westland into a circular organic industry, therefore enhancing the spatial quality?* The project is based on the idea that energy and community are closely linked. The project began with the problem of too low an energy production and too high a consumption. We view Westland as an interesting and complex area.

As urban designers, we serve as a conduit between small communities and complex policies. Our designs have the potential to visualise a possible future and inspire people to initiate the necessary change. Designing a future vision for a system and area is complex because of the different possible scenarios for the future. As part of our policy analysis, we have identified a number of documents that are each focused on achieving different goals. To initiate change, it is essential to possess a comprehensive understanding of the current state and to formulate a feasible future plan for local communities.

It proved challenging to understand Westland and the surrounding area within the ten week timeframe. The current arrangement of Westland is relatively straightforward, but the spatial impact is rather complex. Given the global impact of the system, it was necessary to establish specific focus points.

The fact that we were able to establish our community quickly was beneficial, as we have placed emphasis on the community perspective and the interrelated policies and stakeholders. The global system is too complex to understand in 10 weeks, and there are many policies, yet they all say something different. We have adopted an optimistic approach, focusing on the sustainability goals. We are confident that, with dedication and commitment, the global community can achieve the sustainability goals outlined.

The most difficult task is to design in such a way, so the farmers are willing to change. Their change and commitment function as the start for a better future. It is important to recognize that farmers are currently only willing to embrace change if there is a tangible financial incentive. The mindset of the focus on profit needs to change, to create more sustainable systems.

Carola Schouten's document presents a future scenario in which our design fits into a new circular way of living (Ministry of Agriculture, Nature and Food Quality, 2018). Looking at current governmental actions, this change seems an impossible task. As Geert op t' Hof stated in our interview: every stakeholder needs to change to get to a new system.

The assignment also posed a challenge to the cooperation between the five of us in the group. The groups were established at the end of the first week, at which point we immediately had to choose a location where the energy transition was an important topic, without really knowing each other's interests or strengths. At the start, it was challenging to cooperate effectively. Sometimes, it was difficult that everyone had the same equal role, when differentiating between different roles might have created a more efficient group process, as was the case with the bachelor course ON5. Now, we often got stuck in discussions without knowing how to make a decision. Throughout the process, as we found each other's strengths, everyone did work fitting them the best. As a result, the group as a whole became much more efficient, and we all learned new skills from one another.





Evelien Breit

This research and design project revealed the complexities of regional design and systemic transitions. In ten weeks in a group of five students we designed a regional vision and strategy for the floriculture industry in Westland. The focus lay on the energy transition, and on communities that are either positively or negatively impacted by that transition.

The theme of the energy transition is a topical one, that I had not yet explored in depth. The scope of its spatial challenge was unexpected. Making spatial the energy demand created a strong motivation for implementing the energy transition in Westland. This complexity should be included in more regional visioning, as it will lead to a more cohesive, structured plan.

The second unique part of this project was the focus on community-driven design. The energy transition impacts many communities, making it difficult to choose one to focus on. Our chosen community was one of resistance: willing to join into the transition, up until it impedes on their ability to grow economically. As this growth was antithetical to our vision of sustainable development, our vision felt geared against the community at times. One thing that we did focus on heavily, to partially avoid that feeling, was the incentives and policy strategy, in order to make our desired outcome more tangible. The agreement that kickstarts our strategy was built up of feasible aspirations and parameters, counteracting our vision's way of going against community interests. If given more time, the project would have benefitted from more qualitative community research, as secondary sources were not always specific enough to our particular design challenge. Designing for these communities is imperative, but complex.

Something that had not been apparent to me at the start of this project, was how nonspatial this design would turn out to be. Systemic change largely lies in policy, agreements and mentality change. Understanding these complex drives to societal change proved challenging, but necessary for a realistic strategy. Maps alone do not convince stakeholders.

One aspect I wished could have had more focus was the ethical implications around complex urban design. As an urban designer, we can fall into technocratic elitist thoughts of superiority, disregarding the interests of vital communities. With more time, we would benefit from a more concrete analysis of the impact of certain design choices. Now, we made large statements in our paradigm shift, without adequately envisioning the socio-economic consequences.

The formed team of five students ended up working quite well. We had similar priorities and work habits, which made management relatively easy. We all had invested interest in the project, resulting in several long discussions about our differing views on our narrative, our vision and our strategy. Though these discussions could stretch and be a bit frustrating, they ended up allowing us to critically reflect on different thought processes within the team. The outcome of these discussions was mostly informative.

In conclusion, this project introduced me to the complexity of regional, community-driven design. I wish to implement research techniques learned here in future projects and continue to grow my understanding of the ethical implications of being an urban designer within a political world.

Julia van der Velde

This regional design project, focused on the future of floriculture in the Westland, introduced me to a new way of thinking: designing spatial visions through the lens of a transition community. Instead of implementing top-down (sustainability) policies, the course focused on integrating community perspectives from the start. This approach encouraged us to ask: whose future is this and how can we help co-create it?

We experienced a key challenge in designing for a transition community: blurring our own values to understand those of the community. The vision of an energy and systemic transition for floriculture in the Westland started to take shape, but we realized that the greenhouse sector in the Westland did not necessarily want such a transition.

I noticed that identifying myself with the transition community was a challenge. It became clear that in order to engage the community in the transition process, it was necessary to find openings within the current system that could serve as a catalyst for change. By using Atlas.ti to analyse the voices of the community, we gained insight into the themes that are relevant to the community. Furthermore, we interviewed an organic grower, who explained the current challenges but also the possibilities.
However, our approach is still far from true co-design. Designing for the community instead of with them risks creating visions that are disconnected from the lived experience of the community members. Participatory design requires more inclusive tools to uncover the desires within communities. And I think this is a missing link in our design, because we did not really design with the community.

Our vision and strategy were not only to communicate design choices, but also to make the future tangible and achievable. Our strategy not only introduced new ideas, but also proposed to phase out unsustainable practices and systems over time. This meant identifying what needed to stop. The timeline of interventions responds to both certainties and uncertainties in the transition. For the energy transition in Westland this was an important part. The floriculture sector needs a huge amount of energy, once we had quantified this, the change that had to take place became clear. To maintain the current energy consumption by placing wind turbines, almost three times the size of Westland is needed.

This also meant that we had to weigh up competing values, namely economic productivity, spatial quality and ecology. The prevailing system is focused on pursuing short-term profit and large-scale production. The vision proposed an alternative, bringing together the community and the energy transition.

Looking back, I believe that our design successfully visualised a desirable and plausible future. But it remains true that we designed for the community, not with them. What I take away most from this process is the realization that regional design is not just about achieving spatial outcomes, but rather about facilitating a process in which communities, institutions and designers build agency together. In this way you create a vision that will be diverse and connecting.

Nikki van der Klaauw

This course has firstly introduced me to dive into the field of the energy transition and how crucial it is in order to tackle the climate crisis. Learning about the energy transition from especially a governance, policy and economy point of view, was very interesting and above all important. This was the first time I attended a design course where it was that much about governance, policy and economy. This in combination with designing from the perspective of a transition community and the large regional scale of the project has made it a very learning full project.

We started our project with the common interest for the village Hoek of Holland. Searching on Google Earth we noticed how the village was sandwiched between two enormous energy consuming and producing industries: the Port of Rotterdam and of course Westland's Horticulture. Driving through the area we all were fascinated by the horticulture landscape. Finding out this monocultural landscape with a huge lack of spatial quality is al in order for the large economic interest of the polluting flower industry, our community and topic was born.

Creating the vision for our project was in the beginning quite challenging and led to a lot of discussions in our group. These discussions where actually very useful. They made you really have to understand the main topics and goal of our project in order to discuss about it. Which in the end led to finding and agreeing on the core critical issues and believes of the energy and flower industry transition in Westland. All the discussing open on to a well-built vision which gave us a lot of guidance by developing our strategy.

Because of the new aspect of the transition communities in this course, we firstly didn't really know how to approach it. Because of the lectures and workshop series we managed to become better in designing from the perspective of our community. In the end this led to a much more creative and meaningful project, which we without the community would never came up with. Still it is challenging to really understand the hopes and dreams of a transition community and integrate that in a spatial transformative vision and strategy.

In conclusion this project never would be a success without my teammates. I was able to learn a lot from each one personally and professionally. We challenged each other which keeps us sharp and in the end led to a better project. But mostly we had a lot of fun, which I think can be seen in the report.

Pol Bardet

The past weeks I have been part of a team exploring a possible future for the floriculture in Westland. During our fieldtrip we found out about the impact the large scale greenhouses have on the region. On the one side the immense impact the greenhouses and large infrastructure for trucks has on the landscape and spatial quality, but on the other side the prosperity it brings to all the villages and its inhabitants. With this the challenge of changing the system of the greenhouses from the community became clear. Due to the huge economic impact the greenhouse and flower industry have for local inhabitants, this community seems to take the negative impact it has on the environment for granted and they are not too favourable to a change in the system. Also considering the huge lobbying power the complete sector has in the Dutch political landscape. That is why we struggled in the beginning phase of our project with forming our narrative from within the community and creating a feasible future vision for the region and sector.

With a lot of research using local newspapers and vision documents in combination with Atlas.TI, we eventually found leads to create a change in Westland. With the rising energy prices and the innovation power of the greenhouse sector we found a good combination, linking the energy transition to the strengths of the local community. These leads in the community were combined with factors from outside, using a societal paradigmatic shift where the depleting and polluting agriculture methods are no longer accepted as another important factor to create change. This may look like a big step, but mentality changes like this have happened before on a worldwide scale, for example when the gap in the ozone layer was discovered, after which industries and companies took responsibility and banned the chemicals causing the hole. After the problem becomes clear enough to society, actions can be taken quickly. So, this can and will happen again in the future with the energy transition and the end of depleting agriculture methods.

The community that is already part of this paradigm shift is the ecological flower farmers. For this we got the chance to interview the chairman of the ecological floriculture union. Within this interview we got a good overview of his vision for the future and what was currently going on in the sector. He also underlined the overall societal change, with all different stakeholders moving along, that was needed for this transition to a circular and sustainable flower production. The interview helped us a lot in forming our strategy and to create a narrative as strong as possible, keeping in account all the different stakeholders and policies. Understanding this complex system of different stakeholders was one of the hardest parts of this course. Doing even more interviews could have helped us also in understanding the greenhouse farmers in Westland even better, creating a story as appealing as possible for them.

I hope our vision makes people conscious of the problems our current system is causing and lets them see that a possible way out of this seemingly stuck system is within our reach. Even within our generation. I think that this is one of our most important tasks as urban designers, to make a better future tangible. Even when it does not seem possible because of the current political climate, we can inspire people to reach a better future.

Shifra van Houwelingen

Over the past 10 weeks, we have undertaken an in-depth exploration of the complexity of floriculture. This system, which has a worldwide impact, consists of various components, including production, distribution and consumption. The impact of this pollution system is mostly felt in Westland.

The area is mainly surrounded by the Randstad. The region's densely built environment poses significant challenges to change. The transition from system thinking to spatial output is a complex process when designing a new system. The system is interconnected with numerous stakeholders and locations. The region is also characterized by a diverse range of stakeholders and functions. In our design, we have focused on a select number of functions in Westland and certain parts of the system. We believe that the design is clear and easy to understand. This applies to both the Department of Urbanism and our community, the floriculture farmers of Westland. One potential drawback was that we did not feel fully integrated into the system until the end.

In my opinion, the most interesting part of designing as an urbanist is the starting point of a transition. This stage initiates the dynamic that will shape the future. For instance, if we stop air export, this would have a significant impact on the global floriculture system. This switch is beneficial as it marks the beginning of a period of significant change. However, determining the optimal start of this transition is challenging, as significant change has the potential to destroy the floricultural sector.

As outlined in our report, there is a clear distinction between vision and strategy. Vision can be defined as the spatial output of a transition. The vision is based on future scenarios for agriculture, providing insights into a potential future. It is crucial to understand these different future scenarios to choose which steps will set the transition in motion. The future scenarios for the agricultural sector provided a solid foundation for the design vision. The strategy document clearly articulates the transition, a crucial aspect for our community. It is vital for the community to be aware of the steps they can take.

In an effort to gain a deeper understanding of the community, we analysed a series of interviews with farmers using the software program ATLAS.ti. In addition, we conducted a follow-up interview with Geert op t Hof, an organic farmer. The results of these analyses were interesting, but I believe that in-depth, one-on-one conversations with farmers are essential to fully grasp their perspective. These farmers could be the starting point for a transition in Westland.

In our analysis, it was noted that current policies are somewhat vague. For instance, Greenport aspires to achieve full circularity by 2040. However, the objectives outlined in their policy are not clearly defined. To achieve this, it is essential to provide clear guidance and support to the transition community. I believe that transition communities have the potential to be the catalyst for a more sustainable future, provided we can successfully shift consumer attitudes. To facilitate this transition, it is essential to empower communities with the necessary knowledge and instruments for a bottom-up approach.

SOURCES

Sources

Admin. (2024, January 7). Westlandse burgemeester: Kassen gaan niet geheel of gedeeltelijk verdwijnen - Zeg nee tegen de uitbreiding van ABC Westland. Zeg Nee Tegen De Uitbreiding Van ABC Westland. https://zegneetegenabc.nu/westlandse-burgemeester-kassen-gaan-niet-geheel-of-gedeeltelijk-verdwijnen/

Ajzen, I. (1991). The theory of planned behavior. Organizational Behavior And Human Decision Processes, 50(2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-t

Ansari, S. A., & Tabassum, S. (2018). A New Perspective on the Adoption of Sustainable Agricultural Practices: A Review. Current Agriculture Research Journal, 6(2), 157–165. https://doi.org/10.12944/carj.6.2.04

Artikel 4.790. Light pollution (n.d.) https://wetten.overheid.nl/BWBR0041330/2025-01-01

Atlas Bestrijdingsmiddelen in oppervlaktewater. (n.d.). https://www.bestrijdingsmiddelenatlas.nl/atlas/10/11

Balogh, A. (2021). The rise and fall of monoculture farming. Horizon Magazine. https://projects.research-and-innovation.ec.europa.eu/en/horizon-magazine/rise-and-fall-monoculture-farming

Balz, V. & Katsikis, N. (2025) 2025_Q3_quarter guide https://brightspace.tudelft.nl/d2l/le/content/679889/viewContent/4057365/View

Beleidsondersteunend onderzoek naar klimaatadaptatie in het landelijk en stedelijk gebied. (n.d.). WUR. https://www.wur.nl/nl/onderzoek-resultaten/kennisonline-onderzoeksprojecten-lvvn/topsectoren/kennis-en-innovatieagenda-2020-2023/missie-c-klimaatbestendig-landelijk-en-stedelijk-gebied/beleidsondersteunend-onderzoek-naar-klimaatadaptatie-in-het-landelijk-en-stedelijk-gebied.htm

Berkers, E., & Geels, F. W. (2011). System innovation through stepwise reconfiguration: the case of technological transitions in Dutch greenhouse horticulture (1930–1980). Technology Analysis and Strategic Management, 23(3), 227–247. https://doi.org/10.1080/09537325.2011.550392

Bezoek Westland. (2023, June 8). Geschiedenis van de glastuinbouw | Bezoek Westland. https://www.bezoek-westland.nl/dit-is-het-westland/een-dagje-kassen-lekker-westlands-lekker-anders/geschiedenis-van-de-glastuinbouw/#:~:text=Westland%20is%20bekend%20om%20de,kassen%20voor%20het%20eerst%20verwarmd

Biologische Sierteelt Nederland. (2024). 3-puntenplan voor de biologische sierteelt in Nederland. https://biologischesierteelt.nl/wp-content/uploads/2024/06/Petitie-3-puntenplan-Biologische-Sierteelt-Nederland-20240617-goede-versie.pdf

BKT Tires. (2024, June 7). New EU regulation for agricultural machinery: AGRICULTURAL ROBOTS are making their debut. New EU Regulation for Agricultural Machinery: AGRICULTURAL ROBOTS Are Making Their Debut. https://www.bkt-tires.com/ww/us/blog/agriculture-blog/new-eu-regulation-for-agricultural-machinery-agricultural-robots-are-making-their-debut

CBS Statline. (n.d.-a). https://opendata.cbs.nl/#/CBS/nl/dataset/80781ned/table?dl=5B50E

CBS Statline. (n.d.-b). https://opendata.cbs.nl/statline/#/CBS/nl/dataset/80783NED/table?fromstatweb

Centraal Bureau voor de Statistiek. (2022, August 9). Waar komt ons gas vandaan? Centraal Bureau Voor De Statistiek. https://www.cbs.nl/nl-nl/longread/diversen/2022/waar-komt-ons-gas-vandaan-?onepage=true

Certificering. (2024, December 30). Skal Biocontrole. https://www.skal.nl/certificeren/vervaardigen/bedrijf/certificering

Daar krijg je energie van. (2023, January 18). Hoeveel meer stroom levert een grotere windmolen op? - Daar krijg je energie van. Daar Krijg Je Energie Van. https://www.daarkrijgjeenergievan.nl/veelgestelde_vragen/hoeveel-minder-stroom-levert-een-kleinere-windmolen-op/?

De Beuze, M., De Kool, S., Van Reuler, H., Geers, F. (2005). Duurzame sierteelt in de vollegrond. Systeem Innovatie. http://edepot.wur.nl/24740

De Decker, K. (2015, December 21). De fruitmuur: stadslandbouw in de 17de eeuw. LOWTECH MAGAZINE. https://solar.lowtechmagazine.com/nl/2015/12/fruit-walls-urban-farming-in-the-1600s/

De Weerd, R. (2016, April 29). Factcheck: 'Willen windmolens aan onze energievraag voldoen, dan moeten we heel Nederland volbouwen.' De Correspondent. https://decorrespondent.nl/4413/factcheck-willen-windmolens-aan-onze-energievraag-voldoen-dan-moeten-we-heel-nederland-volbouwen/36694e59-e16c-0666-218b-7855adf3a08d

Dick, M. (2022, August 26). Can greenhouses fit into the regenerative organic movement? - Greenhouse Canada. Greenhouse Canada. https://www.greenhousecanada.com/can-greenhouses-fit-into-the-regenerative-organic-movement/

Dutch horticulture. (n.d.). Facts and Figures. Dutch Horticulture. https://www.dutchhorticulture.nl/en/facts-and-figures

El Makhloufia, A., Smulders, R., Beetsma, K., Hoenderdos, J., Ruiten, T. V., & BA-Studenten Minor 'Airport-Seaport Logistics', Hogeschool van Amsterdam. (2018). Schiphol als 'preferred flower' hub van Europa. In Sander Onstein & Dick van Damme, Tijdschrift Voor Toegepaste Logistiek (pp. 88–91). https://www.kennisdclogistiek.nl/system/downloads/attachments/000/000/421/original/8._Schiphol_preferred_flower.pdf?1544542532

Enviroliteracy Team. (2024). How does monoculture negatively impact soil fertility? The Environmental Literacy Council. https://enviroliteracy.org/how-does-monoculture-negatively-impact-soil-fertility/

Everard, M. (2001). Taking a systems-oriented view of phosphorous enrichment in fresh waters. The Natural Step.

European Commission. (2022, November 7). Civil society. Enlargement and Eastern Neighbourhood. https://enlargement.ec.europa.eu/enlargement-policy/policy-highlights/civil-society_en

European Commission. (2025, February 11). Organic production and products. Agriculture and Rural Development. https://agriculture.ec.europa.eu/farming/organic-farming/organic-production-and-products_en#:~:text=EU%20regulations%20on%20organic%20production,%2C%20yeast%2C%20aquaculture%20and%20more

Filippi, F. (2022). A Paradigm Shift for a Transition to Sustainable Urban Transport. Sustainability, 14(5), 2853. https://doi.org/10.3390/su14052853

Fraser, T. (2021, 16 december). Towards a new, holistic framework of systems change: Adapting Geels' Transition Theory. Medium. https://medium.com/refuge-for-systems-leaders/towards-a-new-holistic-framework-of-systems-change-adapting-geels-transition-theory-8d589fb6de0a

Geels, F. W., Sovacool, B. K., Schwanen, T., & Sorrell, S. (2017). The Socio-Technical Dynamics of Low-Carbon Transitions. Joule, 1(3), 463–479. https://doi.org/10.1016/j.joule.2017.09.018

Gemeente Westland (2023) Westlandse energyopgave https://www.gemeentewestland.nl/fileadmin/Gemeente_Westland/site_assets/In_de_gemeente/Over_Westland/WESTLAND-WEO_definitief.pdf

Gemeente Westland. (2025). Let's grow new opportunities • Gemeente Westland. https://www.gemeentewestland.nl/aanvragen-en-regelen/ondernemen-en-arbeidsmigratie/westland

Geothermie Nederland. (2011). Kennisdossier hernieuwbare energietoepassing. In Kennisdossier Hernieuwbare Energietoepassing. https://www.rvo.nl/sites/default/files/2022-12/Duurzame%20energie%20opwekken%20in%20de%20industrie%20-%20%20Hernieuwbare%20energietoepassing.pdf

Glastuinbouw Nederland. (n.d.). Producten uit de kas. https://www.glastuinbouwnederland.nl/publiek/home/glastuinbouw/producten-uit-de-kas/#:~:text=Een%20kas%20beschermt%20planten%20tegen,dan%20bij%20een%20teelt%20buiten

Glastuinbouw Nederland. (n.d.-2). Wat is glastuinbouw? https://www.glastuinbouwnederland.nl/publiek/home/glastuinbouw/wat-is-glastuinbouw/

Greenport West-Holland. (2024, February 28). Greenhouse energy shift: accelerate the transition to renewable energy - Greenport. Greenport. https://greenportwestholland.nl/greenhouse-energy-shift-accelerate-the-transition-to-renewable-energy/

Greenports Nederland. (2019). 4 toekomstscenario's voor het tuinbouwcluster. Tuinbouwscenarios ACCEZ. https://tuinbouwscenarios.nl/scenarios/

Greenport. (2018). Onze ambities en speerpunten https://greenportwestholland.nl/onze-speerpunten/

Google. (2023). Google Earth. https://edu.nl/ajfyk

Hall, P. A. (1993). Policy Paradigms, Social Learning, and the State: The Case of Economic Policymaking in Britain. Comparative Politics, 25(3), 275. https://doi.org/10.2307/422246

Hoogheemraadschap Delfland. (n.d. -1). Hoogheemraadschap Delfland. https://www.hhdelfland.nl/over-ons/beleid/watervisie/

Hoogheemraadschap Delfland. (n.d. -2). Glastuinbouw. Delfland. https://www.hhdelfland.nl/ontdek-werk/schoon-gezond-water/glastuinbouw/

Hortileads. (2019, May 9). Milieucentraal vergelijkt de klimaatbelasting van bossen bloemen. Vakblad Onder Glas. https://www.onderglas.nl/milieucentraal-vergelijkt-de-klimaatbelasting-van-bossen-bloemen/

Keurmerkenwijzer Milieu Centraal. (n.d.). https://www.keurmerkenwijzer.nl/alle-keurmerken/wijn/demeter

Kronos Solar. (n.d.). Hoeveel zonnepanelen passen er op 1 hectare? – Zonnepark Wehl. https://zonnepark-wehl.nl/ufaqs/hoeveel-zonnepanelen-passen-er-op-1-hectare

Kuhn, T. S. (1970). The Structure of Scientific Revolutions: Vol. I and II (second edition, enlarged). International Encyclopedia of Unified Science.

Metropolitan Region Rotterdam The Hague. (n.d.). Samenwerken maakt sterker. MRDH. https://mrdh.nl/

Milieu Centraal. (n.d.). Landbouwmethoden uitgelegd. https://www.milieucentraal.nl/eten-en-drinken/milieubewust-eten/5-landbouwmethoden-op-een-rij/#kringlooplandbouw

Milieuregels in boerentaal. (2025). Milieuregelsinboerentaal. https://www.milieuregelsinboerentaal.nl/glastuinbouw/

Ministry of landbouw, natuur en voedselkwaliteit . (2018). Landbouw natuur en voedsel; waardevol en verbonden. (Agriculture, nature and food: valuable and connected). In Open Overheid. https://open.overheid.nl/documenten/ronl-db1252eb-89e3-452c-9c2d-9fa9398e5dcc/pdf

Ministry of economische zaken en klimaat. (2024). Programma Energiehoofdstructuur - Ruimte voor een klimaatneutraal energiesysteem van nationaal belang. Rijksoverheid.nl. https://www.rijksoverheid.nl/documenten/rapporten/2024/03/04/programma-energiehoofdstructuur

Nationale Energie Atlas. (n.d.). Zonpotentie velden. https://www.nationaleenergieatlas.nl/zonpotentie-velden

NOS, 2022. Rotterdam meest vervuilende Europese haven, becijfert milieuorganisatie. https://nos.nl/artikel/2415372-rotterdam-meest-vervuilende-europese-haven-becijfert-milieuorganisatie

NPO Radio 1. (2024). Verticale landbouw: de toekomst van voedselproductie in Nederland? De Nieuws BV. https://www.nporadio1.nl/nieuws/binnenland/63f46d19-4dc1-4421-83bd-767269d9ce14/verticale-landbouw-de-toekomst-van-voedselproductie-in-nederland

On the way to PlanetProof. (2024, May 21). On The Way to PlanetProof. https://www.planetproof.eu/zakelijk/.

Owens, A. C., Cochard, P., Durrant, J., Farnworth, B., Perkin, E. K., & Seymoure, B. (2019). Light pollution is a driver of insect declines. Biological Conservation, 241, 108259. https://doi.org/10.1016/j.biocon.2019.108259

Plantenberg, P. (ed.) 1987. 100 jaar veilingen in de tuinbouw [1887-1987]. Centraal Bureau van de Tuinbouwveilingen in Nederland.

Port of Rotterdam (2019). Energie en elektriciteit. https://www.portofrotterdam.com/nl/vestigen/industrie-de-haven/energie-en-elektriciteit

Provincie Zuid-Holland. (n.d.). Provincie Zuid-Holland. Ruimtelijk Economische Visie: sturing op toekomstbestendige economie. https://www.zuid-holland.nl/actueel/nieuws/december-2024/provincie-zuid-holland-lanceert-ruimtelijk/

Rapport CO2-uitstoot - 5. Landbouw - Amersfoort. (n.d.). https://klimaatmonitor.databank.nl/dashboard/rapport-co2-uitstoot/5--landbouw

RES Rotterdam Den Haag. (n.d.). RES 1.0 - RES Rotterdam Den Haag. https://www.resrotterdamdenhaag.nl/over+de+res/res-1-0/default.aspx

Rijksoverheid. (2018). Klimaatakkoord. In Open Overheid. https://open.overheid.nl/documenten/ronl-7f383713-bf88-451d-a652-fbd0b1254c06/pdf

Royal FloraHolland. (2025, March 12). Over ons. https://www.royalfloraholland.com/over-ons?_gl=1*jvx8bw*_up*MQ..*_ga*MTc1MjczNDA0LjE3NDQxOTQ3MDE.*_ga_NXV8QX28P8*MTc0NDE5NDcwMC4xLjAuMTc0NDE5NDcwMC4wLjAuMA..

Sahu, G., & Das, S. (2020). Regenerative Agriculture: Future of Sustainable Food Production. Biotica Research Today, 2(8), 745–748.
Sijmons, D., 2014. Landscape and energy. Designing transition. NAI, Rotterdam.

Skal Biocontrole. (2025, March 24). Skal Biocontrole. https://www.skal.nl/

Smit, P., & Van Der Velden, N. (2021). Energiemonitor van de Nederlandse glastuinbouw 2020. https://doi.org/10.18174/555540 P. 7.

Spruijt, J. (2015). Wat levert een Zonneweide per ha op. ACRRES. http://edepot.wur.nl/336567

Stanghellini, C., & Katzin, D. (2024). The dark side of lighting: A critical analysis of vertical farms' environmental impact. Journal of Cleaner Production, 458, 142359. https://doi.org/10.1016/j.jclepro.2024.142359

Statkraft. (n.d.). Agrivoltaics: combining solar panels and agriculture into a win-win result. https://www.statkraft.com/newsroom/explained/agrivoltaics-combining-solar-panels-and-agriculture/

SystemIQ & Soil Capital. (2020). Regenerating Europe's soils. https://www.foodandlandusecoalition.org/wp-content/uploads/2019/12/Regenerating-Europes-soils-FINAL.pdf

United Nations. (n.d.). Net Zero Coalition | United Nations. https://www.un.org/en/climatechange/net-zero-coalition

United Nations. (n.d.-b). Sustainable Development Goals: 17 Goals to Transform our World | United Nations. https://www.un.org/en/exhibits/page/sdgs-17-goals-transform-world

Upham, P. (2000). An assessment of The Natural Step theory of sustainability. Journal Of Cleaner Production, 8(6), 445–454. https://doi.org/10.1016/s0959-6526(00)00012-3

Scholten, G. and Sonneveld, C., 1999, 'Van langzaam herstel tot grote bloei, 1945-1965' ('From slow recovery to rapid growth'), in: Van Doesburg, J. (ed.), Honderd jaar praktijkonderzoek voor de glastuinbouw (' Hundred years of practical research for greenhouse farming'), Doetinchem: Elsevier
Van Doesburg, E. Kooistra, C. V. Vonk Noordegraaf, & W. van Winden (Eds.), Honderd jaar praktijkonderzoek voor de glastuinbouw (pp.21–35). Doetinchem: Elsevier.

Van Vliet, M. (2022). Gaan met die circulaire kas. Glastuinbouw Nederland. https://www.glastuinbouwnederland.nl/publiek/gaan-met-die-circulaire-kas/

Verheul, J. (2022, October 26). 'Grotere tomatenbedrijven Westland' - Groenten & Fruit Actueel. Groenten & Fruit Actueel. https://www.gfactueel.nl/grotere-tomatenbedrijven-westland/

Vijverberg, A. J. (1996). Glastuinbouw in ontwikkeling: Beschouwingen over de verwetenschappelijking van de sector. Delft: Eburon.

Vollering, M. (n.d.). Kassen in het Westland: van plat glas tot megakas. Geschiedenis Van Zuid-Holland. https://www.geschiedenisvanzuidholland.nl/verhalen/verhalen/kassen-in-het-westland/

Vullings, J. (2019, August 14). 'Economische realiteit mist in klimaatrapport' - Groenten & Fruit Actueel. Groenten & Fruit Actueel. https://www.gfactueel.nl/economische-realiteit-mist-in-klimaatrapport/

Westland in cijfers - Gemeente Westland. (n.d.). https://westland.incijfers.nl/dashboard/bevolking

WOS. (n.d.). De toekomst van de glastuinbouw: robotisering als sleutel naar duurzame productie | WOS. https://wos.nl/nieuws/artikel/de-toekomst-van-de-glastuinbouw-robotisering-als-sleutel-naar-duurzame-productie

WUR. (2024). A fair comparison between high-tech greenhouses and vertical farming. https://www.wur.nl/en/research-results/research-institutes/plant-research/business-units/greenhouse-horticulture/show-greenhouse/a-fair-comparison-between-high-tech-greenhouses-and-vertical-farming.htm

WUR. (n.d.). KAS2030: Duurzaam telen met toekomst. https://www.wur.nl/nl/onderzoek-resultaten/onderzoeksinstituten/plant-research/business-units/glastuinbouw/show-glas/kas2030.htm

WUR. (2014). Kas als Energiebron. https://www.wur.nl/nl/project/kas-als-energiebron.htm

Maps

Actueel Hoogtebestand Nederland https://ahn.nl/ahn-viewer

Klimaateffectatlas. (2025). Klimaateffectatlas. https://www.klimaateffectatlas.nl/nl/regionale-data

LISA. (2011–2022). Bedrijvendata voor Westland floricultuursector [Dataset]. Erasmus Centre for Urban, Port and Transport Economics (Erasmus UPT). https://www.lisadata.nl

Nationaal Georegister. (n.d.). Signaleringskaart geothermie. https://www.nationaalgeoregister.nl/geonetwork/srv/api/records/DAA3EDC6-B835-4333-A96B-858C5016005A?

Openstreetmap. (2020). Basemap [Dataset; QGIS].

PDOK https://www.pdok.nl/

Rijksinstituut voor Volksgezondheid en Milieu (RIVM), 2023

Topotijdreis: 200 jaar topografische kaarten. (z.d.). Topotijdreis. https://www.topotijdreis.nl/

Datasets

Brightspace. n.d. Solar Potential Yearly. Retrieved on 04/03/2025 from https://surfdrive.surf.nl/files/index.php/s/cGOnPkx5yWZrQ5h?path=%2FData%2FRenewable%20Energy%20Potential

Brightspace. n.d. Geothermal Potential. Retrieved on 04/03/2025 from https://surfdrive.surf.nl/files/index.php/s/cGOnPkx5yWZrQ5h?path=%2FData%2FRenewable%20Energy%20Potential

Brightspace. n.d. Wind Potential Speed. Retrieved on 04/03/2025 from https://surfdrive.surf.nl/files/index.php/s/cGOnPkx5yWZrQ5h?path=%2FData%2FRenewable%20Energy%20Potential

Open-dataportaal Zuid-Holland https://opendata.zuid-holland.nl/geonetwork/srv/dut/catalog.search#/home

APPENDIX

Appendix 1; Atlas.ti

Combined sources in Atlas.ti:

Fred Vermeer. (2024). Samen in actie tegen misdaad in de sierteelt. AD/Haagsche Courant. https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:6DM4-RF11-DYRY-X35N-00000-00&context=1519360.

Carel van der Velden. (2024). Experts aan het woord over verleden en toekomst van Royal FloraHolland. AD/Algemeen Dagblad.nl. https://advance.lexis.com/api/document?collection=news&id=urn%3acontentItem%3a6DH8-DY21-DY0X-90BP-00000-00&context=1519360&identityprofileid=Q6FFCK68393.

Fred Vermeer. (2024). Ondernemers en gemeente bundelen krachten tegen ondermijning in de sierteelt. AD/Algemeen Dagblad.nl. https://advance.lexis.com/api/document?collection=news&id=urn%3acontentItem%3a6DM1-H981-DY0X-91YV-00000-00&context=1519360&identityprofileid=Q6FFCK68393.

Rianne de Zeeuw (2022). 'Zonder gas geen sierteelt mogelijk'. AD/Haagsche Courant. https://advance.lexis.com/api/document?collection=news&id=urn%3acontentItem%3a658S-JKK1-JC8X-61X0-00000-00&context=1519360&identityprofileid=Q6FFCK68393.

Fred Vermeer. (2024). Westlandse ondernemers vragen lokale politiek om hulp: 'Draag tuinbouw positief uit naar buitenwereld'. AD/Algemeen Dagblad.nl. https://advance.lexis.com/api/document?collection=news&id=urn%3acontentItem%3a6CFC-D6W1-DY0X-901G-00000-00&context=1519360&identityprofileid=Q6FFCK68393.

Esdor van Elten. (2024). 'Westlanders bedenken altijd wel een oplossing'. AD/Haagsche Courant. https://advance.lexis.com/api/document?collection=news&id=urn%3acontentItem%3a6BDY-18G1-DYRY-X0D4-00000-00&context=1519360&identityprofileid=Q6FFCK68393.

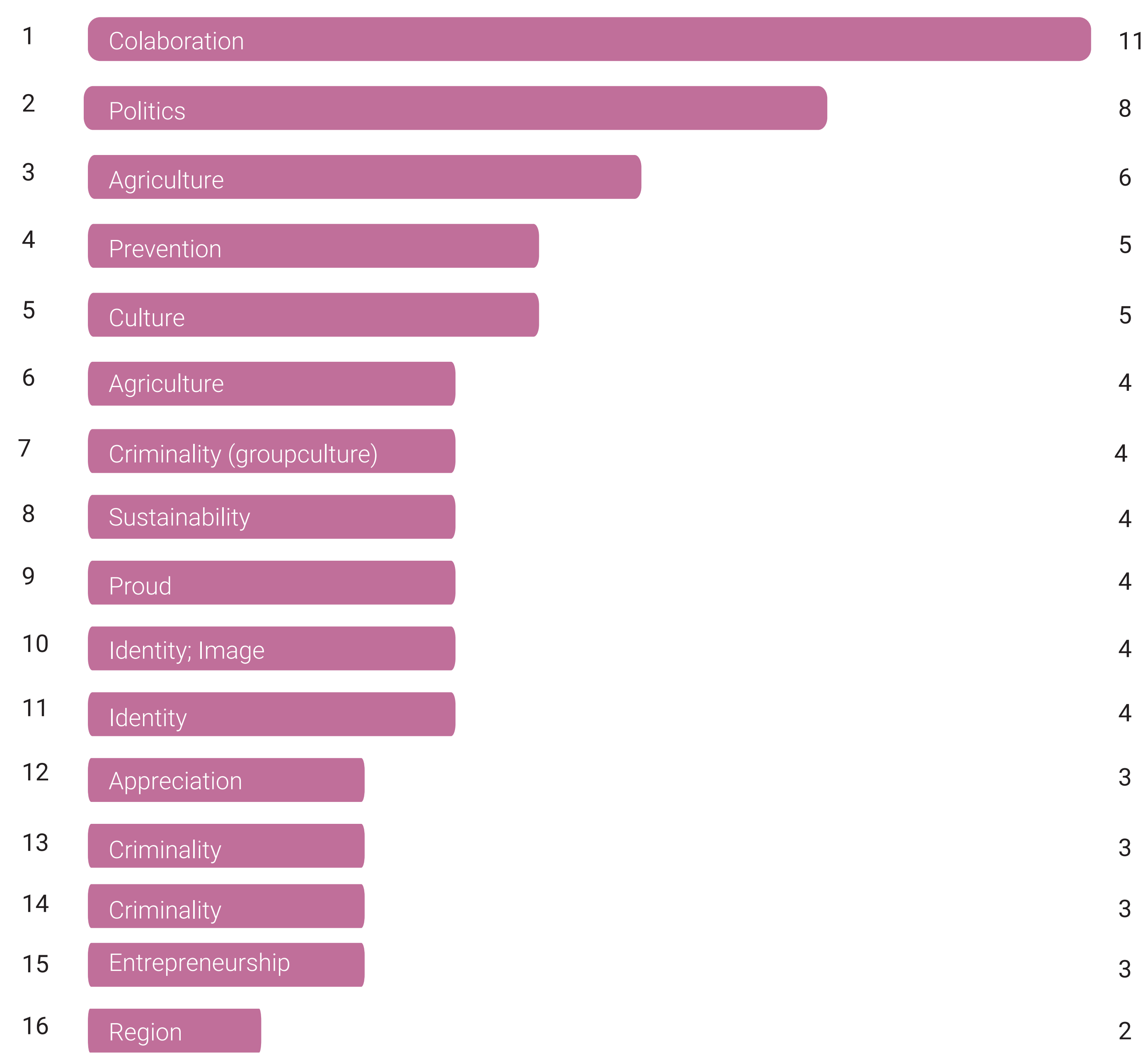
Fred vermeer. (2024). 'Imago tuinbouw moet positiever'. AD/Haagsche Courant. https://advance.lexis.com/api/document?collection=news&id=urn%3acontentItem%3a6CFG-Y8X1-DYRY-X1MS-00000-00&context=1519360&identityprofileid=Q6FFCK68393.

Alphons de Wit sr. (2023). Sander Nieuwenhuizen: 'De kracht van het Westland wordt doodgedrukt'. AD/Algemeen Dagblad.nl. https://advance.lexis.com/api/document?collection=news&id=urn%3acontentItem%3a68JB-D381-JBHV-K55S-00000-00&context=1519360&identityprofileid=Q6FFCK68393.

With Atlas.ti we identified the key aspects mentioned in the articles, the sources are related to communities' ideas, wishes, or concerns about the implementation of greenhouses. Each identified spatial aspect should be a code category.

text codering: I want to identify key aspects mentioned in these articles by communities, aspects which are related to communities' ideas, wishes, or concerns about the implementation of greenhouses. Each identified spatial aspect should be a code category.

Top Applied Codes



Appendix 2; Calculations energy demand current and future

Current situation

Energy demand Westland (Smit & Van der Velden, 2021):

UseNL = 100 PJ = 30.555.555.555,56 kWh
Westland has 46% of Dutch horticulture
UseWL = 0,46 * useNL = 14.055.555.555,56 kWh
Floriculture is 49,5% of Westland's horticulture
UseFC = 0,496 * useWL = 6.957.500.000 kWh

Solar energy (Nationale Energie Atlas, n.d.; Spruijt, 2015; Kronos Solar, n.d.):

ProductionSOLAR = 0,65 MWp * 900 kWh/kWp = 585.000 kWh/ha
SolarFC = useFC * productionSOLAR = 11890 ha
Panels = 2000 * SolarFC = 24 million solar panels

Wind energy (De Weerd, 2016; Daar krijg je energie van, 2023):

ProductionWINDMILL (diameter = 130 m, height = 130 m) = 17.500.000 kWh/y
WindmillsFC = useFC / productionWINDMILL = 398 windmills
DistanceWM = 6 * diameter = 780 m
AreaWM,FC = 20 WM * 20 WM = 24.500 ha

Geothermal energy (Geothermie Nederland, 2011; Nationaal Georegister, n.d.):

ProductionGEO = 7 M * 7.000 hours/y = 49.000.000 kWh/y
GeoFC = useFC / productionGEO = 142 sources = 142 ha

Vision

We are removing 25% of the greenhouses. Automatisation and vertical farming will influence the energy demand in unknown ways. We will work with the 25%, with the assumption that our energy supply will become positive and can serve as a give-back to surrounding inhabitants or other industries. In the vision, 18 total geothermal sources are placed. The remaining energy demand was divided 50/50 between solar and wind energy.

Enrgy demand Westland:

UseFC,NEW = 0,75 * useFC = 5218125000 kWh/y

Solar energy New:

ProductionSOLAR,NEW = 2.168.062.500 kWh/ha
SolarFC,NEW = useFC,NEW * productionSOLAR,NEW = 11890 ha
Panels = 2000 * SolarFC,NEW = 7,4 million solar panels

Wind energy New:

ProductionWINDMILL,NEW = 2.168.062.500 kWh/ha
Windmills = productionWINDMILL,NEW / productionWINDMILL = 124 windmills
AreaWM,FC,NEW = 7.400 ha

ProductionWINDMILL,LAND = 700.000.000 kWh/ha
WindmillsLAND = 40 windmills
AreaWM,LAND = 2418 ha

ProductionWINDMILL,SEA = 1.470.000.000kWh/ha
WindmillsSEA = 84 windmills
AreaWM,SEA = 5148 ha

Geothermal energy New:

ProductionGEO,NEW = 18 * productionGEO = 882000000 kWh/y
AreaGEO,NEW = 18 ha