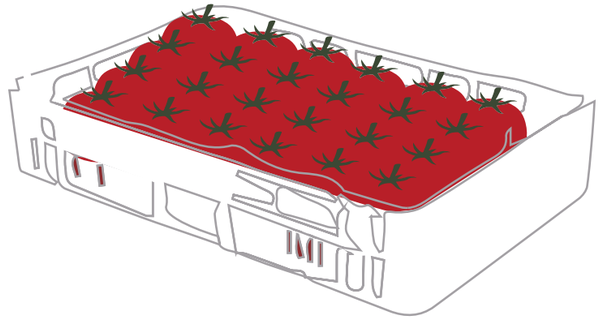
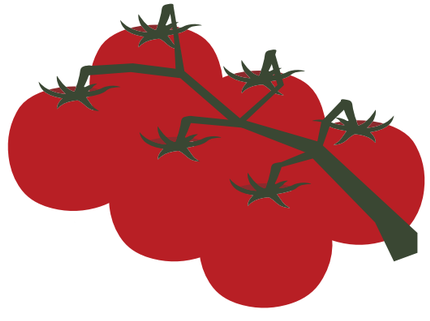
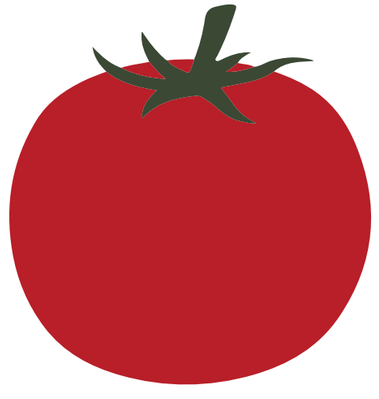
Life of a Tomato







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Disclaimer

This report was prepared within a limited timeframe, which required the use of certain assumptions and simplifications. While we aimed to ensure accuracy and clarity, the time constraints may have influenced the depth of analysis and completeness of information.

To support the writing process and improve the overall clarity of the report, various digital tools may have been used, including AI text editors. All content was reviewed and adjusted by the authors to align with the intended message.

The findings, conclusions, and recommendations in this report are based on the information available at the time of writing and should be interpreted accordingly. This document is intended for general informational purposes and does not constitute professional advice.

Abstract

The Netherlands plays a significant role in the global economy, particularly in the agricultural sector. However, this global economy is heavily reliant on fossil fuels, making it unsustainable. Transitioning to renewable energy sources like wind and solar power will not resolve this issue due to overconsumption. This project uses the Dutch food supply chain to analyze key factors such as energy consumption, spatial impact, global trends, waste, and human conditions. The aim is to lay the groundwork for a radical approach to reduce consumption and promote sustainability, based on the principles of people, planet, and prosperity. To achieve this, the concepts of Growth & Degrowth, Global & Local, and Linear & Circular will be explored to develop two radical scenarios, which will form the basis for a vision. The project proposes a spatial vision for the Rotterdam/The Hague metropolitan area, where the global growth-based economy is replaced by a stable, local economy. This vision is supported by strategies focused on enhancing democracy, circularity, community, identity, and equity. These broad strategies address societal challenges but are made tangible through the analysis of the tomato supply chain and its specific energy demand. Given the central role of food, the project involves numerous stakeholders and communities, represented by personas that illustrate the various actors within the food supply chain and the changes they go through.

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01 Introduction

Context and Urgency

Renewable energy

In the context of the energy transition, society predominantly seeks solutions in sustainable energy sources such as wind and solar power. However, this approach overlooks the fundamental issue of overconsumption, which remains a primary driver of environmental degradation and resource depletion (Moriarty & Honnery, 2020). Paradoxically, the shift toward solar and wind energy exacerbates this very problem by increasing the demand for critical minerals, infrastructure, and land use, thereby perpetuating unsustainable consumption patterns.

The implementation of solar energy entails various ecological and social drawbacks. Large-scale solar installations require significant land areas, which can lead to habitat loss and ecosystem disruption. Additionally, these installations may consume large amounts of water for cooling and cleaning, potentially causing conflicts over water use during dry periods. They also have visual and noise-related drawbacks, particularly in areas of high landscape value. Moreover, the production and processing of photovoltaic (PV) panels pose significant environmental and health risks due to the use of toxic substances such as cadmium and herbicides (Hamed & Alshare, 2021).

Wind energy also has considerable disadvantages, particularly regarding biodiversity and the living environment. Wind turbines pose a risk to birds and bats through collisions and can affect their behavior and habitats. Additionally, they generate both mechanical and aerodynamic noise, which may cause disturbances and health issues for nearby residents. The visual impact of wind farms is subjective but can be perceived as disruptive, especially in scenic areas. Furthermore, large-scale wind farms alter local wind patterns and microclimates. Finally, there is the issue of land use; although the turbines themselves occupy little space, they require a surrounding clearance zone, and the necessary infrastructure demands additional land (Hamed & Alshare, 2021).

More importantly, the transition to sustainable energy is heavily reliant on the availability of critical minerals such as lithium and cobalt, which are essential for batteries in electric vehicles, energy storage systems, solar panels, and wind turbines. The Democratic Republic of the Congo holds a substantial share of these resources, possessing approximately 70% of the world's cobalt reserves (UN, 2022). However, the DRC faces significant developmental challenges. In 2021, it ranked 179th out of 191 countries on the Human Development Index, and in 2018, more than 70% of its population lived on less than $1.90 per day. The demand for minerals has historically contributed to environmental degradation and violent conflicts, exacerbating the country's ongoing humanitarian crisis. Various studies indicate that mining plays a crucial role in financing armed groups, while the extraction of these resources also places immense pressure on the country's biodiversity (UN, 2022). The mismanagement of the extractive industry also deepens socioeconomic inequalities, while the energy transition causes the demand for critical minerals, such as those found in the DRC, is expected to rise, intensifying these challenges (UN, 2022).

Consumption

An answer to these significant problems caused by the energy transition is to look at different sources of energy, such as nuclear power. However, A world entirely powered by renewable energy would inevitably have lower energy consumption. (Moriarty & Honnery, 2020) This is because the current global energy usage is driven by a 'business-as-usual' growth model, which is largely dependent on fossil fuels. (Moriarty & Honnery, 2020) This is also true for the Netherlands, as shown in figure 1, where the dutch energy consumption per source is shown compared to the GDP. The graph shows a steep rise in consumption after the second world war, when oil was introduced and a large gas field in Groningen was found. In only 60 years, the energy consumption has multiplied by a factor of 19. As shown in the graph, the GDP follows this increase almost exactly. This is because the extensive use of fossil energy has been a defining factor in modern globalization. This has also defined the way in which production, labor, and living conditions influence one another globally (Altvater, 2007).

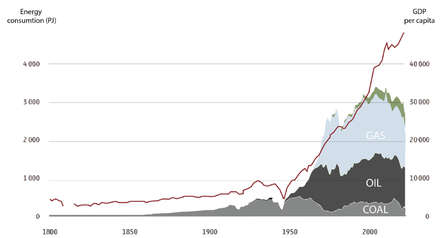

Figure 1 (CBS)

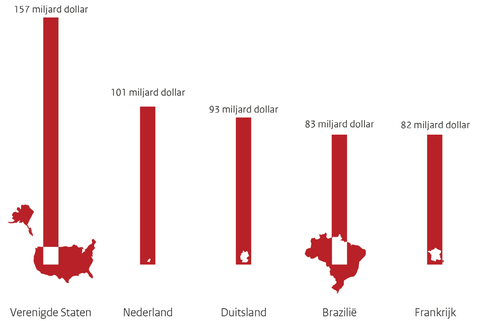

Figure 2 (PBL, 2012)

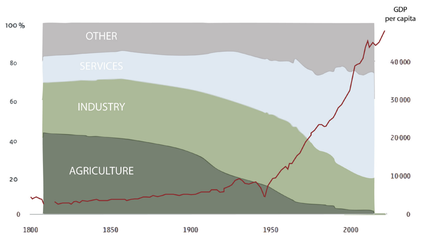

Figure 3 (CBS)

Figure 4 (Own work, 2025)

Figure 5 (Own work, 2025)

Context and Urgency

Globalisation

Firstly, the availability of fossil fuels, combined with modern machinery, has led to an unprecedented increase in productivity. This has enabled the reorganization of production processes, resulting in global supply chains. Labor-intensive segments of these chains are often located in regions with low labor costs, while technology-intensive sectors are situated in areas with robust knowledge infrastructures, such as the Netherlands. The cheap energy derived from fossil fuels makes it economically viable to maintain transportation and communication between these specialized locations. (Altvater, 2007) For the Netherlands this is clearly visible in the agricultural sector, as figure 2 illustrates. Thanks to technology and fossil fuels, a small country such as the Netherlands can be the second largest food exporter in the world.

However this productivity comes at a cost. Financial markets, fueled by the economic growth dependent on fossil fuels, exert pressure on the labor market to increase growth and reduce labor costs. This pressure leads to deteriorating working conditions, lower wages, reduced job security, and the erosion of social services. (Altvater, 2007) The pressure on the labor market has created a 'redundant population,' for whom insufficient new jobs are being created. This is a significant cause of migration. (Altvater, 2007) The Westland, shown in figure 6, is the perfect example of technology driven efficiency, powered by natural gas. Still, it is highly dependent on migrant workers for cheap labour, as will become clear in the Overarching Issues chapter.

The IMF reports that the effective global workforce has quadrupled over the past two decades, partly due to advanced economies' access to labor through imports, offshoring, and immigration. This has resulted in a sharp decline in the share of income derived from labor in developed countries and an increase in the wealth of financial asset holders (Altvater, 2007). This is clearly visible in the Netherlands, where a shift from labour towards service jobs has taken place as displayed in figure 3. This shift is viewed as a manifestation of a new phase of capitalist 'accumulation by dispossession,' thereby contributing to growing wealth disparities (Altvater, 2007).

This new global economy is also visible in the built environment. For instance in the Port of Rotterdam, which is the leading hub in Northwestern Europe for the transshipment of crude oil. The crude oil that enters Rotterdam, amounting to 95 to 100 million tons annually, is almost entirely destined for refineries in the port itself (figure 5) causing 13% of the greenhouse gas emissions of the Netherlands. (Kampman & Manna, 2024) In addition to the import of crude oil, the Port of Rotterdam also serves as a distribution hub for petroleum products. (Port of Rotterdam, 2025) Although the port mostly handles fossil fuels, As Europe's largest sea port it is also a global hub for international trade (figure 4) and home to some of the world's leading industrial clusters. However it is these chemical industry clusters which use most of the energy in the Netherlands. (CBS, 2024) With all these large-scale activities the Port of Rotterdam illustrates the global scale and economy in which the Netherlands is a large player.

The current open and formal economy relies on fossil fuels to remain competitive in the global market. (Altvater, 2007) This means that in order to reduce our energy consumption significantly, there needs to be a fundamental shift in our economy, mentality and way of living.

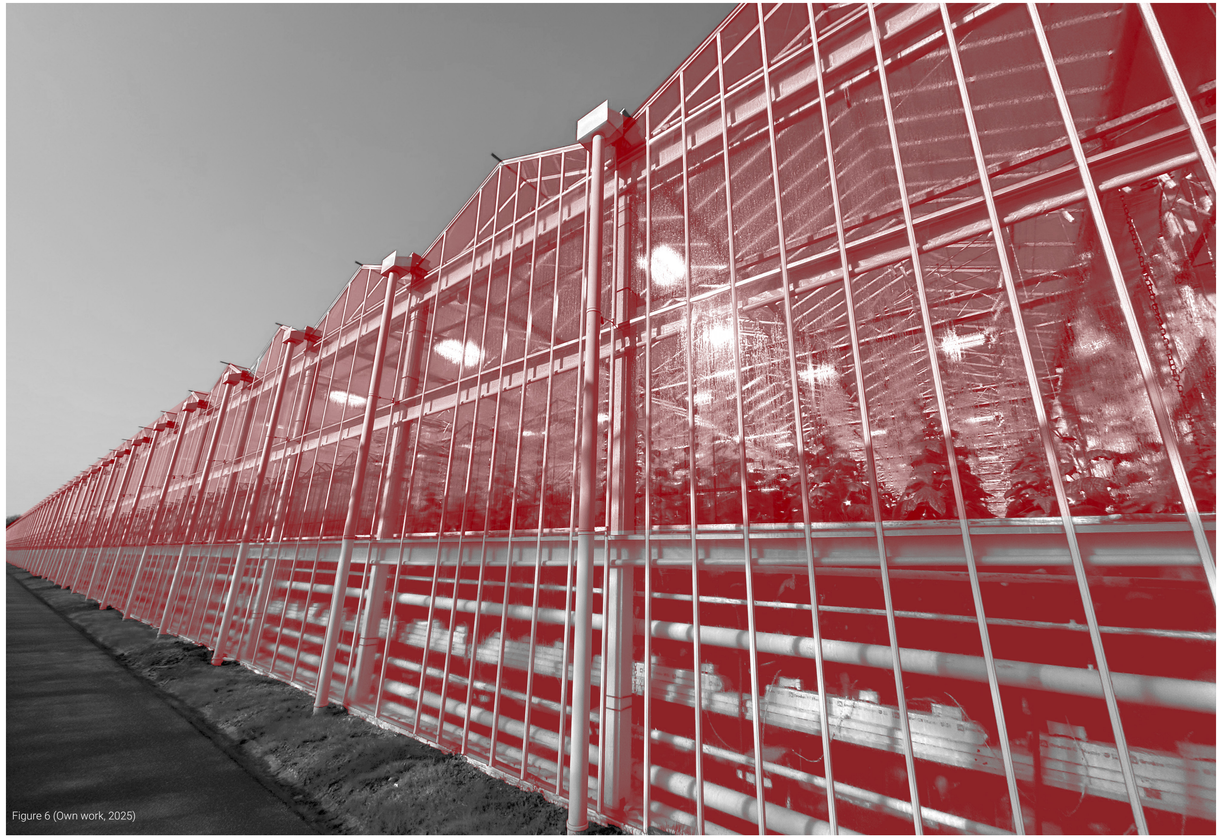

Figure 6 (Own work, 2025)

Context and Urgency

Supply chain

Corporate globalization, which relies heavily on fossil fuels, has already sparked counter-movements such as the growth of the informal economy and the rise of cooperative and solidarity-based production models. The solidarity economy, with its focus on regional and local markets, offers a potential alternative to the global market (Altvater, 2007). An economy centered on sustainability may require slower, more localized forms of production and distribution in order to reduce consumption (Altvater, 2007).

In these alternatives, the supply chain is the central element. When the supply chain can be adjusted to be sustainable, most of the different forms of energy consumption through direct and indirect inputs can be eliminated or reduced. However, the transition is expected to have profound implications for the labor process and income distribution, which stresses the importance of a just transition. (Altvater, 2007) To make this tangible, it is useful to analyze a specific supply chain to identify where consumption occurs and how it can be altered. Figure 7 illustrates a simplified example of the tomato supply chain from Westland within the current global system. It also shows the alternative supply chain based on the principles of solidarity, a slow economy, and local distribution. This report presents a plan for transitioning from the global to the sustainable tomato supply chain.

When these principles are applied across all supply chains, a new way of living could emerge. Figure 12 envisions the Rotterdam-The Hague metropolitan area in 100 years, incorporating the sustainable tomato supply chain across the entire economy. In this vision, democracy, circularity, community, equity, and identity are key elements of society, achieved through education, innovation, shared ownership, and mixed-use practices within the supply chain.

However, as noted earlier, the Netherlands is a significant player in the global economy, and relinquishing this position is no easy task. To realize this vision, a major economic crisis may be required to strip large multinationals of their wealth and power, which they currently use to dominate the global market and political decisions that define policy frameworks. Figure 8 depicts a market crash in relation to the Netherlands' fossil fuel consumption. Such a crisis could open the door for the public to take action towards a sustainable world, creating an economy that is not based on growth but is instead stable and resilient.

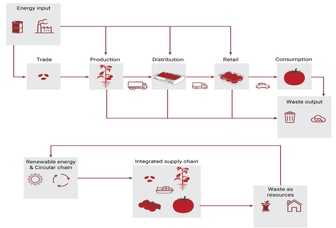

Figure 7 (Own work, 2025)

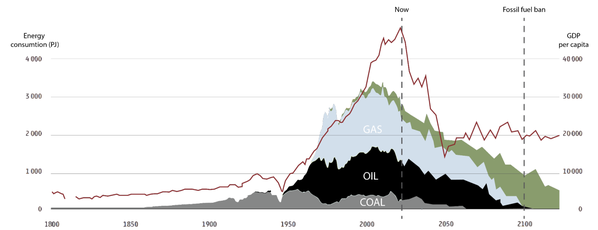

Figure 8 (Own work based on CBS, 2025)

Vision insights

Figure 9 (Own work, 2025)

Industrial Areas

A robust water network forms the backbone of both the broader and local trading system in the Netherlands, where small-scale harbours emerge as vital social and economic hubs in both rural and urban areas. These harbours serve as spaces for trade, craftsmanship, commerce, and recreation. They provide enough room for small industries, local businesses, and food production, contributing to a thriving, community-centered economy.

Figure 10 (Own work, 2025)

Urban Areas

To promote equity, the urban fabric is designed with a fine-grained mix of people and functions. Achieving this requires high-density development, built upon both small and large communities engaged in co-living and farming activities. At the core of this high-density structure lies a strong recreational green network, providing spaces for social interaction and connection to nature.

Figure 11 (Own work, 2025)

Rural Areas

In the transformed farming landscape, climate and ecology take center stage, creating a farming system that supports food security while nurturing the environment. Small farming communities are leading agricultural innovation, with practices that promote sustainability. These areas provide spaces for both recreation and the flourishing of nature, ensuring that agriculture and ecology thrive together.

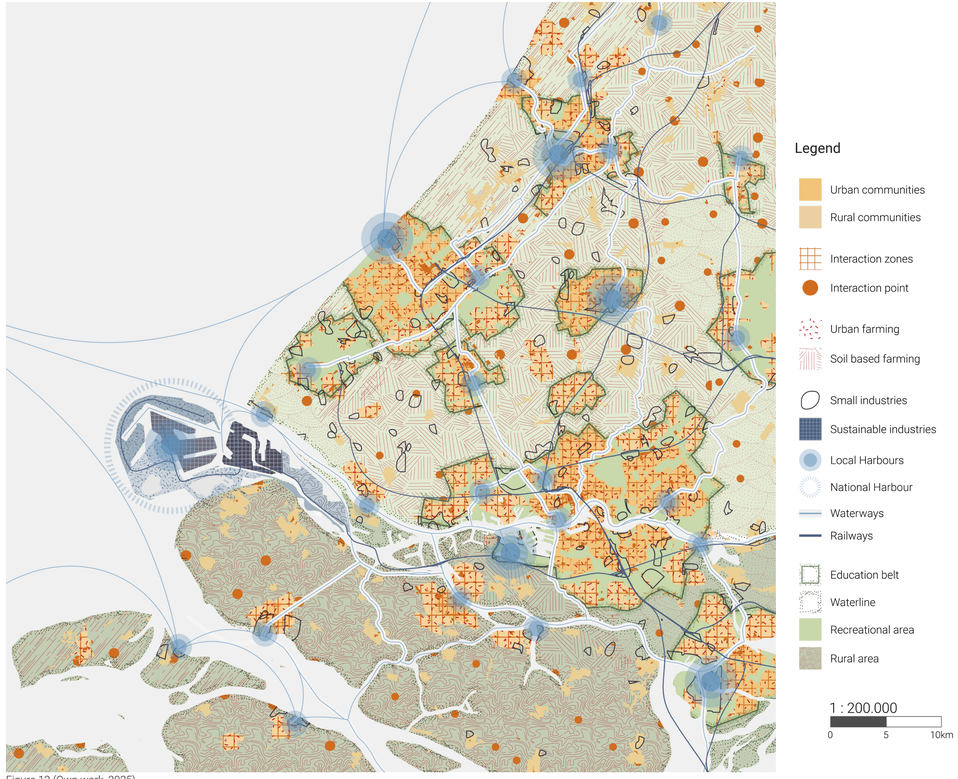

Figure 12 (Own work, 2025)

02 Framework & Methodology

Problem statement

The Netherlands is a country born in the heart of Europe's Delta, providing fertile land for farming and a strategic location for trade. Through its strong relationship with water as well as technological advancements, the Netherlands has successfully maintained food security and fostered economic growth. Its innovative approaches to land engineering, agriculture, and trade have made it the world's second-largest food exporter, securing a prominent position in the global economy (Masimova, 2023).

However, the globalized economy and technological advancements are heavily reliant on fossil fuels, resulting in a significant increase in energy consumption (CBS, 2023). This surge is driven not only by long-distance transportation but also by indirect inputs in production processes such as the excessive use of plastic packaging materials (Posen et al., 2017). The consequences have been devastating for the climate, while also widening the gap between the prosperous and the poor (Talen, 2012). In this globalized system, it is now possible for imported apples from Chile to be cheaper than locally produced apples from the Netherlands, as the system prioritizes profit over energy efficiency, environmental impact, and social conditions (source). With fossil fuels keeping energy costs artificially low, globalization has not only led to a massive rise in energy consumption but has also added considerable complexity to global supply chains (VPRO Tegenlicht, 2023).

That is why, even if a transition to renewable energy were made, it might still not sustain the globalized economy and its required energy consumption (Moriarty & Honnery, 2020). Therefore, it is necessary to rethink systems in order to reduce their energy demand. To reduce the Netherlands' energy use as a global player, attention must be directed beyond its borders to examine supply chains. By decomplexifying and decentralizing global systems, such as the food supply chain, energy consumption could be significantly reduced (Meyer et al., 2020), leading to improvements in environmental impact and social divides (Talen, 2012).

Research question

How can the Netherlands reorganise its food supply chain in a just and sustainable way, in order to reduce its energy consumption?

Sub-questions

1. What is the energy demand and impact of the current, globalised food supply chain of the Netherlands?
2. What are the spatial implications of the current food supply chain?
3. Who are the stakeholders involved in the food supply chain?
4. What are the existing solutions to reduce the energy demand of the food supply chain?

Theoretical framework

Theoretical framework

This report is anchored in Sustainability Theory, a multidisciplinary field that gained prominence in the 1960s and has since evolved to incorporate a variety of approaches to balancing environmental, social, and economic well-being. The strategic lens applied in this work is also shaped by post-capitalist economic theories, such as Degrowth and the Doughnut Economy, which critique the limits of traditional growth-based models. Together, these perspectives inform a framework that seeks to redefine prosperity through equity, resilience, and ecological integrity.

The evolution of the theory of Sustainability

The most widely accepted definition of sustainable development comes from the Brundtland Report, Our Common Future (Brundtland, 1987), which states that Humanity has the ability to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs. Initially, discussions on sustainability primarily addressed the environmental consequences of industrial and economic expansion. One of the key conclusions of the first major global discussion on sustainability, the United Nations Conference on the Human Environment (Stockholm Earth Summit 1972), was that environmental challenges are inseparably linked to the unequal distribution of global resources: the conference advocated for integrating environmental protection with development policies (UNEP, 1972). By the time of the Rio Earth Summit in 1992, the concept of sustainable development had evolved into a framework encompassing three core dimensions: social, environmental, and economic sustainability—often summarized as People, Planet, and Profit. A key takeaway from the summit was the principle that "human beings are at the center of concerns for sustainable development and are entitled to a healthy and productive life in harmony with nature" (United Nations, 1992). Leading up to the Johannesburg Earth Summit (2002), there was a shift in terminology, with some stakeholders—particularly South Africa, the United Kingdom, and the European Commission—proposing that 'profit' be replaced with 'prosperity' to emphasize broader societal well-being over purely financial gains (European Commission, 2002).

Another theoretical contribution that shaped this report and its strategy came after the 2004 International Sustainable Development Research Conference. Van Dorst and Duijvestein (2004) argued that in practice, sustainable development in the living environment often gets limited to themes like liveability and energy efficiency. To address this, they propose adding the quality of the built environment as a fourth binding element, summarized in general by the word 'Project'. This fourth corner of the tetrahedron aims to connect the theoretical aspects of People, Planet, and Prosperity with practical experience and the various sustainability themes. The tetrahedron model allows for different objectives by placing a specific "quality" at the top. For example: for sustainable entrepreneurship, economic quality would be on top; for sustainable living, social quality would be on top. In all cases, the quality at the top is supported by the other three, meaning it cannot be achieved without considering them.

A crucial step in our group's understanding of sustainability and how it will shape our future comes from Transforming Consumption: From Decoupling, to Behavior Change, to System Changes for Sustainable Consumption. In their 2015 paper O'Rourke and Lollo identify a "consumption-sustainability dilemma," emphasizing the inherent conflict between increasing societal consumption and the resulting ecological, health, and social risks. The authors critique the predominant approach to sustainable consumption, which focuses on "decoupling" economic growth from environmental impacts through efficiency gains (referred to as "weak sustainable consumption"). They argue that this approach has limitations because improvements in efficiency are often outpaced by increases in population and affluence, making it insufficient to address environmental concerns.

To address these challenges, the authors propose a shift towards "strong sustainable consumption," which incorporates a systems-based perspective that goes beyond technological solutions. This framework emphasizes the need to consider how current lifestyles and societal systems contribute to environmental and social problems, promoting a balance between efficiency, sufficiency, and resiliency. The paper's methodology includes a critical review and synthesis of literature from various fields to develop an integrated framework for sustainable consumption. The authors suggest that effective change requires actions at multiple levels:

- Technological Improvements: Necessary but not sufficient for achieving sustainability.
- Individual Behavior Change: While important, changes in consumer behavior alone are inadequate due to the ingrained nature of consumerism in economic and cultural systems. Insights from behavioral economics and social psychology are used to understand decision-making processes and the limitations of individual interventions.
- Systemic Changes: The most critical step, focusing on altering the systems of production and consumption, involving understanding the decision-making processes of key actors (consumers, businesses, and governments) and addressing the "lock-in" of unsustainable practices.

Donut and Degrowth: insights from post-capitalist economic theories

The Doughnut Economy, developed by economist Kate Raworth, is a framework that challenges traditional economic models based on endless growth and profit maximization. It envisions a "safe and just space for humanity", which is defined by two key boundaries: a social foundation and an ecological ceiling. The social foundation represents the minimum necessary conditions for human well-being, such as access to food, clean water, healthcare, education, political participation, and income security. Falling below this threshold means people are living in deprivation. The ecological ceiling, on the other hand, consists of planetary boundaries that humanity must not exceed to prevent environmental collapse, including climate change, biodiversity loss, pollution, and resource depletion. The space between these two boundaries—the doughnut-shaped area—is where economies should operate, ensuring both social justice and ecological sustainability. Unlike conventional economic models that prioritize GDP growth, the Doughnut Economy advocates for regenerative and distributive systems. It promotes economic models that restore ecosystems, reduce waste, and distribute wealth and resources more equitably rather than concentrating them in the hands of a few.

The DeGrowth movement is committed to forging a world in which we respect Earth's limits and become more fully human. The word degrowth was formulated for the first time in 1972 during a debate organized by the Nouvel Observateur, in which André Gorz (1923-2007) examined the relation between growth and capitalism. Degrowth refers to a critique of capitalist growth that emphasizes organizing the economy around human needs rather than capital interests, advocating for de-accumulation, de-enclosure, and de-commodification to address issues of excess throughout and colonial appropriation.

Our interpretation

The way we interpreted the 4P approach proposed by Van Dorst and Duijvestein (2004) is by expanding on the meaning of the word 'quality' and interpreting the fourth corner, the Project, as a flexible concept applicable both to the built environment and to broader systemic structures such as food and energy networks. The spaces we inhabit, the ways we consume, and the expectations we hold towards infrastructure are not natural or inevitable; they are the result of deliberate planning and economic priorities.

One key example is the supermarket—an engineered environment that ensures products are available year-round, regardless of seasonality or local capacity. This model is sustained by global supply chains that prioritize efficiency and profit accumulation, often at the cost of environmental and social sustainability. Similarly, our energy system has been designed around large-scale, centralized production, reinforcing dependency on a few key actors rather than fostering decentralized, resilient alternatives. Recognizing these structures as designed rather than incidental opens the possibility of redesigning them with sustainability and collective prosperity as guiding principles.

Our research highlights how the global energy and food supply chains in the Netherlands concentrate profit in a few hands, exacerbating inequality while externalizing environmental and social costs. In response, we explored the idea of collectivizing key assets—such as land, infrastructure, and energy—treating them as commons rather than commodities. This aligns with historical and contemporary movements advocating for food sovereignty, community-owned energy projects, and cooperative business models. By treating essential resources as commons, we can shift the focus from profit maximization to equitable distribution and resilience.

A crucial point in our research is the recognition that sustainability efforts cannot focus solely on production-side solutions (e.g., transitioning to renewable energy) or efficiency-oriented technical solutions, without addressing consumption patterns. Even if fossil fuels are replaced with renewables, the demand for scarce materials such as lithium and rare earth elements will reproduce the same extractivist dynamics. Therefore, reducing material consumption and restructuring consumer expectations must be integral to sustainability efforts. This perspective challenges mainstream narratives that assume technological advancements alone can resolve sustainability crises. Instead, it calls for systemic shifts in how goods are produced, distributed, and consumed.

If sustainability is to be genuinely transformative, it must move beyond traditional economic growth models that equate prosperity with increasing GDP. Alternative economic frameworks, such as Doughnut Economics and Degrowth, propose measuring well-being through social equity, ecological health, and resilience rather than financial performance alone. Cities and regions experimenting with these models will provide insights into how urban spaces can be restructured to prioritize collective well-being rather than endless expansion.

By integrating these perspectives, this report seeks to not only critique existing sustainability paradigms but also contribute to a broader reimagining of what it means to build a just, sustainable, and inclusive society.

Conceptual framework

Framework explanation

This conceptual framework is based on the People, Planet, Prosperity & Project (4P's) model of sustainability by Van Dorst and Duijvestein (2004), as it integrates fundamental aspects of society into sustainability.

People focuses on well-being and social needs, including livability, health, freedom, social cohesion, participation, and safety.
Planet emphasizes sustainability by minimizing environmental impact through sustainable construction, resource efficiency, and ecological preservation.
Profit ensures economic viability through development, affordability, fairness, and long-term financial stability.
Project, added later, relates to spatial aspects, highlighting the quality of the built environment alongside sustainability. This project not only represents the built environment, but it reflects the spaces we inhabit, the ways in which we live and work in urban and non-urban settings, our patterns of consumption, and the expectations we place on infrastructure and everyday urban life.

In this framework, a safe serves as a metaphor for the project. Just as a safe requires carefully aligning numbers to unlock it, the project must carefully balance key sustainability concepts: Growth & Degrowth, Global & Local, and Linear & Circular, to achieve an optimal outcome according to the 4P's.

A Just Transition toward sustainability can be enriched by a degrowth perspective (Velicu & Barca, 2020). Instead of merely creating green jobs within the existing growth model, a degrowth-oriented transition would also rethink the nature of work, making space for alternative and autonomous economic activities. Additionally, McNeill and Lichtenstein (2003) identify the global/local divide as a key fault line in environmental and sustainability debates. Velicu and Barca (2020) highlight in their section on "Entropy" that natural processes are irreversible, unlike the circularity of capital. From an ecological standpoint, sustainable systems should align more with the circular nature of natural processes rather than linear, extractive economic models.

However, these concepts have limitations and must be assessed within specific contexts. A Just Transition must consider the unique social, cultural, and ecological conditions of different communities, recognizing and valuing their local knowledge and experiences (Velicu & Barca, 2020; McNeill & Lichtenstein, 2003). In other words, community is key.

To apply this framework in a tangible way, the tomato supply chain serves as a central case study, much like the lock of a safe, to analyze and balance the 4P aspects in shaping sustainability.

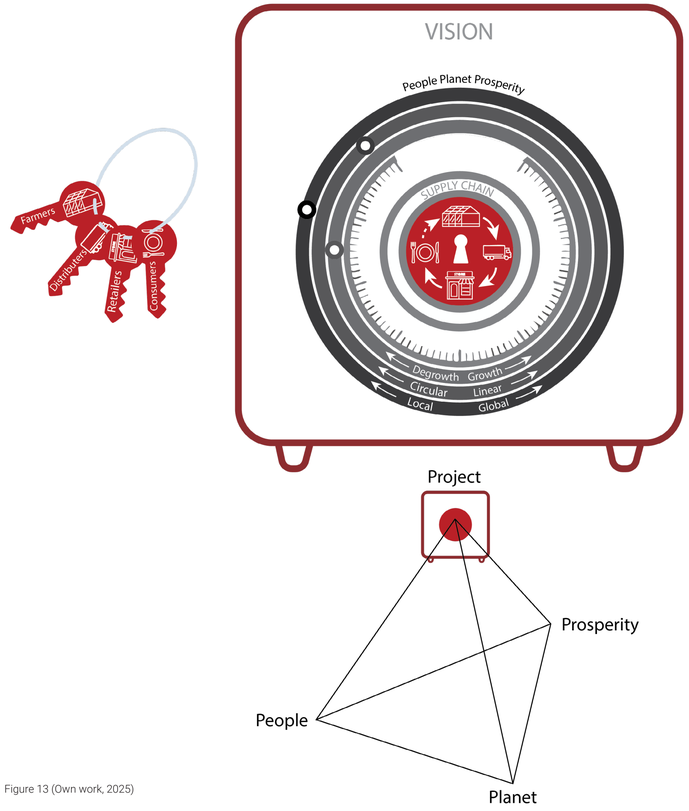

Figure 13 (Own work, 2025)

Methodology

Methodology framework

In figure 14, a schematic representation of the process of this project is shown. The process consists of five phases, each with its own focus points and outputs. The first phase was used to explore the topic and its framework, as well as to visit the site in order to gain a better understanding of the context.

At the beginning of the second phase, a broad literature review led to the formulation of a problem statement, which addresses the Netherlands' reliance on complex, fossil-fuel-driven global supply chains and the urgent need to rethink and decentralize such systems. This problem statement was followed by a research question, with the Dutch food supply chain as its central focus. This supply chain touches upon several key aspects of the issue, such as trade, the use of plastics, and overconsumption, making it an interesting subject to investigate. To ensure the feasibility of the project, the focus was narrowed to the food supply chain of tomatoes as the primary case study. Among all crops, tomatoes provide the most consistent and comprehensive energy-use data, making them the most suitable choice for this project. Quantitative, spatial, and technical research was done to gain a deeper understanding of the complexity of this supply chain. The analysis done during this phase was used to form the conceptual framework, which then guided a significant part of the vision-making process.

In the third phase, extreme scenario thinking was used as a tool for radical spatial imagination concerning the future of the food supply chain, helping to push beyond conventional solutions. Both the analysis and the conceptual framework were applied to these extreme scenarios. The vision was then formed by integrating the analysis with the scenarios into a new spatial map and section. To further develop this vision, key values and corresponding strategies were identified. These values form the foundation of the vision and serve as core objectives for both policy and spatial strategies, developed in the fourth phase. During this phase, a series of design interventions was created and structured along a 100-year timeline, which provides a strategic roadmap to guide long-term decision-making.

Finally, to get a better understanding of the topic, four personas were developed to use as a narrative throughout the whole project. Imagining and mapping out the lives of these characters shows how the problem and possible solutions will work in practice. In each phase of the designing part of the process (Critical analysis, Vision and Strategy phase) gained insights, data and ideas were translated into the lives of the persona's to see how it affected them.

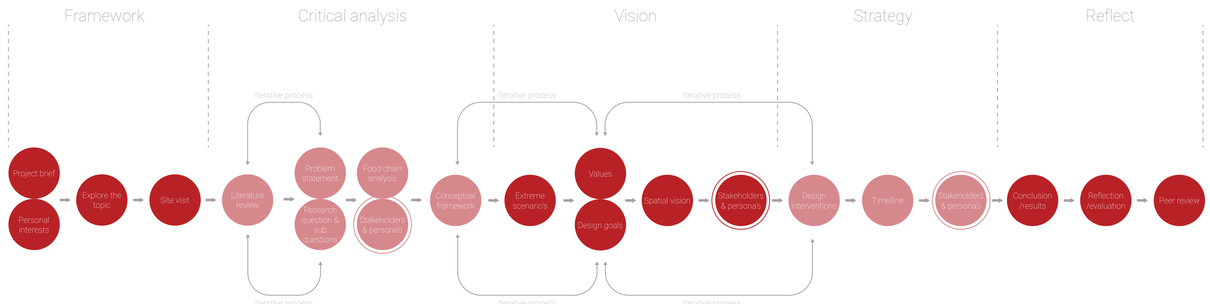

Figure 14 (Own work, 2025)

03 Analysis & Background

Introduction

Understanding the Food-Energy Problem

The Netherlands' energy consumption has surged since the Second World War, contributing significantly to its economic growth (CBS, 2023). As the country looks to reduce its energy use, it is crucial to understand where the majority of this consumption occurs. However, gaining an accurate picture is challenging for several reasons. First, as a major player in the global economy, the Netherlands is involved in extensive import and export flows that embed energy use, such as the energy required to produce and transport mobile phones, which are not reflected in national statistics. Additionally, there is a lack of strict regulation requiring large energy consumers to accurately report their (embedded) usage, making it difficult to precisely measure or compare energy consumption across sectors.

An example of this is the Dutch chemical industry, which, according to figure 15 (CBS, 2024), is the most energy-intensive sector. It comprises large multinational companies that are deeply intertwined with various other sectors, including agriculture, plastics, and the oil industry itself (VNCI, n.d.). Due to its international operations, it is difficult to trace the full energy flow; where the energy originates, how it is transformed, and where it ends up. Moreover, the sector is closely linked to oil and gas companies, as raw fossil fuels are often used in chemical production processes. As a result, the industry has a vested interest in resisting regulations that would enforce greater transparency in energy consumption.

These factors contribute to what is known as energy blindness (VPRO Tegenlicht, 2023), a condition in which consumers are unaware of the energy embedded in the products they purchase and see only the monetary cost. The abundance of fossil fuels has made energy extremely cheap, and by extension, consumption itself has become inexpensive (VPRO Tegenlicht, 2023). However, for the energy transition to succeed, a significant reduction in all consumption is essential (Moriarty & Honnery, 2020).

To better understand the true impact of Dutch consumption, the tomato supply chain is used as a case study. This chain is particularly relevant, as it involves a wide range of energy-intensive processes and plays a major role in both domestic use and international export. Figure 16 illustrates the proportion of tomatoes consumed within the Netherlands compared to those exported, as well as the number of households that could be powered by the energy used in their production, highlighting the scale of our export-driven energy footprint.

Beyond the literal energy use, the analysis also considers three additional dimensions: the spatial footprint, environmental impact, and human implications. Together, these perspectives provide a more comprehensive view of the Netherlands' energy footprint, laying the groundwork for more informed, effective, and just strategies to reduce energy consumption sustainably. Lastly the analysis covers initiatives, innovations and strategies to reduce consumption, to get a more comprehensive image of how the supply chain could be changed in the future.

The tomato's journey - A food chain analysis

Tomatoes, a staple in Dutch agriculture, represent a complex supply chain with significant energy consumption at various stages. The energy demands associated with their production, transformation, transportation, sale, and consumption highlight the environmental and logistical challenges we will face in the future.

Figure 17 outlines the tomato supply chain to begin addressing the question: "What is the energy demand and impact of the current globalized food industry in the Netherlands?" It shows the energy input at each step, along with total energy demand and production figures. These numbers were derived from an extensive analysis based on the sources listed here. Some energy values were taken from similar research, such as Stilma et al. (2010), while others were calculated by combining data from sources like transportgeography.org (2022) and co2emissiefactoren.nl (n.d.). While all values are based on these sources, some may lack precision due to the absence of tomato-specific data. For example, when energy values for all vegetables consumed were used, they were multiplied by the percentage of tomatoes in the total vegetable consumption in the Netherlands. Due to the variety of sources and calculations, the reference list may not be complete. Additionally, the scheme does not cover all aspects of the supply chain, such as food processing and some other streams.

The results show a linear supply chain where both direct and indirect fossil fuels are the inputs, and waste and emissions are the outputs. The thickness of the arrows represents the amount of energy, and the arrow towards consumption illustrates the total energy input per kilogram of tomatoes. The analysis also reveals that each step is carried out by different stakeholders, with transport occurring between each stage, also handled by different parties. One notable finding is that transport consumes minimal energy per kilogram, as each mode of transport carries a substantial amount of weight, except for consumers who do groceries by car, as they only transport an average of 12kg per trip (Stilma et al., 2010). Furthermore, heating and cooling requirements take up the majority of the energy, with greenhouses relying on natural gas for these processes (Stanghellini et al., 2016).

Finally, plastic use significantly contributes to the unsustainability of the food supply chain, as it requires a large amount of oil to produce, and more than half of it ends up as waste. This waste is mostly exported to Asian countries, such as Indonesia, highlighting the global impact of the supply chain (EenVandaag, 2022). To answer the question "What is the energy demand and impact of the current globalized food industry in the Netherlands?" further analysis is required.

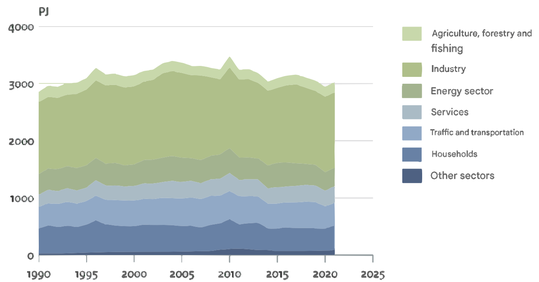

Figure 15 (CBS, 2024)

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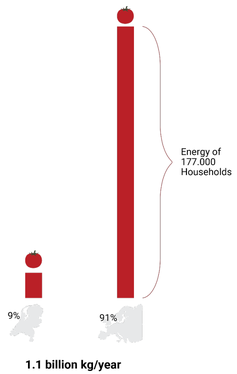


Figure 16 (Own work, 2025)

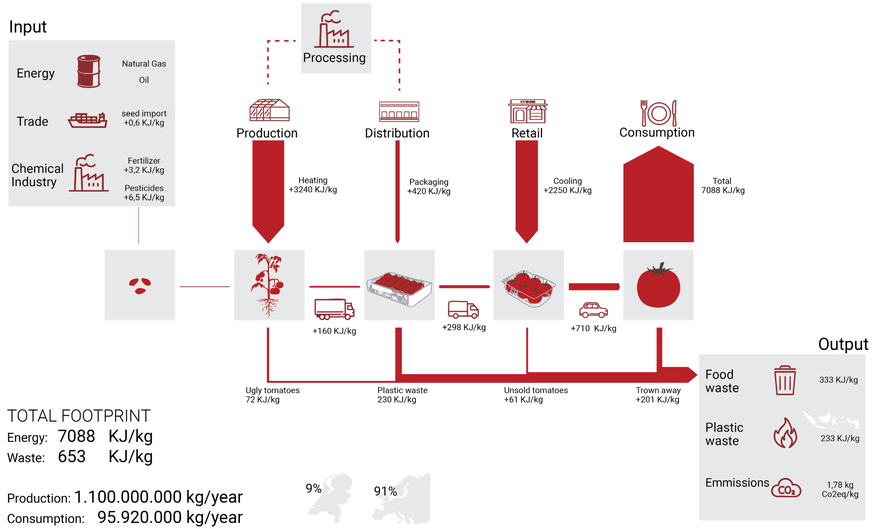


Figure 17 (Own work, 2025)

Focus area

Where the food chain takes place

The global economy, to which the Dutch food supply chain plays a significant role, is visible in many aspects of our daily lives, both directly and indirectly. To answer the question, "What are the spatial implications of the current food supply chain?", a spatial analysis has been conducted on the Rotterdam/The Hague metropolitan area. In this region, various parts of the supply chain come together. First, the Port of Rotterdam stands out due to its importance in fossil fuel handling, global trade, and its strong connections with Europe's hinterland. Second, the Westland region combines advanced, efficient production methods with a large amount of manual labor. Third, more rural areas in the region are active in efficient open-field farming. Finally, the urban areas of The Hague and Rotterdam, with a high population density, are where most retail and consumption activities take place. This region provides a clear view of the spatial aspects involved in the food supply chain.

Figure 18 (Own work, 2025)

Trade

The trade of food and energy in the Netherlands is integral to the country's economic landscape. As a major importer of fuel and tomato seeds, the Netherlands' agricultural sector remains heavily reliant on fossil fuels, even as it innovates agricultural practices to reduce chemical dependencies.
The Netherlands is among the top three global importers of tomato seeds (Volza Global Import Data). However, the country's most significant import is fuel, which accounts for 29% of total imports (TradingEconomics.com).

Imports

In terms of energy supply, 41% of the total energy consumed in the Netherlands comes from oil, while 36% is derived from natural gas. (This dependence on fossil fuels is also reflected in the agricultural sector. A key category of imports related to food production includes crop protection chemicals such as fertilizers and pesticides. However, the Netherlands has been refining its agricultural techniques, reducing reliance on chemical inputs in favor of advanced technological solutions, such as humidity control and the use of beneficial insects for pest management.
Ultimately, the country's heavy reliance on fossil fuels is evident not only in its energy sector but also in the way food production is structured.

Dutch tomatoes are a significant part of the European agricultural market, and only a small percentage of the tomatoes grown are consumed domestically. This export orientation shapes the production practices and energy demands associated with tomato farming in the Netherlands, making it an essential player in the global food supply chain.

Exports

Despite its significant tomato production, only 9% of tomatoes grown in the Netherlands are consumed domestically. The country produces nearly 20% of all tomatoes grown in Europe, with the largest export markets being Germany, Belgium, and the United Kingdom. Additionally, Dutch tomatoes are shipped to France, Italy, Spain, Poland, the United States, and China.
This strong export-oriented production highlights the Netherlands' role as a key player in the global agricultural supply chain, emphasizing efficiency and innovation in food production and distribution.

Figure 19 (Own work, 2025)

Production

Dutch greenhouse agriculture is one of Europe's most advanced and energy-intensive farming systems. Covering only 9,688 hectares, mainly for vegetable production, the sector achieves high yields (50 kg per square meter in the case of tomatoes) among the highest in Europe. However, this productivity comes with significant energy consumption, making it the most energy-demanding agricultural sector in the Union.

Energy Demand in Greenhouse Farming

Greenhouse farming in the Netherlands relies heavily on advanced climate control systems, including heating, cooling, artificial lighting, and ventilation, to optimize productivity. These systems make the sector highly energy-intensive, especially for tomato production. In 2019, total energy consumption reached 106.8 petajoules annually, with heating accounting for 74% and electricity for 26%. The industry depends on natural gas for heating, representing 99.9% of fossil energy use, and much of the electricity is generated on-site through cogeneration. Innovations like multi-layered screens and optimized temperature management have been introduced to reduce energy consumption, yet the sector remains one of the most energy-demanding in Europe, consuming 8–12 times more energy than lower-intensity farming systems. (Stanghellini, C. et al., 2016; Paris, B. et al, 2022)

Indirect Energy Inputs

Beyond direct energy use, indirect energy inputs also play a significant role. The construction and maintenance of greenhouse structures, including materials for frames and coverings, contribute substantially to overall energy consumption. These materials can account for over 50% of total indirect energy use, highlighting the embedded energy costs of greenhouse farming. While these inputs are essential for maintaining the high productivity of greenhouses, they underscore the hidden energy demands of the sector. As the agricultural industry seeks to transition to more sustainable practices, reducing the energy footprint of these materials and the structures themselves will be a key challenge.

In Dutch greenhouse agriculture, humidity management accounts for about 20% of total energy use, often leading to simultaneous heating and ventilation to control excess moisture. This process helps prevent condensation, which can promote fungal and bacterial diseases. For organic growers, humidity control is even more critical due to limited crop protection options, leading to 5–10% higher energy consumption compared to conventional greenhouses. Effective humidity management reduces the need for chemical treatments and protects yield and quality. (Stanghellini, C. et al., 2016)

Spatial Distribution and Regional Planning

The concentration of greenhouses in the Netherlands, particularly in regions like Westland, is closely tied to the energy and trade infrastructure that supports them as well as historical developments. Westland, historically known for its farming heritage, has been transformed by the extensive spread of large greenhouse structures. These greenhouses rely on energy networks, including natural gas pipelines and electricity grids, to meet their high energy needs. As renewable energy use grows, the integration of geothermal energy systems and new energy networks will be essential. Furthermore, the land-use footprint of greenhouse agriculture in Westland is clearly visible and has a defining role in the experience and quality of urban and rural life in the area. The sector's energy consumption and environmental impact will continue to shape spatial planning decisions, as the Netherlands works toward a more sustainable agricultural future.

Additionally, the move toward monoculture and intensive livestock farming has displaced important natural features, contributing to an overall simplification of the landscape. With 60% of the national land area dedicated to agriculture, these spaces are critical habitats for many plant and animal species. However, increasing scale and mechanization have led to a sharp decline in biodiversity. Heavy machinery requires dry, firm soil, prompting the lowering of groundwater levels—a change that harms both flora and fauna. Early and frequent mowing disrupts breeding cycles of meadow birds, while the use of pesticides and veterinary medicines weakens the ecological fabric further. The shift from diverse mixed farms to specialized monocultures has not only altered the land but also the kind of relationships farmers can have with it, reducing their role as stewards to mere producers in a global chain.

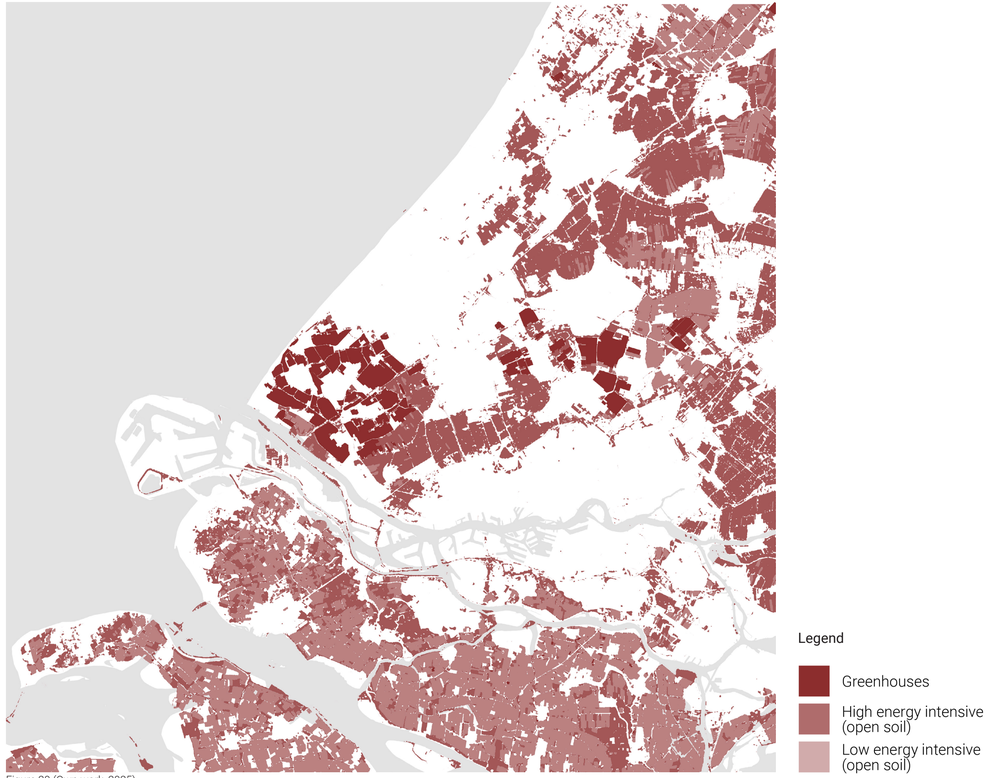


Figure 20 (Own work, 2025)

Distribution and Logistics

The movement of goods, including tomatoes, is essential to understanding energy consumption in agriculture. The need for transportation infrastructure, along with the energy required for cooling during distribution, contributes to the overall energy footprint of the agricultural sector, from farm to consumer.

The Impact of Distribution

The Netherlands has long been a center of trade and is often referred to as the gateway to Europe (Nefs, 2024). This is reflected in the built environment, which features extensive infrastructure for trade, including highways, railways, and waterways. Beyond infrastructure, the Dutch landscape is increasingly dominated by logistics centers. Since the 1980s, policy initiatives have strongly stimulated the logistics sector, and trends such as e-commerce have further expanded its footprint, quadrupling in size since 1980 (Nefs, 2024). In the case of the Port of Rotterdam, home to a significant amount of chemical industry, this expansion has even extended into the sea (Port of Rotterdam, 2024).

The logistics sector not only has major spatial implications but is also highly energy-intensive. This includes the concrete and steel required for infrastructure and logistics centers, the emissions generated by transportation, and the extensive use of plastic packaging within the sector (Dembińska & Marzantowicz, 2019).

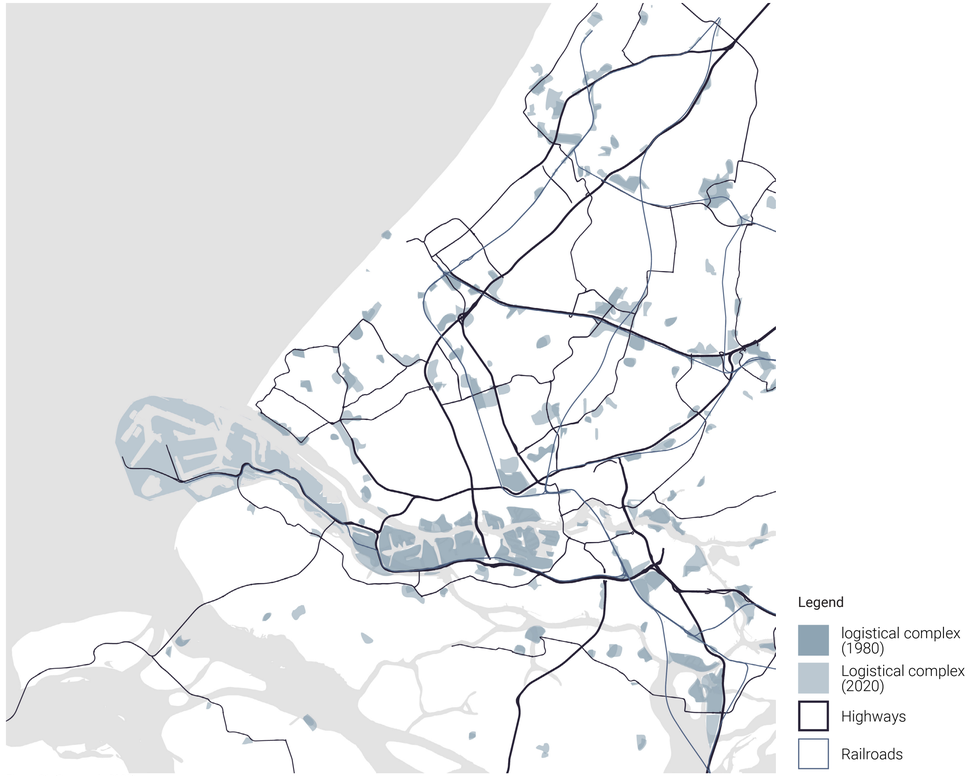


Figure 21 (Own work, 2025)

Retail and Consumption

Consumer behavior plays a pivotal role in shaping the energy demands of the agricultural sector. The growing preference for individual consumption, higher waste production, and transport choices all contribute to the overall inefficiencies and environmental impacts associated with food consumption in urban areas.

Consumer Behavior

Because the Netherlands serves as the gateway to Europe (Nefs, 2024), only 9% of the tomatoes grown in the country are consumed domestically, with the rest exported across Europe (Van den Born & Lelie, 2024). However, Dutch retail and consumer behavior still have a significant impact on the energy demand of the supply chain. For example, the average Dutch consumer uses four plastic packages per day (Kro-NCRV, 2023), 42% of people do their groceries by car (CE Delft, 2024), and consumers are responsible for two-thirds of all food waste (Van Lieshout & Knüppe, 2023).

Of course, consumers are not solely responsible for these issues. Supermarkets play a major role in plastic usage, while broader societal shifts—such as increasing individualism and a strong focus on work—have made home cooking less common (Eurostat & Cook, E., 2024). This is reflected in the rise of single-person households, where cooking for one often leads to more food waste, a trend further amplified by the growing popularity of food delivery services (Eurostat & Cook, E., 2024).

The built environment also significantly influences consumption behavior. Since the modernist movement, shopping centers have emerged as centralized retail hubs where consumers can purchase everything in one place, primarily from large retailers. This separation of functions has increased the distance between residential areas and retail locations, encouraging car use (Harbers et al., 2022).

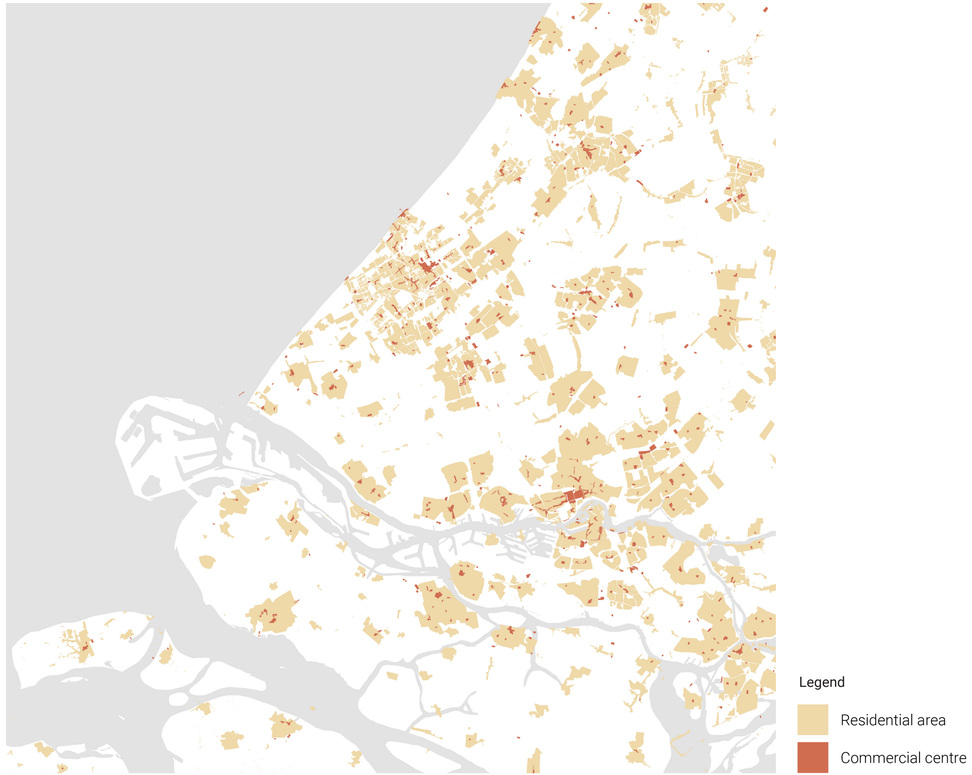


Figure 22 (Own work, 2025)

Spatial conclusion

The Legacy of Modernity

A close examination of the spatial components of the food supply chain reveals a pattern of centralized production and distribution, most notably concentrated in the Westland greenhouse cluster and the Port of Rotterdam. This spatial organization is not incidental—it mirrors the guiding logic of post-war modernist planning: a strict functional separation of land uses. So, what are the spatial implications of the current food supply chain? They lie in this very separation, where agricultural production, logistics, housing, and consumption are each allocated distinct zones, optimized for efficiency but divorced from one another in practice and meaning.

While this separation once represented a rational approach to managing growth, it also facilitated the spatial expression of an extractive, hyper-capitalist economy. The supply chain is not just a network of goods and services—it is embedded in and reinforces a worldview that prioritizes economic throughput over ecological or social cohesion. Our urban landscapes have been molded to reflect this logic. Individualistic lifestyles are reproduced in isolated housing typologies, and spaces of community increasingly double as sites of consumption. Food production is distanced from daily life, concentrated in specialized zones, while ports and fossil-fuel infrastructure dominate strategic urban nodes such as Rotterdam.

This model, which once aligned with the optimism and scale of the post-war economic boom, now reveals its limitations. It lacks the flexibility, equity, and ecological sensitivity required for today's challenges. Reconsidering the spatial implications of food systems invites us to question not only where food is produced and consumed, but how space itself can reflect more just, resilient, and integrated modes of living.

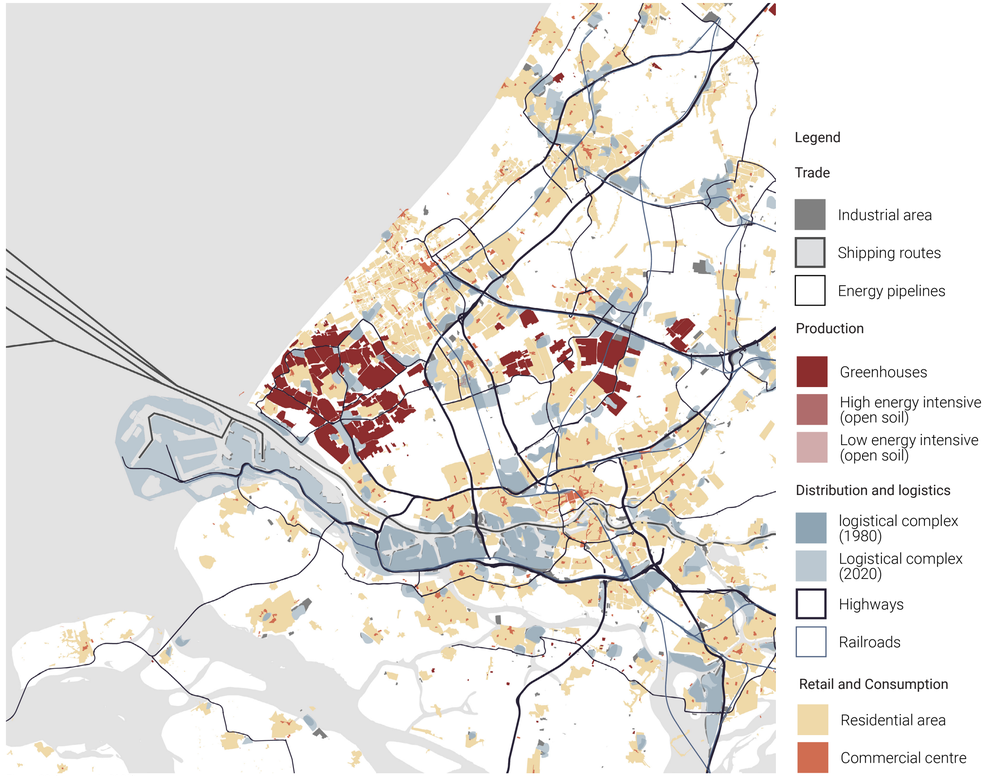


Figure 23 (Own work, 2025)

Overarching issues - Market consolidation

Across the Netherlands, the pursuit of scale has transformed the countryside. Farms have grown larger and more specialized, logistics hubs have multiplied across the landscape, and supermarkets have consolidated their power over the food system. These shifts, though rooted in economic rationales of productivity and efficiency, have generated far-reaching spatial, social and ecological consequences.

Bigger Farms

Dutch agriculture has long been recognized for its productivity, yet this success has come with trade-offs. With 60% of the national land area dedicated to agriculture, these spaces are critical habitats for many plant and animal species. However, increasing scale and mechanization have led to a sharp decline in biodiversity. Furthermore, the sector is facing a period of profound economic and social strain, marked by historically low returns on labor and capital. Despite post-war policies that encouraged expansion and productivity, many farmers find themselves burdened by significant debt, unable to pass rising production costs on to consumers. As the sector becomes more specialized and mechanized, the pressures to meet evolving environmental standards and consumer expectations are at odds with financial viability. Meanwhile, the consolidation of power within retail markets, rising energy costs, and inflation further complicate farmers' ability to sustain their businesses. These economic forces, combined with social isolation and growing vulnerability, are driving many to question the future of farming in the Netherlands, with some even considering leaving the profession altogether. This shift is not only reshaping the landscape of agriculture but also challenging the identity and social fabric of rural communities.

Bigger Logistics

In tandem with agricultural intensification, the logistics sector has exploded—eating up land once used for farming or biodiversity corridors. The Dutch landscape is now dotted with vast, box-like distribution centers near major transport corridors, ports, and urban peripheries. These structures represent a new logic of spatial planning: maximum throughput, minimum friction. While often advertised as engines of economic growth, these facilities offer limited benefits to local communities. Most are highly automated and offer few stable jobs. They contribute to landscape sealing and homogenization, replacing diverse rural textures with anonymous grey boxes, and increasing energy demand, traffic, noise, and environmental pressure on the surrounding areas. As logistics infrastructure multiplies, the countryside becomes a zone of circulation rather than habitation—a transit space in service of global supply chains rather than local life. (Nefs, 2024)

Bigger Stores

Over the past decade, the Dutch supermarket landscape has grown, with the number of supermarkets increasing from 6,100 in 2012 to 6,620 in 2023 and the total supermarket space rising from 4.1 to 5 million square meters. However, the growth of supermarket locations slowed after 2019, shifting towards smaller, independent stores and city-focused, convenience concepts. Larger stores, like hypermarkets and large supermarkets, have increased, while the number of small supermarkets has decreased.

Supermarkets are also expanding in size, with average store size growing from 909 m² to 1,068 m². Major players like Albert Heijn, Jumbo, and PLUS dominate the market, while international discounters Lidl and ALDI hold significant shares. Consolidation is a key trend, with large chains acquiring smaller competitors to achieve economies of scale. The rise of online shopping is further intensifying competition, leading to the decline of smaller chains.

The supermarket sector is expected to continue consolidating, potentially reducing the number of major players to six or eight. The aim of the Authority for Consumers and Markets (ACM) is to ensure that consumer choice is preserved by monitoring mergers and acquisitions.

Overarching issues - Farmers struggle

Local Farmers vs Corporate Agriculture

Amidst these transformations, many farmers find themselves increasingly marginalized: rising land prices, debt, and the lack of generational succession add to their vulnerability. The emotional toll is profound: many experience feelings of isolation, anxiety, and disillusionment. Policies often favor efficiency and productivity over care and regeneration, leaving little room for alternative models of farming. The disappearance of small farms means not just a loss of jobs, but a loss of local knowledge, culture, and identity. In this battle between local farmers and corporate agriculture, the stakes go far beyond economics—they touch on the future of the Dutch landscape and the kinds of lives it can sustain.

Economic Pressures and Structural Vulnerabilities. Farmers face historically low returns on labor and capital, often without the ability to pass rising production costs on to consumers. Post-war policies emphasizing expansion have left many with substantial debt. In some cases, greater productivity has paradoxically led to lower income or penalties for overproduction. In parallel, farmers are under growing pressure to meet evolving environmental standards and consumer expectations—demands that are sometimes at odds with financial viability. Banks are increasingly cautious about lending, and surveys report widespread pessimism within the farming community. These conditions have led some farmers to consider emigration or to avoid investing in their future.

Social Consequences and Isolation. The social consequences of this shift are also significant. Mechanization has reduced the need for labor, contributing to isolation and weakening traditional support networks. Many farms are now operated by individuals or couples, with children often choosing non-agricultural careers. The stress of declining incomes and growing regulatory demands can result in serious personal and family challenges.

The Experience and Stigma of Leaving Farming. For those who leave the profession—a group known as wijkers—the experience often carries a sense of failure and loss. Leaving farming remains a social taboo in many communities, with some individuals facing stigma even after selling their land. The financial impact can be severe, including the loss of homes or savings, prompting the emergence of support programs to offer both emotional and practical assistance.

Tensions in the Westland Horticulture Sector. In the Westland region, greenhouse horticulture—central to the area's identity and economy—is also under pressure. Discussions about reducing greenhouse space to make room for housing raise concerns about the viability of the broader horticultural ecosystem, which includes suppliers, distribution networks, and research institutions. Meanwhile, the sector continues to grapple with its image due to past issues such as illegal labor and, more recently, the unauthorized cultivation of hemp by a small number of financially struggling growers.

Energy, Retail Power, and Inflationary Effects. Rising energy costs further complicate the outlook, particularly for greenhouse operators who rely heavily on energy and now face challenges in securing financing. The supermarket sector, with its significant market power, is exerting downward pressure on prices, reducing farmers' ability to invest in more sustainable or efficient operations. Inflation has driven up consumer costs while also affecting retailers and service providers, leading to broader operational difficulties and, in some cases, closures. These overlapping economic and social dynamics are contributing to a growing sense of uncertainty—not just within agriculture, but across rural communities and the systems that depend on them.

Overarching issues - Waste problems

Plastic and food waste are closely linked through patterns of consumption and packaging. In the Netherlands, most plastic waste comes from food and beverage products, while household habits contribute significantly to both waste streams. This chapter outlines the scale of the problem, current recycling practices, and the environmental impact of waste exports. By understanding these connections, we can identify more effective strategies for reducing waste, improving recycling, and fostering more sustainable design and consumption practices.

Plastic waste

In 2017, the Netherlands introduced 1.9 million tons of plastic to the market, with 530,000 tons being plastic packaging. Of the packaging, 512,000 tons were made entirely of plastic, marking a 10% increase from 2013. The main types of plastic packaging in 2015 were LDPE films (35%), PET bottles and trays (26%), PP containers and buckets (16.5%), and HDPE bottles (15.5%). Composite packaging like beverage cartons made up around 16,500 tons.

In waste processing, almost half of the plastic packaging (47.5%) was recycled, while the rest (52.5%) was incinerated. The Netherlands surpassed the EU's recycling target, achieving a 50% recycling rate in 2017, with future goals set at 50% by 2025 and 55% by 2030. Despite progress, issues remain, including plastic litter, greenhouse gas emissions from incineration, and the export of plastic waste.

Furthermore, the Netherlands is a leading exporter of plastic waste, with the country sending over 200 million kilos of plastic waste to nations outside the EU each year, according to a study by the Plastic Soup Foundation (2022). Nearly 70 million kilos of this waste end up in Indonesia, which has become a significant destination after China closed its borders to plastic imports in 2018. The export of plastic waste is often cheaper than recycling it domestically, as many municipalities struggle with effective recycling practices. This has raised concerns, particularly in Indonesia, where people like 15-year-old Nina Aqilani witness the environmental damage firsthand. The Plastic Soup Foundation advocates for a ban on plastic waste exports to non-EU countries, arguing that wealthy nations should invest in better recycling technologies instead. Innovations like chemical recycling, which allows plastic to be endlessly reused without quality loss, are emerging in the Netherlands, but the foundation stresses the need to reduce plastic use overall. The situation highlights the urgent need for global action on plastic waste management, as countries like Indonesia bear the brunt of foreign waste, affecting their environment and public health. (Plastic Soup Foundation, 2022; Snijder, L., & Nusselder, S., 2019)

Food waste

In the Netherlands, a significant portion of plastic waste—nearly 60%—originates from food and beverage packaging, highlighting the strong link between plastic use and food consumption patterns (Rijkswaterstaat). On a household level, food waste remains substantial: Dutch residents waste about 60.2 kg of vegetables per person per year, of which around 5.5 kg are tomatoes, representing roughly 9.1% (Centraal Bureau voor de Statistiek, 2025).

Much of this waste stems from behavioral patterns such as buying too much due to large packaging sizes, promotional offers, and impulse purchases. A lack of oversight in home storage also contributes to food spoilage. While two-thirds of organic waste is composted directly, the remaining third is typically fermented to produce both compost and biogas, contributing to green energy generation (Voedingscentrum, 2023).

Together, these insights reveal not only the environmental costs of overconsumption but also opportunities to reduce both plastic and food waste through better design, awareness, and infrastructure.

Overarching issues - Labour conditions of migrant farm workers

Behind the success of Dutch horticulture lies a largely invisible workforce that plays a central, yet precarious role in sustaining the country's food production system. Migrant workers, many of whom come from Eastern Europe as well as other parts of the world, are the backbone of the greenhouse economy—yet their labor is often undervalued, their rights neglected, and their living conditions overlooked. In regions like Westland, systemic exploitation has become almost normalized, as economic dependence, housing precarity, and administrative invisibility create a perfect storm of vulnerability. This local reality reflects broader European patterns, where the promise of "cheap vegetables" often hides exploitative labor practices. What emerges is a system that profits from disempowerment, raising urgent ethical questions about how food is produced and at what human cost.

Migrant Workers in Westland: Living and Working Conditions

The employment of migrant workers under exploitative conditions is a well-documented issue in Westland and its surrounding municipalities. Many workers face poor housing, lack of rights, abuse, and social isolation. Their dependence on employment agencies—for work, housing, and transportation—makes them particularly vulnerable, especially when they lack residency permits. Losing a job often means losing housing, creating a cycle of multiple dependency. Poor living conditions are widespread, with reports of overcrowded homes plagued by mold, drafts, broken heating, and faulty wiring. In cities like Den Haag, many Westland workers live in inadequate accommodations, and there are growing tensions between municipalities over who should bear responsibility for housing them, with Westland criticized for not providing enough support.

Exploitation and Lack of Rights

Similar to the situation in agricultural sectors in countries like Spain and Italy, migrant workers in Westland are often underpaid and subjected to harsh labor conditions. The push to produce cheap vegetables translates into a system that prioritizes profit over fair treatment—workers are paid as little as possible for intense labor without proper benefits or safety measures. Many remain unregistered with local authorities due to employer complacency or even active discouragement by landlords, which restricts their access to healthcare, legal protection, and community support. This invisibility makes it difficult for the state to monitor or regulate their conditions effectively.

Abuse, Isolation, and Integration Challenges

Abuse of power by employment agencies is another critical issue, with reports of identity documents being withheld and physical or verbal threats used to maintain control. Sometimes, agency coordinators—often better-positioned migrants themselves—can act ruthlessly to discipline workers, who rarely speak up out of fear of retaliation. Socially, many migrant workers are isolated, with limited access to leisure, community interaction, or language support. Integration is often poorly managed, leading to neighborhood tensions. Local residents may associate migrant communities with noise, parking problems, or unclean streets, and events like "matrassendag" (the bulk disposal of mattresses) symbolize both transience and a lack of rootedness or connection to the area.

Persona's

Name: Adrian
Age: 32
Country of Origin: Romania
Employment Status: Temporary contract through an agency, greenhouse worker
Current Location: Westland, The Netherlands
Housing Situation: Lives in overcrowded temporary housing, provided by the employer
Political preference: Not allowed

Adrian moved to the Netherlands 3 years ago in search of better wages to support his family back home. He works long shifts picking vegetables under extreme temperatures, often without proper breaks. His wages are barely enough after deductions for housing and transport, leaving little room for savings.

"We work hard, but they treat us like we are disposable. If we complain, there are ten others ready to take our place."

Name: Teun
Age: 59
Country of Origin: Netherlands
Employment Status: Long term- contract trough employer, truck driver
Current Location: Zoetermeer
Housing Situation: Lives in social housing from corporation with wife.
Political preference: PVV

Teun, 59 is a truck driver from Zoetermeer who supplies supermarkets with tomatoes via a distribution centre. He lives in a social housing with his wife, his two children have already moved out. He has a terrible back ache.

"Sometimes it feels like the work is being taken over by migrant workers, and I can't help but think, after all these years, it should be people like me getting these jobs, not newcomers."

Name: Femke
Age: 43
Country of Origin: Netherlands
Employment Status: Employer, owner of franchise supermarket
Current Location: Delft
Housing Situation: Lives with her family in a house with mortage.
Political preference: VVD

Femke owns a Albert Heijn franchise location in Delft, where she is responsible for 55 staff members and even more customers who all like tomatoes. She makes a lot of money with her business and wants to expand it in order to provide for her three children.

"Everything I have is because I worked very hard for it, so I can send my children to university"

Name: Niki
Age: 28
Country of Origin: Netherlands
Employment Status: Employee, Offce worker
Current Location: The Hague
Housing Situation: Lives alone in a rented apartment.
Political preference: Groenlinks/pvda

Niki studied law and now works in an office job. She is single, lives alone in an appartment building in Amsterdam, and loves to eat together with her old study friends that live nearby. She loves to eat fresh tomatoes and even has money for organic ones.

"I care very much about people and the environment. Also, I love avocado toast."

Figure 24 (Own work, 2025)

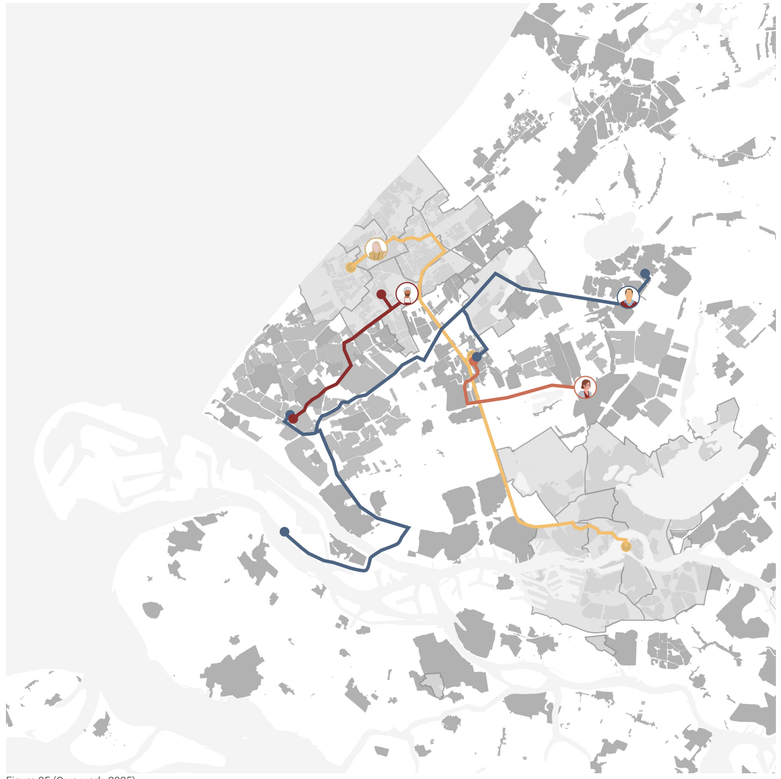


Figure 25 (Own work, 2025)

Persona map

Four personas are introduced that are central to this project. Each of them represents a different part of the food chain in South Holland: Adrian works in production as a greenhouse worker, Teun works in distribution as a truck driver, Femke works in retail as a supermarket owner, and Niki represents the consumer.

Adrian works in the greenhouses of Westland, harvesting vegetables under harsh conditions. Teun drives daily from Zoetermeer to supply the supermarkets. Femke runs her Albert Heijn franchise in Delft and is responsible for the details of her shop team. Niki lives in The Hague and works in Rotterdam, her social life partly takes place nearby, where she likes to eat with friends and is food conscious so she doesn't have to eat alone every day.

The map shows how these four people physically move around the region. Their routes show how connected they are by the food that flows through South Holland every day, and at the same time how dispersed they live and work. The distances between them show how fragmented the food chain is, not only logistically, but also socially and economically.

By following these personas, a better understanding emerges of how the community moves through the region and the impact of this food chain on the daily lives of different people.

Stakeholder analysis

The stakeholder analysis aims to answer the question: "Who are the stakeholders involved in the food supply chain?" It builds on the previous analysis, where each actor is placed within the power-interest matrix. The stakeholder analysis reveals that large multinational corporations hold the most power in the global food supply chain, but have relatively limited interest compared to those more directly involved. Smaller stakeholders, such as individuals and small companies, depend heavily on the food supply chain but possess little power. A strong example of this is the migrant workers who come to the Netherlands for work, and are exploited. Ultimately, those who control the money hold the most power.

However, since food is a basic human need, the answer to the question "Who are the stakeholders involved in the food supply chain?" is, in fact, everyone. To emphasize this and track the impact of changes within the food supply chain, personas are introduced on the following page. These personas represent individuals who are both directly involved in the supply chain and consumers, reflecting a broad cross-section of the population. This approach allows for the measurement of the food supply chain's impact on different communities.

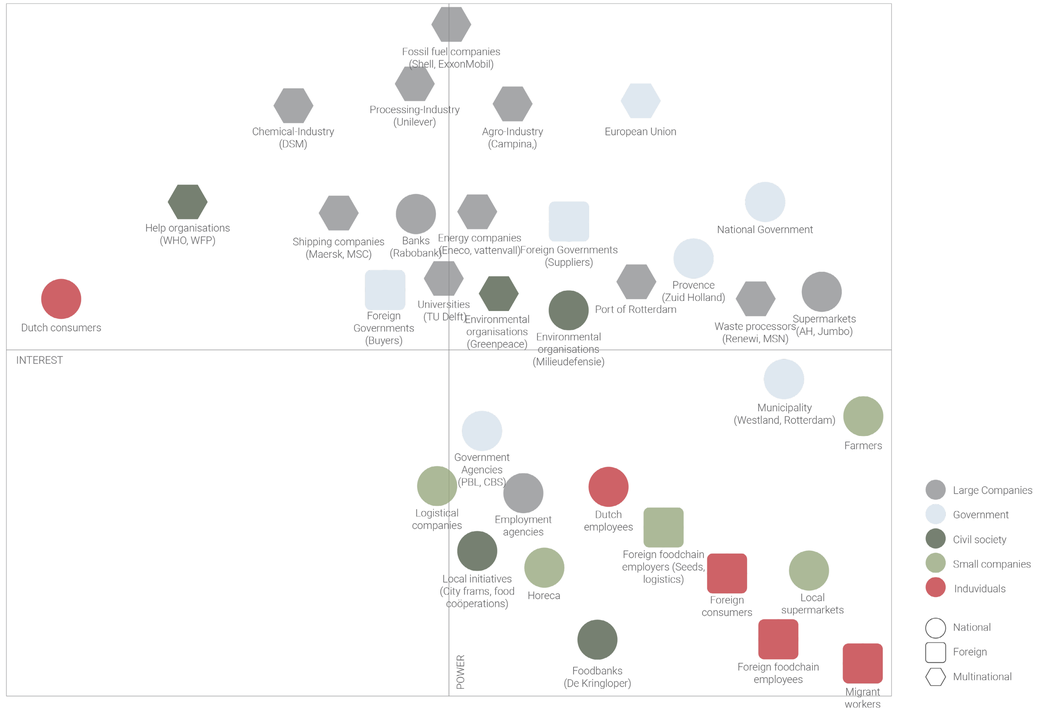


Figure 26 (Own work, 2025)

Best practices and critical insights

1. Citizens and food participation

Amid growing concerns over the transparency, sustainability, and fairness of global food systems, a parallel movement has been quietly gaining ground—one rooted in community, proximity, and shared responsibility. Across the Netherlands, citizens are increasingly taking food matters into their own hands, fostering direct relationships with local producers and reclaiming agency over how and what they eat. From the boom in interest during the COVID-19 lockdown to the widespread growth of community-supported agriculture, this shift signals more than just a dietary preference—it reflects a deeper cultural reorientation toward local resilience, ecological awareness, and democratic food participation. The following examples highlight how individuals are reshaping food systems not only as consumers, but as co-producers and stewards of the land.

Increased Intrest in Local Food

Following the first lockdown, there was a noticeable surge in public interest in local food. People, being more confined to their homes and surroundings, discovered the appeal of locally sourced food.

Community-Supported Agriculture at Land en Boschzigt

This heightened interest led to an explosion of interest in initiatives like the bio-tuinderij Land en Boschzigt, which operates on an 'oogstaandeel' (harvest share) system, demonstrating a direct form of citizen participation in food production. Individuals pay a seasonal fee of 325 euros for the right to harvest their own vegetables and fruit weekly during the growing season. The significant number of participants (190) and the long waiting list (250 people) indicate strong citizen engagement with this model.

Citizen Influence on Crop Planning

The tuinder (grower) at Land en Boschzigt, Sijmen Brandsma, considers the "wensen van de oogsters" (wishes of the harvesters) when planning what to grow. While acknowledging limitations based on soil conditions, there is an effort to accommodate the preferences of the participating citizens, showing a degree of consumer influence in this local food system.

Growth of Local Food Communities Nationwide

Across the Netherlands, there is a steadily growing trend in the number of local food communities. Approximately five hundred such initiatives provide fresh food to 150,000 people. These regionally based initiatives where producers deliver directly to consumers, without intermediaries, including community harvest gardens, collectively buying groups, and citizen-financed farms, highlight a widespread movement towards more direct and decentralized food systems. These initiatives are supported by the community, and the appreciation for it is one of the positive things that the past year has yielded, suggesting a positive citizen sentiment towards this form of food engagement.

2. Energy and Dutch Farming

Behind the global reputation of the Netherlands as a leader in high-yield, efficient agriculture lies a complex web of technological innovation, policy support, and energy strategy. Particularly in greenhouse farming—where climate control is essential—Dutch farmers have pioneered energy-saving methods that blend precision engineering with sustainability goals. As pressure mounts to reduce fossil fuel reliance and align agriculture with climate targets, the sector is increasingly turning to renewable sources and advanced systems to meet its energy needs. This section explores how technology, market incentives, and policy frameworks come together to shape the energy profile of Dutch greenhouses, and the implications this holds for the future of organic and conventional farming alike.

The Role of Technology, Market and Policy

The Netherlands has integrated advanced technologies and policies to address the high energy demands of organic greenhouse farming. Dutch farmers have adopted energy-efficient greenhouse designs and climate control technologies to minimize energy losses and maximize productivity. For example, aluminized thermal screens can theoretically reduce energy consumption by up to 70%, though actual savings are closer to 20% due to operational constraints. Double covers with glass and film create insulating air gaps, while precision climate control systems optimize temperature and humidity management, further reducing energy needs. Temperature integration (TI) has shown energy savings of 5-15%, with minimal impact on production.

Government policies have played a significant role in encouraging renewable energy adoption. In 2019, 10 PJ (9.4%) of energy used in Dutch greenhouses came from renewables, a figure that grew by 35% between 2017 and 2018. The use of geothermal heat, in particular, is expected to continue increasing. Key renewable technologies in greenhouse operations include:

- Biomass CHP systems, utilizing local biomass, including greenhouse waste, to generate heat and electricity.
- Anaerobic digestion, producing biogas for heating and electricity, while also providing nutrient-rich digestate for fertilizer.
- Solar thermal systems for heating and humidity control, optimizing solar energy capture through the greenhouse cover.
- Photovoltaic panels on roofs or adjacent land to offset electricity demands.
- Geothermal systems providing low-emission, stable heat from underground resources.

Cogeneration, or Combined Heat and Power (CHP), is another efficiency strategy, producing both electricity and heat from a single energy source, such as natural gas. In greenhouses, this system powers lighting, supplies heat, and provides CO_2 for plant fertilization, which boosts growth and yield. Exhaust from gas engines, which contains CO_2, is used to fertilize plants, enhancing their growth through increased absorption of CO_2.

This focus on energy optimization aims to reduce fossil fuel dependence, lower operational costs for farmers, and promote sustainability. While many technologies developed for conventional greenhouses are applicable to organic systems, further research is needed, particularly on energy management challenges in soil-based cultivation. (Stanghellini, C. et al, 2016; Paris, B. et al., 2022)

3. The importance of Logistics in Short Food Supply Chains (SFSCs)

Short Food Supply Chains (SFSCs) have gained attention as more sustainable, resilient alternatives to the dominant globalized food system, offering closer connections between producers and consumers. Yet, the success of these systems hinges not just on geographical closeness or ethical motivations, but on something often overlooked—logistics. Efficient and sustainable distribution is the backbone that enables SFSCs to scale up, reduce environmental impact, and remain economically viable. This section delves into the logistical challenges and innovations shaping SFSCs today, revealing why smart infrastructure and coordination are just as crucial as values and vision in transforming the way we feed our communities.

Why Logistics Matter in Building Sustainable Food Networks

Short Food Supply Chains (SFSCs) are increasingly recognized as vital alternatives to conventional, globalized food systems, primarily due to their potential for enhanced sustainability. However, the development and widespread adoption of SFSCs are significantly influenced by the efficiency and sustainability of their logistical operations. While geographical and social proximity between producers and consumers are defining characteristics, effective logistics is paramount for realizing the environmental, economic, and social benefits that SFSCs promise.

Improving SFSC logistics necessitates a holistic approach encompassing various strategic actions:
- Making environmentally conscious choices throughout all stages of food distribution, including transportation modes, packaging, and storage.
- Optimizing the geographical location of key nodes within the supply chain, such as aggregation points and distribution centers, to minimize travel distances and associated emissions.
- Improving the efficiency of distribution routes to reduce fuel consumption and delivery times.
- Considering the restructuring of the supply chain itself, potentially through collaborative models.

Furthermore, farmers and other actors within SFSCs need to be receptive to adopting new logistical strategies and fostering collaboration to enhance overall efficiency. Hybrid Food Hubs (HFHs) represent a promising organizational innovation in this regard, acting as intermediaries that can provide essential logistical services such as aggregation, storage, processing, and distribution, thereby overcoming some of the inherent limitations of individual small-scale producers in accessing larger markets.

Despite the critical role of logistics, research in this specific area of SFSCs has been relatively limited, with a greater emphasis on socio-economic and ethical considerations. Key areas requiring further investigation include:

- A more detailed analysis of the environmental impacts of SFSC logistics, with robust comparisons against conventional food systems, considering factors such as transportation efficiency, vehicle load factors, and the impact of consumer travel.
- Developing methodologies to optimize the location and routing within SFSC networks to minimize environmental footprints and operational costs.
- Exploring the effectiveness of different supply chain structures and innovative distribution patterns, such as HFHs and collaborative networks, in enhancing efficiency and market access for small producers.
- Fostering greater cooperation and integration among the diverse actors within SFSCs to build more resilient and efficient logistic models.
- Investigating the potential of leveraging Information and Communication Technologies (ICT) to improve coordination, transparency, and market reach within SFSCs.

Ultimately, recognizing logistics as a core element of SFSC functionality and implementing strategic improvements are essential steps towards establishing these alternative food systems as truly sustainable and competitive options (Paciarotti, C., & Torregiani, F., 2021).

4. Beyond efficiency: Degrowth

Improving energy efficiency and optimizing logistics are necessary, but insufficient, steps toward sustainability. As the climate and ecological crises deepen, there is a growing call to move beyond the dominant paradigm of growth and confront the more complex question of consumption itself. Despite technological progress, the rebound effect and rising overall demand risk canceling out environmental gains. This section explores how a shift in societal values, economic priorities, and structural systems is essential to tackle the roots of unsustainability. It highlights degrowth thinking as a lens to reimagine food systems—one that prioritizes equity, sufficiency, and systemic change over perpetual expansion.

Rethinking Growth for a Truly Sustainable Future

While enhancing energy efficiency in agricultural production and optimizing logistics in food supply chains are crucial for reducing environmental impacts, achieving genuine sustainability necessitates a broader perspective that moves beyond the paradigm of purely "green growth". Technological advancements and efficiency gains are important, but they alone may not be sufficient to address the deep-seated consumption-sustainability dilemma, where the societal goal of increased consumption clashes with ecological limits and issues of inequality.

A critical insight from research is that addressing unsustainable consumption patterns requires a fundamental shift in societal values and behaviors, alongside structural and policy changes . Simply increasing efficiency without addressing the scale of consumption may lead to limited overall impact due to phenomena like the rebound effect. Therefore, alongside technological and logistical improvements, there is a growing recognition of the need to advance more equitably distributed consumption patterns and to question the prevailing growth-oriented economic models.

A systems-level understanding of unsustainable consumption highlights the importance of social and political innovations in driving rapid and significant reductions in environmentally damaging activities, such as excessive private vehicle use and high levels of meat consumption . This involves advocating for and implementing initiatives that promote transit-oriented development, reduce food waste throughout the supply chain and at the consumer level, and foster a culture of increased recycling, repairing, sharing, and reuse of goods. Moreover, the pursuit of equitable consumption levels on a global scale, particularly ensuring basic needs are met in the developing world, is a central ethical and practical consideration.

The transition towards sustainability is a multi-layered process, with interventions at individual, organizational, and societal levels interacting and influencing one another. Effective regulations and innovative analytical frameworks are needed to support sustainable practices and business models, while stronger social programs and thoughtful urban planning can facilitate and encourage reduced consumption lifestyles. Civil society organizations and social movements play a vital role in advocating for policy changes and driving societal shifts through grassroots action and political pressure .

Given the challenges of achieving consensus and action at national and international governmental levels, the potential for less powerful actors—including civil society groups, social entrepreneurs, and local and regional authorities—to drive significant change through bottom-up transitions is increasingly acknowledged. Niche innovations such as permaculture initiatives, community-supported agriculture (CSA) models, and vibrant farmers' markets offer tangible examples of more sustainable practices within the food sector. However, for these niche innovations to have a broader impact, it is crucial to understand the mechanisms for their scaling, replication, and diffusion across diverse contexts, ultimately challenging and transforming mainstream regimes of production and consumption. Therefore, while efficiency and technological advancements are undoubtedly necessary components of a sustainable future, they must be embedded within a broader framework that addresses fundamental issues of consumption patterns, social equity, and systemic change driven by a diverse array of actors and processes (O'Rourke & Lollo, 2015).

Conclusions from the analysis

The energy demand and environmental cost of the Netherlands' globalised food supply chain reflect the deeper systemic issues rooted in our fossil-fueled, consumption-driven world. "What is the energy demand and impact of the current, globalised food supply chain of the Netherlands?" The answer lies in examining how, despite progress in renewable energy, the core of our economy—its infrastructure, logistics, and social systems—remains overwhelmingly dependent on fossil fuels. As a result, energy abundance has enabled unsustainable levels of production and consumption, especially since the post-war period, leading to a food system that prioritises volume, speed, and profit over equity, health, and ecological integrity.

True sustainability must go beyond technical fixes. It requires a holistic approach that balances environmental limits (planet), social justice (people), and economic fairness (prosperity). However, globalism, as it currently operates, undermines this balance. It centralises power, deepens inequality, erodes democratic agency, and externalises harm—both to ecosystems and to the workers who sustain the system. In the Netherlands, this is evident in the built environment: from the scale of Westland's greenhouses to the ports of Rotterdam, where logistics, branding, and infrastructure reflect a culture shaped by extractive logic.

At this critical juncture, we face a choice. We can continue on a path of global growth, linear extraction, and energy-intensive systems that alienate people and degrade the planet. Or, we can begin a transition toward a slower, more localised, circular, and regenerative food system—one that restores community, identity, and equity. This transformation will not come easily, but it is the only direction that aligns sustainability with justice.

04 Design Strategy

Extreme scenario thinking

To answer the main research question, "How can the Netherlands reorganise its food supply chain in a just and sustainable way, in order to reduce its energy consumption?", a vision for over 100 years was developed. This was achieved by combining the analysis with the conceptual framework through extreme scenarios. These scenarios explore potential futures based on the themes of Growth, Linear & Global versus Degrowth, Circular & Local. Personas are then projected within these two scenarios to help visualize the effects.

The vision is created by integrating the analysis with the extreme scenarios into a new spatial map and section. To develop the vision further, key values and corresponding strategies were identified, offering a sense of how the vision could take shape over time. Here, specific policy and spatial measures come together to shape an image of the future. These are once again projected on the persona's to make it more measurable. The vision is a concept that aims to illustrate the possibilities of a different way of living in relation to the food supply chain. However, it goes beyond just the food supply chain, as the issues revealed by the analysis are also deeply embedded in broader societal structures.

Extreme scenario I: Global - Linear- Growth

Figure 27 (Own work, 2025)

Trade:
The map shows the strong concentration of heavy industry and infrastructure around the Port of Rotterdam - the economic heart of the region. This is where global trade, logistics and technology come together in a large, efficient system. Think ports, warehouses, energy hubs and distribution centers, with the ultimate example being the Maasvlakte: an artificial port area that symbolizes economies of scale and globalization.

This type of infrastructure allows goods to be sent around the world at lightning speed, but it also creates a hard boundary between industrial efficiency and the daily lives of people elsewhere in the chain.

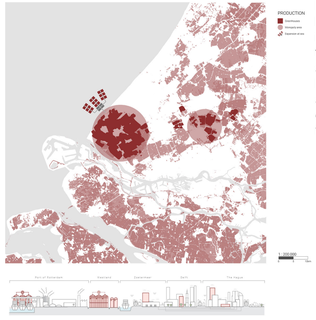


Figure 28 (Own work, 2025)

Production:
Production in South Holland is highly concentrated in high-tech industrial areas, particularly around the port of Rotterdam and Westland. These areas are designed for scale, speed and global efficiency. Innovations in agricultural technology, automation and logistics make it possible to produce and export food and goods in large quantities - often far from where they are ultimately consumed.

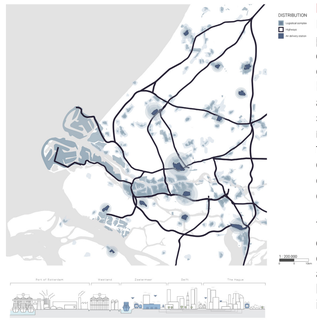


Figure 29 (Own work, 2025)

Distribution:
Distribution is the link between large-scale production and daily consumption. Distribution is evolving rapidly under the influence of technology, globalization and economies of scale. In the Zuid-Holland region, we see how intelligent systems are making supply more efficient. Large ports, such as Rotterdam, play a central role - water is regaining its importance as a clean, space-efficient transport axis. At the same time, new forms of distribution such as autonomous vehicles and drones are being tested for fine-tuned, just-in-time deliveries.

These infrastructures are built for speed, connectivity, and constant growth. They connect global production chains to local networks, often in a linear fashion: from producer to consumer, with little room for reuse or local feedback. Everything is focused on throughput - faster, further, bigger.

Figure 30 (Own work, 2025)

Retail and Consumption:
This infrastructure is built for growth: more choice, more convenience, more sales. Larger cities are where this dynamic is most evident. They are home to major commercial centers, smart delivery networks, and digital shopping platforms. But this efficiency and abundance is not evenly distributed. In the shadow of this growth, sharper contrasts are emerging between neighborhoods, income groups, and access to quality food.

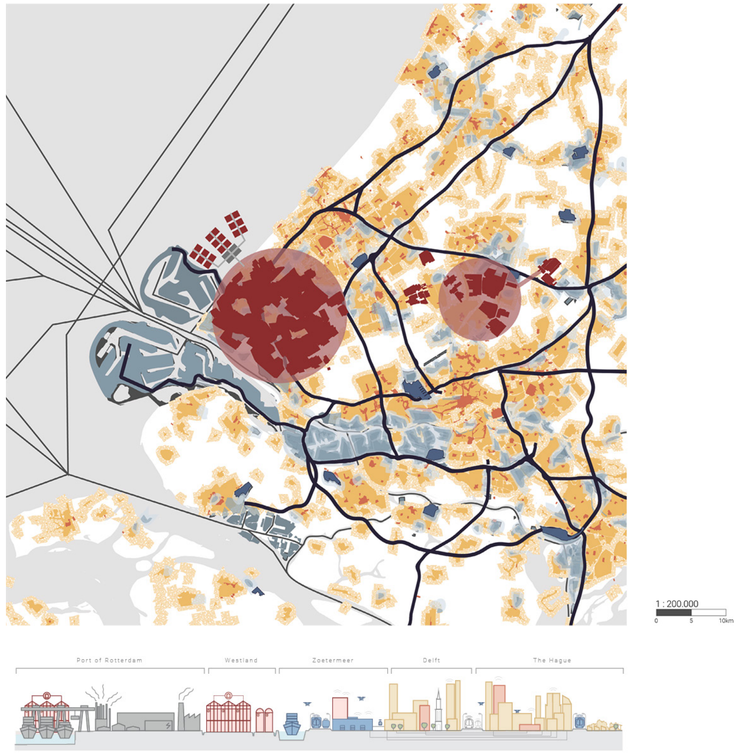


Figure 31 (Own work, 2025)

In summary, the current global system, centered on a linear economy and driven by the pursuit of continuous growth, creates a high-density, highly interconnected environment that links production, distribution, consumption, and trade in increasingly efficient but unequal ways. The infrastructure exemplified by the port of Rotterdam and the surrounding high-tech industrial hubs illustrates the scale and speed of global trade, where goods and services are moved across vast distances at breakneck speed, often with little regard for local sustainability or the well-being of communities outside the immediate industrial network.

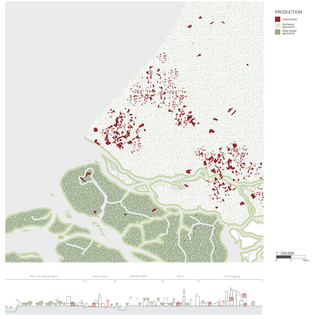
Technological advances such as automation, drones, and digital platforms are accelerating this trend, driving ever-increasing consumption, convenience, and choice. However, these efficiencies often exacerbate social inequalities, leaving gaps in access to resources and services, especially in less affluent areas.

In this high-density scenario, the global system appears optimized for speed and scale, but the externalities - environmental degradation, resource depletion, and growing inequality - are becoming more apparent. To sustain this model, it is important to rethink its foundations, moving away from the linear, growth-oriented approach to a more resilient and circular system that incorporates local feedback, sustainability and shared prosperity. The current growth-focused trend must adapt to meet the challenges of an economy that prioritizes efficiency over long-term stability and inclusiveness.

Extreme scenario II: Local - Circular- Degrowth

Trade:
This map highlights the shift to a more localized, circular economy. By decentralizing trade, supporting local production, and building sustainable networks, we aim to reduce our environmental impact and promote self-sufficiency. By focusing on local ports, resource-sharing systems, and community-driven innovation, we're working toward a sustainable, low-impact lifestyle.

Figure 32 (Own work, 2025)

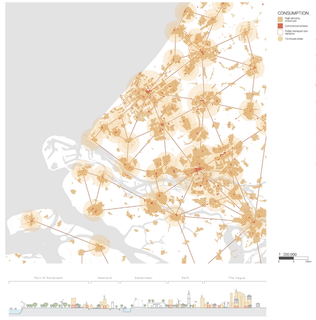


Production:
A shift toward less reliance on heavy industry, decentralized ports, and soil-based agriculture is key to building a sustainable, local economy. By encouraging local production, reducing transportation emissions, and promoting regenerative agricultural practices, we can create a resilient and environmentally friendly system that strengthens communities and minimizes environmental impact.

Figure 33 (Own work, 2025)

Distribution:
Decentralized distribution networks are essential to reducing waste and improving efficiency. By focusing on local hubs and sustainable logistics, we shorten supply chains, minimize carbon emissions, and ensure goods are distributed more efficiently. This localized approach supports the principles of the circular economy, enabling faster, greener movement of resources within communities.

Figure 34 (Own work, 2025)



Retail and Consumption:
Retail and consumption patterns are changing, with a clear contrast between high-density urban areas and open landscapes. Well-connected centers serve as hubs for sustainable consumption, offering local, environmentally friendly products and services. In high-density areas, efficient systems promote shared resources, while rural landscapes focus on direct access to locally produced goods, reducing transportation costs and environmental impacts.

Figure 35 (Own work, 2025)

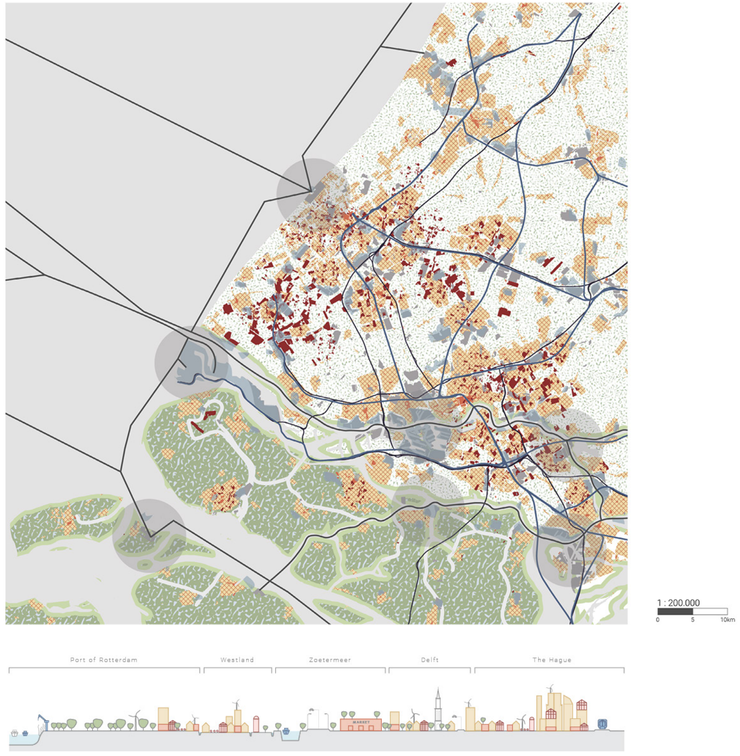


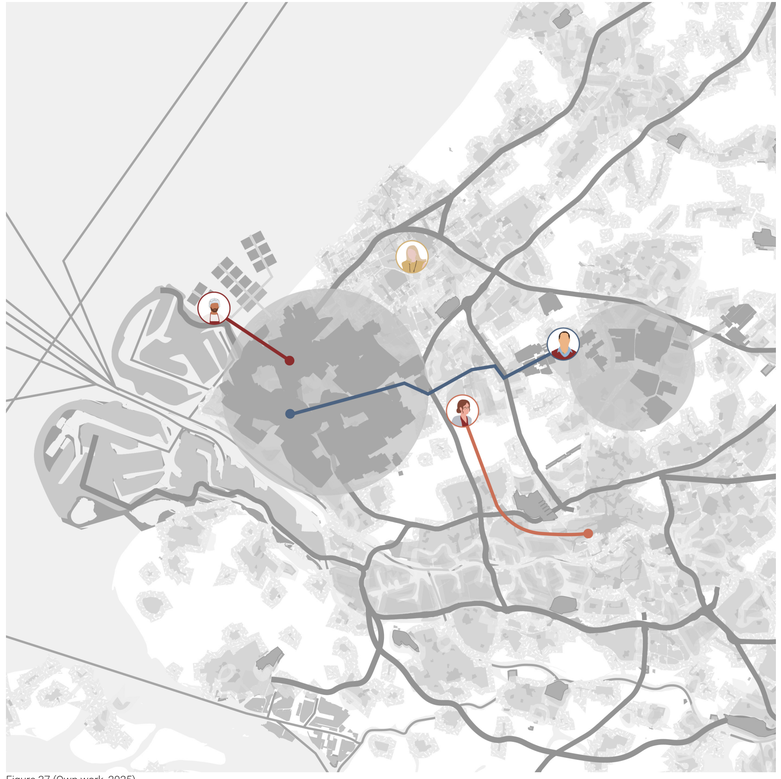
Figure 36 (Own work, 2025)

The transition to a localized, circular economy represents a fundamental shift in how we think about production, distribution, retail, and consumption. By moving away from heavy industry and embracing decentralized ports and local networks, we can shorten supply chains, reduce transportation emissions, and build community resilience. By focusing on local production and soil-based agriculture, we not only reduce our environmental footprint, but also build systems that regenerate rather than deplete natural resources.

In high-density urban areas, well-connected centers serve as efficient hubs for sustainable goods, promoting local trade and shared resources. In contrast, open landscapes benefit from direct access to locally sourced food and goods, reducing reliance on long-distance transportation and supporting regional economies. This localized approach strengthens communities, promotes self-sufficiency, and provides more equitable access to resources while minimizing the negative externalities associated with a globalized, linear economic system.

By reducing our impact through circular systems, decentralized infrastructure, and mindful consumption, we are creating a more sustainable future. This shift to a sustainable, circular economy will allow us to meet today's needs without compromising the ability of future generations to thrive, ensuring a more balanced relationship between people and planet.

Persona map I



Global — People
Linear — Planet
Growth — Prosperity

Global - Linear- Growth

Life in the fast-growing city is efficient and highly individualized. People work remotely or commute quickly between high-rise apartments and specialized workplaces, while food, goods, and services are delivered right to their doorsteps. With everything optimized for speed and convenience, there's little need to interact with the neighborhood. Daily routines are streamlined, but often isolating, as social life becomes more digital and mobility more private. The city continues to grow-faster, smarter, denser-yet the sense of community and connection to place continues to fade.

Figure 37 (Own work, 2025)

Persona map II

People — Local
Planet — Circular
Prosperity — Degrowth

Local - Circular- Degrowth

Daily life now revolves around the neighborhood, where people can find everything they need - fresh food, repair services, shared tools and local shops - within walking or biking distance. This local focus has reduced the need for long-distance travel, lowering emissions and freeing up time for what really matters. Communities have grown stronger through collaboration, mutual care, and a shared sense of responsibility. Instead of chasing perpetual growth, the emphasis is now on sufficiency, balance, and well-being. Circular economy practices-such as reusing, repairing, and sharing-are woven into everyday life, keeping resources in use and minimizing waste. It's a slower, more grounded way of living where people and place are deeply connected.

Figure 38 (Own work, 2025)

Vision Statements

This vision presents a balanced configuration of the sliders, aiming to achieve a just and sustainable energy transition across the dimensions of people, planet, and prosperity over the course of the next 100 years. Previously, the conceptual tensions between Growth & Degrowth, Global & Local, and Linear & Circular were explored. To translate these into a spatial vision, five guiding values were identified through the analysis: democracy, circularity, community, identity, and equity, aimed to place people at the center (see figure 39). These values form the foundation of the vision and serve as core objectives for both policy and spatial strategies. Given their strong emphasis on people, as well as dependence on policy, it is valuable to distinguish between a vision statement aimed at policymakers and stakeholders, and one that focuses on the communities involved.

Figure 39

Statement for experts

In 100 years, the Netherlands will have significantly reduced its energy demand by establishing a localized, stable, and circular agri-food system that upholds human rights and ensures universal food security. Achieving this requires integrated governance approaches that reinforce democratic participation and foster resilient communities. Citizens will play an active role in co-shaping policy, supported by education and cultural initiatives that promote environmental awareness and a new identity rooted in water and nature-based values.
Decentralized food networks, supported by local manufacturing and repair economies, will replace extractive, resource-intensive supply chains. These systems will prioritize material circularity and minimize ecological impact. Context-specific agroecological practices, adapted to regional landscapes and climate, will enhance local resilience while aligning with broader European cooperation frameworks.
The Netherlands will leverage its expertise to act as a frontrunner in international sustainability transitions, serving as a model for a socially just, ecologically balanced, and energy-efficient food economy.

Statement for citizens

In 100 years, the Netherlands will have transitioned to a local, stable, and circular food system, reducing energy consumption while ensuring food security for all. However, this transformation requires a united effort. A sustainable future depends on strengthening democracy, building vibrant communities, and ensuring that everyone is part of the solution.
We need to actively shape today's policies and embrace cultural and behavioral shifts that align with sustainable practices. This begins with education and deepening our connection to nature, water, and the environment. These values can reshape and strengthen our national identity.
Decentralized food systems, supported by small local industries for making, repairing, and regenerating, will replace today's resource-draining corporate industries. These new systems will be grounded in the principles of circularity, ensuring that nothing goes to waste and that resources are reused and regenerated. This process starts with small steps, whether it's reducing waste, supporting local production, or making sustainable choices in our daily lives.
New farming practices, in harmony with the environment and climate, will emerge. These methods will balance local resilience with cooperation across Europe. By prioritizing local solutions while working together at a regional level, we can address challenges like climate change and food security.
To help everyone, the Netherlands will share its knowledge, becoming a beacon of sustainability on the global stage, demonstrating how a fair, energy-efficient food system can work for all and ensure a thriving future for generations to come.

Spatial typologies

Vision map

The vision is centered on the Rotterdam/The Hague metropolitan area, where trade, food production, retail, and consumption converge in three distinct spatial typologies: industrial, urban, and rural areas.

All of these typologies are mixed-use, achieved through a focus on small-scale industries, local commerce, and, most importantly, integrated farming. Food production has become a central aspect of society, taking many forms. It is carried out by various communities in industrial, urban and rural areas, either for self-sufficiency or for trade.

The industrial complex is structured around a water network that connects urban and rural areas, with both large and small-scale harbours serving as the social and economic hubs of society. In addition to this, the Port of Rotterdam has transitioned into a focal point for sustainable industries, operating at both national and international levels.

Nature, like farming, is an integral part of society. Within the city, a network of recreational green spaces provides ample room for ecological functions. Cities no longer expand outward into the surrounding landscape. Instead, the borders become vital connections between urban and rural, that allow people to connect with nature. Outside the city, farming and nature coexist in synergy, fostering innovative climate-resilient and soil-based practices.

By focusing on its local networks, the Netherlands can position itself as a leader in the energy transition, providing assistance and support to other countries in securing food and advancing towards a sustainable future.

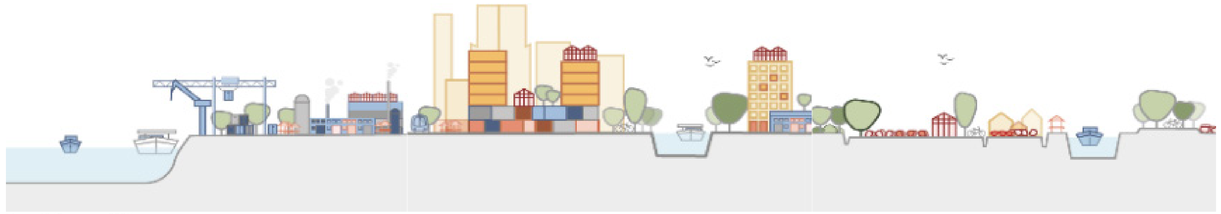


Figure 40 (Own work, 2025)

Industrial Areas

A robust water network forms the backbone of both the broader and local trading system in the Netherlands, where small-scale harbours emerge as vital social and economic hubs in both rural and urban areas. These harbours serve as spaces for trade, craftsmanship, commerce, and recreation. They provide enough room for small industries, local businesses, and food production, contributing to a thriving, community-centered economy.

Urban Areas

To promote equity, the urban fabric is designed with a fine-grained mix of people and functions. Achieving this requires high-density development, built upon both small and large communities engaged in co-living and farming activities. At the core of this high-density structure lies a strong recreational green network, providing spaces for social interaction and connection to nature.

Rural Areas

In the transformed farming landscape, climate and ecology take center stage, creating a farming system that supports food security while nurturing the environment. Small farming communities are leading agricultural innovation, with practices that promote sustainability. These areas provide spaces for both recreation and the flourishing of nature, ensuring that agriculture and ecology thrive together.

Vision map

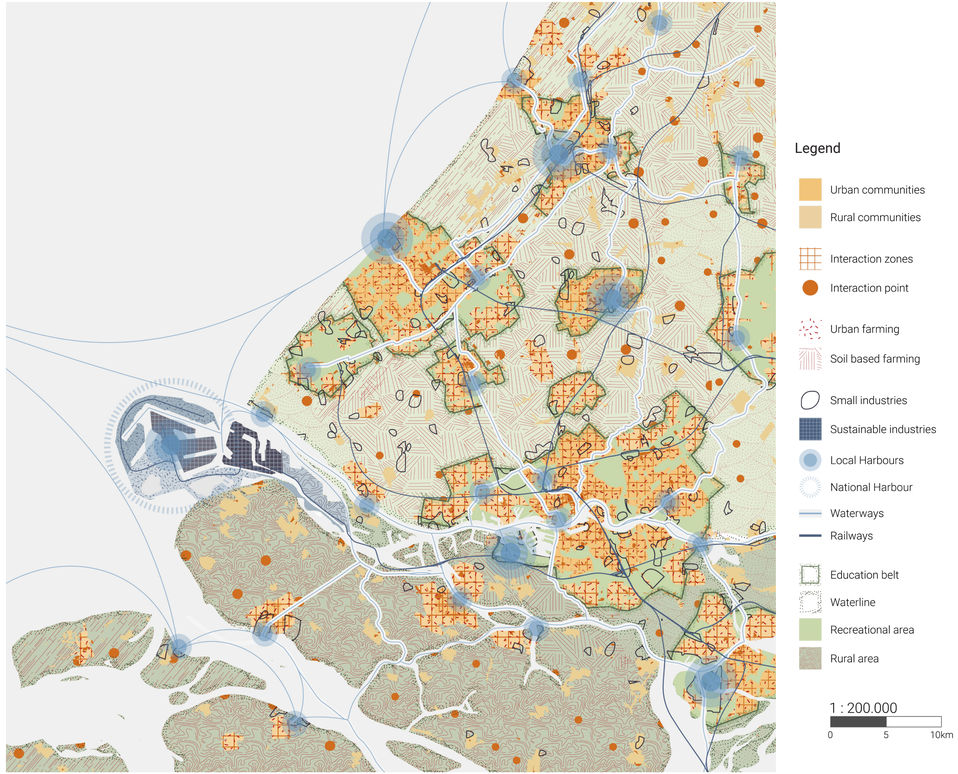


Figure 41 (Own work, 2025)

Persona's vision

Name: Adrian
Age: 32
Country of Origin: Romania
Employment Status: Independent worker, greenhouse caretaker, and community mentor
Current Location: The Hague, The Netherlands
Housing Situation: Shares a co-house
Political preference: Actively engaged in local community discussions

Figure 42 (Own work, 2025)

Adrian has built a fulfilling life in the Netherlands, sharing a co-house with Niki in a close-knit community. He works in greenhouses both at home and in the city, balancing stability and independence. Passionate about education, he occasionally teaches at a local school, helping children grow. Respected in the neighborhood, Adrian is always ready to support others, fostering strong connections and a true sense of belonging.

"I love how we've built a community where everyone belongs. I can't wait to share my knowledge and expercience back home in Romania."

Name: Teun
Age: 59
Country of Origin: Netherlands
Employment Status: Independent worker, boat navigator, and food courier
Current Location: Zoetermeer, The Netherlands
Housing Situation: Lives in a social housing community with his wife
Political preference: Values local traditions and community connections

Teun spends his days on the water, navigating small harbors, enjoying the fresh air, and connecting with different people along the way. Half the week, he pilots his boat through the waterways, transporting fresh goods, while the other half, he cycles through town, delivering local food. He loves the independence of his work and the connection to nature, moving at a steady, peaceful pace.

"It's a good feeling to know that no matter where someone comes from, we can work together and make something happen."

Name: Femke
Age: 43
Country of Origin: Netherlands
Employment Status: Small business owner, community supporter
Current Location: Delft, The Netherlands
Housing Situation: Lives with her family in a co-housing community
Political preference: Advocates for local and circular economies

Femke runs a small local store that focuses on seasonal and locally sourced products. More than just a shop, it's a hub for sustainability, where people can repair their goods and clothing, reducing waste and promoting a circular economy. She believes in creating a space where the community can support each other, fostering a stronger, more self-sufficient neighborhood.

"Success isn't just about making money; it's about making a difference. I'll be happiest if my children use their skills to create or support their community."

Name: Niki
Age: 28
Country of Origin: Netherlands
Employment Status: Part-time local advocate and community gardener
Current Location: The Hague, The Netherlands
Housing Situation: Shares a co-house
Political preference: Advocates for sustainable and cooperative living

Niki has embraced a balanced lifestyle, working four days a week while dedicating the rest of her time to gardening and supporting her co-living community. She finds joy in tending to shared green spaces, growing her own food, and strengthening local connections. She often visits the city center, where she engages with people, exchanges knowledge, and fosters a sense of togetherness.

"I used to rush through life. Now, I take the time to grow, connect, and enjoy the simple things."

Figure 43 (Own work, 2025)

Persona map vision

With local shops, shared spaces, food production, repair hubs, and services available everywhere, people no longer need to travel long distances for their work and daily needs. With less emphasis on the economy, individuals can work less and instead dedicate their time to contributing to their immediate surroundings.

In this future, the lives of Adrian, Teun, Femke, and Niki would be very different. No longer spread across the region, their daily routines now center more around their own neighborhoods. Adrian not only grows food in community greenhouses but also teaches children how to farm. He lives in a co-housing community with Niki in The Hague. Teun delivers fresh produce from nearby farms by boat and bike, navigating a vibrant distribution network where he meets lots of people everyday. Femke supports her neighborhood with a small grocery store and repair center, where people can repair their own items, borrow tools, or receive help fixing products. Niki assists with collective ownership initiatives from a legal perspective, while also enjoying cooking for her co-living community and embracing a slower pace of life in general.

The map illustrates their new paths, shorter and more connected to their surroundings. These routes reveal a food system that is no longer separated and concentrated, but woven into the fabric of everyday life. With local production, distribution, and consumption, the food chain has become a shared experience, one that connects people socially, economically, and even ecologically.

Aims and objectives

As mentioned in the vision chapter, five guiding values—democracy, resource efficiency, social cohesion, identity, and equity—were identified based on the analysis and the conceptual framework. To move from conceptual thinking to tangible change, it is essential to translate these guiding values into actionable design goals and strategic interventions. These design goals serve as core objectives for both the developed policy and spatial strategies (figure 44) and operate across all stages of the food supply chain. This strategy forms the connection between vision and spatial implementation, showing how normative principles can be operationalized through spatial design and policy.

Collective ownership

Democracy, in this context, is approached as a systemic condition of collective ownership, where citizens have direct influence over their living environments, food systems, and energy infrastructure. This design goal focuses on redistributing power within the food supply chain by reducing the dominance of large companies and shifting agency to citizens at every stage of the process.

Reuse, repair, recycle

Resource efficiency is pursued through the principles of reuse, repair, and recycling, shifting away from an unsustainable linear food supply chain systems towards a circular process. Especially policy interventions are implemented to extend product lifecycles, encourage sharing of goods, and minimize waste. This design goal supports the development of resilient local economies that operate within ecological boundaries and reduce dependency on global supply chains.

Collectivity

Social cohesion responds to the growing individualization of society by promoting a shift toward collectivity. This design goal emphasizes the importance of communal practices—such as co-living and collaborative food systems—that foster mutual care, solidarity, and daily cooperation. By reinforcing social bonds, these interventions contribute to stronger, more adaptive communities. Instead of isolated, corporate-driven systems, food production will be integrated within local communities, where shared farming practices become part of people's daily lives.

Culture shift

Identity is understood as a dynamic and evolving concept, with the goal of fostering a culture shift that is essential for driving meaningful change. This shift is achieved through education, beginning at a young age, focused on farming and practical knowledge that can be applied in everyday life. The strategy rejects the notion of identity as fixed or heritage-based, instead emphasizing the role of education in cultivating environmental awareness and a collective sense of responsibility. By integrating lifelong learning and community-driven knowledge exchange, future generations are equipped to adopt sustainable practices. This cultural shift, supported by education, will ensure that sustainability becomes a core part of societal values and daily routines.

Mixing functions

Equity is pursued by designing mixed-use areas that promote inclusive access to space, resources, and services. This goal emphasizes spatial justice by ensuring that urban, rural, and industrial areas support diverse populations and functions. By integrating production, distribution, retail and consumption within the same environments, the strategy reduces socio-spatial segregation and promotes equal opportunities across regions.

Together, these design goals form the foundation for a comprehensive set of spatial and policy-based actions. In the following section, these interventions are presented.

Design goals

Figure 44 (Own work, 2025)

Action cards - Production

To support the realization of our vision - projected 100 years into the future - a set of design actions has been developed. These actions are presented as 58 cards (figures 45, 46, 47, 48), each representing a distinct intervention aimed at addressing the complexity of the task. By implementing these interventions through time (figure 49), a just and sustainable energy transition can be achieved.

The actions are categorized based on two key dimensions: the specific step in the supply chain they target and the design goal they aim to achieve. The interventions are carefully aligned with these design goals, ensuring that every action contributes meaningfully to the overarching key values of the vision. Each intervention takes the form of either a spatial design, which alters physical or infrastructural conditions, or a policy change that influences institutional structures and behavioral patterns.

Furthermore, each design intervention is positioned along the three sliders of the conceptual framework: global & local, linear & circular, and growth & degrowth. By assigning a specific position on each slider to every action, it becomes possible to assess where the project stands in relation to these dimensions. The cards present a wide set of interventions that offer the possibility to navigate towards the long-term vision.

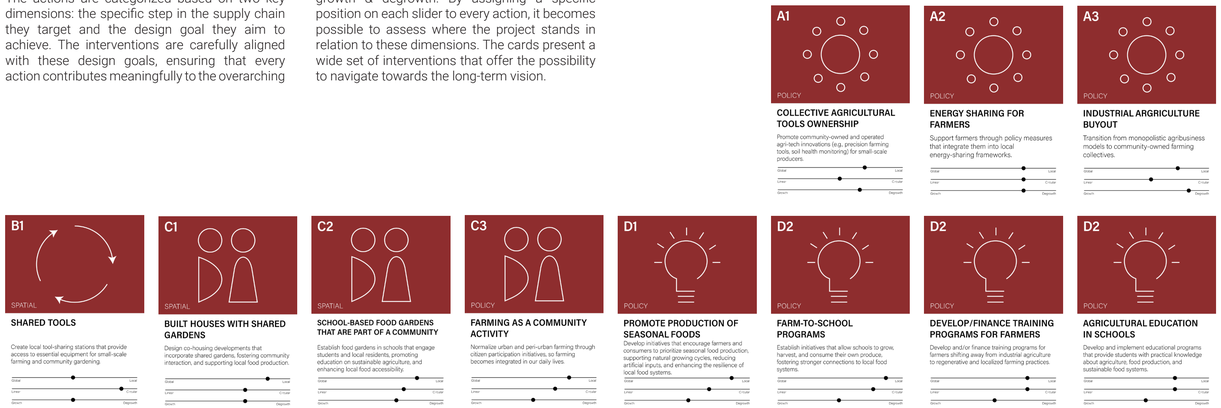


Figure 45 (Own work, 2025)

Action cards - Distribution

Figure 46 (Own work, 2025)

Action cards - Retail

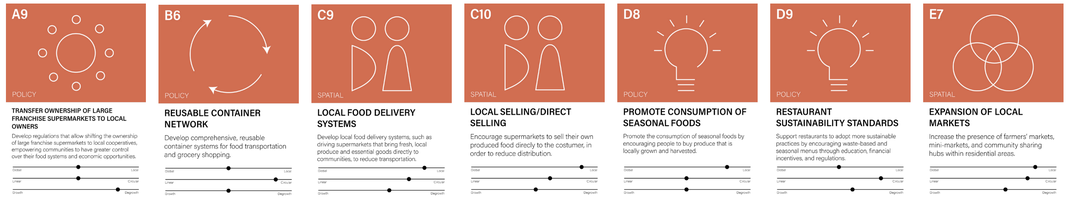


Figure 47 (Own work, 2025)

Action cards - Consumption

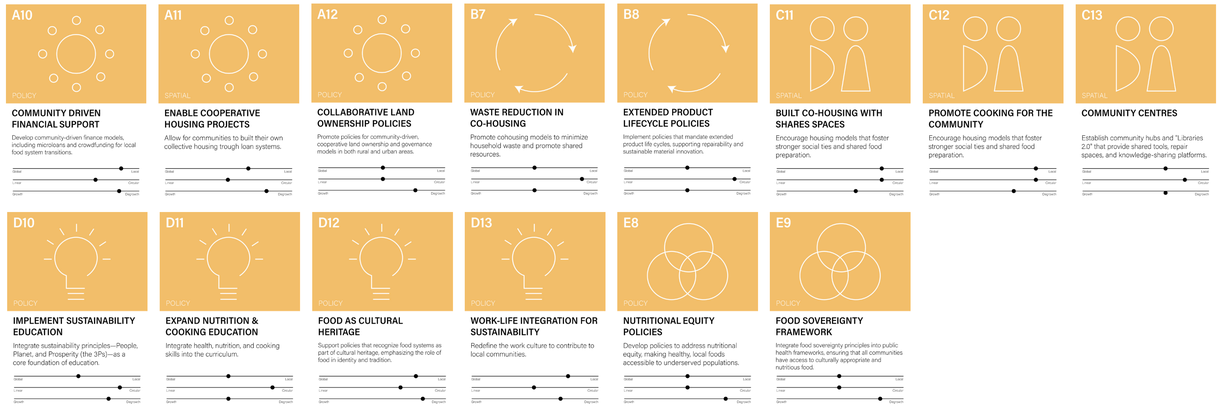


Figure 48 (Own work, 2025)

Timeline

To contextualize the implementation of the design actions, the 58 interventions are positioned along a timeline (figure 49) that spans from the present day to 100 years into the future. This timeline is organized according to the identified design goals, providing a temporal structure that indicates when specific actions should be initiated to effectively contribute to the envisioned transition. By sequencing the interventions over time, the timeline serves as a strategic roadmap, illustrating the progression of change required to achieve the vision.

The timeline is divided into four distinct phases: the Initiating, Investing, Transitioning, and Stabilizing phase. Each phase represents a specific stage of 25 years in the pathway toward the vision, characterized by different priorities, challenges, and types of interventions. In the Initiating phase, actions that can begin immediately - such as educational initiatives - are implemented to lay the groundwork for change. The Investing phase focuses on investing in initiatives, such as the development of reusable packaging networks and local food delivery systems, which supports the shift toward new lifestyles. During the Transitioning phase, approximately 50 years from now, big transformations have become possible. Smaller businesses begin to replace larger corporations, for example through the buyout of large agricultural companies. Finally, the Stabilizing phase consolidates the changes made, marking the establishment of a new way of living. By this stage, plastics and fossil fuels have been phased out, urban farming is integrated into city life, and harbors have evolved into diverse making and repair hubs.

For each of these phases, one crucial step has been identified and highlighted (figure 50).

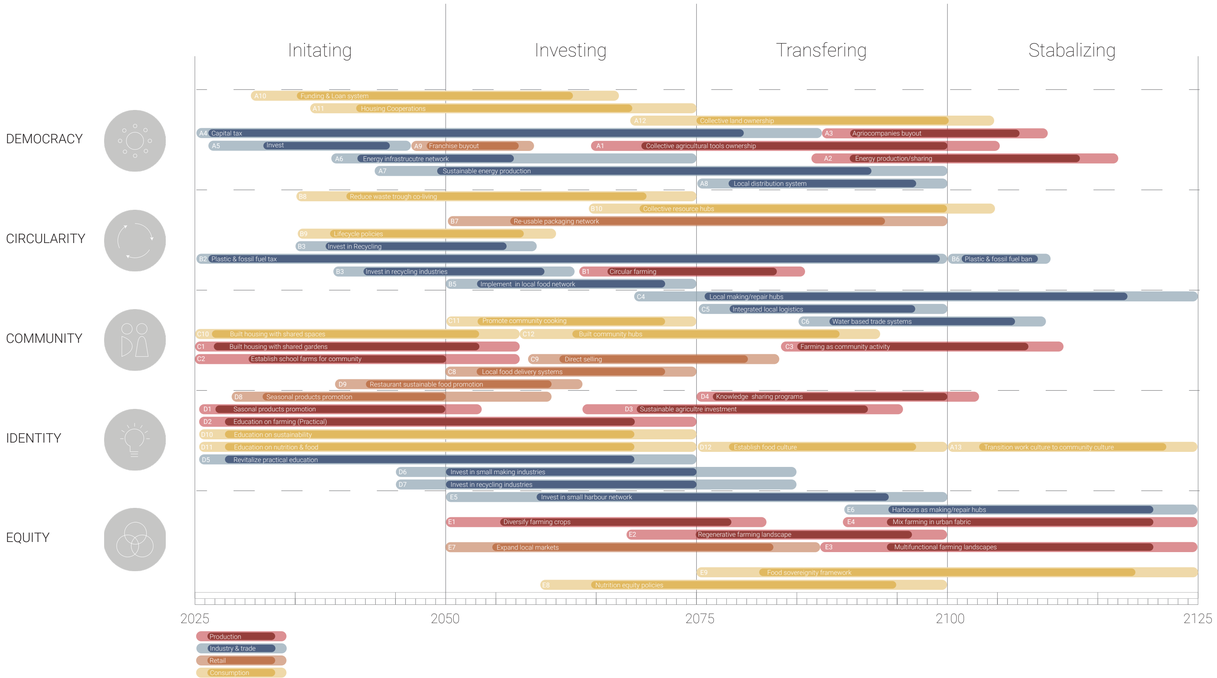


Figure 49 (Own work, 2025)

Key phasing moments

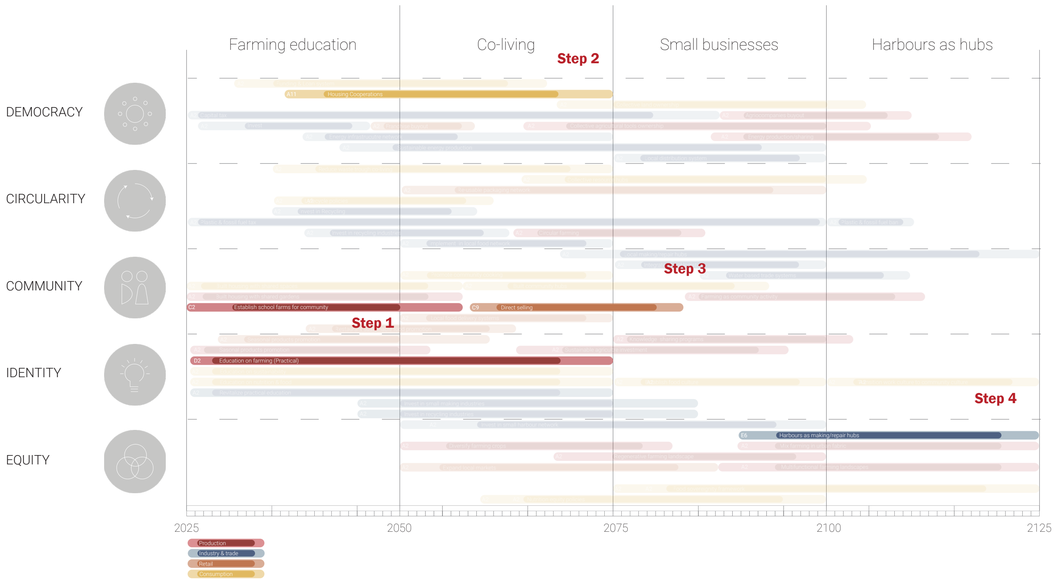


Figure 50 (Own work, 2025)

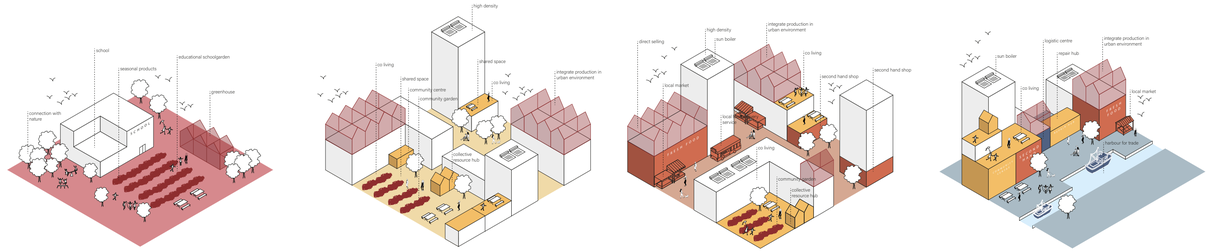


Figure 51 (Own work, 2025)

Step 1: education

The first crucial step of the timeline focusses on transforming food production through education. Early engagement with food systems and knowledge about food production and food waste helps children become more aware of natural processes and the value of food. Initiatives such as school gardens offer hands-on experience and help children gain practical knowledge about farming, which they can later apply in their own lives. In addition to traditional practices, children are also introduced to alternative methods of food production, such as permaculture and vertical farming. This ensures that new generations are equipped with the knowledge and mindset needed to sustain future systems.

Step 2: co-living

The second milestone promotes a shift from individual to collective modes of living and consumption. Co-living arrangements, such as shared housing with communal kitchens and gardens, facilitate sustainable food practices in everyday life. By growing food together, cooking collectively, and reducing redundant consumption, communities become active participants in the transition. Community hubs and shared infrastructure encourage social cohesion while minimizing food waste and resource use. This phase is where the values instilled through education are translated into lived experiences. The emphasis lies on reconnecting people to food systems and fostering a sense of responsibility and mutual care.

Step 3: decentralized small businesses

The third key moment centers on restructuring retail by empowering decentralized, small-scale food businesses. Instead of relying on large corporate supply chains, this phase supports local markets, direct-selling models, and the emergence of second-hand shops as part of a more circular and sustainable economy. Smaller businesses begin to replace larger corporations, including through the buyout of large agricultural companies, thereby shifting the balance of power within the food system. This decentralization enhances transparency, traceability, and trust, forming a critical link between producers and consumers, and anchoring food systems more firmly within their local contexts.

Step 4: harbours as hubs

The final key step involves redefining distribution through the transformation of harbors into multifunctional hubs. As much of the system becomes increasingly localized, the need for long-distance transport is reduced. However, for the goods that do require movement, water-based distribution becomes central. Harbors evolve into dynamic, sustainable hubs that serve not only logistical functions but also cultural, economic, and social purposes. These diverse hubs strengthen regional networks and accommodate the flow of resources in ways that align with environmental goals. By integrating distribution over water, this step ensures a resilient and low-impact infrastructure for the future.

Step 1: Farming education in 25 years

Figure 52 (Own work, 2025)

"I love our welcoming community and can't wait to share my knowledge back home in Romania."

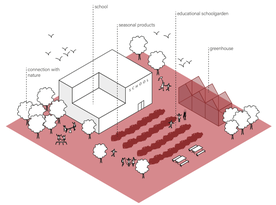


Figure 53 (Own work, 2025)

Step 2: Co-Living in 50 years

Figure 54 (Own work, 2025)

"I used to rush through life. Now, I take the time to grow, connect, and enjoy the simple things."

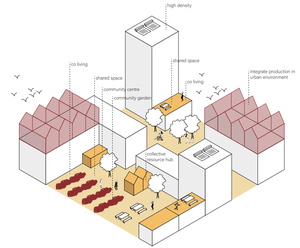


Figure 55 (Own work, 2025)

Step 3: Local retail in 75 years

Figure 56 (Own work, 2025)

"Success is about impact, not just money. I'd be happiest if my children used their skills to uplift their community."

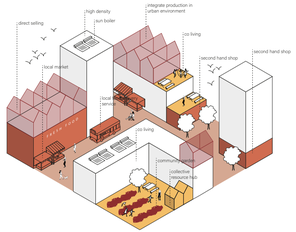


Figure 57 (Own work, 2025)

Step 4: Harbours as hubs in 90 years

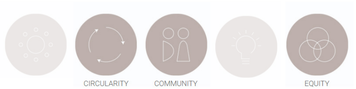


Figure 58 (Own work, 2025)

"It's a good feeling to know that no matter where someone comes from, we can work together and make something happen."

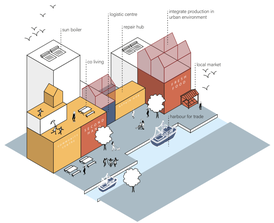


Figure 59 (Own work, 2025)

Zoom in

This zoom map highlights key spatial elements that define the interconnected local networks across residential, logistical, and rural areas.
Residential areas are designed around cohousing communities, where shared spaces and tools foster collaboration in daily life. Community gardens decentralise food production, making it a communal activity. Residents co-manage these spaces, taking turns in cultivation and harvesting, creating tight-knit local food networks.
In the logistical districts, a local distribution centre receives goods via waterways, avoiding road congestion. Packaging is designed for efficient bike or cargo-tram transport, entirely free of unrecycled plastics or single-use containers. The district supports circular economies through a repaired appliance store, recycled materials depot, and thrift market, where objects are restored with advanced tools and sold locally. The infrastructure prioritises cargo micro-mobility, with streets tailored for smooth transfer to and from cargo bikes and trams.
In the rural zones, soil-friendly agriculture adapts to the specific characteristics of local soils, promoting biodiversity and ecological connectivity. Instead of heavy infrastructure, lightweight, car-free routes link these areas, integrating ecopassages to support wildlife movement and reduce fragmentation.
Together, these elements form a spatial narrative that supports a regenerative, collaborative, and low-impact tomato supply chain.

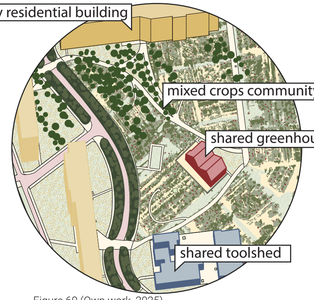


Figure 60 (Own work, 2025)

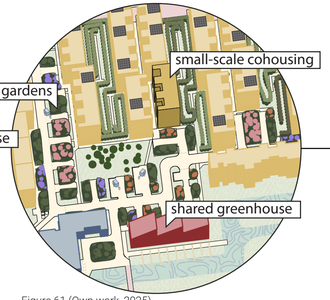


Figure 61 (Own work, 2025)

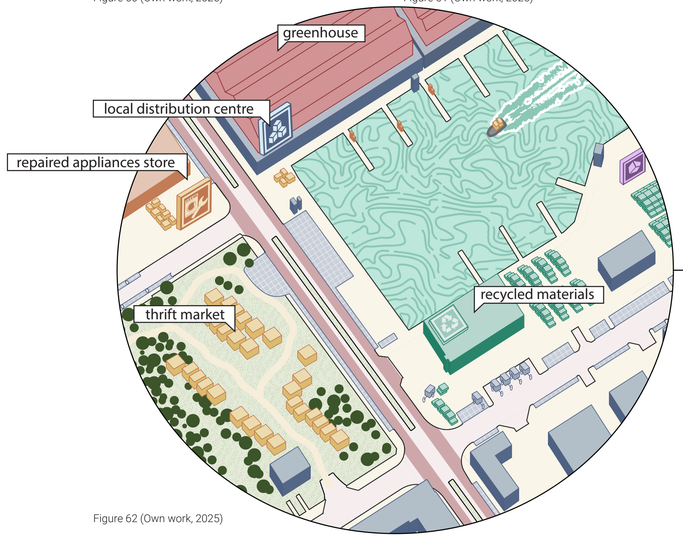


Figure 62 (Own work, 2025)

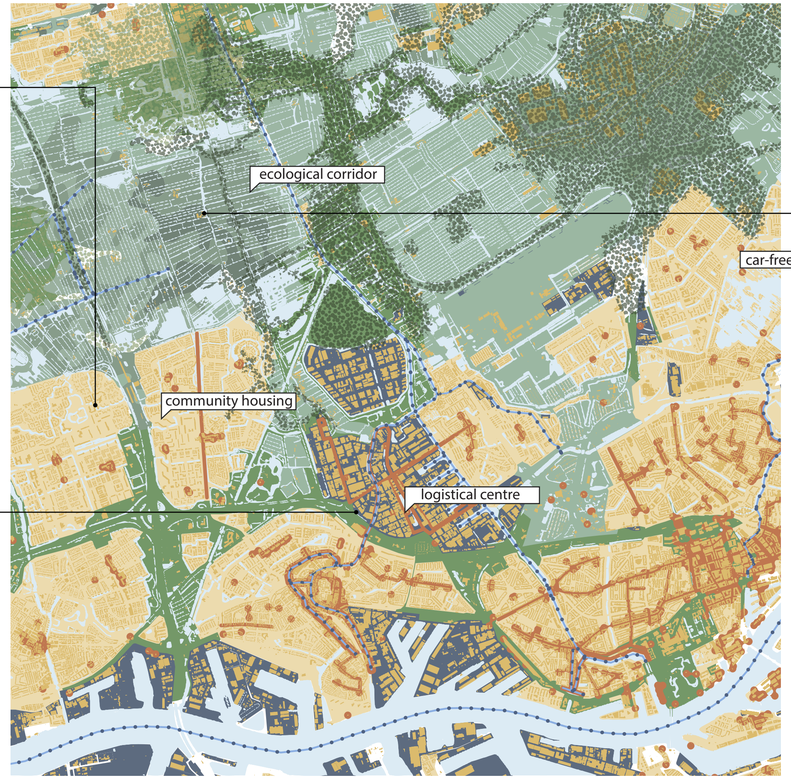


Figure 63

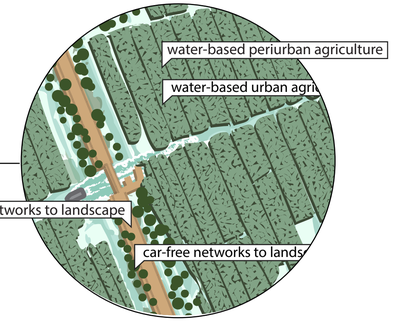


Figure 64 (Own work, 2025)

Results: Anticipating change

The new food chain

The goal of the project is shown in figure 65, where the tomato supply chain is transformed into a more sustainable, less energy-intensive loop. What was once a complex, linear, centralized, and fossil fuel-intensive supply chain evolves into a sustainable, local, and integrated supply loop. This transformation is not only aimed at reducing energy, but also at making it a just and sustainable part of society. The vision and strategies outline how society could change to make this new supply chain work. Now, it is possible to examine specific aspects of the analysis and compare them with a new version based on the vision, such as the tomato's energy demand and the stakeholder analysis.

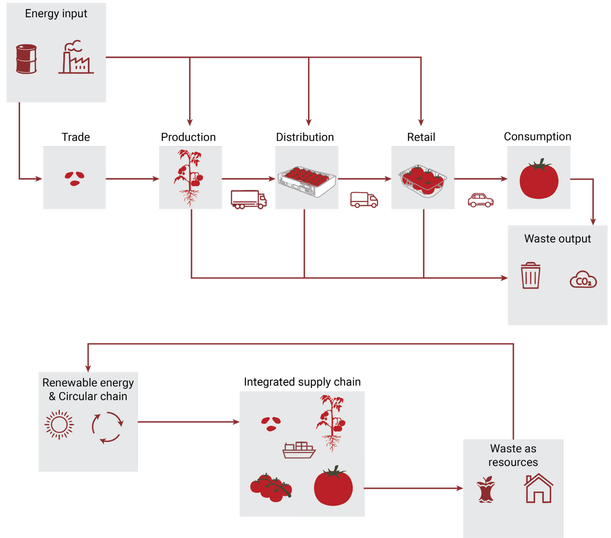


Figure 65 (Own work, 2025)

Energy demand shift

With energy as an overarching theme, the first focus is on the new energy demand for tomatoes in Figure 66. The box compares the new energy consumption with the previous model, showing a total reduction equivalent to the annual energy consumption of 161,000 households. On the left, domestic consumption is shown, which remains unchanged in terms of weight, providing a clear indication of the energy reduction per kilogram, which is a reduction of more than 80%. The amount of export has been halved through improved collaboration and knowledge sharing with Europe. Nevertheless, the percentage of export indicates that the Netherlands continues to produce a significant amount of food for its neighboring countries. These numbers are explained in more detail in the extensive tomato supply chain diagram on the next page.

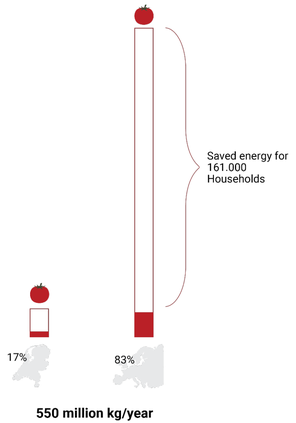


Figure 66 (Own work, 2025)

Energy input shifts

The new tomato supply chain is shaped by our vision and strategies, where energy inputs come from solar and geothermal sources, and other inputs are sourced from a circular industry. The chain is now integrated, meaning production, retail, and consumption either can take place in the same location or be connected through waterways or bicycle routes. Plastic is entirely eliminated, significantly reducing waste impact. While the energy input for tomato production remains the same, most of the heat is now reused to warm homes. Within communities, there is less reliance on precooked and processed food, as people have more time to cook for each other, also reducing food waste. Any remaining food waste is either donated or repurposed as compost. This revised diagram demonstrates how simple actions, such as community cooking, can relate to a fundamental change with significant results.

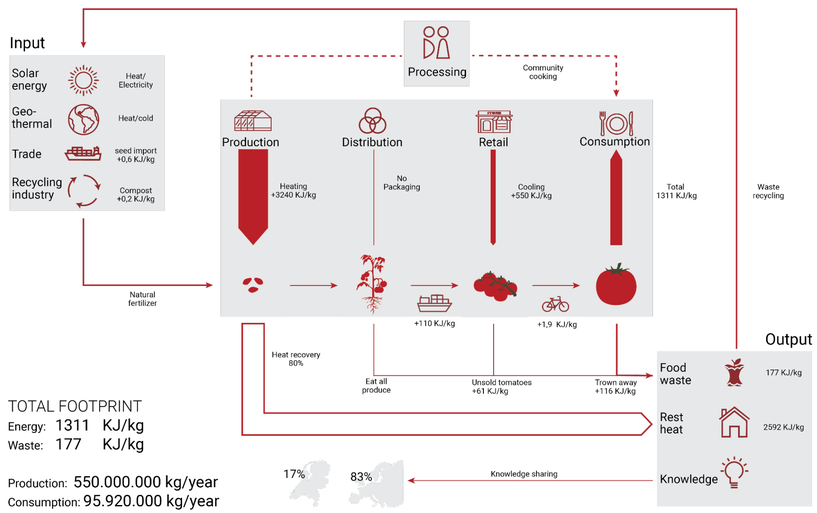


Figure 67 (Own work, 2025)

Stakeholder changes

In the new stakeholder map, the changes proposed by the vision become clearer. Many large industries, such as the chemical, agricultural, and oil sectors, have been replaced by a greater number of smaller-scale companies and organizations. Through collective ownership, NGOs, individuals, and small farmers now hold more power. Unfortunately, foreign consumers and workers have lost some interest in our food supply chain. However, with a new approach to knowledge development and sharing, they will still have food security, with universities playing a key role in this. Despite the rise of collective ownership and organizations, the government remains crucial in regulating and safeguarding certain societal qualities, such as safety. The different levels of government now share more similar interests and collaborate more effectively.

A significant shift of money and power has occurred, moving from large multinationals to the public and smaller sectors involved in the food chain. This shift aims to strengthen democracy, promote equity, and enable sustainability.

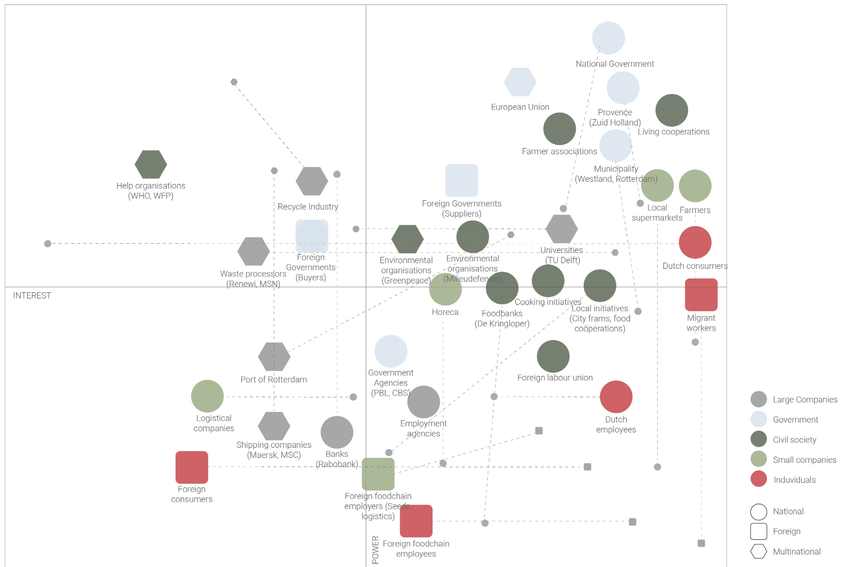


Figure 68 (Own work, 2025)

Market change

This project gives an extensive representation of a different way of living. However, given the current global context, a fundamental change in identity, work ethics, and international relations seems nearly impossible, even with a direct reformation of education. For people to radically change their lives, a strong wake-up call will likely be necessary. Figure displays the energy consumption graph from the context chapter, extended into the future. It shows a gradual decline in fossil fuel consumption. The renewable energy consumption projected after 100 years aligns with the current reduction in tomato energy use, roughly 80%. The graph also includes the GDP of the Netherlands, which shows a steep decline due to a potential market crash. This crash could serve as the wake-up call people need to change their lives, offering the public an opportunity to gain more power in shaping a sustainable world. After the crash, the new economy is unlikely to grow as it once did but should instead stabilize.

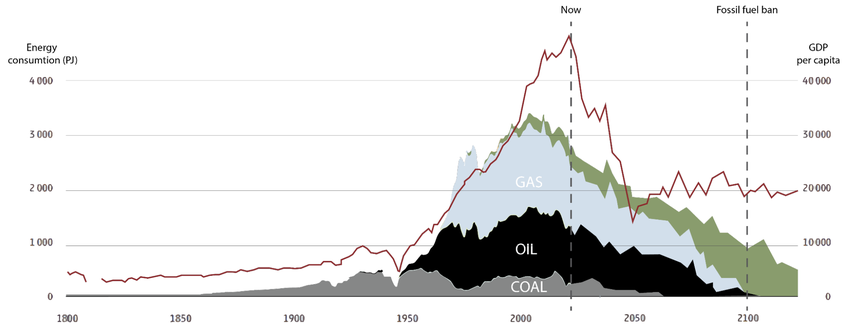


Figure 69 (Own work based on CBS, 2025)

Conclusions

The current food supply chain is highly complex and remains heavily reliant on fossil fuels, contributing significantly to environmental degradation, widening socioeconomic disparities, and posing challenges to human well-being. This system is deeply embedded in societal structures that have grown and centralized over time. It is a product of a society where energy has recently been abundant and inexpensive, leading to a shift from manual labor to office-based jobs. This transition has contributed to a decline in practical skills, which are vital for the effective functioning of society. Furthermore, contemporary society is characterized by an emphasis on work life and individualism, leaving little time for communal engagement. The wealth generated from fossil fuels, combined with the diminishing role of practical skills, has fostered a consumer-driven culture where wastefulness is normalized.

In light of the challenges identified, it is clear that a profound and radical transformation is necessary to shift our current way of living towards a more sustainable model. While such a transformation may require a significant crisis to catalyze meaningful change, it is worth acknowledging that several initiatives are already emerging, pointing towards localized, stable, and circular alternatives. These initiatives offer potential answers to the question:

"How can the Netherlands reorganize its food supply chain in a just and sustainable way, in order to reduce its energy consumption?"

This project addresses this question by rethinking the way we want to live as a society. It involves integrating the fundamentals of life back into our society, such as the relationships with those in our immediate environment, engaging in food production, and reconnecting with the identity around us, in this case water. Achieving this transformation will require more time of our daily lives, space for smaller industries and businesses, and increased involvement in decision-making processes, with a strong focus on equity.

A starting point for this change lies in education, particularly in areas such as food and nutrition, nature, ecology, climate, and practical skills. This would enable a shift towards a decentralized, "do-it-yourself" food supply chain, tailored to local environments and powered by innovation and renewable sources.

This transformation does not necessarily imply a decline in the quality of living conditions; in fact, it is likely to enhance them as well as give us a stronger identity. It may mean that we no longer have access to everything, everywhere, at all times, but it will encourage a slower pace of life and foster a greater appreciation for the essential aspects of life, such as the people around us, our connection to nature, and the consumption of healthy and delicious food.

05 Reflections

Group reflection

This project approaches the energy transition by addressing the core issue of overconsumption, rather than focusing on easy solutions like renewable energy sources that replace our current demand. In doing so, it necessitates a broader exploration of fundamental topics such as prosperity, nature, human rights, and basic needs. Given the wide scope of these themes, the project inevitably leaves out several important aspects. It tackles issues like overconsumption, globalism, human (worker) conditions, individualism, and inequality, relating them to spatial elements such as water systems, mixed-use development, and household size. Additionally, it considers policy aspects like education, innovation, and democracy, though the depth of exploration is somewhat moderate. However, other significant aspects, such as capitalism, polarization, and loneliness, are either left out or receive less attention.

One of the main shortcomings of this project is its positioning in relation to global contexts outside the Netherlands. The aim of the project is to transition towards a more sustainable, decentralized model; however, given the Netherlands' status as a major global food exporter, such a shift would have far-reaching implications. Many countries depend on the Dutch food system, and while solutions like knowledge-sharing and positioning the Netherlands as an example were offered, a comprehensive solution to this essential socio-economic dilemma remains absent.

Besides the interdependence in our globalized world, this challenge highlights another primary obstacle to achieving sustainability: the potential economic vulnerability a country faces when opting for local, decentralized systems in a globalized economy. As the project proposes significant changes, it is possible that such a shift could undermine national safety and security, which may be the most valuable public good in society. Therefore, international collaboration is crucial in the pursuit of sustainability. Without cooperation between countries, any effort to transition into a sustainable future risks compromising global stability.

Adriano

Over the past six months, I have come to realise that the Netherlands is a far more compelling place to work with than I initially imagined. This landscape and its urbanity reveal an intentionality unlike anything I had previously encountered. As I approached it through the lens of research and design, I was met with a disquieting silence — not the echo of distant cultures or the murmur of an animated land, but rather a landscape seemingly devoid of agency. Here, one can hear no whisper of bygone peoples, no song of the land itself: all that resonates is humanity's restless ambitions, and the instruments we use to spatialise them. Behind the dikes of this vast submarine city, the modernist ideal of the "city as a machine" may have found its most refined expression. As the philosopher Cacciari observed in his book La Città, post metropolitan urbanity reflecs modernity's strive toward a disembodied existence, a pure soul without flesh. Yet I have never felt more soulless than when walking, side by side with my teammate Femke, among Westland — the Dutch "greenhouse city". Through those tall walls of glass, our experience was uncannily virtual, as if I had become a glitch in a digital landscape: a body without memory, an unwelcome guest. Our legacy, here and elsewhere, has been transforming our world and our homelands into non-places, in an act of denial of our own embodied presence. I thought, perhaps this is the face of the world we are heading toward — one that only has space for boxes where the crude magic happens that fills the world with products, in which whatever is deemed unproductive, or the bodies and ideas which do not conform to the image we wish to construct, is displaced, negated, erased.

Our exploration began with a specific question: that of energy blindness — our collective inability to grasp the sheer magnitude of energy consumption that has shaped the last century. In a few decades, we have been burning through millennia of sunlight embedded in ancient forests — the dark, dense liquid that powers the planet — and in this blindness, we have constructed a world of extraordinary complexity, which paradoxically reveals itself, when compared to the pain and beauty of present and past, as a profound simplification. This world — shaped by markets, by social constructs, by the imaginations of a few — is undergoing a process of virtualisation. As modernist thought dictates, the body is weight, and only the mind — a very specific kind of mind, the Western mind — has the right to shape the world according to its desires, regardless of the consequences. Within this framework, hiding, masking or outsourcing the true costs of the instrumentalisation of the world becomes a central tenet of the modern project: not only a spatial rationalisation, which means isolating the ugly and the dirty to curate a steril, beautified surface that we all inhabit, but the cementing of structures that are progressively ignorant of the material and sensitive realities of life, a systemic suppression of the assumptions that fuel our current existence, and of alternative modes of living, perceiving, and caring for others.

Of course, two months are not enough to fully grasp the layers of this context, let alone to identify and engage deeply with a specific community — to understand their ambitions, their fears, their hopes. The pace of this studio was relentless, and the web of interconnections often overwhelming. But it was enough time to learn how not to get lost in the noise — to hold on to one's intention, to trace the root of a problem, and from there begin to imagine meaningful alternatives; a process that demands not only curiosity, but also rigour, presence, and an unwavering willingness to question one's own assumptions. It became increasingly clear to me that critical work cannot be done in half-measures: the state of our world today is helpful in revealing that when engagement is shallow or sporadic, it shows — in the outcomes, and in the conversations we fail to have. Disengagement — whether systemic or individual — isn't neutral; it actively reproduces the very conditions we claim to challenge. This project taught me to follow my own critical drive, to include and facilitate other people's presence in the conversation, and to remain attentive to the ways my own position — my privilege — shields me from the costs others must bear. From now on, I will never look at a tomato with indifference, this plump, bright fruit which travelled a long way from its ancestral home to become a staple of my culture. It is something someone planted, someone harvested, and someone packed, shifted from box to box until it arrived at my table, wrapped in plastic. It has become, for me, a symbol of the invisible systems and displaced costs that sustain our lives — and of the possibility, however small, of imagining a different path forward.

Teun

The assignment for this quarter focuses on the 'energy transition,' and while this project is deeply concerned with energy, it somewhat diverges from the conventional interpretation of the assignment. Typically, the energy transition refers to the shift from fossil fuels to renewable energy sources. However, the true issue of sustainability runs far deeper than simply transitioning to renewable electricity. It is easy to look at technology such as solar panels or nuclear power for solutions, but that overlooks the fundamental problems that underlie unsustainability. Energy, as a central element in both the universe and life, holds a tremendous power. The abundance of practical, portable, and compact energy has given that power to humans which has shaped the world into what it is today, with all its benefits and, more notably, its negative consequences. The current world is driven by technology, which is itself one of the main causes of unsustainability.

Advocating for sustainability, therefore, directly challenges the embedded systems of power, which may seem like an impossible task. Still, this project tries to address the core of the energy problem: overconsumption fueled by the abundance of resources. It seeks to make this issue tangible by focusing on the tomato supply chain, using it as a metaphor for the fossil-fuel-driven world. This approach provides an opportunity to reflect on everyday aspects of life across multiple levels. However, this is also where the limitations of the project become evident. Given how deeply embedded and fundamental the energy problem is, attempting to address it in such a short time is a significant challenge. It is very hard to cover all the relevant aspects in the necessary depth and detail that are related to the project.

Nevertheless, the dramatic changes in society and the built environment over the past century point to a strong relationship between societal structures and their physical form. This suggests that, with thoughtful planning, the built environment could play a key role in redirecting the course of change. Achieving this shift will require broad collaboration across different sectors and disciplines, emphasizing the need for a collective effort to address these deep-rooted issues.
It is this very collaborative aspect that I personally struggled with during this course. Since I feel very strongly about the state of the world as I learn more, I was excited by the opportunity to work on an open, free project about energy that could address many of my frustrations. However, this initial enthusiasm led me to overlook the importance of listening to my teammates in order to shape the project together. As a result, the quality of the work was sometimes compromised, which in turn demotivated me at several moments. This experience serves as a valuable lesson, illustrating how good intentions do not always contribute to the bigger picture. It highlights the importance of actively listening to the people involved and collaborating to find solutions together.

Femke

Working on a regional design project that centered around the energy transition made me realize the complexity and multi-layered nature of such a task. While the energy transition is often simplified as the shift from fossil fuels to renewable energy sources, our project challenged us to look beyond these conventional solutions. The Research & Design studio did not always push us in that direction, partly due to the limited time frame of just eight weeks to develop a complete and coherent report. This limited time frame often meant we couldn't dive as deeply into certain topics as we would have liked. Nonetheless, it was through team discussions that I began to understand the need to address deeper systemic structures. A truly sustainable energy transition demands a shift in how we live, not just in what powers our systems. Instead of simply adding solar panels or wind turbines, we explored how spatial design could fundamentally transform the way energy, food, and materials flow through regions.

The relationship between research and design proved to be both the strength and the challenge of our process. In the beginning of the project, we engaged in extensive research to gain a solid understanding of the many dimensions of the energy transition. Through literature research, we developed a clearer picture of the food supply chain, and the complex problems and potential solutions connected to it. This thorough foundation led to a conceptually rich and well-grounded understanding of the context of the problem. However, it also became a pitfall. At times, we found ourselves lost in the amount of research we did, which made it difficult to maintain an overview or find a clear focus on a specific topic.

A good example of this was our exploration of the Dutch food supply chain. Initially, the topic felt overwhelmingly broad. By choosing to focus on the tomato as a narrative throughout the project, we found a way to narrow down the topic without losing sight of the larger system. This small but symbolically rich element enabled us to tell a bigger story in an understandable and accessible way. It also made the consequences of our spatial strategies more tangible.
Looking back, I learned a lot throughout this quarter. Not only about the topic itself, which was largely unfamiliar to me at the start, but also about the nature of collaboration within such a project. Working in a group of four, all with different perspectives, experiences, and working styles, taught me how to learn from each other, communicate ideas clearly, and work together under pressure. While this diversity was valuable for the variety of skills and knowledge within our group, it also occasionally led to friction when aligning visions or priorities. The pace of the course was intense, and it was impressive to see how much can be achieved in such a short time when responsibilities are effectively shared. The insights gained from our group discussions and doing research, in combination with the tools and theories provided by the studio, helped me to develop a much deeper understanding of regional design.

Niki Sophie

During the Spatial Strategies course, I worked with my group on a design proposal around the theme of energy transitions, with a specific focus on reducing energy consumption in the food chain, using tomatoes as a case study. I found this topic challenging at first, as I still had little knowledge about energy and the complexity of such systems. However, I gradually learned how spatial design can contribute to a more sustainable future.

Our group's vision focused on drastically reducing energy use in the food chain over a 100-year period. This long-term vision significantly influenced our approach: instead of just looking at technological solutions, we began to look at the role of communities and stakeholders within each step of the chain. We looked at four core steps in the food supply chain: production, distribution, retail, and consumption. For each step, we selected a representative 'community', such as gardeners in Westland, logistics actors around the port of Rotterdam, retail shopping areas and consumers in urban areas such as The Hague and Zoetermeer. The choice of location - South Holland - provided a strong basis because of the concentration of relevant actors in this region.

Although we did not conduct direct interviews with these communities, we visited their living and working environments to understand their context. By observing physical places such as the port, greenhouses in Westland and shopping areas, we got a sense of the spatial dynamics between the different links in the chain. This led to the realization that the energy transition is not only a technical, but also a social and cultural process.

Designing for transition communities - communities that are playing an active role in the energy transition - proved to be very valuable. By looking at the chain from their perspective, a design strategy emerged in which cooperation, proximity and local connection became central. In my opinion, good practices here include: using spatial proximity (e.g. shorter chains), encouraging cooperation between links, and visualizing energy consumption in an understandable way. This approach helped us not only to restructure the chain, but also to bring the different communities closer together, leading to potentially lower energy costs as well as stronger social connections.

Personally, I learned a lot from this project, especially about working in a multidisciplinary team. Because my group mates had more prior knowledge about energy transition, I found myself sometimes holding back. At the same time, I learned a lot from them - about systems, concepts, and how to translate a vision into a spatial design. One important lesson was that researching the context - i.e. the community - is essential in order to arrive at a well-founded story. In the future, I would like to use contextual research more actively and weave it more into my design approach.

If I were to do the project again, I would work with my team members more often on the same products and be less stuck in fixed "tasks". Due to time constraints, we sometimes worked too fragmented at the expense of collective knowledge sharing. Still, I look back positively: I discovered how powerful a vision can be as a guide, and how important it is to connect design to the dreams, goals, and dynamics of real people.

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