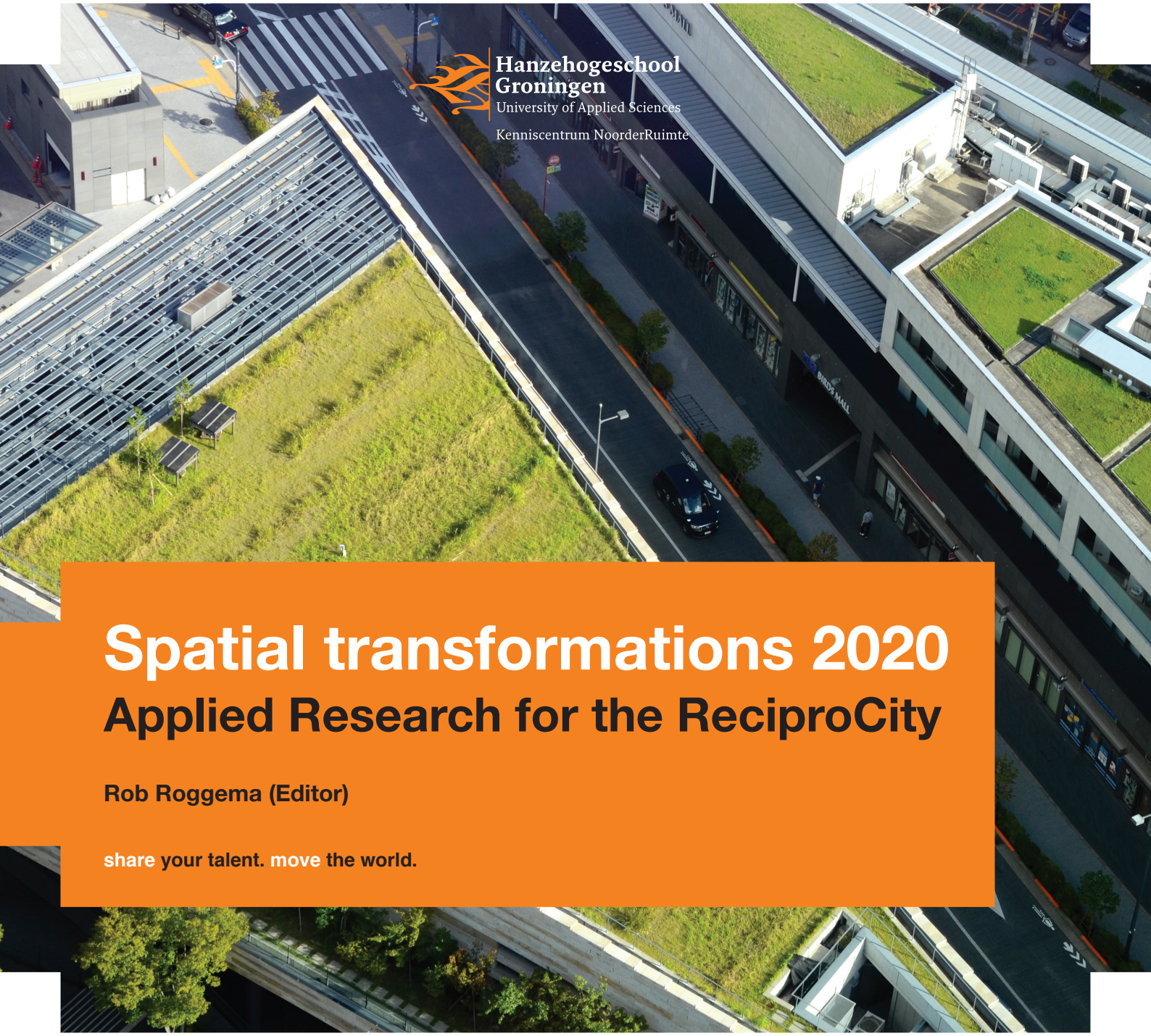

Spatial transformations 2020

Applied Research for the ReciproCity

Rob Roggema (Editor)

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Title:
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When entering the third decade of the 21st century, what spatial transformations do we need?

1

Rob Roggema
Floris Boogaard

We are very pleased to present the first Spatial Transformations book. In this book several research projects that were undertaken in 2019-2020 are highlighted. This gives only a small overview over the sort of research the professorship is concerned. Moreover, it illuminates the way of working we cherish. We can only highlight some of the work that has been carried out by our students, our researchers and often in collaboration with external parties from practice. The individual projects show how applied research manifests itself in the current timeframe, understanding the changes and challenges are large, and more work waits so we can improve the quality of our built environment.

1.1 Our ambition

The professorship of Spatial Transformations is ambitious. As a major part of the Research Centre for the Built Environment 'NoorderRuimte' at the Hanze University of Applied Sciences, it plays a leading, transformational role in discovering ways into the 21st century that will provide confidence in a continuous high quality of life for all humans and non-humans In the Groningen, Northern Netherlands, and global ecosystems. The major question the professorship asks itself is:

'*How can we create an adaptive and regenerative community by design and co-creation in towns, neighbourhoods, cities and the countryside?*'

This ambition is further detailed in concrete objectives. The professorship of Spatial Transformation develops research with a focus on the following questions:

- How can local, organic food systems be created?
- How can a built and natural environment be created which is able to adapt to (climatic) changes?
- How can the dynamic capabilities of the landscape be used to adjust to change?
- How can more than energy neutral precincts be created?
- How can circular built environments be constructed?
- How can all waste flows (nitrate, carbon, sludge, building materials, wastewater) be used as resources?
- How can ecological diversity be enhanced as a beneficial natural living environment for humans?
- How do we map and evaluate policy, design and implementation measures?
- How do we effectively involve different stakeholders in planning, design and realisation processes?

And the professorship instigates collaborative planning and design processes in which:

- Academic knowledge is connected to local expertise;
- People obtain data by themselves for co-creation of the future;
- Design approaches, tools and expertise is used to access an innovative mind, map current problems and future propositions in a spatial way, present and visualise attractive futures and envision future potential urban and rural environments.

1.2 Our philosophy

Not everything is possible anymore. In a world that is connected in endlessness it becomes more and more important to be more carefully and develop more resilient systems, that are capable of self-organising. The more we become dependent on virtual networks the more we need to be certain they work properly and safely. This to prevent transitions of human, animal and technological viruses becoming pandemics.

We stand for a bifurcation point in history. After decades during which building, growth and economic greed was seen as the greatest good, personal gain as the high mass of life, it is crucial we reconcile, look back in history and retake responsibility for our community, family, village, neighbourhood or country (Kinneging, 2020). This required wisdom rather than economic expertise. This implies a new reality, which will ask in all our actions what I, as a person, and I, as an organisation, do for the larger entirety. Does my action make the whole stronger; will it last longer? Is everyone evenly capable of taking part, of living? Are people, animals and pants, the abiotic and biotic systems parts of a larger whole, supporting the quality of each other's existence?

The economy should no longer be solely focused on growth, being a separated entity, loosened from society. It has become independent from nature, while it should be seen as embedded in society, which at its turn is embedded in nature (Costanza et al., 2013). After the economy has undergone a period of adolescence it is now time to grow up and reach maturity. The economic system shall consider the reasonability and sensibility of its being. An economy commits suicide when it sees its environment as an inexhaustible resource, while, in fact, the earth system is finite. Instead of using more resources than, on earth, are available the global economy is obliged to itself to reach a sustainable equilibrium. In this new order, mass consumption is replaced by valuation of the quality of life. Specifically, this implies we need to bring our use of resources and the way we deal with nature, as a society, back in balance. We need to replenish resources and let a society emerge that is more self-sufficient, locally organised and capable to sustain on the long term.

This should determine our actions, and therefore the core theme of the professorship of Spatial Transformations: the development of the *ReciproCity* (Roggema, 2019).

In the past few centuries humanity abused the earth's stocks severely and taken much from the system of our planet. To stop doing this will not be enough, the earth will also need a chance to revalidate. This forms a new challenge: it is time to start giving back more than we use. This will need to happen in a number of ways:

- Spatially: in terms of physical amounts of materials and stocks;
- Mentally: by taking care of the entire (eco-)system;
- Socially: by developing common values together with others that create a sustainable, enjoyable environment at a local level;
- Ideologically: by realizing that humanity has gotten caught up in a transition process, by accepting decay and adapting to the new era.

There is evidence galore that, despite successful interventions and policies, like diminishing the hole in the ozone layer and improving the water quality of the Rhine, real fundamental changes have had no or barely any effect (HIER climate bureau, 2016; PBL, 2009; 2018; IPCC, 2013; IPBES, 2019). With well-meant policy alone, we apparently cannot reach the goals we have set for ourselves. Instead of considering the sustainable city to be our goal, in which we try to find balance between ourselves and our environment, for example through realising zero-energy households, the city will need to become reciprocal and start giving back more to its environment than it takes. This is necessary because in the last 170 years we have used too much of the earth's natural resources, causing water pollution, a decrease in biodiversity, and large-scale deforestation, which in turn led to enormous amounts of waste. It is time to view the city as a source rather than a drain. Therefore, we must go further than closing cycles. *ReciproCity* would work as a living organism rather than a technologically driven system (figure 1.1, Rees, 2002; 2003; 2006a; 2006b; Wackernagel and Rees, 1996).

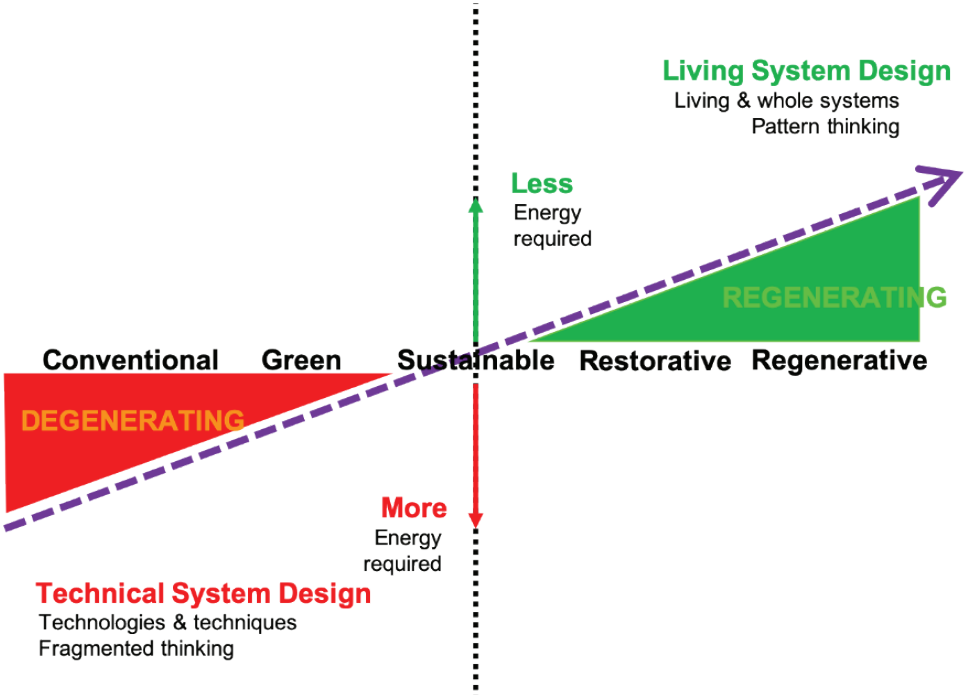

Figure 1.1 From a technologically driven system to a living system.

The professorship of Spatial Transformations therefore focuses on designing and researching a *ReciproCity*, which is renewable, reciprocal, adaptive and anti-vulnerable.

- How can the city become totally renewable, both mentally and physically, through the use of infinitely available sources, such as the sun, geothermal heat, or our unlimitedly flexible mind?
- How can the city become reciprocal?
  a. It works as a filter for polluted water. Waste enters the urban area, is filtered, used and then leaves the city purified. The water thus becomes cleaner and more valuable thanks to its stay in the system;
  b. The city captures more CO_2 than it expels, for example by capturing carbon and using it to make high quality products;
  c. It creates an Urban Ecology, which increases biodiversity compared to 'real' nature, for example by saving space in the city where nature can freely develop;

d. It implements more green areas close to citizens, so it can leverage children's concentration – and even improve their math's performance – and decreases stress, domestic violence and crime rates (GANSW, 2017);
e. Being linked to a green urban infrastructure, it is also important to attach a cultural-historical infrastructure. In this 'grid', Indigenous heritage plays a structural role;
f. It produces a surplus of food, which can also be delivered to the areas in the vicinity of the city. By introducing places where healthy food can be cultivated, citizens will not only be more concerned with each other, but they also learn more about local production and health, leading to them eventually eating more healthily and becoming healthier.

- How can the city permanently continue adapting to future changes, however uncertain they may be? For this, we will need to create space within urbanised regions, in order to thus literally create space for unexpected events. A part of this is accepting the consequences of climate change and taking them seriously (Global Commission on Adaptation, 2018). This goes for politicians, policy makers, CEOs of businesses, and citizens. Only in this way can our society as a whole anticipate what we do not know is coming.
- How can the city become anti-fragile (Taleb, 2012)? Is it possible to develop an urban landscape that is strengthened by setbacks? Can the threat of earthquakes be converted into a better, more sustainable, more liveable and resilient land? In this, counter-intuitiveness will play an important role, as in the current reality, threats only lead to more misery. With a radical reversal of the perspective, as exemplified by the 'floodable landscape' idea, a threat can be converted into a landscape with better qualities.

1.3 Our themes

Following our philosophy four core themes can be distilled:

a. We strive to redefine the concept of sustainable development in two stages. The first transition is from providing next generations equal opportunities as the current toward the development of a regenerative environment. This environment is able to restore, and literally regenerate from the exhaustion caused. The second transition is taking the regenerative environment into the context of radical change. As we can see changes are increasingly unprecedented and unpredictable. This makes a (relatively) 'simple' regeneration to a sustainable equilibrium in itself vulnerable. In a completely new context what does regeneration mean? Therefore, the regeneration needs to occur within a dynamic, complex environment. This urges us to think in complex adaptive systems and self-organisation of society and land use.

b. We acknowledge the importance of the natural system as our common basis within which life takes its place. Even the highest forms of technological systems, smart city-thinking and artificial intelligence is embedded in the universal integrated systems that nature offers. It is important to let natural systems determine the working of technical systems of our human, urban lives.
c. We apply a design-led, creative way of investigating research questions. A design-led approach offers integration, innovation and visualisation of the solutions. Through this, unknown futures can be imagined, people collaborate better and new solutions can be developed that otherwise could never be within scope.
d. We see leadership as the setting of the scene, framing the clear direction within which the freedom to act is established. Instead of declaring directives about how to detail the future, the eye is on how participation can be arranged so people can start supporting the transition towards a wise future society. In this sense it is key to link society, knowledge, the wider public and science, being the ultimate form of applied sciences. We foresee the synthesis of the work we have been undertaking on design charrettes (Roggema, 2013) and climatecafes (Boogaard et al., 2020).

1.4 Our future

In this book several research projects illustrate our focus and thematic interest, see the respective chapters. The type of projects we want to focus on in the near future will ask questions related to:

- The current time asks for research that has a meaning. Not only fundamental, but mainly to be of use in the society, developed for and with the society.
- The future will continue asking for energy transition, such as an ongoing search for the spatial integration of solar parks in the landscape.
- How can the food supply become safer, lower scale more certain and less environmentally harmful, emitting less nitrate and carbon.
- The future will continue to demand more attention to adaptation to climate change impacts, in the landscape, along the coast, in the countryside and in urban environments. Here we have to link the different spatial scales the impacts have effect.
- The attention for green space as a primer for improved health is evident. Green could provide clean air, it is the environment for active leisure and sports, it can boost biodiversity and delivers potentially building materials, such as natural forest could achieve.

And there is space for more.

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Toukomst of Groningen: linking public with policy

2

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2.1 Introduction

Ever since 2012 the province of Groningen suffered from earthquakes resulting from the large-scale gas extractions from the Slochteren field. The residents of the province, confronted with uncertainty, damage to their properties and an exploitation company (NAM) together with the National government who did, in the eyes of the population, not enough to protect or compensate for the incurred damage, lost their trust in just and equal treatment by government. This has led to the launch of the so-called Toukomst project in which the residents of the province could propose large, impressive projects that could bring back pride in the hearts of the people hence restoring trust in the government. The NPG (National Program Groningen) is in charge of spending the total budget provided by the National government on local and regional transformative projects that would enrich the quality of life in province, both physically as mentally. The Toukomst project is, literally translated the conception of a future image for the province of Groningen. The professorship of Spatial Transformation works, together with West 8 and different other organisations on this imagination.

The main question in this project is how public policy and public ideas and wishes can be brought together, without losing the sense of transformational change. In order to investigate this, 87 public policy documents have been analysed, together with the nearly 900 ideas that have been submitted by groninger population to the toukomst website (https://www.toukomst.nl). Both categories, policies and ideas, have been positioned on two axes: the level of uncertainty and impact of change (low, middle or high), and the time horizon (short-middle-long term). In general, the most transformative policies and ideas are the ones that deal with a high level of (potential) impact and looking at the longer term.

This chapter is structured as follows: the first section describes the methodology, including research design, data collection, and data analysis. Within the results section, the analysis on both policies and ideas is discussed in 12 themes which is then followed by the discussion and conclusion where the findings are critically evaluated to bridge the gap between theory and practice in policymaking hence how the policy-sphere engages with the public-sphere.

2.2 Design of 'common ground' integrating the public and policy sphere

More people are expected to relocate to cities and urban regions in the upcoming decades as anticipated by the United Nations in 2018 (UN, 2018). Theories and models based on urban expansion and agglomeration have been the dominating discourse in the field of contemporary urban planning and design theory. Less attention has been paid, nevertheless, to territories experiencing reverse development phases such as shrinkage (Martinez-Fernandez et al., 2012), urban decline, depopulation, and hybrid models of uneven geographic development (Soja, 1985).

The non-linear urban development patterns of Groningen province reveal the complexity of the aforementioned opposing forces and hybrid models of uneven geographic development. Specifically, the exploitation of the province's operational landscapes (Brenner & Katsikis, 2020) and its socio-spatial repercussions perfectly exemplify the complexity of the province of Groningen's urban condition. On the other hand, the tradition of social-democratic urbanism (Duineveld et al., 2013) in the urban history of Groningen province exposes the dynamism and potentiality of the city to confront the challenges and provide a progressive pathway forward. At this juncture, this study aims to comprehend the multi-layered urban landscape of the province of Groningen by utilizing a thorough analysis of two primary data sets – 87 policy documents of local governments and nearly 900 Toukomst ideas received from inhabitants of the province – that reflect the urban visions of two primary actors, policymakers and the public. Taking the deep-rooted discussions on the paradoxes of policymaking (Hall, 2010) into account this project identifies three main areas which the findings can contribute to:

- Assessment of the risk/time dimension of local policies for Groningen. Risk relates to the impact of change or the level of uncertainty, while time is viewed as a time horizon of 1-5 (short-term), 5-20 (mid-term) and 20-50 year (long-term) time span.
- Deciphering the geographic distribution of different policy approaches within the province by mapping these policies.

- Assessment of the risk (level of uncertainty/impact of change)/time span dimension of public ideas generated for the province.

Contrary to the generally accepted 'short-term/low-risk' approach of policy makers, this research aims to generate visionary future scenarios for the province that bridges the gap between the public sphere and the policy sphere by linking urban theory and practice. Drawing on the aforementioned analyses, the research project will specifically focus on identifying the potentialities and challenges of long-term high-risk developments such as food supply, education and health, climate change, energy supply and adaptation. To this end, all policy documents and Toukomst ideas have been analysed and mapped by researchers and categorised in 12 themes: Landscape and Nature; Water Systems; Food Systems & Agriculture; Energy Systems; Demography; Urban Development Patterns/Built Environment; Housing; Transportation, Mobility, & Infrastructure; Economy; Social Development/ Well-Being Services; Public Space/Leisure/Recreation and Urban Governance. Subsequently, both data sets have been evaluated based on their timeframe and risk-degree.

2.3 Research objective and methodology

The primary objective of this research is to project innovative and visionary future scenarios for the province of Groningen through an analytical approach. The formulated research questions are as follows:

1. What is the role of local policies in shaping the future development of Groningen province? What are the potentials and shortcomings of these documents in responding to the risks and challenges the province is facing over the course of the 21st Century?
2. In what ways can these policy documents be engaged effectively with the public opinion to bridge the gap between the policy makers and the public sphere? How can the Toukomst ideas be utilized in this regard?
3. How can spatial design and designers play a proactive role in facilitating the generation of innovative and visionary future scenarios for the province? And in what ways can spatial thinkers bridge the gap between theory and practice in urban policymaking?

2.3.1 Structuring of research design for students

Creating a multi-stakeholder research environment for students is a fundamental aspect of the Research Centre for the Built Environment NoorderRuimte (KCNR) education strategy. The structure of the Toukomst project, including Nationaal Programma Groningen (NPG) and West8 as the external clients – besides the KCNR instructor – perfectly corresponds with this strategy. For KCNR, the first semester students explored the primary spatial, qualitative, and quantitative data sets for the province hence initiated research on mobility and accessibility, urban land use, agricultural patterns, liveability, shrinkage, demography, residential retail real estate, education and labor market development. Moreover, the students participated in the idea-collection process in collaboration with NPG and West8. The second-semester students proactively involved in the analysis and visualization of policy documents and the Toukomst ideas.

2.3.2 Data Collection

The principal sources of data in the present study are the 87 policy documents of local governments, collected and provided by the NPG and the Toukomst ideas collected by Hanze University of Applied Sciences students and through the online platform. Both data sets are an invaluable resource to decipher the public opinion, the contemporary urban planning agenda and the spatial development strategies within the province of Groningen. If analyzed carefully, these data sets, enable the researcher to make comparisons and establish linkages between the public sphere and policy sphere.

2.3.3 The collection of Toukomst ideas

The Toukomst game is a "serious game", built around an educational ambition to make the participation processes in the province of Groningen fun. Toukomst game specifically aims to reach out to the younger generations living in the province of Groningen to initiate a discussion among these age groups about their future. The KCNR students were trained as facilitators by the game producer Kasper Sluiter and the Toukomst staff. The game was primarily played at high schools, youth centers, student groups, and municipal and provincial youth councils. The Toukomst game is played with seven people and a game facilitator. In each game session, a KCNR student was involved to introduce the game, to guide the session, and to collect the ideas. The collected ideas were then uploaded into a Google Drive folder and presented on the Toukomst website.

The game has the format of a board game in which Groningen is presented as a village. Each session lasts for ninety minutes and comprises three phases:

Phase 1: Introduction to the game:

- Explanation of the Toukomst project and the Nationaal Programma Groningen by the game facilitator.
- Explanation of the goal and progress of the game by the game facilitator.
- The game has seven characters with a specific interest: the major, the energy cooperation, the farmer, the village pub, the junior, the nature lover, and the miserable whiner. Each player is assigned a character card. Therefore, the player has to represent the interests of that particular character in the village of Groningen.

Phase 2: Playing game cards:

- The game is played via cards: Each card stands for an event. These events also include the contemporary problems of Groningen including demographic shrinkage, energy transition, and climate change.
- When discussing the events, the players have to weigh in the interests of the characters they present.

Phase 3: Seeing possibilities:

- These events are used to encourage the players to think about the future of the province and generate ideas for the player's village or town or the whole province of Groningen.
- During the brainstorming session, all players contribute to the final idea which is documented by the facilitator.

13 sessions have been organized to collect the ideas and the idea-collection process is completed on March 21, 2020.

2.3.4 The assessment of the policies and Toukomst ideas

The 87 policy documents provided by NPG have been analyzed based on the aforementioned 12 themes. The policy statements in these documents were subdivided in trends, strategies and transformations, which is used as the baseline by researchers to analyse the policies in the indicated documents.

Trends - A policy statement is categorised as a trend when a development in the (near) future is described as a single, as if development

Strategies - A policy statement belongs to the category of strategies when it is formulated as an objective or ambition that is strived for.

Transformations - A policy statement belongs to the transformation category when a concrete to be achieved measure is defined that aims to realise the objective hence realises a transformation in the specific policy field.

The data set of all policy statements is, subsequently, imported into a spreadsheet, in which each policy is identified with a unique cell ID and classified according to location, policy type (trend/strategy/transformation), the risk level (low/medium/high), and the time frame (short/medium/long term). The data set is then organized to match and link the relevant trends, strategies, and transformation groups to set up a logical framework across different policy documents. This approach enabled the synchronization and utilization of the policy documents of various scales towards a common direction hence facilitated the identification of different policy-making patterns within the larger data set. For instance, while an autonomous trend – that is neither supported by a strategy nor by a transformation – is explicitly described in one policy document, a reverse approach is observed in other policy documents, in which the trend is implicitly mentioned. The findings based on the analysis are discussed in the results section to illustrate the current urban policy landscape of the province reflecting a diverse set of priorities and future projections. To ensure the comparability of the public sphere with the policy sphere the collected Toukomst ideas were categorized in the same format based on 12 themes, the risk level, and the time frame. Taking the progressive approach of the Toukomst project into account the ideas have been considered as transformations by definition.

2.3.5 The making of maps and risk/time graphs

The generated dataset is utilized for two different types of data visualizations:

1. The policy maps that aim to spatialize the distribution of different themes, trends, strategies, and transformations across the province (figure 2.1).
2. The risk-time graphs testing the relevancy of policies and ideas to respond to the local and global challenges (figure 2.2).

To create integrity between different themes utilized for this study, initially, a base map is created in ArcGIS by utilizing Open Street Map data. The RD New EPSG: 28992 projection is applied as the coordinate system for the ArcGIS operations. Each theme is transferred into the ArcGIS environment as a separate shapefile and each policy, with a unique cell ID, is mapped under the same theme and geocoded with the same symbol. Three different thematic maps are obtained from the analysis:

1. The policy agglomeration maps that illustrate the distribution of all policy themes across the province (figure 2.3).
2. The intensity maps that show the concentration of one theme in different administrative units (figure 2.4).
3. Trends/Strategies/Transformation maps that reveal the distribution of different policy types per theme across the province (figure 2.5).

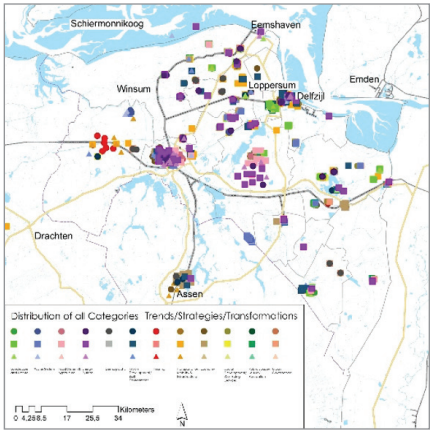

Figure 2.1 Map with all policies collected

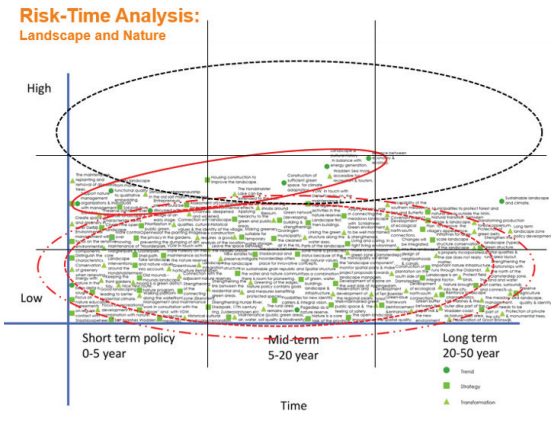

Figure 2.2 Risk-time analysis of the landscape and nature theme

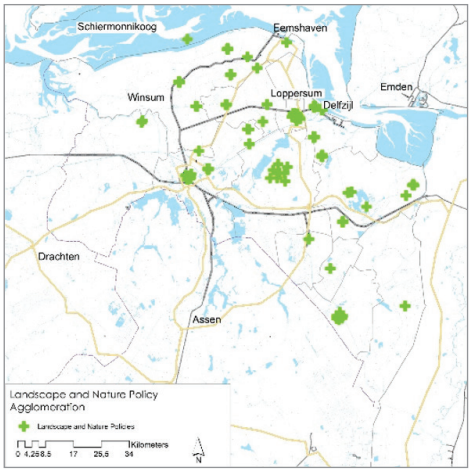

Figure 2.3 Agglomeration map of the Landscape and Nature Theme

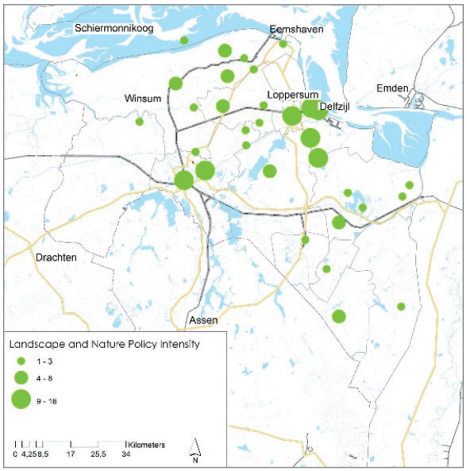

Figure 2.4 The intensity map of the Landscape and Nature theme

These policy maps reveal the different patterns of urban policy themes and actions adopted by the provincial and local administrative units to respond to the provincial problems and to meet the demands of the local residents. The database constructed as a result of this analysis can be further utilised in several ways. For instance, the data set can be merged with other spatial data sets and used for spatial analysis. The database can also be converted into an online platform and used as an open source for public participation and co-creation.

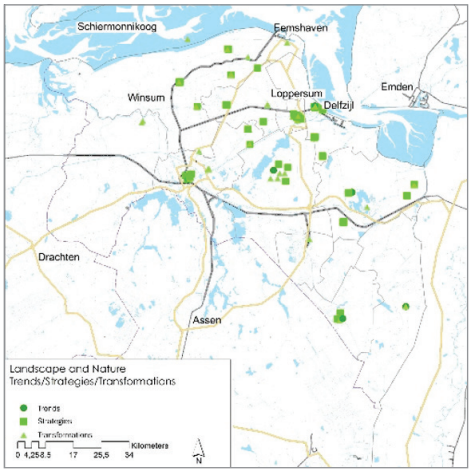

Figure 2.5 Trends/Strategies/Transformation map of the Landscape and Nature theme

2.4 Results

In this section the analyses of policies and ideas for each of the 12 themes will be discussed. In every section the spread of policy statements (in trends, strategies and transformations) is visualised and the graphs of policy statements and ideas respectively show the distribution according their level of uncertainty/risk and time span.

2.4.1 Landscape and Nature

Policies

Landscape and Nature forms, together with the theme of Leisure, a substantial part of the policy mapping. While these policies demonstrate a temporal variety, they are mostly composed of low and medium risk policies, almost neglecting long-term, high-risk developments such as climate change and adaptation. Damsterdiep, Delfzijl, Appingedam and Midden Groningen areas have a specific focus on Landscape and Nature oriented policies (Figure 2.4, Bosch Stabbers, 2004; Kleine et al., 2018 -2022, 2017; Poort et al., 2019; KAW and Boersma Interim Management, 2002; Breunis et al., 2019).

The transition from a mono-functional quality landscape to a multi-functional landscape and the need for a sustainable landscape are the two major trends in this theme. The relevant strategies mostly focus on the enhancement, restoration, and preservation of the different landscape types and

their cultural-historical values. These are followed by transformation policies with a particular focus on the reinforcement of particular green zones, routes, and sightlines in the periphery of villages and towns and in the countryside and natural reserve areas. The landscape character and landscape qualities, aiming at 'giving meaning' to the green of the city and incorporating it in the daily routine of citizens, are particularly mentioned in Diepenring, Hunze river, Stadspark, Zuiderplantsoen areas (Gemeente Groningen, 2018). Specific elements including the wadden (mudflats), the oude wierden (mounds), the dikes, and the salt marshes are commonly referred to (Stuurgroep Herindeling BMWE, 2017). As such, the verge between residential and rural areas and the enhancement of other functions concerning recreation and water storage in green spaces in villages, towns and, the city receive particular attention.

The short-term low-risk approach of these policies brings along a particular focus on preservation and maintenance issues. The management of landscape and green spaces is identified by trends aiming to achieve a balance between economy, ecology, cultural history, and energy generation. Besides the municipalities, the provincial administration plays a key role in landscape management– concerning the strategies of public green prioritization and the hierarchy of green and public areas.

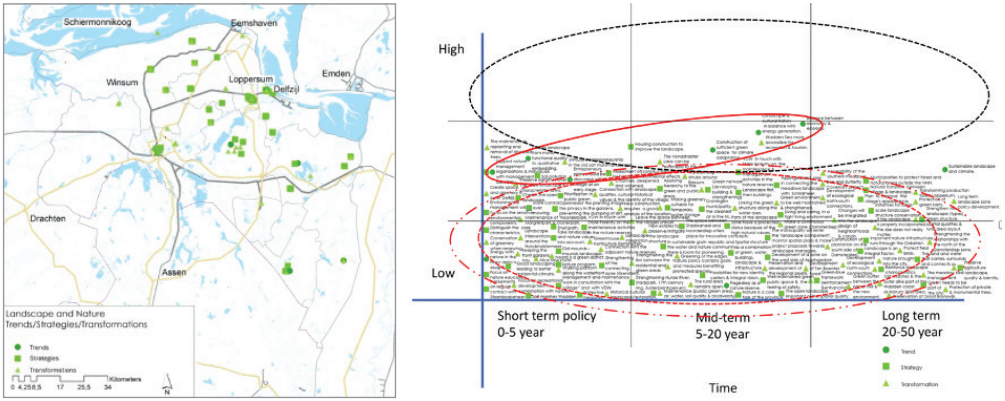

Figure 2.6 Map with all Landscape and Nature policies (trends, strategies and transformation) and the risk/time graph (Roggema et al., 2020)

Ideas

The Toukomst ideas on Landscape and Nature demonstrate a different pattern than the policies. Firstly, unlike the related policies, these ideas construct a small portion of the overall Toukomst ideas. Secondly, Toukomst ideas in this theme include high-risk approaches, neglected in Landscape and Nature policies. Therefore, contrary to Landscape and Nature policies, Toukomst ideas concerning this theme adopt a more comprehensive approach that takes the impact of high-risk developments such as climate change into account.

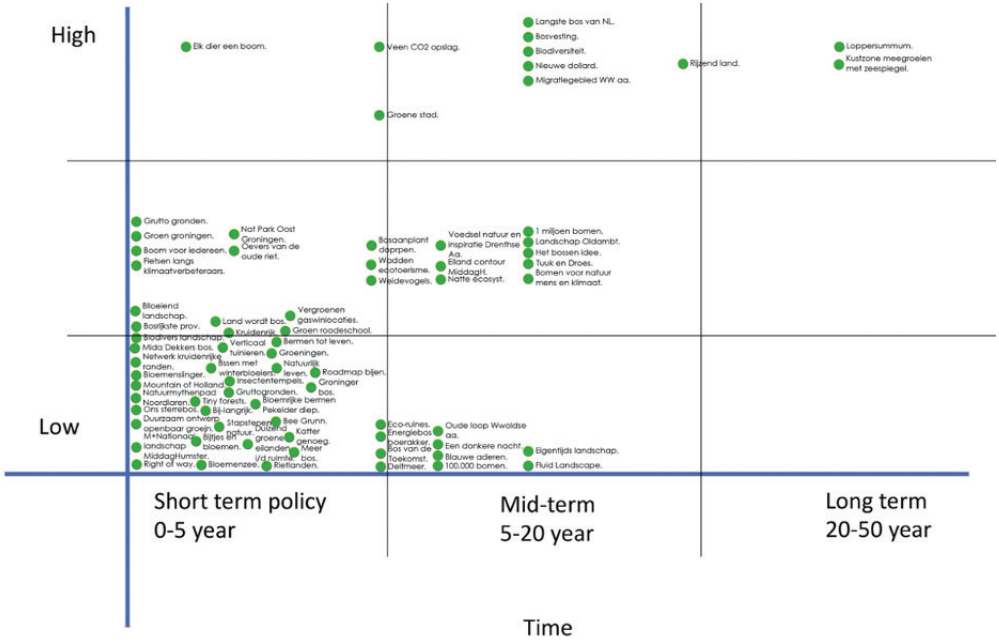

Figure 2.7 Risk/time graph with Landscape and Nature ideas (source: www.toukomst.nl; Roggema et al., 2020)

2.4.2 Water Systems

Policies

Water-related developments and risks are crucial parts of Groningen province landscape structures. Therefore, they should play a key role in the provincial future planning. Water-related policies, nevertheless, can only be found in a limited number of documents including the provincial policies and some of the district- and town plans such as for the Eemsdelta and Middag-Humsterland (Gemeente Appingedam, Gemeente Eemsdelta and Gemeente Loppersum, 2019; Eindversie Stuurgroep Economie, 2012; Bosch Stabbers, 2005). With a particular concentration on short- and mid-term solutions, these policies consider high-risk interventions concerning the transformation of sea dykes and rising sea-levels. The lack of policies with long-term projections leaves a lot to be desired. The water-system policies also point to conflicting trends, strategies and transformations per se. For instance, the Omgevingsvisie Groningen states that more large-scale water storage areas are no longer needed (Gemeente Groningen, 2018). On the contrary, several policy documents, such as for the Eemshaven, embody various (rain) water storage proposals aiming an increase in both the storage and discharge capacities that materialise in the Eemshaven reservoir and the proposed waterpipe from the Eems-canal to Eemshaven (Provinciale Staten van Groningen, Gemeenten Delfzijl, Eemsmond, Appingedam en Loppersum, 2013).

- 'Making room for water' emerges as a fundamental strategy, addressing an increase in the ecological significance of watercourses and surface water extraction for industrial activities (Waterbeheerprogramma Waterschap Noorderzijlvest 2016 – 2021, 2016). Major transformations within this theme focus on the reinforcement, extension, and deepening of dyke routes, as well as short to mid-term low-risk recreational projects on recreational sailing connections.
- Access to fresh water is a major point of concern. In the current situation, in an extremely dry period of 20 days, a freshwater shortage of approximately 0.35 million m3 is estimated (Eindversie Stuurgroep Economie, 2012). The use of groundwater or desalinating seawater is considered expensive if not durable. Freshwater strategies, such as sustainable water treatment management, are overarching policies that meet the standards of the European Water Framework Directive (Gemeente Groningen, 2018).
- Saving water is another major concern, which can be linked to the following trends:
  - The demand from the industry for freshwater (of different qualities) will increase and water from the Eems Canal is best suited for this purpose (because of the distance, the security of supply and the quality, low chloride content)
  - The need for sustainable wastewater collection and purification.

The strategies and trends are carrying out a pilot 'process water supply industry', together with the national government, ensuring the transport and purification of the collected wastewater, implementing a 'chain agreement for the phosphate cycle', and the construction of an industrial water network in Eemshaven (Provinciale Staten van Groningen, Gemeenten Delfzijl, Eemsmond, Appingedam en Loppersum, 2013).

- Climate adaptation is related to the following trends:
  - the rise in sea level,
  - extreme precipitation,
  - sea dikes no longer meeting safety standards.

  These trends are related to the strategies concerning the broadening and raising of the current sea defenses and broader scale considerations, such as the need for 'multi-layer safety' in spatial planning and to respect the natural conditions of water systems. A foreshore in the form of salt marshes, a phased site increase, use of mobile quays, and flood-proof operation to keep the land outside the dikes dry in Eemsdelta are the indicative transformations.

The strengthening of the Wadden region ecosystem and connecting the Wadden Sea World Heritage with the 'cultural values' of the inner are other important transformations.

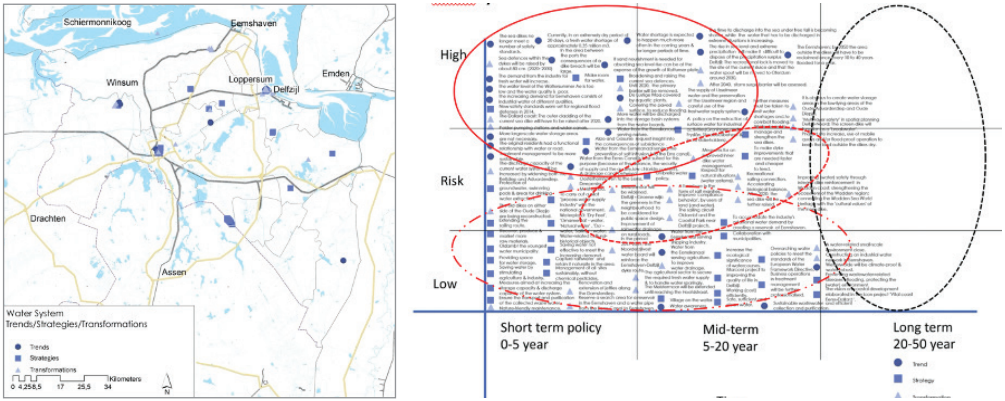

Figure 2.8 Map with all water policies (trends, strategies and transformation) and the risk/time graph (Roggema et al., 2020)

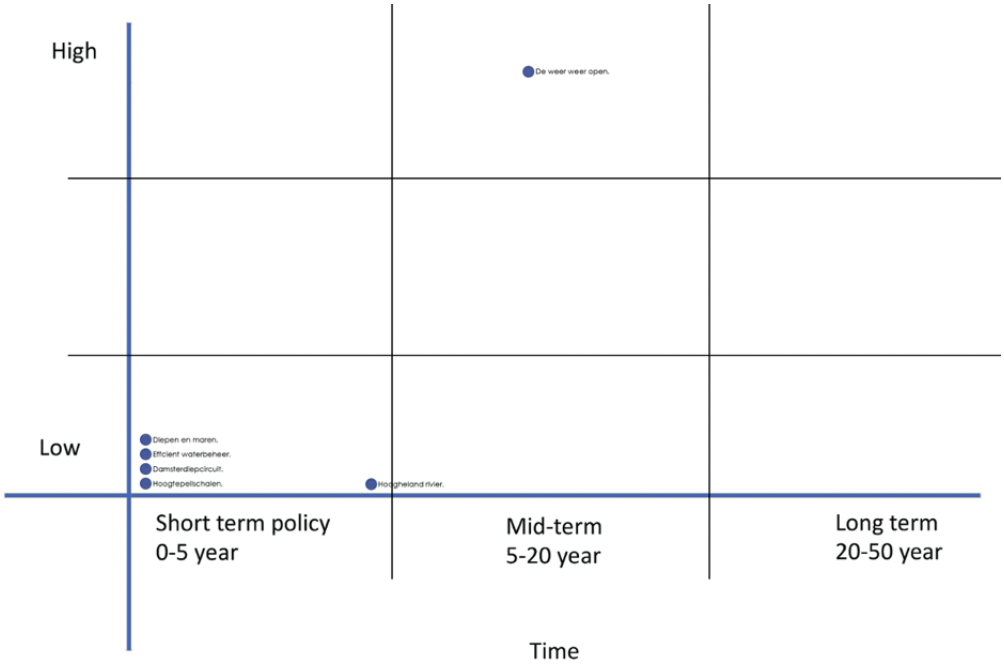

Figure 2.9 Risk/time graph of all water ideas (source: www.toukomst.nl; Roggema et al., 2020)

Ideas

Surprisingly, water-related ideas are only a very limited portion of the Toukomst ideas. This points to a certain disinterest in the public domain despite the importance of water for the provincial landscape. This situation suggests policymakers might need to put more effort into raising awareness in water-related potentials and risks of the province.

2.4.3 Food System & Agricultural Development

Policies

While the majority of the food systems and agricultural policies adopt a short to medium-time and low to medium-risk approach, they also embody an important number of long-term policies. The most striking aspect of this theme is the predominant discourse on innovative agricultural production techniques, highly engaged with energy-related policies. This interest in innovation represents a stark contrast if compared with the research findings of the Toukomst students that address a decline in the number of

Within this framework, the policies based on the land competition between agriculture and solar panels threatening the future of local food production are identified as high-risk operations. Not surprisingly, these innovative approaches intensify in the Eemsdelta and Midden Groningen areas (Gemeente Appingedam, Eemsdelta and Loppersum, 2019; Eindversie Stuurgroep Economie, 2012; Breunis et al., 2019), identical for ambitious energy policies. Specifically, rich sea clay soils, temperate maritime climate and efficient subdivision make the Eemsdelta area suitable for agriculture where the financial product revenues, except for seed potatoes, are relatively low and employment in agriculture is declining. This leads to strategies focusing on the biobased economy, economic effectiveness in the agricultural sector. The primary and secondary economic currents, in addition to the food and feed industry, transform into other useful applications, such as biochemicals, biomaterials and biofuels. This is then followed by relevant transformation policies that suggest the production of green raw materials for the chemical industry (Provinciale Staten van Groningen, Gemeenten Delfzijl, Eemsmond, Appingedam en Loppersum, 2013).

Furthermore, recycling agriculture – entailing the minimal use of raw materials and the valorization of residual flows such as manure – is identified as an important trend in several policy documents. On the contrary to more conventional agricultural modes of production that mainly produces food for people and animals, recycling agriculture enables the supply of renewable raw materials. No competition is triggered between producing food and biomass, therefore, new income opportunities emerge for the farmers. This innovative approach materialises in the following strategies (Verschuren et al., 2019):

- In 2030, in the agriculture and horticulture, the use of raw materials and excipients will be substantially reduced, and all end products and residues will be as much as possible brought to value.
- Agriculture can also become a supplier of renewable raw materials, e.g. for the production of green chemicals, plastics, and (animal feed) protein. This mainly involves valorizing residual flows (e.g. manure) and closing agricultural cycles.

The transformation policies on (dairy) cattle farming sector and the algae processing industries refer to recycling agriculture as an important theme (Provinciale Staten van Groningen, Gemeenten Delfzijl, Eemsmond, Appingedam en Loppersum, 2013). The increasing interest of companies in vegetable, mushroom, and algae cultivation under glass is another technology-dependent trend for Eemshaven, operationalized by the preparation of a large industrial glasshouse horticultural complex as a transformative policy (Verschuren, et al., 2019; Eindversie Stuurgroep Economie, 2012).

The trend for increasing demand for locally produced, organic food is the second pre-dominant topic in this theme, engaged with a set of medium-term policies. Essentially, strategies for valued, healthy and safe food in 2030, stand out (Verschuren, et al., 2019). The use of sludge from the Dollard to replace artificial fertilizers exemplifies the relevant transformation policies (Gemeente Oldambt, 2017). Climate adaptation is a long-term strategic goal for climate-neutral agriculture and food production (Verschuren, et al., 2019). Moreover, the agricultural sector is declared as the key actor in finding solutions for heat stress (Provinciale Staten van Groningen, Gemeenten Delfzijl, Eemsmond, Appingedam en Loppersum, 2013). The increasing number of livestock farmers engaged in energy production is a fundamental transformation policy concerning climate change.

Finally, more conventional policies (Gemeente Oldambt, 2017; Gemeente Oldambt, 2010; Gemeente Veendam, 2015; Gemeente Veendam, 2016) address the link between agriculture and landscape conservation such as indicating the agricultural land as an appealing component of ancient cultural landscapes. The efforts to this end generate strategies aiming at a balance between economically profitable agriculture and nature conservation and transformations that prohibit new intensive livestock farms.

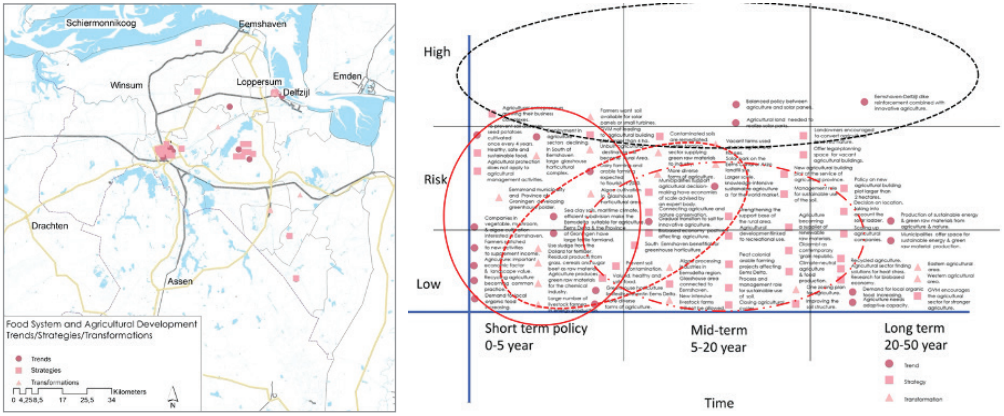

Figure 2.10 Map with all Food systems policies (trends, strategies and transformation) and the risk/time graph (Roggema et al., 2020)

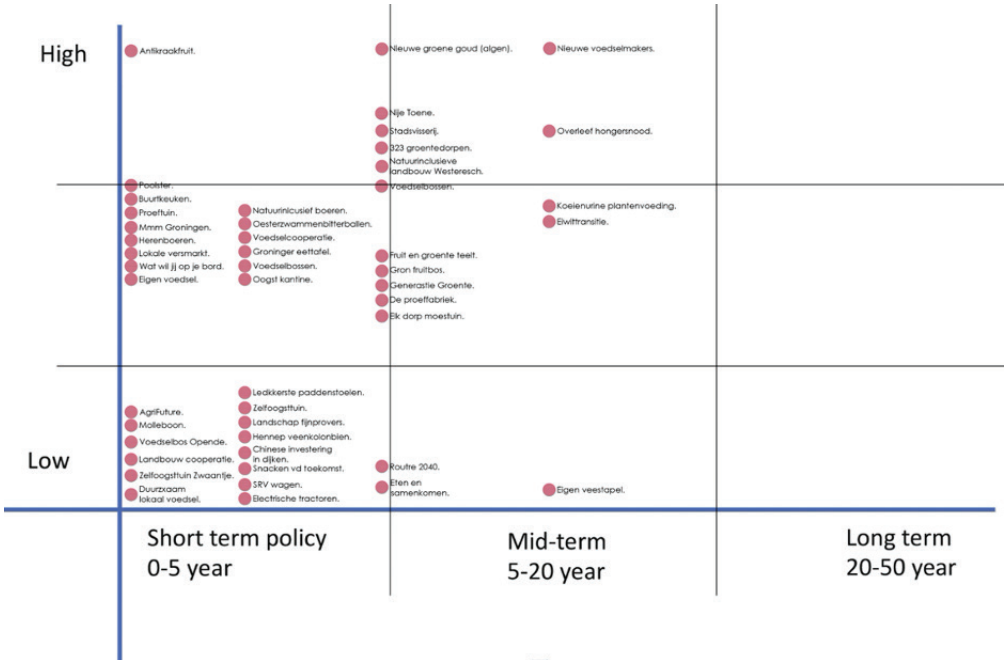

Figure 2.11 Risk/Time graph for all food systems ideas (source: www.toukomst.nl; Roggema et al., 2020)

Ideas

The Toukomst ideas, related to food systems and agriculture, include medium-term and medium to high-risk ideas. Unlike policies related to food systems and agriculture, the Toukomst ideas under this theme lack long-term propositions. Within this context, the Antikraakfruit idea that focuses on the brownfield sites as potential agricultural land differs from the rest as a short-term high-risk idea.

2.4.4 Energy Systems

Policies

The energy systems policies represent a unique category with a particular focus on long-term high-risk policies, contrasting with most of the other themes. The policy documents refer to the province of Groningen as a key player in the production of renewable energy, due to the infrastructural capacity of Eemshaven in gas distribution, and assert that City of Groningen and its broader region

should operate as a testing ground in the energy transition (Gemeente Groningen, 2018; Stuurgroep Regio Groningen-Assen, 2013). Considering the ambitious goal of Groningen to transform into a natural gas-free and energy-neutral province by 2035, these policies also state that more attention should be given to circular systems of water, raw materials, and waste. Wind (including both small windmills and large-scale wind farms, both on land and at sea), solar energy (via solar parks), geothermal energy, hydrogen, biomass, green gas, industrial residual heat, and the cooperative decentralized energy supply, in this regard, represent the trends with alternative solutions. Strategies such as the production of new battery types, electric cars, and nanotechnology also support this process. The construction of biomass yards and a manure fermentation plant, energy generation from the fermentation of sewage sludge, and the waste heat project, focusing on the use of residual heat released during the production of energy in the chemistry industry (Gemeenten Appingedam en Delfzijl, 2010), are more progressive policies that aim for a transformation. Special attention is given to the energy transition of buildings as seen in neighborhood-wide investments in generating sustainable energy. Better insulation, district systems for heat and cold storage, green electricity, extensive use of solar panels, and collective sunroofs are indicative transformations.

Besides the comprehensive provincial vision on energy systems, these policies aggregate in three primary areas within the province: the city of Groningen, Midden-Groningen, and Eemsdelta. While the strategic approach dominates this theme, Roodeschool, Zijldijk, Middelstum, Woltersum, Appingedam, Oostwold, Midwolda and Eemsdelta are mentioning trends (Gemeente Eemsmond, 2005; Boersma, et al., 2010; Stichting dorpsbelangen Middelstum, 2016; Municipality of Groningen, et al., 2019; Poort, et al., 2019; KAW and Boersma Interim Management, 2002; Alma, et al., 2018; Vereniging Dorpsbelangen Midwolda, 2018; Gemeente Appingedam, Eemsdelta and Loppersum, 2019; Eindversie Stuurgroep Economie, 2012). Socially supported wind farms, strategies focusing on smart grids (where the supply of energy adapts to the current demand of energy), and transition towards completely emission-free mobility in the inner city are energy-transition policies specifically generated for the city of Groningen (Gemeente Groningen, 2018). The development of an energy hub at sea, smaller generation units in Delfzijl, and the controversial nuclear power plant are significant policies proposed for the Eemsdelta (Provinciale Staten van Groningen, Gemeenten Delfzijl, Eemsmond, Appingedam en Loppersum, 2013).

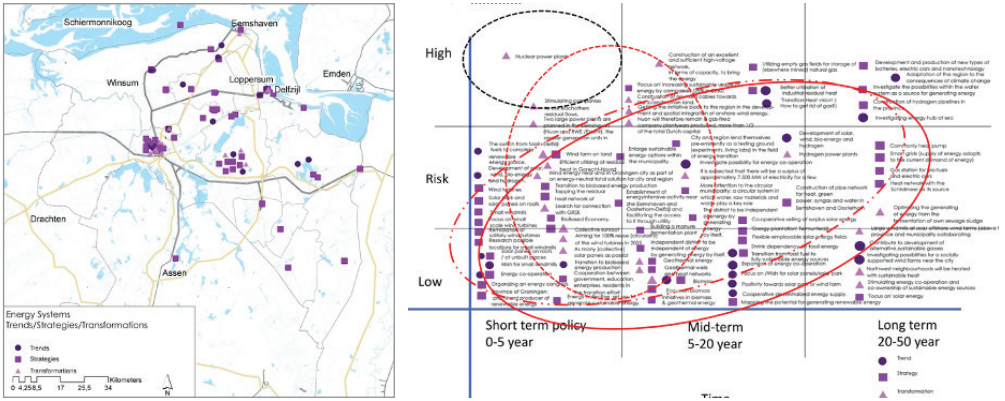

Figure 2.12 Map with all Energy systems policies (trends, strategies and transformation) and the risk/time graph (Roggema et al., 2020)

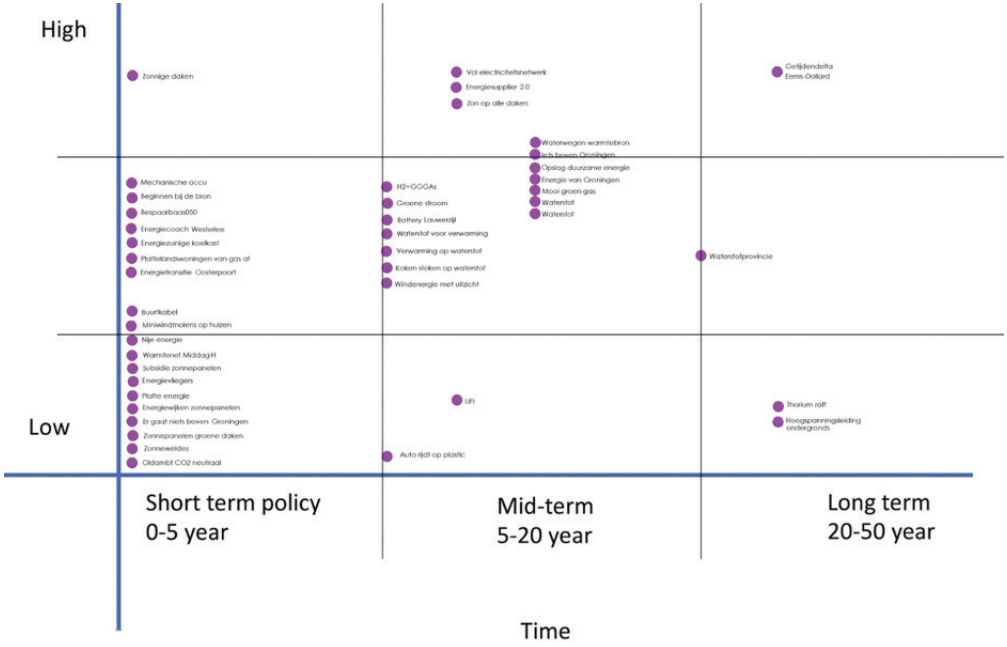

Figure 2.13 Risk/Time graph for all energy systems ideas (source: www.toukomst.nl; Roggema et al., 2020)

Eemshaven stands out with ambitious policies such as the planning of two large power plants and the construction of a pipe network for heat, green power, syngas, and water in Eemshaven and Oosterhorn (Gemeenten Appingedam en Delfzijl, 2010; Provinciale Staten van Groningen, Gemeenten Delfzijl, Eemsmond, Appingedam en Loppersum, 2013). Ten-post, Loppersum, Onderdendam, and Pekela are other areas with a strong interest in energy systems policies (Gemeente Pekela, 2019; Enno Zuidema Stedebouw et al., 2016 Dorpstafel Ten Post and Gemeente Ten Boer, 2018; Bronts, et al., 2016). The construction of new sea cables towards Scandinavia, as well as the construction of a high-voltage network (generating energy both for the inland and abroad) and utilitarian networks (that allow companies to use each other's residual flows) are among the important transformation policies that should be acknowledged (Eindversie Stuurgroep Economie, 2012).

Ideas

The Toukomst ideas on Energy systems are clustered in two main groups: short-term, low to medium-risk ideas and medium-term medium to high-risk ideas, which is very different from the evenly distributed pattern of energy systems policies. *Getijdendelta Eems-Dollard*, *Waterstofprovincie*, *Thorium Raff*, and *Hoogspannings-leiding ondergrond* represent the limited number of long-term ideas in this category.

2.4.5 Demography

Policies

Compared to the other themes, demographic policies are limited in the policy documents. These policies adopt a short-term, low to high-risk approach, particularly focusing on describing trends. This pattern addresses a negligence in generating effective policies for long term developments that stem from the lack of medium to long-term transformation-oriented policies. These findings are also supported by the student research conducted at KCNR. The provincial maps produced by KCNR students demonstrate that the share of Groningen's population within the Netherlands has been in decline since the early 20th Century (Roggema et al., 2020). The 1990-2019 map points to a deep cleavage in the demographic growth of the province. While the city center and the western districts increased their share in the province, the rest of the province–specifically the Delfzijl area–witnessed decline. The demographic projections of the province between 2019 and 2040 demonstrate that this trend will continue, and besides Delfzijl, it will essentially affect the northeastern part of the province strengthened via an increase in the share of the aging population. Given that context, the policies related to imbalanced growth of one particular group, such as 'a large group of unskilled people' and 'more elderly' (Gemeente Groningen, 2018; Stuurgroep

Herindeling BMWE, 2017; Stuurgroep Regio Groningen-Assen, 2013; Gemeente Loppersum, 2011), have been identified as high-risk developments. Besides the overall population decline, in most villages the total number of households decreases, while the share of single households is increasing.

In terms of geographic distribution, demographic policies prevail across the province including an important number of the villages. 'Fewer children' and 'fewer young people' are the other shrinkage-related trends. In general, residents are becoming increasingly mobile and, interestingly, in some villages, former residents return to start a family.

In Groningen city, the student population is increasing and around 25% of the student population and 50% of the researcher population is international (Gemeente Groningen, 2018). The rise of the sub-economy, new jobs originated by zzp-ers (freelancers without personnel) and start-ups, with more people working from home, are employment-related policies, transforming the demography of the province. Health care, the construction industry and real estate are the sectors with increasing employment rates.

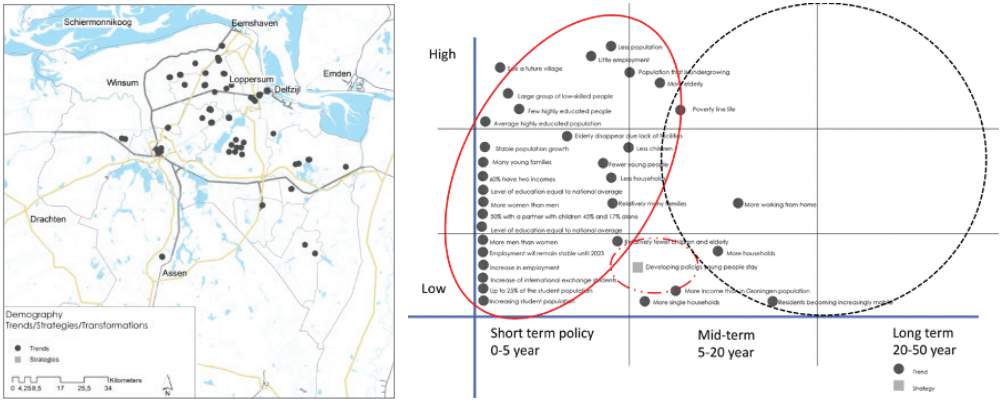

Figure 2.14 MMap with all Dempgraphy related policies (trends, strategies and transformation) and the risk/time graph (Roggema et al., 2020)

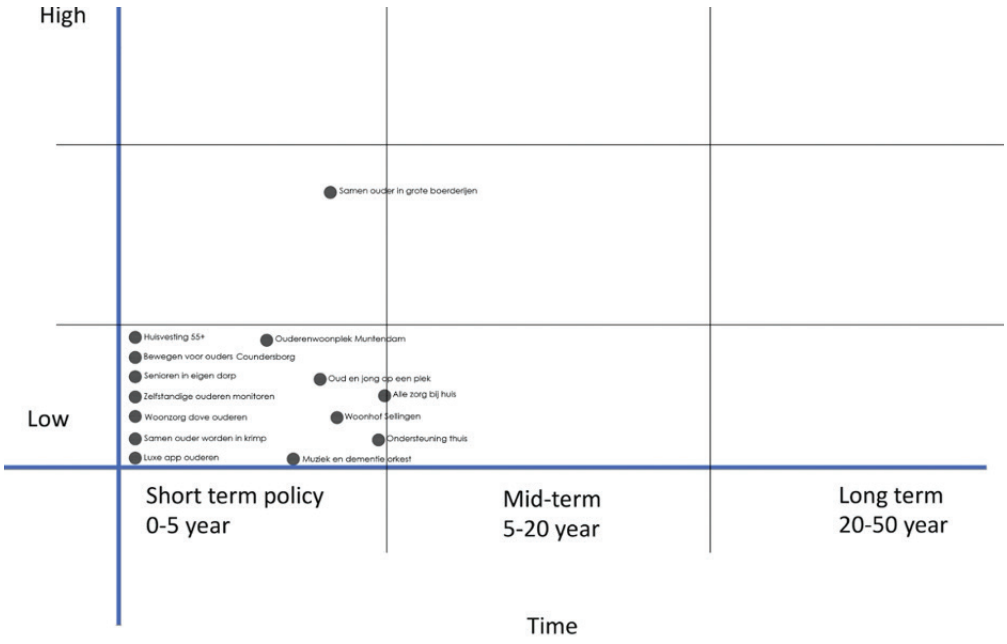

Figure 2.15 Risk/Time graph for all demography related ideas (source: www.toukomst.nl; Roggema et al., 2020)

Ideas

Similar to demographic policies, the Toukomst ideas on demography are underrepresented, revealing a short-term, low-risk pattern. Only the 'Samen ouder in grote boerderijen'-idea stands out from the rest as it takes shrinkage and an aging population simultaneously into account. This idea proposes the conversion of abandoned farms into housing for the elderly, therefore it has been evaluated as a medium-risk approach.

2.4.6 Urban development and built environment

Policies

Urban design-oriented urban development and built environment policies generally lack a long-term approach, except for climate-adaptation policies in the Midden-Groningen area (Breunis, et al., 2019; Verschuren, et al., 2019). The notion of the need for a 'compact city' (Gemeente Groningen, 2018), has been a fundamental policy since 2004 (Roggema et al., 2020). The compact city aims to shape the urban form and urban development patterns of the province, opting to safe and generate more green and public space and an intensified city center. The prevention of a barrier effect in the working spaces and the inclusion of minimum percentages for social rent in the new middle-income residential buildings, to promote diversity in the mixed-use neighborhoods, are relevant strategies for the compact city policy. These are then followed by the conversion of former industrial sites and business parks into mixed residential areas and abolishing the spatial barriers around the railroads and the ring roads as corresponding transformations. Within that scheme, cities are regarded as anchoring points for work, education, and culture, thereby daily commute is expected to increase. In the RegioVisie Groningen-Assen and the Herindelingsadvies Midden Groningen, a transition from space division to a mosaic of growth and contraction is suggested (Stuurgroep Regio Groningen-Assen, 2013; Gemeenten Hoogezand-Sappemeer, Slochteren en Menterwolde, 2016). This can be achieved by decreasing the contrast between the city and the countryside, as this way an intensive interrelationship can be enhanced. Lack of space concerning the expansion to reconstruction and smart management is another relevant topic. Therefore, the development strategy for Eemsdelta describes a sustainable, cross-border port region, with Appingedam and Delfzijl embedded into one cohesive urban network (Provinciale Staten van Groningen, Gemeenten Delfzijl, Eemsmond, Appingedam en Loppersum, 2013). Enhancing the individual, compact and lively character and the cultural-historical values of the villages is a major trend identified in the policy documents. Improved accessibility, architectural and industrial heritage conservation, the reduction of empty buildings and vacancy tracking are the key strategies in this regard, leading to transformations policies that combine living, well-being, and care. Wagenborgen and Veendam areas perfectly exemplify common approaches within this theme, including facility management, strengthening the spatial quality, preservation, refurbishment, renewal and demolition (HzA Stedebouw and Landschap, 2009; Gemeente Veendam, 2015; Gemeente Veendam, 2016).

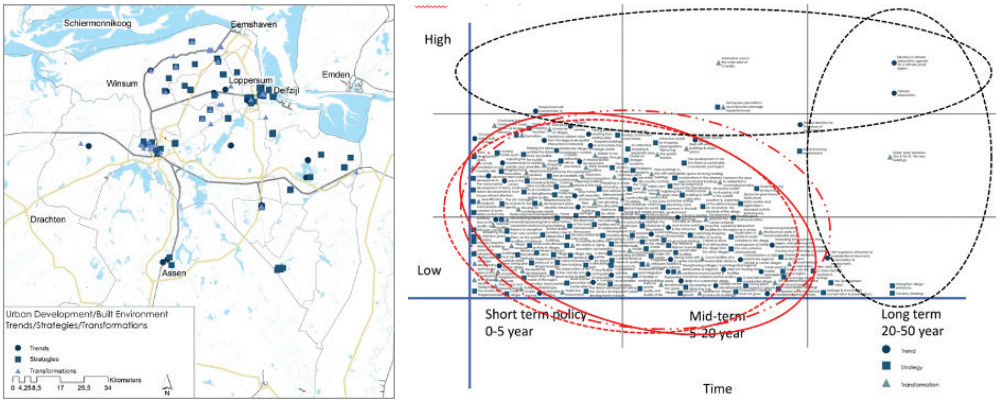

Figure 2.16 Map with all urban development related policies (trends, strategies and transformation) and the risk/time graph (Roggema et al., 2020)

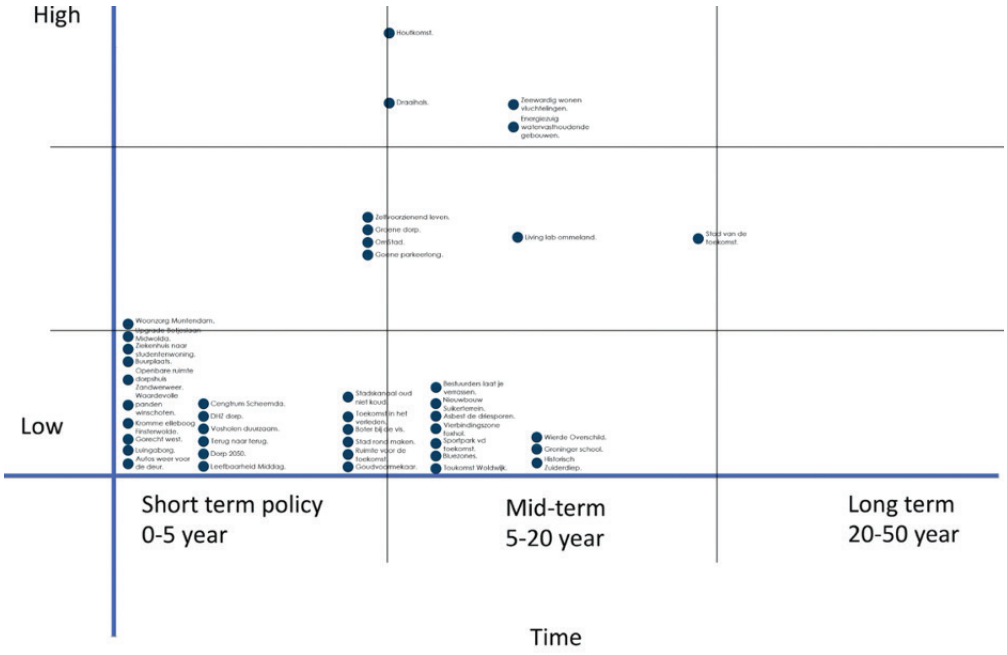

Figure 2.17 Risk/Time graph for all urban development related ideas (source: www.toukomst.nl; Roggema et al., 2020)

Ideas

Toukomst ideas on urban development and built environment cover short to medium-term, low-risk propositions. Despite their limited number, they reveal a similar pattern to the concerning policies, almost ignoring high-risk approaches both on the long- and short-term. Within this scheme, the cluster of medium-term, medium to high-risk ideas materialise as an exception, embodying a diverse set of ideas on wood construction, sustainable energy, circular agriculture and sustainable energy.

2.4.7 Housing

Policies

Housing-policies follow the short to medium-term, low to medium-risk pattern with a very limited number of long-term and high-risk policy statements. Policies concerning the housing stock and energy-transition in this category have been evaluated as belonging to the high-risk category. Housing policies are mostly dominated by strategies and prevail across the province. Within this context, Uithuizermeeden, Usquert, Zandeweer, Eppenhuizen, Doodstil, and Farmsum areas are driven by trends (*Gemeente Het Hogeland*, 2014a; *Gemeente Het Hogeland*, 2014b; Slotegraaf, et al., 2018; Peeters and Dijk, 2010) and Appingedam and Midden-Groningen areas opt for transformation policies (Poort, et al., 2019; Breunis et al., 2019). Degradation and the increasing number of vacancies in some villages have been evaluated as the major trends and the architectural identity and maintaining the living quality are the common strategies. The transformation policies such as increasing earthquake resistance and making houses more energy efficient are common across the province. This theme also includes conflicting approaches as seen in several inconsistent policies on the construction of new houses. Within this context, Groningen city is identified with housing policies concerning the development of mixed urban areas, the use of existing qualities and cultural-historical values and gas-free homes (Gemeente Groningen, 2018).

Housing policies are closely intertwined with social development and well-being policies as indicated in strategies on lifecycle-proof houses (*Levensloopbestendige woningen*), stemming from the increasing population of elderly living longer and preferring to stay in their residences. Another relevant trend in this regard is the need for free sector-dependent (life-course) social housing due to the increasing number of vulnerable groups that demand care. This is followed by a trend for affordable starter- (*Starterswoningen*) and single-family homes.

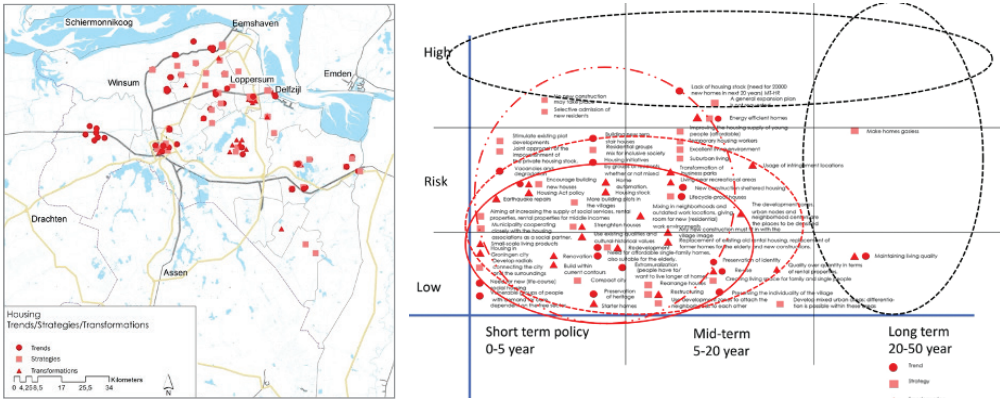

Figure 2.18 Map with all housing policies (trends, strategies and transformation) and the risk/time graph (Roggema et al., 2020)

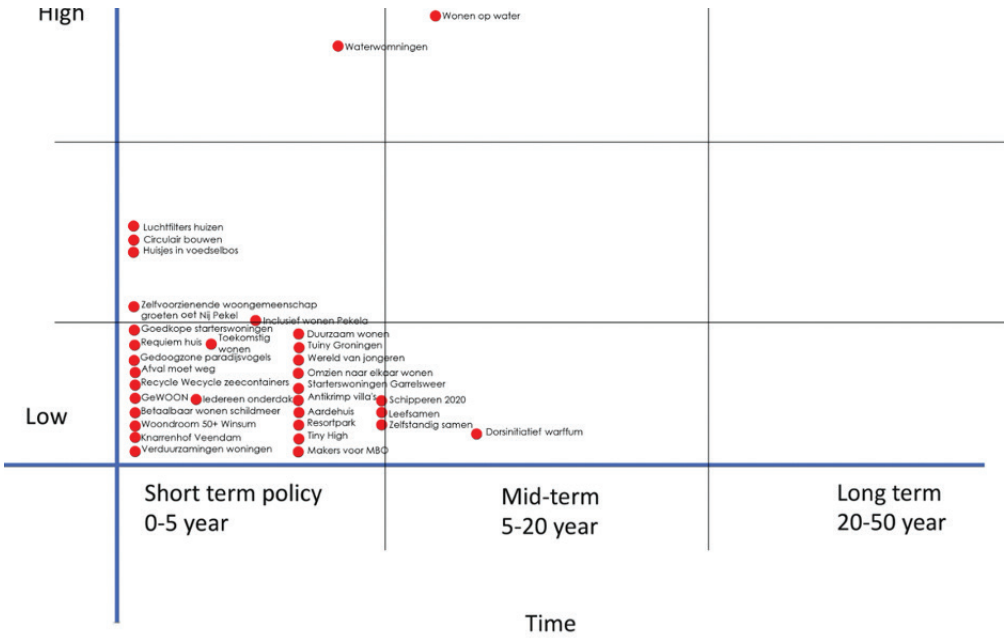

Figure 2.19 Risk/Time graph for all housing ideas (source: www.toukomst.nl; Roggema et al., 2020)

The need for 20,000 new homes, with contemporary design solutions on working, shopping, entertaining and educating from home, in the next 20 years in the City of Groningen (Gemeente Groningen, 2018) underlines the housing shortage problem. Housing projects often refer to urban development policies including the compact city, catching the growth for two-thirds in the (inner) urban areas, not building extra in the outlying area, developing radials that connect the city and the surrounding area, and using development zones to attach the neighborhoods. Despite the general demand for new housing projects with novel construction techniques and typologies, the research of the KCNR students demonstrates that the existing provincial housing stock embodies great variety, therefore, it is imperative to avoid over-generalized housing policies at the provincial level (Roggema et al., 2020).

Ideas

The distribution of housing ideas in Toukomst corresponds to the pattern of housing policies, with more concentration on short-term, low-risk approaches. A set of proposals including *Luchtfilters huizen, Circulair bouwen, Huisjes in voedselbos, Waterwomningen*, and *Wonen op water* represent more adventurous albeit innovative approaches by engaging housing with climate change and adaptation, circular economy and water.

2.4.8 Transportation, mobility and infrastructure

Policies

Transportation, mobility and infrastructure policies are clustered in certain areas within the province such as the north-eastern part. While these policies are spread over time, they exclude high-risk approaches with a vast number of small-scale projects including bike paths. Essentially, Appingedam, Eemsdelta, Delfzijl, and Farmsum areas show a significant interest in transportation, mobility, and infrastructure policies as exemplified in two major policies generated for Eemsdelta (Eindversie Stuurgroep Economie, 2012):

- The improvement of infrastructure (roads, waterways, railways, pipelines).
- The extension and improvement of sea locks (zeesluizen) in Delfzijl.

Despite the dominance of strategies within this theme, Actualisatie Regiovisie Groningen holds an important number of transformation policies (Stuurgroep Regio Groningen-Assen, 2013). These policies also prioritise the connectivity of the province with other regions in the Netherlands and Europe, via improved digital connections as exemplified in the establishment of a faster connection between Randstad-Groningen-Hamburg and the reduction of travel time to Amsterdam and Bremen.

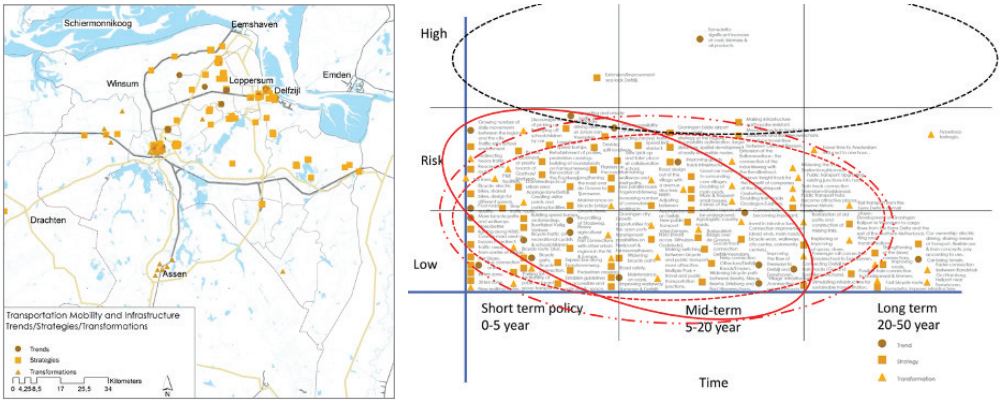

Figure 2.20 Map with all transport and mobility policies (trends, strategies and transformation) and the risk/time graph (Roggema et al., 2020)

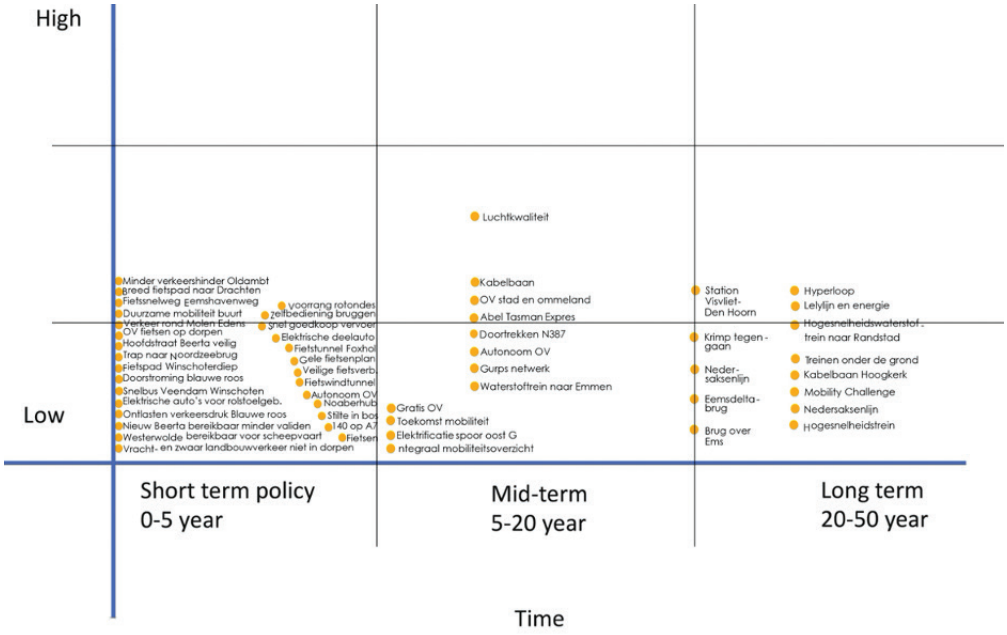

Figure 2.21 Risk/Time graph for all transport and mobility ideas (source: www.toukomst.nl; Roggema et al., 2020)

Traffic in rural areas of the province is a major concern, identified by the trends concerning heavy agricultural traffic, bicycle traffic of schoolchildren and recreational cyclists, speeding and unsafe traffic situations and poor road quality. Strategies including the creation of traffic-safe school environments, the establishment of slow traffic routes and the redirection of traffic away from the center of some villages, promotion of car sharing, creation of multiple P&R facilities and public transportation junctions and new bicycle paths aim to enhance the traffic safety.

The growing number of daily commutes between the region and the city, required for work, education, the use of medical facilities, shopping and recreation, reveals the need for better accessibility of the City of Groningen. Strengthening the connections between the municipality of Groningen and its surroundings, proposing the renewal of the ring road, improvement of public transport and the bicycle network are the strategies and transformations that serve this purpose.

Ideas

Toukomst ideas on transportation, mobility and infrastructure demonstrate a very similar pattern to that of the policies. The sole difference is the lack of medium to high-risk proposals in ideas. This resemblance points to an alignment in the public sphere and policy sphere on this theme. Therefore, it can be used as a common ground to discuss the future of the province.

2.4.9 Economy

Policies

Economic policies are concentrated in the Eemsdelta, Midden Groningen, Assen and Oost-Groningen areas (Gemeente Appingedam, Gemeente Eemsdelta and Gemeente Loppersum, 2019; Eindversie Stuurgroep Economie, 2012; Breunis et al., 2019; Verschuren, et al., 2019; Stuurgroep Regio Groningen-Assen, 2013; Bessembinders, et al., 2011) . Therefore, unlike other themes, they adopt a more 'regional focus' to strengthen the economic links with other regions in the Netherlands and Germany. High-risk policies such as industrial and agricultural decline and unemployment only reflect a limited number of the challenges the province has to face in the short-term. Despite the relatively high unemployment rates in the province, an increase in the number of new jobs and start-ups is expected in the city of Groningen (Gemeente Groningen, 2018). Work gets more fluid – independent of time and place – and the villages – where mostly one-man businesses survive – tend to become residential places of commuters. Moreover, reaching out to qualified employees is getting more difficult. The manu-

facturing industry, especially shipbuilding, trade, and energy sectors seem to remain stable (Gemeenten Hoogezand-Sappemeer, Slochteren en Menterwolde, 2016; Alma, et al., 2018).

On the other hand, the growth in care and welfare sectors is supported by a diverse set of strategies such as the stimulation of tourist-recreational entrepreneurship, the redevelopment of vacant properties, the preservation of neighborhood and village shopping centers, and the enforcement of the economical connection between the City of Groningen and the province. Development of more meeting places, innovation workshops, incubators, and business collection concepts in Groningen city are the transformations that aim to materialise the aforementioned strategies (Gemeente Groningen, 2018). The culture and identity of Groningen province is considered as an important economic driver followed by the notion of internationalisation, based on strategies for an active welcoming policy, better integration and more suitable housing, study, work and culture (Gemeente Groningen, 2018).

Eemsdelta is characterized by the presence of several strong sectors: agriculture, chemistry, energy, and seaport logistics, and recycling and data centers. Seaports maintain the profile of an industrial port with clearly identifiable logistic flows such as coal and biomass. Companies are encouraged to use each other's residual flows–including heat, wastewater, and by-products–and develop utility networks. The Eemsdelta Economy Vision 2030 aims to make the economy 40% greener, more knowledge-intensive, and innovative than in 2012, increasing its added value by 50% and the employment by 20%. This objective leads to an expansion space for greenhouse horticulture, data centers and biobased agrifood (Eindversie Stuurgroep Economie, 2012).

Figure 2.22 Map with all economy policies (trends, strategies and transformation) and the risk/time graph (Roggema et al., 2020)

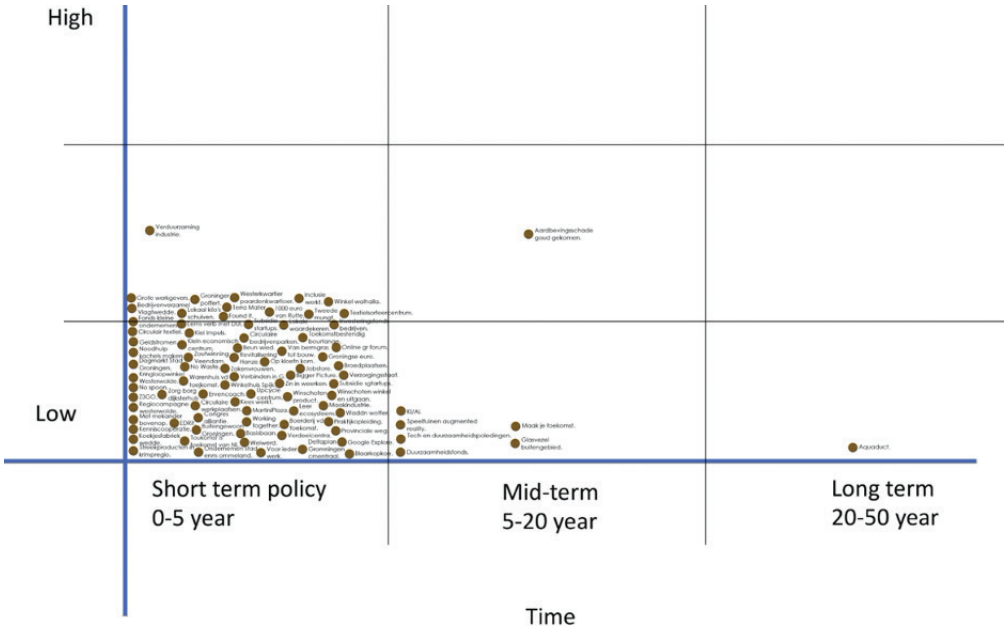

Figure 2.23 Risk/Time graph for all economy ideas (source: www.toukomst.nl; Roggema et al., 2020)

Ideas

In contrast to the economic policies, Toukomst ideas about economy are mostly limited to short-time, low-risk approaches. *Verduurzaming industrie* and *Aardbevingsschade goud gekomen* are visionary projects that deal with the contemporary challenges of the province while the *Aquaduct* proposal stands out with a long-term approach.

2.4.10 Social development and well-being

Policies

Policies related to social development and well-being services take up only a very limited part in all policy documents, demonstrating a unique time-risk pattern with several medium to high-risk interventions potentially revealing the real threats the province faces. The lack of long-term and transformation-oriented interventions, however, points to a substantial gap between theory and practice. Within this category, Loppersum, Zuidwolde, Eenum, and Appingedam areas come into prominence with many community and youth-focused projects (Bronts, et al., 2016; Snoey, et al., 2016; Gemeente Loppersum, 2011; KAW and Boersma Interim Management, 2002). Positive youth policies concentrate on social bonding, encouraging participation in social, cultural, and recreational activities, offering sports and other facilities, and supporting village care initiatives targeting all ages. Strengthening mutual cohesion, the need for new community/multifunctional centers, combating poverty and reducing illiteracy are the major community-focused projects. A more self-reliant and supportive community for the City of Groningen, transforming and updating educational facilities, developing community/neighborhood centers and strengthening the international profile of the city are other important youth and community-focused policies (Gemeente Groningen, 2018). Finally, policies on the elderly including intramural healthcare, neighbourhood help with groceries, development of new forms of daytime activities and the support of small-scale target transport group construct an important part of this theme.

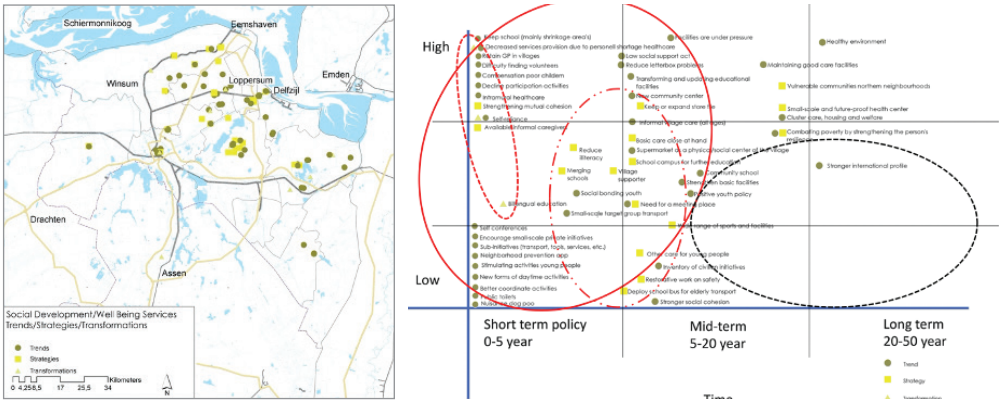

Figure 2.24 Map with all well-being policies (trends, strategies and transformation) and the risk/time graph (Roggema et al., 2020)

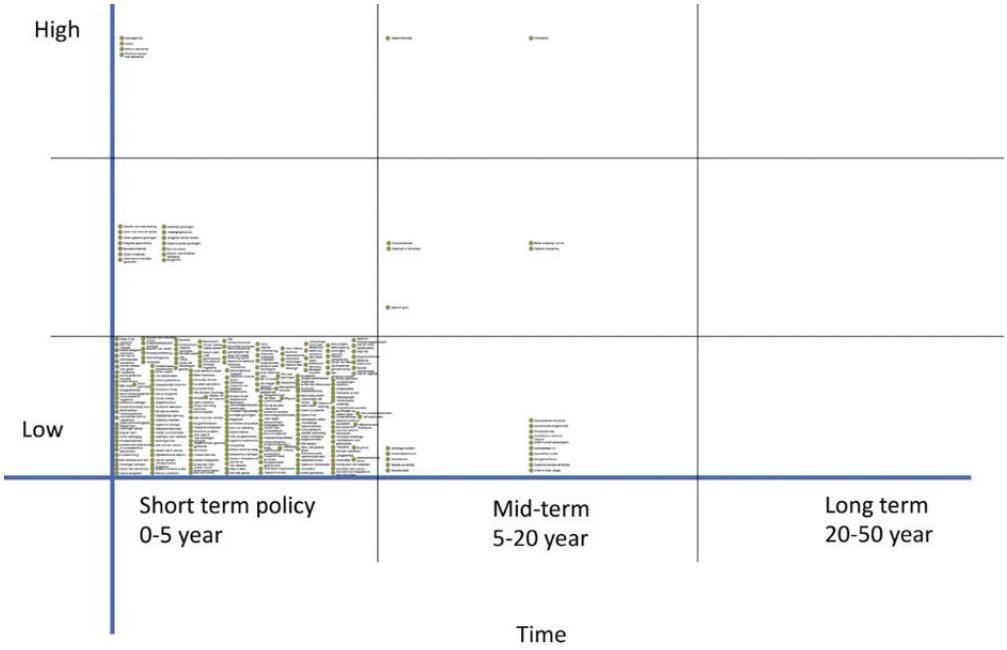

Figure 2.25 Risk/Time graph for all well-being ideas (source: www.toukomst.nl; Roggema et al., 2020)

Ideas

Social development and well-being services is one of the most commonly used themes amongst all Toukomst ideas with a wide range of topics including proposals on dementia, healing herbs and education. However, contrasting to the policies in the same theme, the majority of these ideas propose short-term and low-risk solutions.

2.4.11 Leisure, recreation and public space

Policies

Together with urban development and landscape and nature policies, the leisure, recreation and public space category covers a large part of the policy documents. These policies are spread over time, yet they exclude medium-to high-risk interventions. The policies in this theme embrace a strategic and transformational approach based on conventional urban design proposals such as the construction of shopping centers, and biking, walking and cycling paths. Strengthening tourism and recreation is another common approach with strategies on the encouragement of tourist attraction facilities and activities, the support of large open-air events and the provision of better information to visitors. Mapping and preserving the cultural heritage, nature and landscape and further development of cultural tourism are other important strategies for leisure and recreation.

Public space is considered a key player in enhancing the quality of life via social cohesion. Maintenance of green, safety, cleanliness and intactness are frequently discussed in the policy documents. For instance, in Omgevingsvisie Groningen, the street is envisioned as a pleasant, green living environment (Gemeente Groningen, 2018). The principles for the public green areas are based on sustainability and climate resilience to improve the quality of neighbourhood green, enhancing landscape qualities, protecting biodiversity and efficiently organising the management of green. Green play and meeting places for children, vegetables, fruit trees and herb gardens, and natural monuments are transformations that aim to enhance the public space quality.

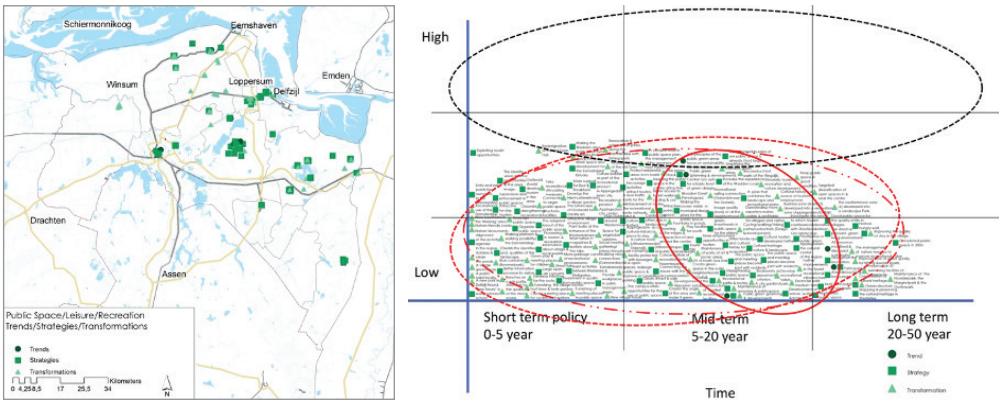

Figure 2.26 Map with all leisure policies (trends, strategies and transformation) and the risk/time graph (Roggema et al., 2020)

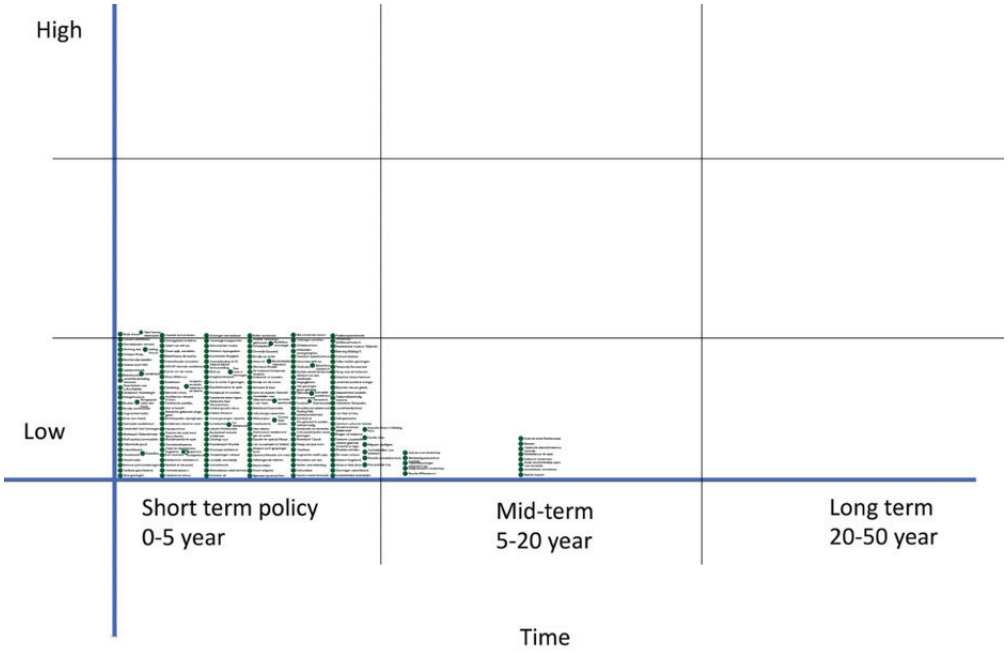

Figure 2.27 Risk/Time graph for all leisure ideas (source: www.toukomst.nl; Roggema et al., 2020)

Ideas

Leisure, recreational and public space is another common theme in the Toukomst ideas adopting a short-term approach. This general trend in the Toukomst ideas shows the need for the involvement of urban planning and design professionals as key players in the materialisation of the Toukomst ideas.

2.4.12 Urban governance

Policies

Urban governance policies are strongly intertwined with the themes hitherto discussed. Despite the general lack of long-term policies, this theme includes an important number of medium to high-risk interventions. While trends and strategies prevail across the province, transformation-oriented policies, with a diverse set of scales, cluster in Ten Boer, Midden Groningen, Loppersum, Eemsdelta, Appingedam and Delfzijl (Gemeente Ten Boer, 2018; Breunis et al., 2019; Verschuren, et al., 2019;

Gemeente Loppersum, 2018; Bronts, et al., 2016; Gemeente Appingedam, Eemsdelta and Loppersum, 2019; Eindversie Stuurgroep Economie, 2012; Poort, et al., 2019; Kleine, et al., 2017; Schollema, et al., 2017; Gemeenten Appingedam en Delfzijl, 2010; KAW and Boersma Interim Management, 2002). Among other policies, citizen participation across communities and institutions is a common approach supported by organizations like 'Dorpstoafels' and village evenings (Gemeente Ten Boer, 2018).
The major trend regarding the role of the central government is decentralisation that excludes the central government from the spatial policy by delegating responsibilities to regional authorities and municipalities. In this context, municipalities become a network organisation ensuring a cross-border integral approach of living, working, mobility and landscape. This leads to the weakening of the city-country differentiation as described in Regiovisie Groningen Assen (Stuurgroep Regio Groningen-Assen, 2013).

Other important governance goals are accessibility, proximity and customization, and more clarity about the distribution responsibilities to improve communication between municipalities and villages and to formulate coalitions for large-scale renewal and integral village plans. The urban governance policies also take the recent administrative conversion into account.

Within this context, Eemsdelta stimulates education, entrepreneurs and government co-operation opting for fewer management layers and further encouragement of innovation and entrepreneurship. Brain ports, main ports and green ports have priority in the implementation of projects. The designation in 2011 of North Netherlands and the energy port is, therefore, been of high importance for the Eemsdelta (Eindversie Stuurgroep Economie, 2012).

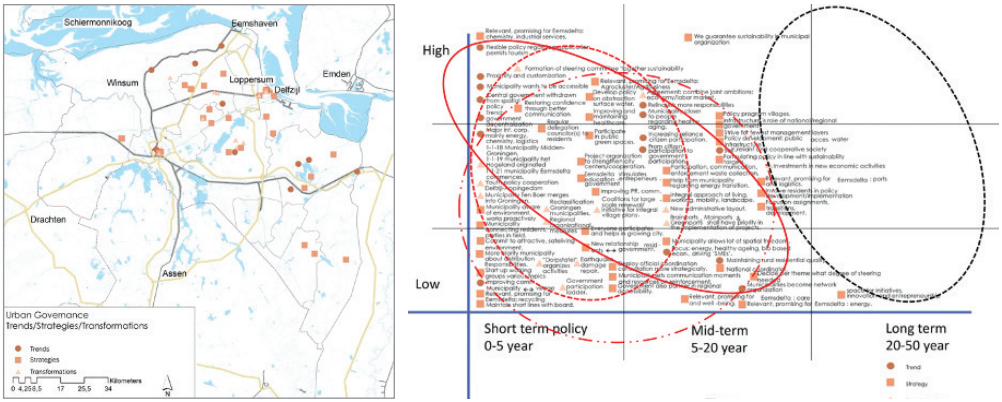

Figure 2.28 Map with all urban governance policies (trends, strategies and transformation) and the risk/time graph (Roggema et al., 2020)

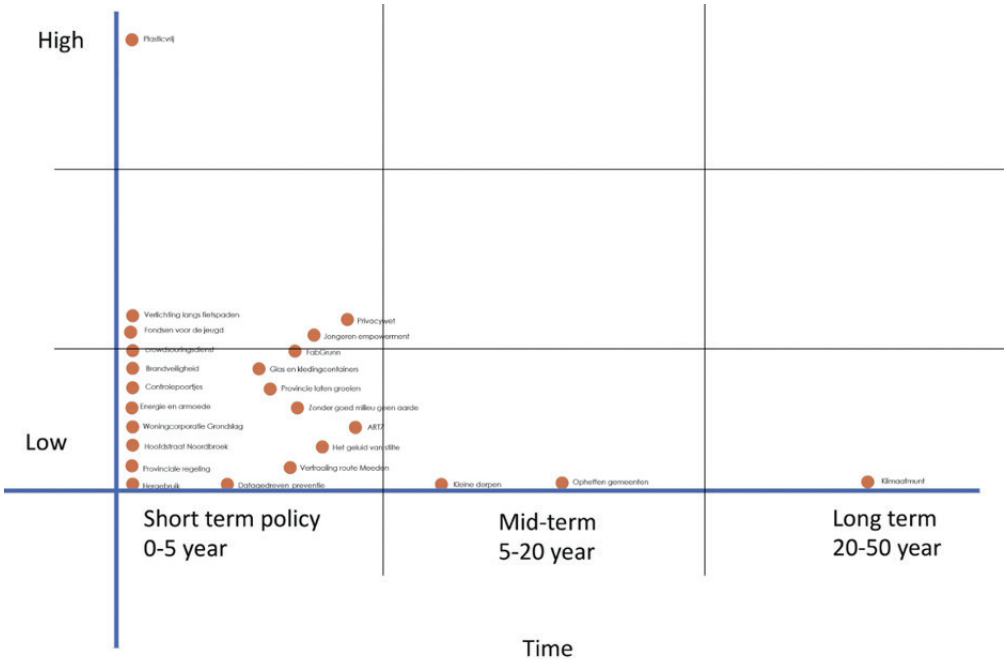

Figure 2.29 Risk/Time graph for all urban governance ideas (source: www.toukomst.nl; Roggema et al., 2020)

Ideas

Urban governance is an underrepresented theme in the Toukomst ideas in which *Plasticvrij*, proposing public participation to deal with plastic pollution, stands out as a unique approach. *Kleine dorpe*, *Opheffen gemeenten* and *Klimaatmunt* are other important ideas aiming for long-term impact.

2.5 Conclusion and Discussion

The empirical findings of this study contribute to efforts bridging the gap between the public-sphere and policy-sphere in urban policymaking. The exploratory method adopted in this study has enabled the research team to compare two different datasets and reveal the implicit patterns within these documents in an analytical way without any apriori assumptions. Based on the adopted analytical approach, the results point to divergence at several levels.

- Firstly, regardless of spatial proximity, towns and villages in the province adopt very different approaches to tackle the problems of the province.
- Secondly, the results address a serious discrepancy between the policymakers and the public opinion in imagining alternative future scenarios for the future of the province of Groningen. The only common point between the public-sphere and the policy-sphere is the interest in generating short-term, low-risk projects that fail to comprehend complex problems such as climate change and earthquakes.

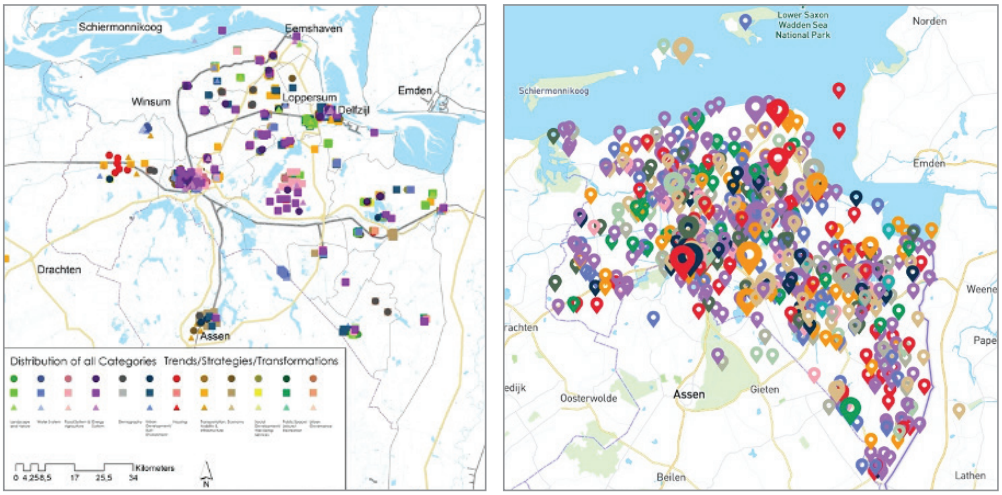

Figure 2.30 Maps showing the distribution of all policystatements (left) and all submitted ideas in Toukomst (right)

- The spatial distribution of policies and Toukomst ideas is in disbalance. The ideas are distributed evenly over the entire territory of the province while clear concentrations of policies are seen in the City of Groningen and the earthquake zone.
- When the policies and ideas are plotted onto the graphs according the level of uncertainty/impact of change versus the time horizons (figure 2.31), the conclusion is rather clear. The vast majority are concentrated in the left below corner, being the short-term and minor change area. This is nothing sensational, as most of the people, politicians, decision-makers are relating their opinions, voting and choices to what they already know. This explains a preference for short-term, low-risk, and often local policy statements and ideas.

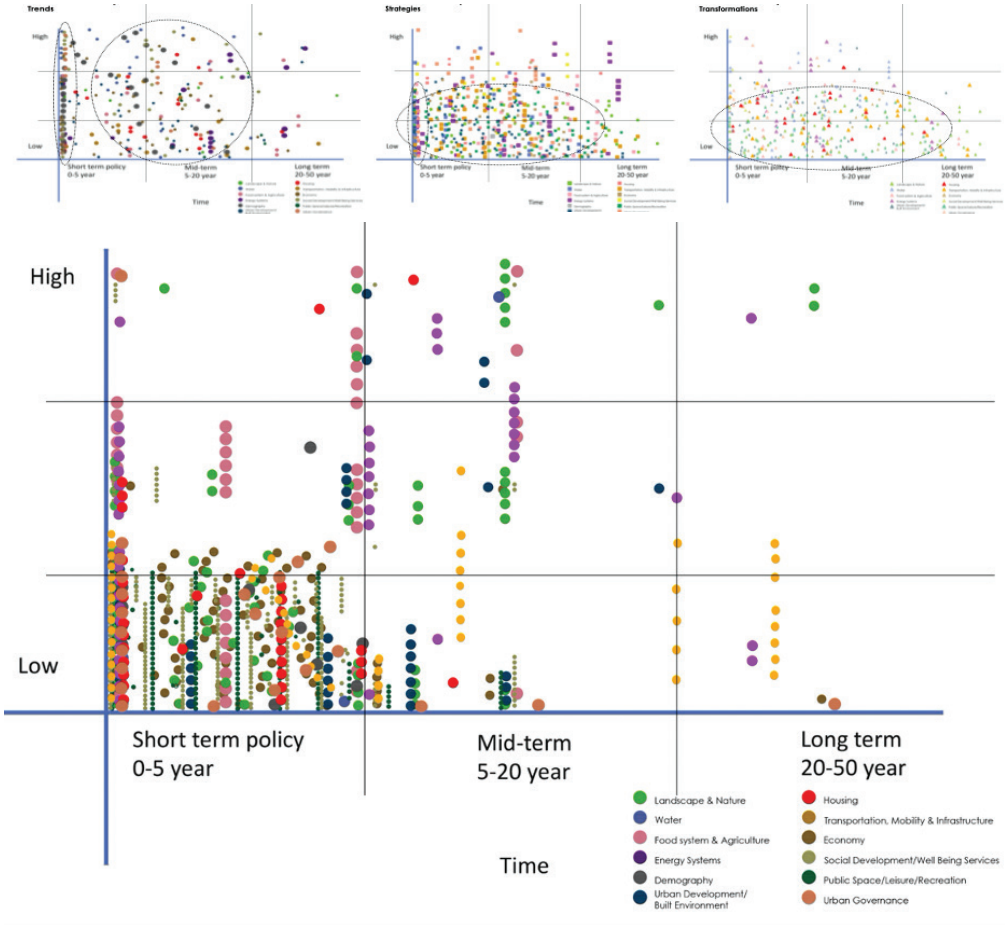

Figure 2.31 Graphs depicting the distribution of trends, strategies and transformation across level of uncertainty and time span (above), and similarly for all ideas submitted in Toukomst (below)

- However, this focus on incrementality, in planning terms 'muddling through' (Lindblom, 1959) beholds a danger on the long term, as the added policy measures, plans and decisions, based in the existing reality, become path dependent hence repeating what has been there before. As Einstein already mentioned, one can never solve the problem with the means that created it. In other words, the consequence of this, natural, way of thinking and responding is that problems and risk that only become apparent in the far future, or problems that imply radical changes, cannot be integrated in day-by-day policy decisions, nor the mindsets of all the Groninger people.

Figure 2.32 Map of a 'doomed Groningen'

- Over time, this has led to a degraded landscape of a doomed Groningen province, in which the different subregions are in real danger, and cannot perform any reasonable resilience when it comes to adaptation to changing circumstances, no matter when it has to deal with sudden earthquakes, joblessness, climate impacts or demographic change. The Wadden Sea is at risk of drowning as result of sea level rise, the northern clay edge is becoming rapidly saline, the peat colonies are sop dry in summer, the top soil transforms in a sand dust storm, and the Eemshaven-Delfzijl industrial areas are a source of upheating the Eems river, exhausting carbon whilst dominating the skyline of the former beautiful Groninger farmscape. Therefore, incremental change has lead to degradation of the landscape, its quality, to resource depletion and to a serious loss of the quality of life in a biomonotonous environment.

2.6 Recommendation

The analysis shows that focus lies on the short term and immediate moderate changes at hand. This is in contrast with the desire to restore the pride of the Groninger population through enhancing transformational projects and ideas. The main concern regarding the Toukomst of the province of Groningen is therefore not whether the people in the province will cope and make the best of it, but whether the trust in the government can be really restored. In order to do so, the research suggests using the most extreme propositions, ideas and policy statements alike, and design long-term, adventurous projects that people can attach to. These 'grootse' ideas will then reinforce the support of the local population for a future that is appealing to all residents in the province. The ideas that need to be extracted out of the enourmous amount of policies and Toukomst ideas can be found at the edges of the risk-time diagrams and should form a combinatory of extremities to become the first antifragile (Taleb, 2012) province of the Netherlands.

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FOODscape Groningen: local application of circularity in the food chain

3

Rob Roggema

- **Funding:** SIA KIEM Fonds
- **Partners:** De Stadsakker, Eet Waar, Hogeland Catering, Metabolic
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3.1 Introduction

Food is our lifeline. An average adult should consume between 2000 and 2500 calories, depending his/her age, weight and diet (American Heart Association, 2017). Though the world is able to produce enough food to sustain humanity (EAT-Lancet Commission, 2019), the current way of producing food leads to malnutrition, food-related illnesses and has negative impacts on plant- and animal life. The food system degrades and exhaust the earth. Farming has become a large scale industrial activity in efficiently run complexes, the processing takes place in high-end technological labs and supermarket and fastfoodchains determine the scale of production. One of the main problems is the uneven distribution of consumed food groups (figure 3.1).

Our food system has detrimental impacts on the environment and health of human and eco-systems. This is the reason why it is utterly important to design a food system that is healthy for the consumers, environmental-friendly, minimising climate change, safe and secure. In a recent article in Lancet (Willett et al., 2019) 37 international scientists of different academic disciplines have investigated which food patterns would lead to a food system that 'can save the planet'. Increasing evidence shows that food production is the largest cause of global environmental change. Greenhouse-gas emissions, land and water use, nitrogen and phosphorus application, biodiversity loss, and chemical pollution from herbicides and pesticides are increasingly assessed and used in definitions of sustainable food production.

- Anthropogenic emissions of greenhouse gases cause climate change, which leads to disruptions in the Earth system for instance in the form of sea-level rise and increasing frequency of extreme weather events. Food production systems release greenhouse gasses (carbon dioxide, methane, and nitrous oxide) into the atmosphere and changes in land use release additional carbon dioxide when forests are cleared, wetlands are drained, and soils are tilled.
- Food production is the world's largest form of water-consumption. 84% of cropped land, uses freshwater from rain, and the remaining 16% uses irrigation (water in freshwater lakes, rivers and aquifers). Water consumption for food production has more than doubled between 1961 and 2000.

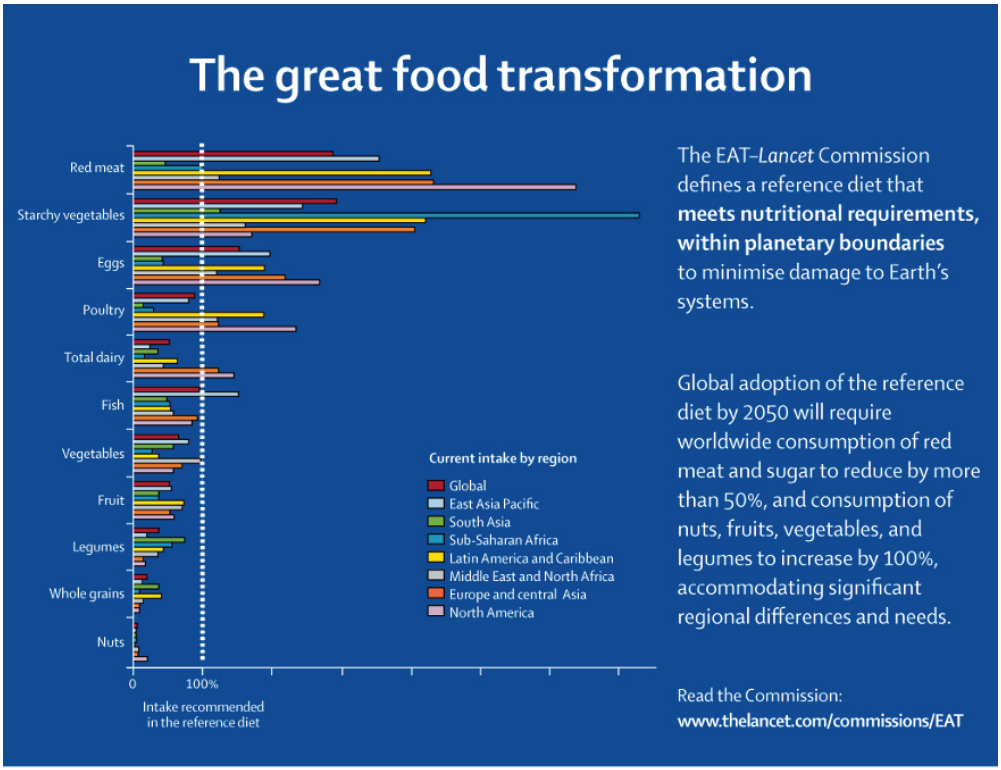

Figure 3.1 The great food-transformation

- Nitrogen and phosphorus are crucial for plant growth, but their natural availability limits plant growth in most terrestrial ecosystems. Production, application, and trade of fertilizers disrupts global nitrogen and phosphorus cycles. Excessive application of nitrogen and phosphorus in food production has substantial consequences, notably in runoff into streams and rivers, driving eutrophication of freshwater and marine ecosystems and subsequent development of hypoxic (oxygen-free) conditions causing fish dieback and other environmental harm.
- Food production is the largest driver of land use and land-use change, mainly through clearing of forests and burning of biomass. For instance, between 2000 and 2014, Brazil lost on average 2.7 million ha/year of forest, the Democratic Republic of Congo lost 0.57 million ha/year with a 2.5 factor increase since 2011, and Indonesia lost 1.3 million ha/year, with 40% occurring in primary forests.

Figure 3.2 shows that grains, fruits, and vegetables have the lowest environmental effects per serving, and meat from ruminants the highest effects per serving.

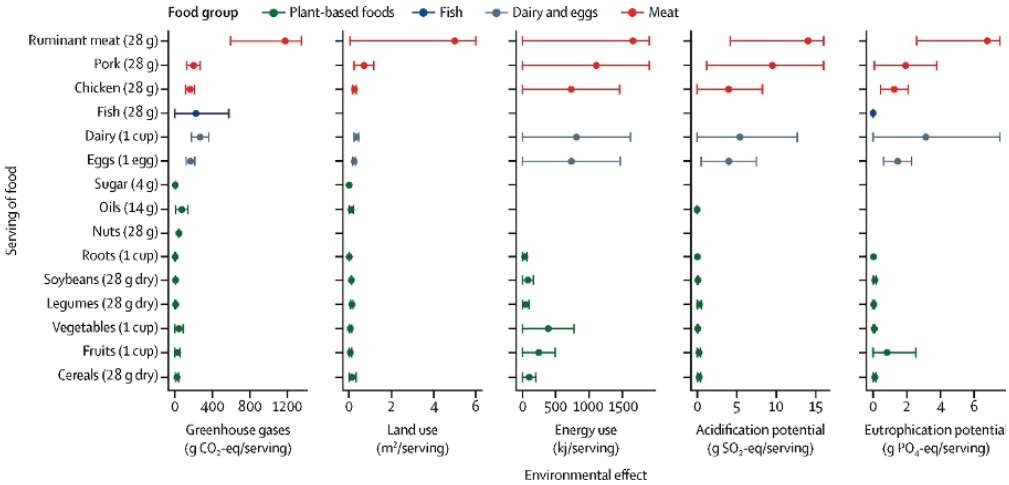

Figure 3.2 Environmental impacts per food group (Willett, et al., 2019)

From this research it becomes clear that our diet has to transform from a meat and starchy vegetable-based diet towards the consumption of more fruits, nuts and vegetables. Moreover, the current diet does not meet nutritional standards for a healthy life of an average person. Vegetables play a crucial role in this so-called Planetary Health Diet (PHD), which presents a solution to growing enough healthy food in a sustainable way, within the planetary boundaries (Rockström et al, 2009) for the estimated 10 billion people that inhabit the Earth in 2050. The diet has estimated what nutrients a human being usually needs and how this could be grown without hampering earth too much. The PHD divided the ingredients in eleven groups: whole grain, potatoes, vegetable, fruit, dairy, red meat, chicken, eggs, fish, legumes peanuts and nuts, fats and sugar. The maximum amount of consumable red meat is significantly reduced to 14g. per day. On the contrary, consumption of legumes is increased to 75g. per day and it is advised to eat 300g. vegetable per person per day.
For now the implications of such a diet are uncertain, for instance whether it would really improve people's health and nutritional value. The Dutch Voedingscentrum has therefore translated the EAT proposition to the Dutch context (Van Dooren, 2019a). Figure 3.3 shows the amounts of food and their energy-content (in KCal) per category per person for the Dutch situation (Van Dinther, 2019).

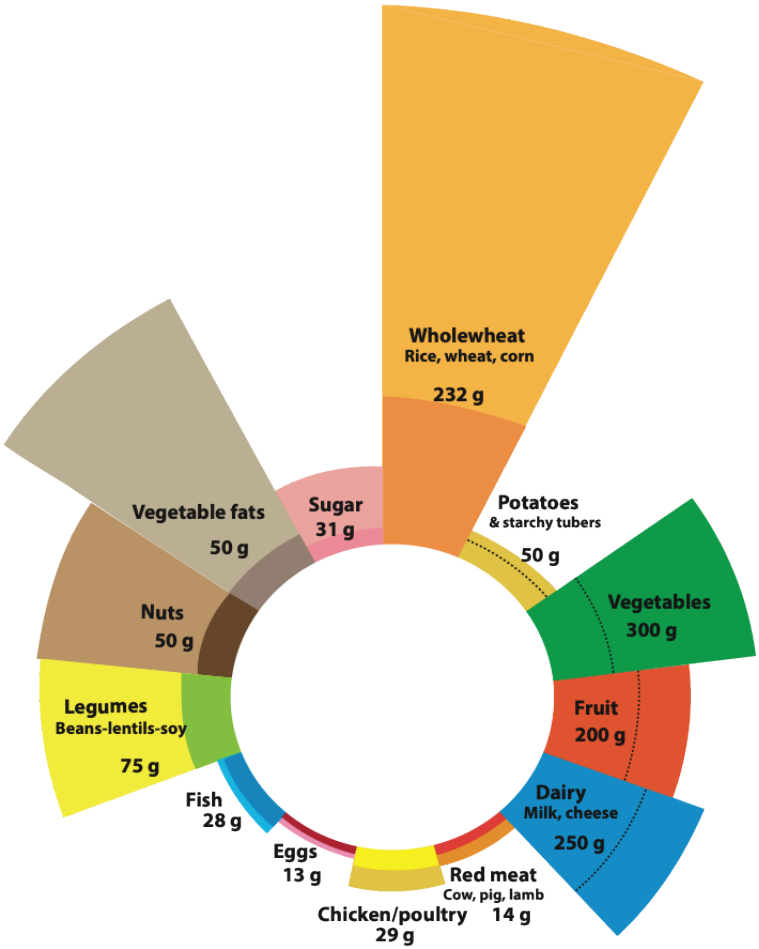

Figure 3.3 Amounts of food according the EAT-research, translated for the Netherlands (Roggema, 2019, after Van Dinther, 2019)

To realise the PHD two scientific goals are formulated: grow healthy food and grow food sustainably. Five strategies aim to realise these goals: human effort, agricultural priorities, intensive sustainable growth of crops, coordinated governance of land and oceans and a minimum of 50% reduction of food waste. The food transition can only be achieved by global collaboration between many disciplines and organisations.

3.2 Meat: the elephant in the room

It is expected that the world population will reach 9 billion people by 2050 (Van Bavel, 2013), who all need to be fed. According the FAO food production needs to increase with 70% to feed the growing population, knowing the ecological boundaries are already exceeded through climate change and extreme environmental pressure of the current food consumption (FAO, 2009).

The current Western food consumption pattern is responsible for 30% of global greenhouse gas emissions (Foley et al., 2005). Food production alone is responsible for 70% of freshwater use and occupies approximately 40% of globally available land. Of this, a large portion is used for meat production (FAO, 2017; Willett et al., 2019). The environmental impact of the Dutch food system, using carbon emissions, acidification, eutrophication of fresh- and seawater, and land- and water use as criteria, shows that meat, together with dairy, is the most important factor (Valk et al., 2016). The least impactful are vegetables and legumes.

The average Dutch food-pattern is far from ideal with averages of 100g. meat, 350g. dairy and 130g. vegetable per person per day, and only 5g. legumes (Rossum et al., 2018). This diet does not only impact the environment, it is also the cause of health risks (Gezondheidsraad, 2015). In the Netherlands approximately half of the population has a BMI that is too high (Volksgezondheid en zorg, 2018).

A third important factor in the food production system is food waste. One third of all food grown ends up being wasted, e.g. 1.3 billion tonnes of food per year (FAO, 2011). In the Netherlands the total food waste is between 1814 and 2509 kilotonnes per year, approximately 34.3 kg. per person (Van Dooren, 2019b). Bread and dough (7.3kg./person/year), dairy (5.1kg.) and vegetables (3.7kg.) are in the top three of most wasted food. Especially vegetables is a big loss, given their role in a healthy and sustainable food pattern due to their low ecological footprint, high health benefits and low energetic value (Van der Krieken et al., 2018).

Nevertheless, probably the most important issue that need to be addressed is the consumption of meat. Looking at the US food production system, about 50% of its land, 80% of its water and 17% of its fossil fuel is used for the production of food for the population. (Pimental and Pimental, 2003). Meat production take a lot of effort and consumes a lot of feed grains and forage (Table 3.1).

Table 3.1 Grain and forage inputs per kilogram of animal product produced. (https://academic.oup.com/view-large/109811460)

Livestock	Grain[1] (kg)	Forage[2] (kg)
Lamb	21	30
Beef, cattle	13	30
Eggs	11	0
Pigs	5.9	0
Turkey	3.8	0
Broilers	2.3	0
Dairy (milk)	0.7	1

[1] US Department of Agriculture, 2001

[2] Morrison, 1956; Heitschmidt et al., 1996

Table 3.2 Per capita food consumption, energy, and protein of foods of a meat-based compared with a lacto-ovo-vegetarian diet in the United States on a yearly base. (https://academic.oup.com/view-large/109811450)

Food	Meat-based diet[1] (kg)	Energy (kcal)	Protein (g)	Lacto-ovo vegetarian diet[2] (kg)	Energy (kcal)	Protein (g)
Food grain	114	849	24.9	152	1132	33.2
Pulses (legumes)	4.3	40	2.0	7.5	70	4.5
Vegetables	239	147	6.6	286	155	8.8
Oil crops	6	71	3.0	8	95	4.0
Fruit	109	122	1.4	112	122	1.9
Meat	124	452	41.1	0	0	0
Fish	20.3	28	4.7	0	0	0
Dairy products	256	385	22.5	307.1	473	30.0
Eggs	14.5	55	4.2	19.2	73	5.6
Vegetable oils	24	548	0.2	25	570	0.2
Animal fats	6.7	127	0.1	6.7	127	0.1
Sugar and sweeteners	74	686	0.2	74	686	0.2
Nuts	3.1	23	0.6	4.0	30	0.8
Total	994.9	3533	111.5	1001.5	3533	89.3
Feed grains[3]	861.0	0	0	450.0	0	0

[1] FAOSTAT, 2001

[2] Estimated

[3] Cereal grains fed to livestock

A comparison between the amounts of grains and forage needed for a meat and a lacto-ovo vegetarian diet, lacto-ovo-vegetarians consume more kilograms of food overall to reach the same amount of energy, but only half of feed grains is needed to sustain this diet (Table 3.2). Not only does producing food require a lot of energy, feeds and manpower it also requires a lot of water. Around 85% of the fresh water is consumed by agricultural irrigation. It requires between 500 and 2000 litres of water to produce one kg of a certain crop. There is a substantial difference of fresh water required to produce one kg of crops compared to one kg of meat (Pimentel et al., 1997).

3.3 Local application of (inter)national research

The long-term research program Lifelines (https://www.lifelines.nl) has revealed the inhabitants of the province of Groningen are structurally less healthy compared to other Dutch regions. This is, amongst other factors, caused by malnutrition. In general, low quality food is not only a problem for human health, it also leads to ever rising costs for health care.

Recent research has illuminated other related problems, such as food safety (Chakraborty and Newton, 2011), predominantly caused by large scale farming and import and export of food hence the extended distribution of illnesses and epidemics over the world. This also leads to further food insecurity (Schneider et al., 2011). It is increasingly problematic to guarantee sufficient healthy food for the growing world population, for instance due to degradation of resources in a withered landscape (Ramankutty et al., 2008; UNCCD, 2017; Watts, 2017). This increasingly becomes more compromised because harvests are failing due to floods and droughts as a result of climate change (IPCC, 2013). Additionally, the amount of *foodmiles*, transportation of food over the earth is increasing (Pegge et al., 2006; Perrone, 2018; Tubiello et al., 2014). This increases the environmental impact, specifically carbon emissions, exaggerating climate change.

An alternative model of food production looms, one that closes cycles of materials, uses resources prudently and makes safe and healthy food accessible close to where it is consumed without compromising the earth. The study of urban metabolism (Bellemare et al., 2017; Thomson and Newman, 2018; Wolman, 1965) has been applied in Rotterdam (Brugmans and Strien, 2014), with special attention for food (Tillie et al., 2014). A research-by-design methodology (Cross, 2006; Roggema, 2016) has proven to be very successful to identify positive spatial outcomes of a complex technological problem. The design of the growth of food with minimal impact on the environment, using and reusing water and energy together with local stakeholders and instant assessment in a so-called FEW-print is further carried out in the moveable nexus project (Yan et al., 2017; http://m-nex.net), using the approach in six different bioregions around the world (Yan and Roggema, 2019).

The overview over recent international academic findings has revealed a clear gap: There is a huge hiatus between the high-level aims and understandings and the required steps that need to be taken to realise a future food system locally.
The main research question in the FOODscape Groningen project is therefore 'how and at which scale could the growth of food in the entire chain become circular?'

3.4 Partners in FOODscape Groningen

The FOODscape Groningen project started in September 2019. The main ambition of this project is to investigate how the Planetary Health Diet can be realised in the local context of the Groningen area. In the project a very practical approach is taken so it can be literally shown how the alternative food pattern can be grown at a local, small, scale. On a piece of land of 5000m2 all products of the Diet will be grown or bred. The design approach is meant to make it also an attractive place so visitors can learn and become familiar with this new way of farming. Crops and animals are farmed, nutrients, energy and water use is monitored and it is investigated whether cycles can be closed, or even become net-productive. The final 'proof-of-the-pudding' is whether the harvest can be used to cook a healthy and tasteful meal.
The testing of this concept is foreseen on the premises of De Stadsakker a local biological-dynamic farm in Hoogkerk, Groningen. This form of farming takes the natural environment as its basis, meaning the crops are grown without chemical pesticides, fertilisers or otherwise genetically modified organisms. Animals have more space to behave naturally, animal welfare, the quality of nature and landscape and a natural way of processing of food are other important factors (Voedingscentrum, 2019). In the FOODscape project a range of different stakeholders participate.

3.4.1 FOODgrowers

The first and main type of participants are the foodgrowers. Without crops there is no food, no diet and to consumption. De Stadsakker, Hoogkerk and De Tuin naast de Branding, Schiermonnikoog are both local, sustainable and circular farms, that operate at the local scale.

3.4.2 FOODpreparers

The second group of participants is equally important as the preparation of delicious food is the key to make biological-dynamic produce acceptable for the general public. Eetwaar, Hogelandcatering, both in the city of Groningen, and Wad Andersz and Brakzand based on Schiermonnikoog, work with locally produced sustainable produce to develop a tasty menu.

3.4.3 FOODexperts

In order to understand the impact of an alternative diet a broad spectre of knowledge is required.

- In the FOODscape project application of fermentation of produce and use it in cuisine is needed for the yearly availability of food. Smaakpark is a specialist in cooking with fermented products.
- The metabolism of connected flows of nutrients, energy and water is understood, co-designed and measured through the expertise of Metabolic.
- Understanding of the current health (problems) of the Groningen population, and potential positive impact of an alternative diet is covered through the collaboration with Lifelines-Medical Centre Groningen.
- State of the art knowledge about sustainable food and health is provided by the Voedingscentrum Nederland
- The Hanze University of Applied Sciences provides a triplet of expertises:
- Sustainability and spatial design through the professorship Spatial Transformations
- Food knowledge and nutritional values through the School of Nutrition and dietetics
- Sustainable use of biobased resources through the research centre Biobased Economy

3.4.4 FOODpolicymakers

The FOODscape project will deliver new insights regarding growth, processing and consumption of local farming. In order to embed these new insights and incorporate potential constraints in the outcomes of the project, policymakers are essential sources of knowledge when it comes to current policy frameworks, legal possibilities and connection with local and regional spatial policy. Therefore, the municipalities of Groningen and Schiermonnikoog and the province of Groningen bring their expertise to the project.

3.4.5 An iterative collaborative approach

The complexity of the subject requires an iterative design and planning approach. A continuous process of designing the food production in practice, realising it and measure the productivity, and evaluate, and testing the menus on their contribution to the health of the population, improves the understanding of the benefits and constraints of a circular food supply throughout the entire food chain. During realisation, learning from the monitoring results and evaluations, the design can be adjusted by changing its product range, the choice of crops and the ways of preparation of the food. This ultimately leads to a final optimised design, the composition of the product range and crops, the way food is prepared throughout the year, its metabolic impacts, health and health costs.

3.5 Results of FOODscape Groningen

After the first year of research four different types of outcomes can be presented: the program and production of the products to farm, the taste of the prepared food, the spatial design and the nutritional and fermentation findings.

3.5.1 Program and production

The first outcome of the FOODscape project is the understanding of what can be grown on a given site. For this project De Stadsakker in Hoogkerk is chosen as the pilot site (figure 3.4). The intensive collaboration with the owners of the site and determined biological-dynamical farmers is the core reason for this. At the start of the project the team, consisting of academics, practitioners, stakeholders, SME's and students came together on site to investigate the context, see how the current farming system is functioning, and not the least, explore their common and different interests (figure 3.5).

Figure 3.4 Site of De Stadsakker, Hoogkerk

The visit highlighted the way a circular farm currently operates, its constraints and gave insight in the estimated area required for a year-round cycle of food supply. The farmers of De Stadsakker subsequently translated the PHD in space required (table 3). These calculations forms the basis for the design explorations (see section 3.5.3).

Figure 3.5 De Stadsakker site visit

Table 3.3 Overview of crops and produce demand and required space

Products/crops	Need pp/pd (g)	Need pp/pw (g)	Need pp/py (kg)	Harvest per m2	Required m2	Notes
Potatoes	50	350	18.2	3 kg	6	
Vegetables	300	2100	109.2	2 kg	55	
Fruit	200	1400	72.8	>25m2 per tree	1 tree/ person	
Dairy	250	1750	91	800 l/goat 8000 l/cow	1000 m2/goat 10,000 m2/cow	
Red meat	14	98	5	20 kg meat/goat 250 kg meat/cow		
Poultry	29	203	10.5	1.5 kg/chicken	>4m2/chicken	50% rooster, 50% lays eggs
Eggs/protein	13	91	8.5	250 eggs/year per chicken 91g/egg	94 eggs/year	More eggs than chicken calculate in EAT
Fish						
Beans, soy and lentils	75	525	27.3	3kg/m2	8 m2	Detailed harvest soy and lentils is unknown
Nuts	50	350	18.2	5.5 kg/tree	120 m2/3 adult trees	Walnuts, Hazelnut tree uses less m2
Plant based oil and fats	50	350	18.2			
Sugar (sugar beets)	31	217	11.2	1.4 kg/m2	8 m2	Sugar could also come from fruits
Grain	232	1600	84.4	0.5 kg/m2	170 m2	

3.5.2 Taste and test

A second aspect of growing a healthy diet is the translation of produce in a tasteful menu. Therefore, the second stage in the process was to use the produce of De Stadsakker and develop a tasteful menu with the ingredients. Restaurant Eetwaar in Groningen took up this challenge and presented a five-course menu (figure 3.6) to the project team. During every course the team discussed the taste of the dish, and project questions. Most of all, they enjoyed a very pleasant evening with good, sustainable, healthy and local food (figure 3.7).

3.5.3 Design directions

The third step in the project is to use the outcomes of the site visit, the required amounts of space for different ingredient and the confidence this produce could be used to prepare tasteful dishes in a spatial design session. The estimated spatial requirements per crop or produce have been drawn and cut to scale so these could be easily used to understand how large certain spaces need to be, and how different configuration could be designed (figure 3.8). Th main conclusion out of this session was the pilot site is large enough to grow sufficient produce for approximately four persons. The outcomes of this work will be used to conceive a more detailed design.

Menu Foodscape dinner

Datum: 14-10-2

Locatie: FeDe

Aperitief - introducties en kennis making

Voorgerecht

Bestaande uit:

Pompoen Pecan peer blauwe geitenkaas

- Schaalniveau van het Kiem project + Schaal vervolgproject
- Op welke schaal kan je het meeste inbrengen en op welke manier?

Tussengerecht

Bestaande uit: Bieten, beurre Blanc, linzen

- Welke problemen komen op?
- Complexiteit van de problemen

Tussengerecht

Bestaande uit: Hummus, paddestoelen, framboos-roos

- Wat zijn je persoonlijke interesses
- En hoe zou je die willen benaderen

Dessert

Bestaande uit: Creme brullee van haver

- Hoe gaan we verder?

Figure 3.6 Menu prepared with local ingredients grown at De Stadsakker)

Figure 3.7 The team enjoying and testing the tastes

Figure 3.8 Several design options for the Stadsakker pilot site

3.5.4 Food fermentation

The fourth element in the project investigates the nutritional value and preservation techniques of the grown food crops and produce in order to reduce food waste. The research conducted looks at the sustainability, nutritional value and attractiveness of the end-product of grown vegetables (Strolenberg and Kazemir, 2020). The most wasted vegetables at De Stadsakker, zucchini, Pattison, celery and radicchio rosso, have been selected to become part of the fermentation experiment. Celery and radicchio rosso did not respond well to the fermentation experiments while fermentation of zucchini and Pattison is responding well. The pH-value, scent, taste, appearance and texture changed during fermentation. The use of pickle juice (Sáez et al., 2018) can also be used for the fermentation of zucchini. The taste panel found that fermented Pattison was unpleasant due to the combination of texture, scent and herbs. On the other hand, fermented zucchini with red pepper is the best candidate for further sensory investigation. The general conclusion is that fermentation could be well used to preserve otherwise wasted zucchini produced by De Stadsakker. Fermented vegetables have shown to have a longer shelf-life and the lactic acid bacteria can have both probiotic (Marco, et al., 2017; Sanliera et al., 2017) and anti-inflammatory (Kim et al., 2019) effects. Fermented vegetables could also contribute to a more varied diet with their distinctive taste, texture and appearance.

3.6 Outlook

The FOODscape Groningen project investigates an alternative food growing model in which local circular food system is tested in practice, starting from the moment plants are planted until the final consumption. In the near future the preliminary results will be applied in several other pilot experiments, Hoogkerk, Schiermonnikoog and Zernike-campus in Groningen. This additional research will design, plant, harvest and prepare food during two growing seasons. The expected result is to gain further insights in the health, social acceptability, the health costs and economic feasibility of such an alternative model, producing healthy and tasteful dishes throughout the year. The developed knowledge will be continuously evaluated and provides the conditions under which such a model that improves the chance on a multiple healthy life, is viable.

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Loading Loskade

Kim Bode
Rob Roggema

4

- **Funding:** SIA KIEM Fonds
- **Partners:** Van Wijnen. BuildinG
- **Student:** Niels Blaauw, Faciity Management

4.1 Introduction

The former Sugar-area in the city of Groningen has been qualified as an experimental site for spatial development. Building and construction company Van Wijnen has realised the Loading Loskade project, which is dubbed 'the circular neighbourhood of tomorrow'. 46 remountable homes that are constructed onsite are meant to temporarily rent. Tenants are allowedd to stay for maximal six months and after 11 years the houses will be demounted and rebuilt somewhere else. In this sense the Loskade can be characterised as a 'pop-up' neighbourhood. This unique project is simultaneously a testing site and an area in use by end users.

Building the neighbourhood of the future consists of many aspects. Loading Loskade deals with circularity and sustainable building with the newest digital technology and domotica, but aims also to realise an energysaving built environment for satisfied customers. This offers an inspiring context full of challenging questions for students, researcher and practitioners of a range of disciplines and levels of thought.

Van Wijnen regards futureproofing an important issue. Every human being is entitled to a comfortable living environment in which people can live, work, learn, care and enjoy free time. Therefore the company aims to develop products and services that are affordable, use a minimal amount of energy and are comfortable. Besides this, experiments are undertaken that anticipate the housing demand of the future. Concrete objectives formulated are:

- No waste during production in 2035;
- Net carbon neutral in 2030;
- In 2021 the best performing company regarding customer satisfaction.

4.2 Loading Loskade

The building and construction sector is in a global crisis in which the volume of building is larger but materials and people are scrutinised. To deal with these circumstances the circular neighbourhood concept has been developed for which the Loskade functions as the prototype. Until 2030 the Loskade is the living lab where experiments can be undertaken to learn and test new concepts regarding circular building and housing of the future. At Loskade 46 family homes and studios are realised as prototypes for a product that will be taken in production to put thousands of these units in the market in the near future. The prototypes are unique as they are completely remountable. In 2030 the houses can be taken apart and be rebuilt in another location in the same configuration or differently. Van Wijnen acknowledges this as the response to current problems in the building sector and to mitigate climate change.

Each unit at Loskade is unique to provide the case for investigating different innovative building materials, the finishing and the installations. The project is delivered in August 2019 (figure 4.1) and are rented out ever since. The homes are completely furnished and the rental price is inclusive of everything, such as energy, water and cable. The land use at the Sugar Area is limited to industrial use hence the maximal period of renting is six months, as this implies land use as hotel facility. The Loading Loskade aims to be a space for innovation. The Sugar Area in Groningen has nearly one century been indispensible from the sugar capital in Europe. Every Groninger recalls the smell of the sugar campaign in early autumn when jams of truck were bringing the sugar beets from the fertile Groningen soil to the factory. In this period this area was called Loskade, the (un)loading quay. Large concrete silos, high chimneys, coal ovens determined the skyline of the city. Closer, the striking façade of the bonded warehouse attracted all attention. Currently, the sieve building, the old chimney and the Cloud factory are remnants of the industrial history, mysterious and remembering hard work of gone times. Around 130 hectares of former industrial land is ready to be developed, allowing the desires of local 'Stadjers' to be expressed. The site is close to the city centre and offers the opportunity to become a new sustainable heart where temporary living, learning, entrepreneurship culture and leisure come together. This makes the site unique as an in-between of more urban and countryside. Uniqueness and innovation form the thriving factors of this special area.

Until 2030 the Loskade area gives space to temporary innovative and experimental initiatives, of which the proven ones are offered to gain permanence onsite. This gives the area a role in the next economy of local sustainable products and services at the edge of the city centre. A 'makersplace' for the creative

Figure 4.1 Loskade project in August 2019

sector, startups and SME's alike. The Sugarfactory area is therefore a laboratorium for the city and nursery of innovative entrepreneurship. Exploring new types of working adds societal and economic value to the current city of Groningen for traditional strong sectors such as food, small scale fabrication, knowledge and research, events, living, working and energy hence contributing to the learning city.
A sustainable food chain is developed which combines education and self sufficiency in collaboration with companies based onsite. Catering uses produce that is grown on the Sugarfactory Area.
The plan for the Loskade project are realised on a plot of 2500m2. The project does not only focus on providing housing, but gives also ample attention to sustainability, design, energy, ICT, IoT, process innovation, circularity and community based innovations. The houses in the project are all different, but circular, remountable and 'zero-on-the-meter'. By making the buildings remountable circularity

and flexibility is enhanced, moreover, materials will be reused, no waste is generated and the economic life of the product is prolongued. The so-called labyrinth-model is organised around a central square where people can meet, eat together and relax.

The small live-and-work units are as circular as possible. The homes are remountable and are provided with solar panels. The space above and under the ground will be energy-neutral. Over time the area will be entirely off-grid by using a sustainable and flexible smartgrid. The area is developed using ecosystem driven innovation. This is realised by bringing together new ideas, innovators and startups who continuously develop new insights, applications and products. The launching customer can well be the co-developer and consumer of new products and services and this way standing at the cradle of large scale transitions.

The Loskade area is to become the precinct of the future. It aims to become all-electric, temporary as the new permanent, mobility as inherent part of the energymix, small homes with spacious collective amenities and smart grid solutions. This temporary living area can become the accelerator of future sustainable innovations in the city and the region. It is a pop-up precinct where temporary living, working, entrepreneurship, learning and innovating meet each other.

4.3 A Circular Built Environment

Circularity is a transdisciplinary and systemic approach, concerning the different scale levels from city to building, component and material (figure 4.2). Here, social, technological, environmental and economic aspects are of major importance as well as stakeholders, processes and design (TU Delft). A circular approach offers an escape from depleting and wasting valuable resources, but it is also linked to reduced dependencies on other countries for the supply of resources and to the creation of jobs (European Commission, 2014; Stahel and Reday, *1976*; Ellen Macarthur Floundation, 2012). Circular resource flow systems usually imply higher levels of complexity due to large changes in the way actors are interconnected, be it related to water, materials, top-soil for food production or energy systems (Luscuere et al.; 2013), for example regarding decentralized decision-making, extended producer responsibility and reverse logistics (Geldermans, *2016*). A major impact in applying circularity in the design of products and building has been achieved when the keystone book Cradle-to-Cradle® was published (McDonough and Braungart, 2002). Cradle to Cradle® offers a set of design principles standing for innovation, quality and beneficial design. The book describes the safe and potentially infinite circulation of materials and nutrients in cycles. All constituents are

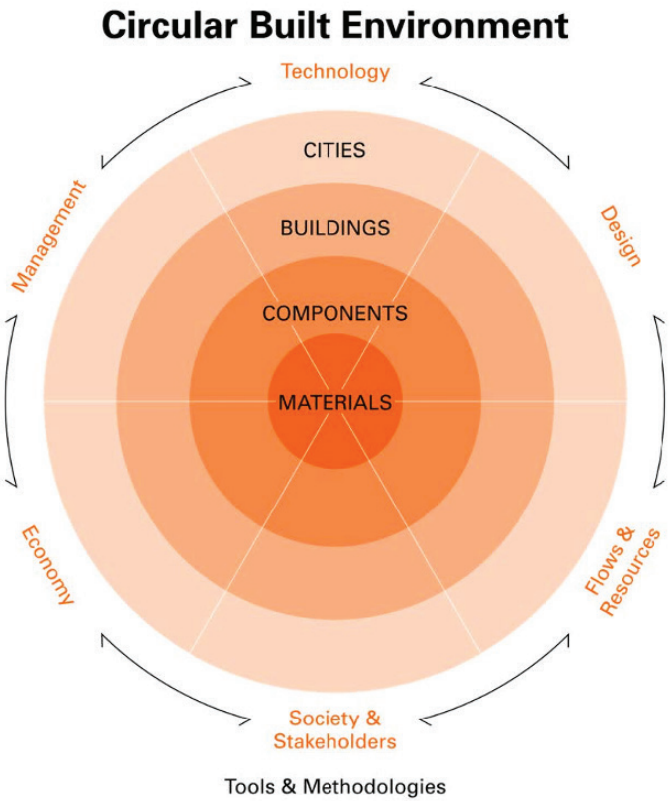

Figure 4.2 Comprehensive model of a circular built environment (Source: TU Delft, https://www.tudelft.nl/en/architecture-and-the-built-environment/research/research-themes/circular-built-environment/)

chemically harmless and recyclable. Waste as we know it today and which is generated according to the pre-existing take-make-waste model will no longer exist, only useful nutrients. Consumables like natural fibres, cleaning agents or biodegradable packaging circulate in a biological cycle (figure 4.3) to which they can be safely reintroduced after use. They turn into compost or other materials which are in turn used to make new products. In this way, old products do not turn into waste but into nutrients for a new product. Consumer goods such as electronic items or flooring circulate in a technical cycle. These products are already optimised during the design and manufacturing process as material resources for their next service life as new products. Components can be sorted according to their constituent materials after use and then reintroduced to a technical cycle (figure 4.3). In doing so high material quality is maintained and downcycling can be prevented.

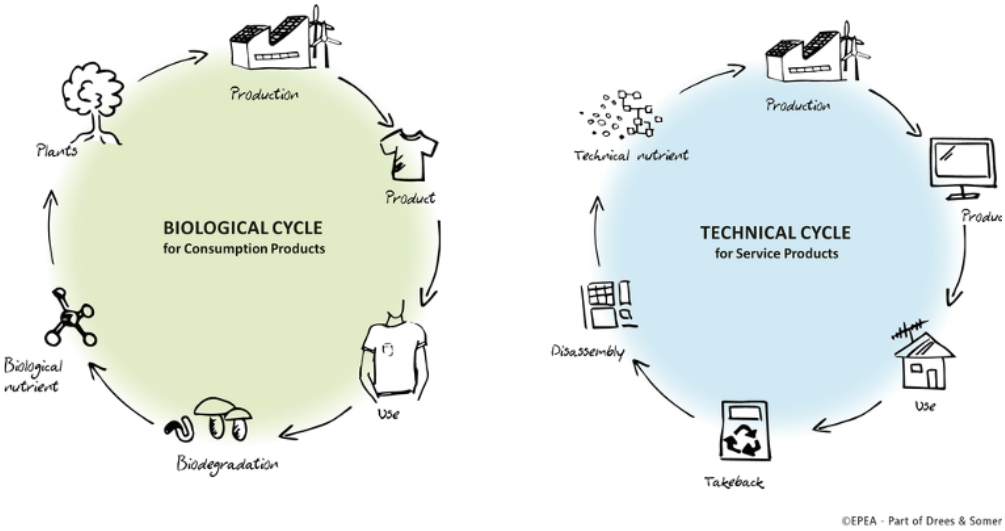

Figure 4.3 Closing cycles in the biological and technical systems (Source: EPEA, https://epea.com/en/about-us/cradle-to-cradle)

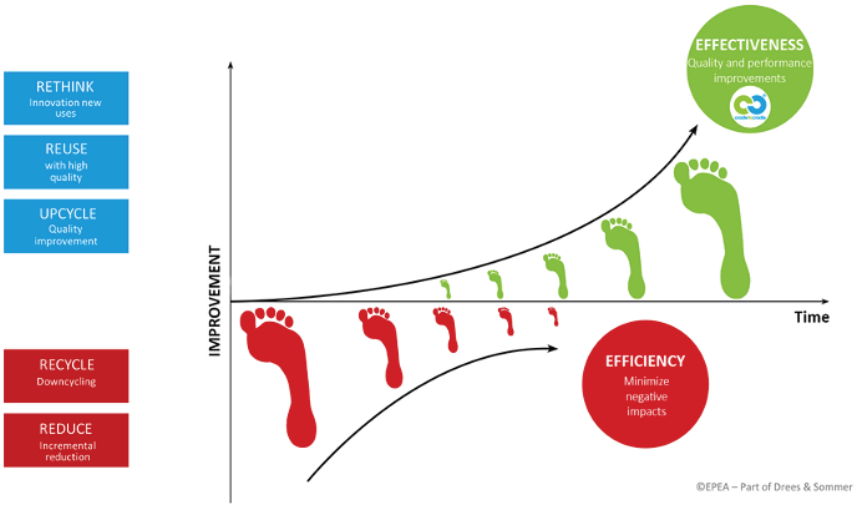

Figure 4.4 Striving to increase of effectiveness (Source: EPEA, https://epea.com/en/about-us/cradle-to-cradle)

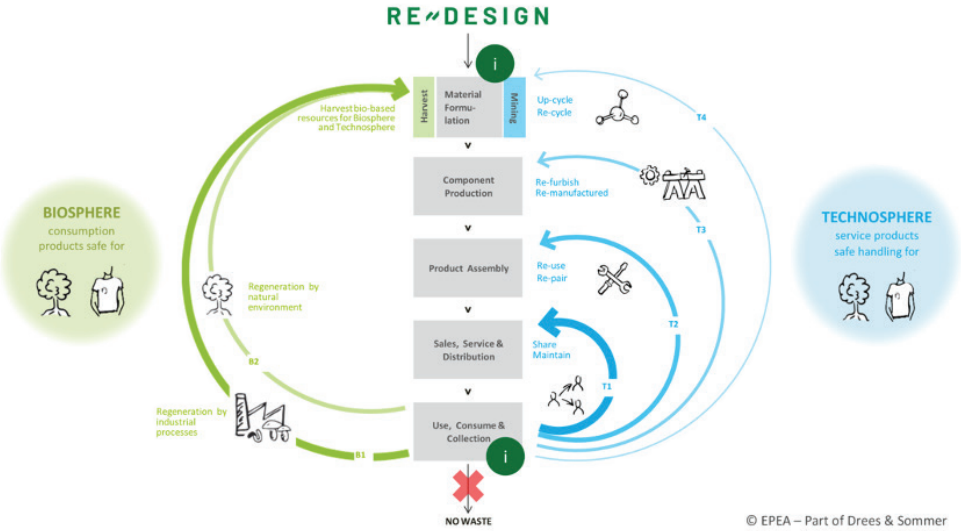

Figure 4.5 Redesigning flows in bio- and technospheres (Source: EPEA, https://epea.com/en/about-us/cradle-to-cradle)

Usually, companies put all their efforts into reducing their impact on the environment (ecological footprint) as efficiently as possible, aiming at a zero emission strategy. However, instead of being less bad positive goals need to be set to create a better future. An eco-effective business model aims at qualitative added value. The mindset has to shift from being less efficient to becoming more effective by rethinking, reusing and upcycling materials (figure 4.4).

By rethinking the design process of materials, buildings, up to entire cities, and closing loops in multiple phases of the building process, both in the bio- as well as the techno-sphere, no waste has to be produced (figure 4.5).
The circular economy (CE) proposes to apply a more resource-effective model by decoupling economic growth from resource consumption (Van Steijn and Gruis, 2019). The model originates from several schools of thought, including industrial ecology (Ayres and Ayres, 2002; Graedel and Allenby, 1995), regenerative design (Lyle, 1994), the performance economy (Stahel, 2006) and biomimicry (Benyus, 1997). The CE model can be summarised by three principles (Ellen MacArthur Foundation, 2013; Mendoza et al., 2017):

1. Preserve and enhance natural capital by controlling finite stocks and balancing renewable resource flows;
2. Optimise resource yields by circulating products, components, and materials at their highest utility at all times in both technical and biological cycles;
3. Foster system effectiveness by revealing and designing out negative externalities.

The building sector consumes 40% of global natural resources, produces 40% of global waste and 33% of emissions (Ness and Xing, 2017). Due to its high impact, the transition to a circular built environment is key to achieve a resource-effective and sustainable society. Within the building sector, the focus is currently on dealing with waste, or recycling. Recycling is mentioned as the 'outer technological cycle' in the CE model (Ellen MacArthur Foundation, 2013). However, a main principle of the CE is to first make optimal use of the 'inner technological cycles', such as maintain, reuse and remanufacture, and thus to prevent waste. Buildings consist of many components such as climate installations, kitchens and facades which could be replaced by 'circular building components' during the natural maintenance

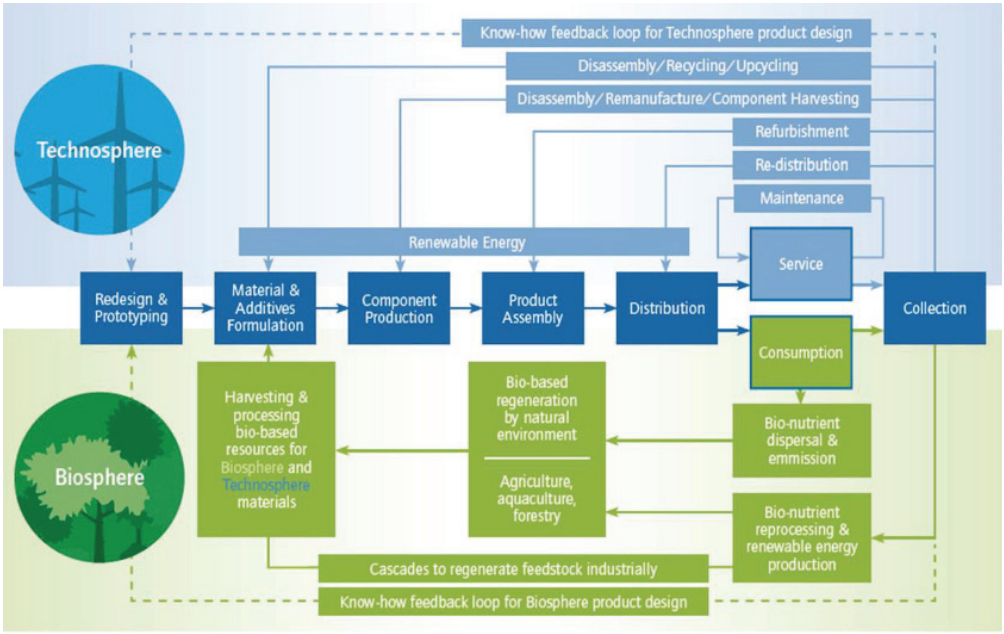

Figure 4.6 Material flows in a circular economy (EPEA and Returnkity partners)

and retrofit moments. By closing the material flows (figure 4.6) the building stock can gradually becoming more circular (Geldermans, 2016).

Once the step has been taken to close material flows and become fully circular, the next question is whether building processes can be made more than circular (Roggema, 2019). In the past few centuries humanity has 'abused' the earth's stocks severely and taken (too) much from the system of our planet. To only stop doing this will not be enough for the earth to recover, our planet will also need to be given the chance to revalidate. This forms a new challenge: it is time to start giving back more than we use. To create the ReciproCity (Roggema, 2019) a holistic approach is required in which multiple perspectives are taken into account simultaneously:

- Spatially: in terms of physical amounts of materials and stores;
- Mentally: by taking care of the entire (eco-)system;
- Socially: by developing common values together with others that create a sustainable, enjoyable environment at a local level;

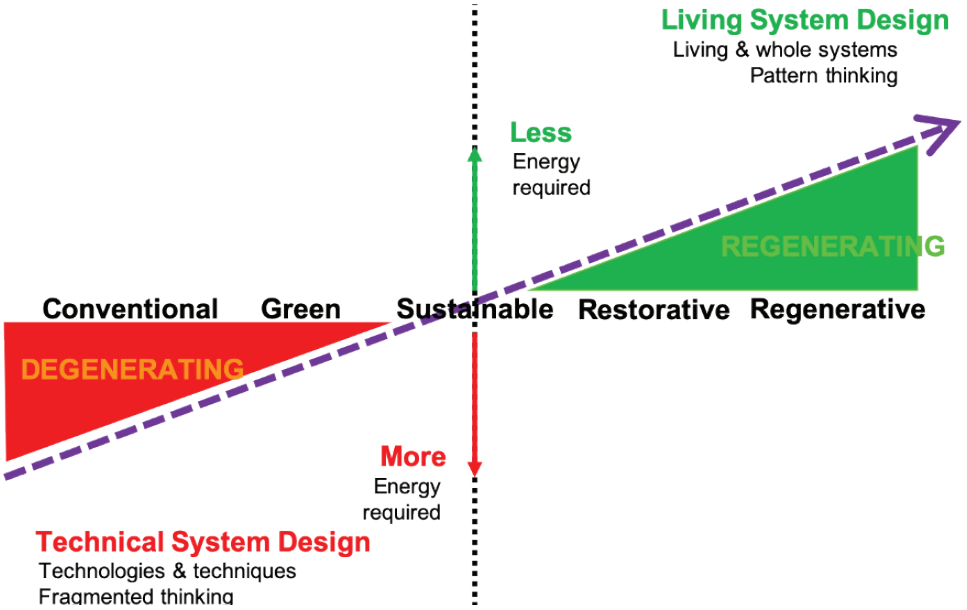

Figure 4.7 From a technologically driven system to a living system.

- Ideologically: by realizing that humanity has gotten caught up in a transition process, by accepting decay and adapting to the new era.

There is evidence galore that, despite successful interventions and policies, like diminishing the hole in the ozone layer and improving the water quality of the Rhine, real fundamental changes have had no or barely any effect (HIER climate bureau, 2016; PBL, 2009; 2018; IPCC, 2013; IPBES, 2019). With well-meant policy alone, we apparently cannot reach the goals we have set for ourselves. Instead of considering the sustainable city to be our goal, in which we try to find balance between ourselves and our environment, for example through realising zero-energy households, the city and countryside will need to become reciprocal, creating a ReciproCity, and start giving back more to its environment than it takes. This is necessary because in the last 170 years we have used too much of the earth's natural resources, causing water pollution, a decrease in biodiversity, and large-scale deforestation, which in turn led to enormous amounts of waste. It is time to view the city as a source rather than a drain. Therefore, we must go further than closing cycles. ReciproCity would work as a living organism rather than a technologically driven system (figure 4.7; Rees, 2002; 2003; 2006a; 2006b; Wackernagel and Rees, 1996), so that there may be hope that we can truly make our environment reciprocal (Hes and Du Plessis, 2015).

In order to lovingly guide this process towards the future civilization, a boatload of creativity is necessary (Brugmans and Stikker, 2019). This reciprocal future cannot be achieved with pursuing old solutions. After all, they were the ones that started the deterioration process in the first place.
The ReciproCity:

a. Works as a filter for polluted water. Waste enters the urban area, is filtered, used and then leaves the city purified. The water thus becomes cleaner and more valuable thanks to its stay in ReciproCity;
b. ReciproCity captures more CO_2 than it expels, for example by capturing carbon and using it to make high quality products (for example, look at the Smog Free Tower project by Studio Roosegaarde, https://www.studioroosegaarde.net/project/smog-free-tower);
c. Creating Urban Ecology, which will lead to more biodiversity in ReciproCity than in 'real' nature, for example by saving space in the city where nature can freely develop;
d. Constructing more green areas close to citizens, due to its positive effect on children's concentration – and even improve maths performance – and the lowering of stress, domestic violence, and crime rates (GANSW, 2017);

e. Being linked to a green urban infrastructure, it is also important to attach a cultural-historical infrastructure. In Sydney, besides the 'Sydney Green Grid' there is also the 'Ocre Grid', Designing with Country (https://www.governmentarchitect.nsw.gov.au/projects/designing-with-country), for exactly this purpose. In this 'grid', Indigenous heritage plays a structural role;
f. Producing a surplus of food in ReciproCity, through which food can also be delivered to the land surrounding the city. By introducing bigger places where healthy food can be cultivated, citizens will not only be more concerned with each other, but they also learn more about local production and health, leading to them eventually eating more healthily and becoming healthier.

4.4 Collaborative research program

The temporary housing at the Loskade area is there to stay until 2030. This makes it a unique opportunity to investigate, monitor and evaluate the planning, building and construction principles used for a period of more than 10 years. Therefore, the Professorship Spatial Transformations and Van Wijnen have agreed, together with BuildinG to conduct applied research of circularity and temporary living at Loskade between 2019 and 2030. The aim is to share knowledge and improve insights about the built innovations that are developed in the project. Concretely, the understanding of circularity in the built environment and the application of the concept in the usage phase of the project is of great interest. In order to give shape to this ambition the Living Lab Loskade has been inaugurated. This Living Lab brings all parties together and coordinates the research of the permanent adaptive, sustainable and circular built environment of the Loskade. Knowledge about materials is combined with the design expertise, understanding of the social domain of human experiences, circularity of the public space (flows of energy, water, mobility and nutrients) and technology is hereto brought together. Novel insights can be considered, designed and realised in a short time and applied, and evaluated, in practice. The satisfaction of tenants, the precise adjustments and adaptations that are designed and realised in a context of continuous climate change influences each other. The research collaboration aims to establish a quick interaction between new knowledge and practical experiences in order to improve circularity and customer satisfaction. Because the tenants of Loskade can only stay for maximal six months the project is an ideal case to observe and investigate changes as this implies the demands for good living may change quickly with every change of tenure. The major question is how in a neighbourhood with solely temporary tenants a high level of circularity can be achieved that is desirable and acceptable. Specific subquestions are:

1. How can the design of the homes and public space be as flexible as possible;
2. What is the technical performance of the houses;
3. How satisfied are the tenants;
4. How fast can changes be implemented on the basis of technical performance or the wishes of the tenants.

In current practice the technical, social and spatial research fields are separated. Especially in the building sector, often seen as conservative, it is important the built solutions are technological innovative, spatially attractive, affordable and socially acceptable. A specific feature of the research collaboration is that the plannable aspects, such as building technology and the design of the houses, are combined with unplanned aspects, being the well-being of tenants and climate change. This way a concrete and easy to use model is developed for a permanent changing dynamic system with continuous feedback loops influencing the proposed next design steps on the basis of analysed data so as to influence the sustainability of the built environment through minimising energy- and water use, and finding local solutions for the growth of food and mobility.
The choices in an emergent, maturing neighbourhood do take place in a force field within which choices and impact can be positioned (figure 4.8).

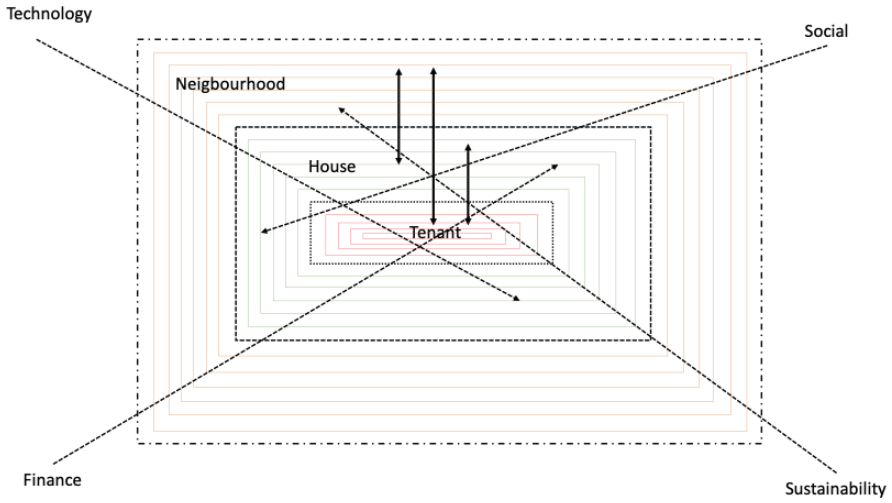

Figure 4.8 Force field of influence and scale

This model exemplifies the types of influence when thinking about solutions. The four corners represent fundamental perspectives on the solution, some may be seen from a technological point of view others see only sustainability aspects. When a certain research question, or solution for that matter is proposed it is helpful to locate this in the force field. Each subject will always impact at the scale of the tenant, the house and the neighbourhood as a whole. However, some will have a profound effect on well-being of the tenant, while others such as mobility could be more impactful at neighbourhood level. An issue such as the price of energy will have a lot to do with the finance and sustainability, the technology of the built constriction and the energy bill of the tenant. This way every research question can be placed in the bigger context, and, the other way around, a set of issues can be combined, for instance all that have something to do with the neighbourhood as a whole and general conclusions can be drawn at that specific scale. Finally, this model makes it possible to quantify and screen the trade-offs of certain solutions on other themes, scales or aspects.
Currently most research questions seem to be relevant at the house and neighbourhood, related to the use of materials and resources, value creation fort he tenant and technical aspects. Less profound is the impact of sudden changes, such as climate impacts or the way resident scan support each other in times of serious changes. These elements influence the built environment in an uncertain or unprecedented manner and are more difficult to investigate in a straightforward way. The following research lines have been distinguished:

1. Measure and monitoring: the energy use, supply and generation, circularity of the building and public space, material use, climate proofing and -adaptation.
2. Design research into the spatial and architectonic quality of buildings and public environment.
3. Research on the quality of life: customer satisfaction.
4. Process research, the involvement of tenants, participation in planning and design and the role of stakeholders and experts in the design-, realisation and usage process.
5. Any other topics that might appear during the lifecycle of the neighbourhood.

Over the entire research collaboration period these research questions will all be subject of student research, and will be constantly judged on their relevance fort he building sector, the education requirements and the market proition of Van Wijnen.

4.5 Customer satisfaction

The first graduation research has been undertaken in 2019-2020, focusing on the customer satisfaction of the first residents, who started their Loskade life in August 2019. Satisfied tenants are seen as an important factor in determining the success of the Loskade project hence the ambition of Van Wijnen. Therefore, the reason for this research is clear to determine the customer satisfaction and ways to improve it (Blaauw, 2020). The detailed aspects of customer satisfaction are specified for the house, the direct living environment and the services provided. In business satisfaction is defined in similar but different ways: 'The customer is satisfied if the experience of a service or product is minimal as good as beforehand were expected' (Drion en Van Sprang, 2006) or 'Customer satisfaction is the experience of the customer as result of an (un)conscious comparison of his experiences with his expectations' (Thomassen en De Haan, 2016). This expectation depends on three factors: word of mouth, personal desire and previous experiences (Zeithalm, Parasuram en Berry, 1990). Itr can be measured according the following elements:

- Reliability ;
- Responsivity;
- Carefulness;
- Empathy;
- Bagibles.

These elements determine the quality of service.

The main research question is formulated as follows: 'How satisfied are the first tenants about their stay at the Loskade?' This question has been detailed in several specific questions:

1. What are the relevant elements that determine the satisfaction of the home, the daily environment and the services?
2. Which way of custumoer satisfaction research is suitable for the Loskade propject and Van Wijnen?
3. How satisfied are the current tenants?
4. What could Van Wijnen doe on the short, middle and long term to keep up current satisfaction or improve it?

The 77 tenants in the 43 homes and studios at the Loskade are the research population. The research consist of desk research, interviews, diaries, a focus group, postcard mailing and a questionnaire. The topics that have been found related to the home, the daily environment and the services are shown in table 4.1.

Table 4.1 Found topics of customer satisfaction at the Loskade

Home	Daily environment	Service
Feeling at home	Neigbours	Furnished home
Sustainability	Safety	All-in rent
Indoor climate	Amenities close by	Rental process
Insulation	Accessibility	Keeping appointments
Size of spaces	Parking	Possibillity for requests
Storage space	Waste treatment	Pace of responses
Interior design	Green	Understanding of staff
Attractiveness inside and outside	Maintenance	Commuincation with staff
Natural light	Neatness	Final contact
Outside view	Attractiveness	
Furnisment	Temporariness	
TV and the Internet		
Value for money		

The initial satisfaction scores for the Loskade is 7.5/10. The score for the house itself is 7.3/10, for the daily environment 5.9/10 and the service 7.5/10. Several points of improvement are deribved from the interviews, the questionnaire and the focusgroup (table 2). It can be concluded the first tenants are relatively satisfied with the quality of living at the Loskade. There are several aspects that can be improved, especially the public space, but this an area Van Wijnen not always has direct control over.

Table 4.2 Points for improvement

Home	Daily environment	Service
Insufficient storage space	State of the tarrain (holes, puddles, sand and stones)	Insights in maintenance
TV and the Internet	Accessibility by foot and bicycle	Awareness of planned guided tours
Indoor climate	Outdoor view	Access to the gauge of personal energy use
	Bike parking	
	Amenities	
	Waste treatment (separation)	

The following conclusions/recommendations are given:

- Continue to measure customer satisfaction using questionnaires and focusgroups
- Pay most attention to the public space and accessibility (by foot and bike)
- Stay in close contact with the manager of the entire Sugarfactory area
- Create more bike parking
- Consider creating more storage space in homes and studios
- Organise more community get-togethers to increase social coherence
- Initiate a newsletter for sharing information about actual developments in the neighbourhood and/or the energy use

4.6 Outlook

The research collaboration at Loskadehas started only recently and the way different involved parties work together in this is interesting and shows a rapid progress. The plan is this collaboration lasts more than 10 years and there is ample time to improve the processes, the project definition and the research outcomes. The plan for the entire collaboration is to capture the outcomes and process in a book, describing the journey that the partners have undertaken.
This type of development is bery interesting and enjoyable, and brings about new insights in a dynamic and emergent context. The primary attention will most probably focus on technical adjustments in the buildings and servoces, together with understanding satisfaction of the tenants. However, on the long term the changing circumstances, policywise, technological, socio-economic and in the field of sustainability demands a pro-active attitude, so new research questions are related to problems that are not yet completely visible or extremely uncertain. More rigourous change, for instance as result of climate change (energy pricing, urban heat, solar radiation, or water scarcity), demand space for a flexible built environment.

Finally, the link between education and the laws of the market economy are challenging yet an opportunity to discover the connections between short term necessities and long term thinking. With this in mind new research projects and -questions can be envisaged that are dealing with sudden change and unprecedented transformations.

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5

Making City: challenges and opportunities for local energy initiatives

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5.1 Introduction

Making City is a five-year Horizon 2020 project funded by the European Commission (European Commission, 2020). The project involves a consortium of 34 partners throughout Europe who aims to investigate the opportunities Positive Energy Districts (PEDs) can offer in the energy transition process. Within this context, a PED is considered to be a demarcated urban area consisting of a variety of buildings, which manages to deliver a higher amount of energy within the district compared to the amount of energy that is supplied from outside, resulting in a positive total annual energy balance (Making City, 2020). In order to achieve this goal, Groningen (The Netherlands) and Oulu (Finland) have been designated as lighthouse cities, in which the PED-concept will be developed and implemented. The findings from Groningen and Oulu will be shared and replicated in six follower cities: Lublin (Poland), Kadiköy (Turkey), Léon (Spain), Vidin (Bulgaria), Bassano del Grappa (Italy) and Trencín (Slovakia).

Consisting of both technical and non-technical actions, the activities undertaken in the Making City project are based on a long-term vision on energy transition, using the City Vision 2050 developed by the European Commission (2019) as a guideline.

Aside from demonstrating the PED concept and its replication, other project objectives include the creation of an accompanying monitoring and evaluation programme, the development of suitable business models and market strategies that enable exploitation of the results and applied technologies, the organisation of social innovation activities to connect stakeholders, and implement a communication and dissemination strategy to raise awareness about the project. It is expected that the development of the PED-concept in Making City will generate several significant impacts, such as an increase in the use of renewable energy sources, waste recovery technologies and innovative storage solutions. Furthermore, by fulfilling its objectives, Making City will enhance energy efficiency and e-mobility within districts, ultimately leading to a positive overall impact on the quality of life of the citizens living in urban areas (Making City, 2020).

As one of the eleven local partners in the city of Groningen, the activities of Hanze University of Applied Sciences (HUAS) within Making City consist of both technical and non-technical actions.

Technical actions include the mapping of district energy flows, studying the impact of the proposed e-mobility solutions on the grid and demonstrating the technical integration of renewable energy sources. Non-technical actions comprise, among others, the (further) development of citizen engagement strategies, co-creation and co-design activities with stakeholders and assessment of legal barriers. In Groningen, two areas have been appointed to be further developed as PED districts. PED North consists of a section of the northern neighbourhood of Paddepoel and PED South is situated in the Europapark district in the south of the city of Groningen. Making City's technical actions will take place within these two designated areas. Some of the non-technical actions, particularly those pertaining citizen engagement, have not been assigned specific districts, but research is expected to be conducted in the neighbourhoods of Oosterpoortbuurt, Gerbrand Bakkerstraat, Noorderplantsoenbuurt and the neighbouring village of Hoogkerk.

In this chapter preliminary findings from research conducted for the Making City project are presented. The first section explores to what extent innovative business models could be implemented in a neighbourhood in Groningen that could contribute to easing the local energy transition. The second research outcomes illuminate the barriers to citizen engagement in energy transition and the role that incentives can play in increasing participation. For both studies, the common denominator is the agency of local energy initiatives, which play a pivotal part in the energy transition process in Groningen.

5.1.1 The role of local energy initiatives

Decentralised energy systems, infrastructure and networks can be seen as important components of low-carbon transition (Goldthau, 2014). Furthermore, the traditional top-down approach adopted by governments can no longer be considered suitable for the energy transition, prompting a need for new agents of change (Hajer et al., 2015). These actors consist of citizen-led energy initiatives, showing that the energy transition occurs along with the transformation of communities and neighbourhoods (Van der Schoor and Scholtens, (2015). Current literature offers a wide range of terminologies in relation to these locally-led and collectively-owned energy initiatives, such as *prosumer communities* (Rathnayaka et al., 2011), *community energy* (Devine-Wright & Wiersma, 2013), *civic energy* (Biekart & Fowler, 2012) and *grassroots initiatives* (Oteman et al., 2017). However, in the following studies, these initiatives will be referred to as *(local) energy initiatives* (Hoppe et al., 2015).

It is noticeable that most research has focused on a certain type of energy initiatives, renewable energy cooperatives, Although community-based renewable energy cooperatives have spread worldwide, academic literature mostly describes cases from Northern European countries, such as Germany (Yildiz et al., 2015), the UK (Smith et al., 2016), Denmark and The Netherlands (Hufen & Koppenjan, 2015).

Moreover, the cases' overall background appears to shift among policy making, governance and the social-technical aspect of energy transition. Seyfang et al. (2013) consider local energy cooperatives as potential key players in the energy transition in the UK. In the Netherlands, the number of local energy cooperatives has rapidly grown from 399 to 484 in 2018. With approximately 70,000 members, these cooperatives work on energy savings, solar and wind projects and district heating, which can generate enough power for more than 140,000 homes. In the city of Groningen, more than 30 renewable energy energy cooperations can be identified (HIER Opgewekt, 2020).

Aside from renewable energy cooperations or communities, which have relatively formalised organisational structures [1], various other types of energy initiatives exist. Based on a study of thirteen local community energy initiatives in the north of the Netherlands, Van der Schoor and Scholtens (2015) constructed a taxonomy of the different ways in which local community energy initiatives organise themselves, ranging from the least to the most formal:

1. Working group with the specific purpose to promote community energy.
2. Working group attached to other groups already operating at the local community level
3. Working group attached to political party
4. Foundation with the specific purpose to promote community energy
5. Cooperative to produce and distribute local energy at the community level
6. Commercial venture

In addition, the authors have also identified the initiatives' main relations to outside networks, showing that the vast majority of initiatives had a relationship with the local or regional government, more than half was connected other community groups, such as schools or village communities, almost half showed a direct relationship with the business community and some had contact with a regional or national non-governmental organisations.

The following two sections highlight some of the challenges that energy initiatives in Groningen face, as reported by the practitioners involved. Based on these preliminary findings, recommendations are made to increase citizens' participation in the energy transition process.

1 According to the EU directive 2018/2001- article 2(16), a renewable energy community is a legal entity: (a) which, in accordance with the applicable national law, is based on open and voluntary participation, is autonomous, and is effectively controlled by shareholders or members that are located in the proximity of the renewable energy projects that are owned and developed by that legal entity; (b) the shareholders or members of which are natural persons, SMEs or local authorities, including municipalities; (c) the primary purpose of which is to provide environmental, economic or social community benefits for its shareholders or members or for the local areas where it operates, rather than financial profits.

5.2 A new business model for accelerating the energy transition

Groningen aims to be energy neutral by 2035. At the same time, the IEA indicates that the pace of the energy transition is too slow to solve climate change problems (IEA, 2018). Financial barriers, such as high upfront costs and low return on investment, have been identified as major barriers for a successful energy transition (Richter, 2013; Boo et al., 2016). In particular households experience difficulties to access modern renewable energy systems. Therefore, it is necessary to rethink conventional business models and design a new business model for local energy cooperatives in order to overcome barriers, appeal to the residents in their respective neighbourhoods and accelerate the energy transition process. This study adopts a qualitative reserach approach to gain more insights into the local energy field and propose a new business model, that is based on experiences shared by representatives from local energy initiatives and cooperatives as well as local residents in the neighbourhood of Paddepoel.

5.2.1 Sustainable business models and energy transition

A *Business Model Canvas* (BMC) is a model that can explain how an organisation creates, delivers and captures value (see figure 5.1). It consists of nine elements describing the customer segments, value propositions, distribution channels, customer relationships, revenue streams, key resources, key activities, key partnerships and the cost structure of an organisation or product (Osterwalder et al., 2014). However, the BMC has been criticised as it fails to take environmental and social values into consideration (Upward, 2013) and does not appear to have a thorough impact on business success (Ladd, 2018). In the last few years, this has led researchers to study the linkage between business models and sustainability (Stubbs & Cocklin, 2008; Schaltegger et al., 2016). It has been concluded that models should be developed that are more sustainability-oriented has been (Lenssen et al., 2013).

Sustainable business models (SBMs) can be defined as: 'models that attempt to balance an ecological, social, and/or economic problem through value propositions, stakeholder engagement as well as a responsibility for ecological burdens, rather than transferring this to customers or suppliers' (Boons & Lüdeke-Freund, 2013). It can be used to integrate sustainability into an organisation's value-creating activities and embed it into business goals. The scope of SBM development usually comprises the enterprise level as well as the socio-economic system (Stubbs & Cocklin, 2008). Designing a new business model, three SBM-aspects , the economic, social and environmental, will be included in the new BMC.

The *Value Proposition Canvas* (VPC), developed by (Osterwalder et al., 2014) is intended as a mapping tool to enable entrepreneurs to visualise, describe and design their business model in a logical way. As technological innovation does not create value by default, it is therefore important for business models to understand the needs of its customers and provide them with accurate value creation

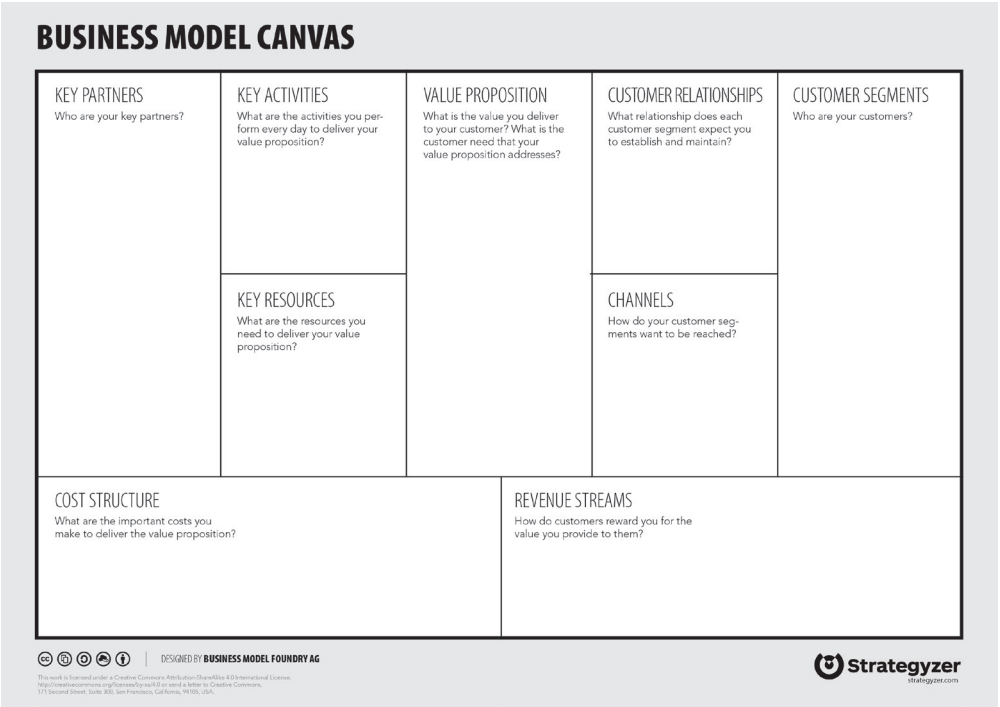

Figure 5.1 The Business Model Canvas (Osterwalder & Pigneur, 2010).

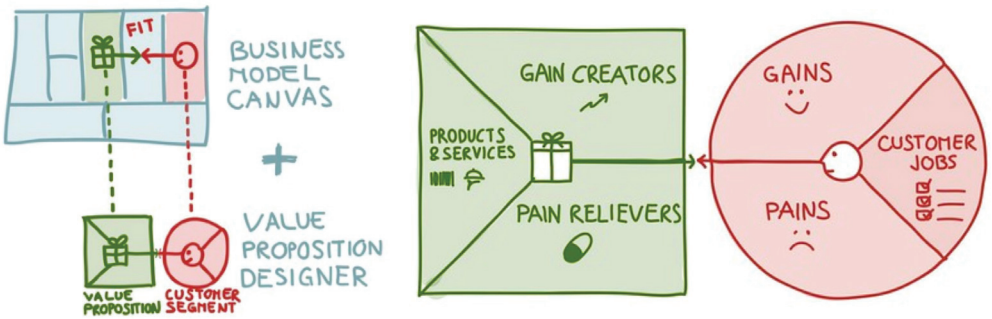

Figure 5.2 Value Proposition Canvas. Left: the 'fit' between the value proposition and the customer segment. Right: Zoom in on value proposition and customer segment (Osterwalder et al., 2014).

(Teece, 2010). The purpose of the VPC is to explain the value created for customers and offer a better understanding into customers' needs. The VPC zooms in on two business model building blocks: the customer segment on the right and the value proposition on the left (see figure 5.2), both of which organisations need to get right – the 'fit'. The composition of the value proposition consists of products and services presented to clients, the comfort to overcome customer pains, and thus creating gain (Osterwalder et al., 2014).

5.2.2 Research objective

The research objective of this study is to design a new business model to accelerate energy transition for a local energy cooperative within a neighbourhood in the city of Groningen. This neighbourhood is currently experiencing difficulties to access modern renewable energy technologies. The following research questions have been formulated:

- What are the barriers and local factors that influence households who are experiencing difficulties to access modern renewable energy technologies in the city of Groningen to change their energy system?
- Which value proposition within the business model canvas would create the most value for the identified stakeholders?
- What sustainable strategy can energy cooperatives utilise for these households?

5.2.3 Methodology

In order to design a new business model for a local energy cooperative, this study utilised an inductive qualitative approach in conjunction with the case study method, defined by (Yin, 2018) as 'an empirical inquiry that investigates a contemporary phenomenon', to gain more insight into the local context. In total, three case studies were constructed for the energy communities De Energiewerkplaats, De Groenste Buurt and Paddepoel Energiek. Data was collected by conducting semi-structured interviews with three representatives from local energy cooperatives, four local homeowners with difficulties to access modern renewable energy system and two experts in energy transition.

The data from the interviews was transcribed and coded using the Altlas.ti qualitative research software. These codes were developed from literature on barriers and enablers as well as the elements from (sustainable) business models. Analysing the code patterns enabled the organisation of the information and the drawing of connections. Next, the codes were categorised into groups, allowing the identification of recurring patterns among the different interviews. The answers were analysed, compared and compiled into a network that visualised the findings. The analysed data was then mapped onto the VPC and BMC, and used as the foundation to design a new business model for Energiewerkplaats, one of the energy communities.

To increase the reliability of the study, a pilot study was conducted together with expert consultations before the data collection phase. Furthermore, the interviews transcripts were sent back to the participants, to confirm the accuracy of the data by allowing them to comment and validate their answers. The data was triangulated by comparing the answers of different participants to the same guided questions. In addition, the categories and codes were cross-checked by other project team members to verify their accuracy.

5.2.4 Findings

In this section, the current business models of the three case studies are presented, along with with the barriers and enablers, both financial and non-financial, that have been identified.

Case 1: De Energiewerkplaats

De Energiewerkplaats is an initiative in the Paddepoel neighbourhood, which is still in its start-up phase. Consisting of a group of five residents, the initiative is currently in search of a suitable form which would enable them to do projects related to sustainability and social issues in the neighbourhood. The activities that the Energiewerkplaats aims to develop are broader than issues surrounding energy. For example, the team has helped to organise a neighbourhood café every Sunday evening, where residents of various backgrounds, such as the elderly and international students, can get to know each other and have a free meal.

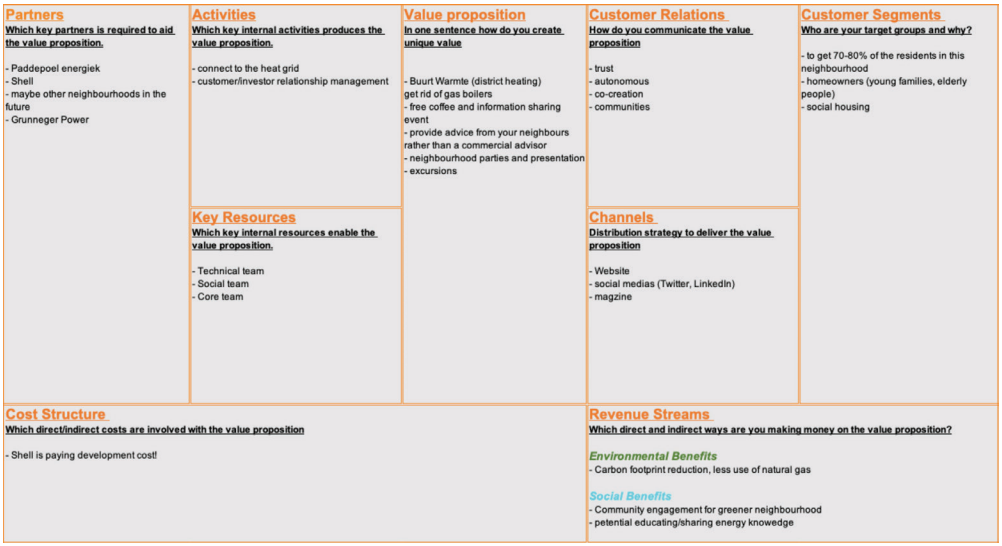

Figure 5.3 The current business model canvas of De Energiewerkplaats.

Case 2: De Groenste Buurt

Initially a neighbourhood committee, De Groenste Buurt became an official cooperative in 2016, aiming to increase sustainability and greenery in the Noorderplantsoen neighbourhood. Their ambition is to become energy neutral in 2024, meaning that the energy generated in the neighbourhood would be equal to the energy consumed. The cooperative provides several services and activities relating to the reduction of energy consumption, such as heat scans, advice from techical experts, publications, joint purchasing and site visits to residences which have already implemented energy saving measures. In 2019, De Groenste Buurt presented the district energy plan (wijkenergieplan) for the Noorderplantsoen neighbourhood. The plan outlines how the relevant stakeholders, such as home owners, tenants, housing coroporations and energy providers, can ensure that the neighbourhood is CO_2-neutral in 2035, a goal set by the muncipality of Groningen.

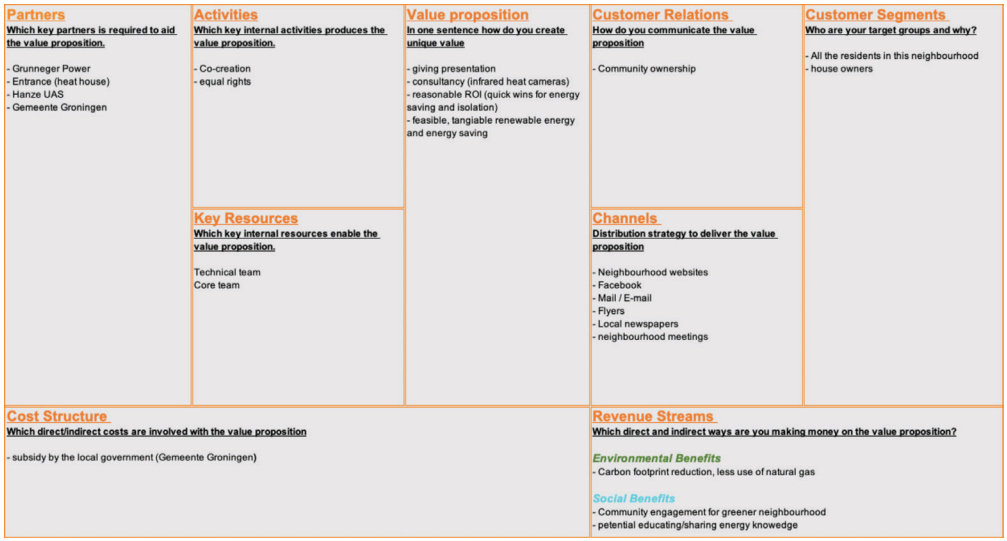

Figure 5.4 The current business model canvas of De Groenste Buurt.

Case 3: Paddepoel Energiek

This initiative was founded in 2012, when a group of home owners decided to make their residences, largely built in the 1960s, more sustainable. Since then, Paddepoel Energiek has grown into an initiative that encompasses the entire neighbourhood of Paddepoel. It is a classic volunteer organisation in the sense that there is no membership and no influence in decision-making; the initiative only provides advice to residents, mainly through its energy coaches. Their activities are geared towards the goal of becoming an energy neutral district in 2035 which is able to generate its own energy.

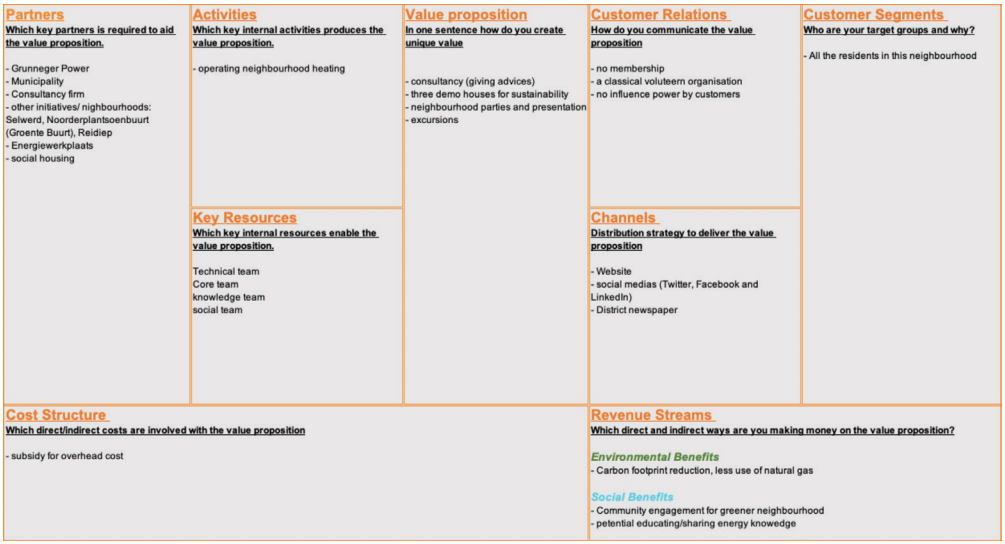

Figure 5.5 The current business model canvas of Paddepoel Energiek.

5.2.5 Barriers and enablers

The study identified several barriers and enablers (figure 5.6), both financial and non-financial, that might either hinder or encourage residents to make changes or to be involved in local energy initiatives or cooperatives. Aside from common financial barriers, such as the significant upfront costs of installing renewable energy systems, interviewees also mentioned that the cost of changing to renewable energy is not usually the cheapest option, discouraging them to make the change. The residents also pointed out that they experienced significant uncertainty when investing in the installation of renewable energy systems which have a long-term return on investment (ROI).

In addition, several non-financial barriers were encountered. Some residents noted that they do not receive much information regarding the projects and activities of energy initiatives through the common communication channels, such as flyers or advertisements in the local media. The language barrier makes it even more difficult to get involved, which is underlined by both residents and energy cooperatives. As the information from local energy cooperatives is always in Dutch, the international residents in Paddepoel will often throw flyers straight into the bin. However, the energy initiatives acknowledge this problem, but point that they are currently lacking the manpower for translating their materials.

General uncertainty regarding the future was also reported as an obstacle. "Is the gas price changing?", "Will I live in the same building for the coming years?", "Does climate change affect my current life or in the far future?". These uncertainties lead to an unwillingness to be involved in energy transition in the short term. Technical limitiations pertaining to older buildings, apartment surfaces and conflicting legislation were also mentioned as barriers in participating in the energy transition.

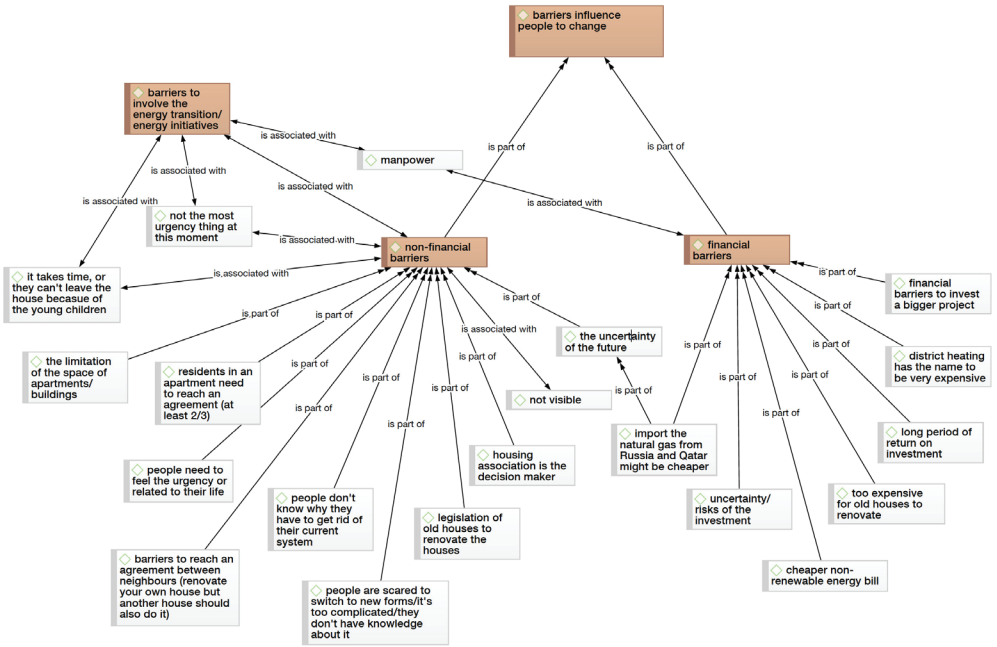

Figure 5.6 Visualisation of the barriers that hinder local residents to be involved in energy transition/initiatives.

The financial enablers that were identified are mainly influenced by external environmental factors, such as the potential increase of energy and electricity prices due to the decrease in use of natural gas. Making changes is particularly challenging if the payback time is short. One of the interviewees stressed the importance of 'quick wins', such as placing thermal fans behind the heater, which are cheap and easy to install, but make a tangible difference, which is also an important incentive. However, interviewees also emphasised difficulties in changing their attitudes solely based on financial motives. Personal interest also appears to be an important driver for residents to be involved in the energy transition. Examples include the awareness of the issues surrounding gas extraction in the province and the desire to participate in something together with others, particularly if these are people that the residents know. Both the representatives from the energy initiatives and residents agree the trust is important factor in these interactions.

In the Noorderplantsoenbuurt district, relations between neighbours can be characterised as close. For them, it is not just about energy, but also about engaging in social activities with one another. For example, 'kitchen table' events are periodically organised in residents' houses. Here, neighbours can sit together and talk face-to-face to talk about anything, reinforcing the connection between residents and increasing community cohesion. Since they feel part of the community, they do things together, such as have dinner or a cup of coffee, opening the possibility of triggering a personal interest towards energy transition. Conversely, an international resident from Paddepoel mentioned that he would be willing to join local activities and even would consider contributing to a local energy initiative. However, due to the language barrier he doesn't know what is happening in the neighbourhood and is unaware of the existince of an energy initiative. Getting involved, even with good intentions, can therefore be quite a challenge.

5.2.6 Discussion

In this section, a VPC will be presented for Energiewerkplaats based on the barriers and enablers, which will include customer gains, customer pains, pain relievers and gain creators and propose a 'fit' between them (see figure 5.7).

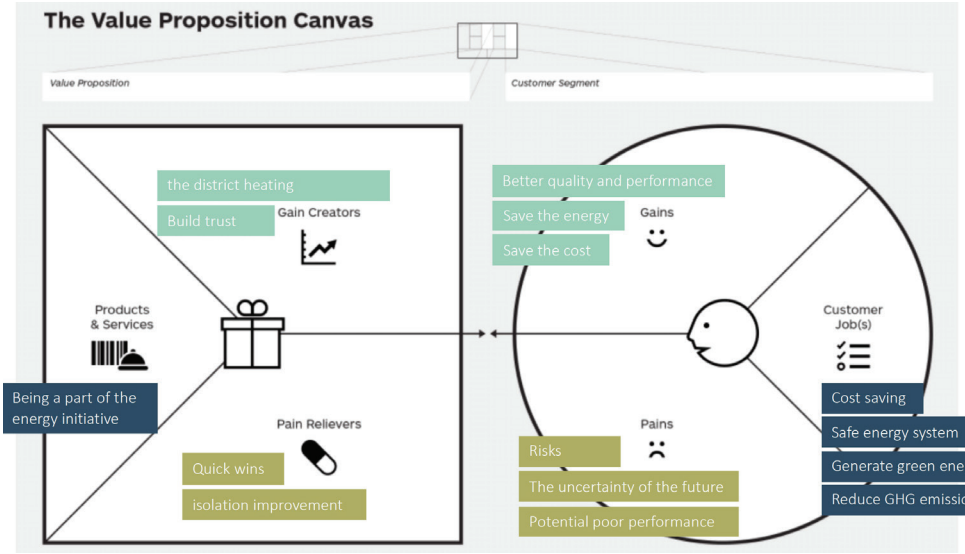

Figure 5.7 The 'fit' in Value Proposition Canvas. Adapted from Osterwalder et al. (2014).

Customers:

- *Customer jobs*: Paddepoel residents report different concerns regarding their energy system. Some prioritise costs while others prefer a safe energy system. Several interviewees were interested in generating green energy and reducing CO_2 emissions.
- *Pains*: Residents were concerned about the risk of investment, particularly in larger projects. The uncertainty of the future increased their negative emotions towards changing their energy system. Other concerns voiced were the poor performance of solar panels on the roof or walls of their apartments.
- *Gains*: Residents want to be involved in sustainable activities if they can save on their energy bills. The expectation of lower costs, fewer investments, lower risk, better quality and performance are seen to increase the likelihood of adopting sustainable solutions.

Value Proposition:

- *Pain relievers*: Focusing on quick wins could be a good choice to get residents involved in the energy transition, as it bypasses issues such as investment risks or uncertainty regarding the future. Improved insulation can also help to reduce energy usage as well as costs. However, De Energiewerkplaats also needs to build up trust and increase connections within the neighbourhood by enhancing their communication channels. Although De Energiewerkplaats makes use of several existing channels, there still exists a communication gap between the initiative and local residents.
- *Gain creators*: District heating creates a positive environmental consequence that customers desire, in terms of saving natural gas and lower green house gas emissions. To promote this, again, trust has to be built and connections have to be made in order to reassure customers that what is recommended indeed is better alternative than what they currently have.
- *Products & Services*: The core idea is that customers who would become a member of the energy initiative could invest in quick wins or district heating. The value proposition is that customers save on both energy usage and costs and produce green energy locally to achieve a sustainable lifestyle and reduce greenhouse gas emission. De Energiewerkplaats is the owner of the service and customer relationships, which means that they offer their customers a one-stop service solution. Serving customers includes acquiring new members, managing, establishing district heating and arranging subsidies on behalf of the customers.

A new business model

An important value proposition for De Energiewerkplaats is the ability to easily save energy as well as generate heat locally. At the development stage, value creation activities establish and manage the channels, customer relationships and key partners that are necessary to provide the core value proposition. The estimated cost structure and revenue streams are based on the available information. To create and deliver the value proposition, De Energiewerkplaats needs to cooperate with local partners, both software and hardware providers. The local providers supply the key resources and carry out key value creation activities, such as building the local heat grid, which can also increase the local job opportunities. After acquiring these key resources and partners, the costs and revenue streams can be calculated.

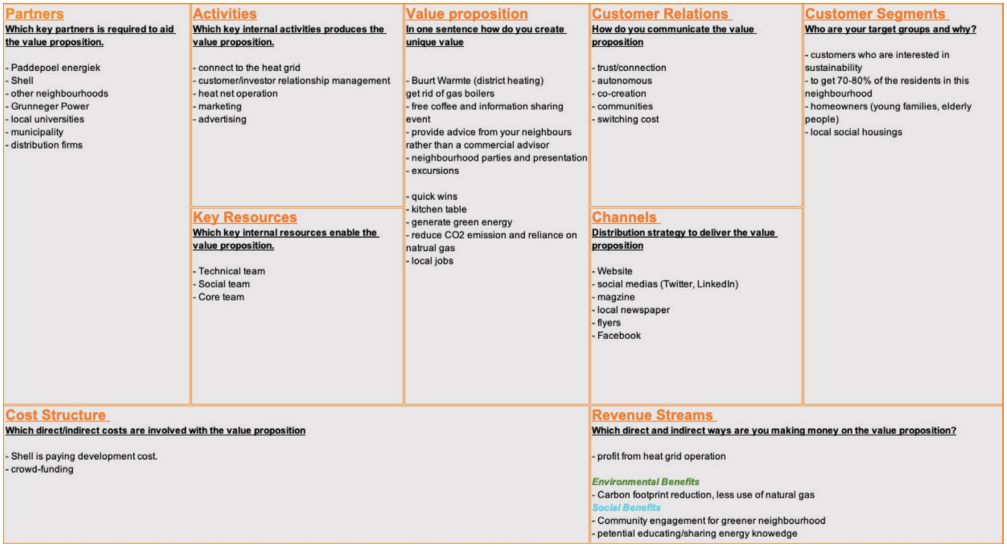

Figure 5.8 A new business model for De Energiewerkplaats.

5.2.7 Conclusion and recommendations

The main purpose of this study was to identify the barriers and enablers that hinder and create value, respectively, for customers who do cannot easily access renewable energy technologies. Using the Business Model Canvas and the Value Proposition Canvas, local energy initiatives in the city of Groningen were analysed, which included factors from residents' perspectives. Barriers to participate in energy transition activities included financial implementation costs, investment risk, insufficient communication and language barriers. Some of the enablers that were identified included saving on energy usage or costs, quick wins and the importance of (existing) social engagement between residents. Both energy initiatives agree that the creation of trust is an important factor in maintaining good social relations. For this study, the business model canvas has proven to be a valuable tool to assess how an organisation functions and develops under specific conditions and in what way they can create value. One of the findings in this study that it is important to build up a solid foundation of community trust. However, due to the frequent shortage in manpower that energy initiatives face, it is suggested to involve the government and universities, who might be able to provide the manpower to build up the channels between the residents and the initiative in order to market and promote the initiative in the neighbourhood. Organising events and activities helps raise awareness regarding the energy

transition and motivates people's interests while strengthening community cohesion. Once trust has been built, the initiative can turn to raising funds for green projects as well as expanding their network of partners or stakeholders. Others parties that could be involved are prosumers, service providers, distribution system operators and local municipalities.
Further recommendations to minimise local residents' negative perception about the local energy transition include:

- Use personal contact in the neighbourhood to inform customers, neighbours and residents amd provide extra information on the performance of the products, how to use them, make recommendations and give additional information for energy saving.
- Continually organise relevant meetings and activities for residents. Some custom activities are needed to meet the needs of certain target groups, such as families with young children.
- Communication channels need to be reinforced. The shortage of manpower could be addressed by cooperating with local government and universities. Students are often perceived as neutral, which can have positive effect on interactions with local residents.
- To strengthen the communication process, some promotional elements are recommended. Costly marketing strategies such as advertising, sales promotion and personal selling should be avoided. Instead, promoting public relations by holding events, conferences and social media are credible in customers' minds. Direct marketing can also be useful, along with email, door-to-door and face-to-face interactions, which also facilitates the relationships with (potential) customers.

Future research should also focus on identifying factors from quantitative methods to determine the majority market in different neighbourhoods. The evaluation can make use of the market metric and marketing dashboard to provide a marketing strategy that promotes local energy initiatives or cooperatives and the projects they are carrying out. Policy-makers should also engage more intensively in the energy transition and introduce policies in terms of different needs. In order to test whether the business model is viable, stakeholders should be able to capture sufficient value to commit to the business model.

5.3 The influence of incentives on energy participation

Energy transition can be defined as a fundamental reconstruction of energy system, patterns of energy consumption, and electricity and heat generation, which can benefit the whole society directly and indirectly, for instance by reducing the greenhouse gas emissions, raising the share of renewable sources, improving the energy efficiency, and stimulating economic growth (Köppl et al., 2014). Although a fair amount of research has sought possible approaches to accelerate energy transition from various perspectives (Lejoux & Ortar, 2014), such as the innovation in technical, social, ecological and economic systems (Loorbach et al., 2017), the government still dominates the development of energy transition, due to the centralized structure of the energy system (Solomon & Krishna, 2011). Furthermore, the paradigm shift needed is so complex and surrounded with uncertainties, the collaboration between the government and the public is necessary to accomplish the whole process (Fattouh et al., 2018). Therefore, there is a growing interest in how the public participation interacts and affects the transformation in the energy system, which is also known as energy participation (Barnes, 2019).

The emergence of local renewable energy cooperatives and communities is a fitting example of energy participation. These initiatives have the potential of engaging citizens in and steering civic acceptance for the required changes of energy transition (Kalkbrenner & Roosen, 2016). Possessing the characteristics and the potential, energy cooperatives and communities are deemed as qualified candidates to provide insights in energy participation.

However, engaging people in energy transition means inducing a change in the patterns of energy consumption or the attitude towards new technologies and energy resources. Energy participation is also related to behavioral change, as citizens have become active players in the energy sector instead of being passive followers (Garmendia & Stagl, 2010). The challenge is the disparity that has been identified between widely shared awareness and limited responsive behavior. Moreover, insufficient information about the effect of certain factors affecting or encouraging civic participation intensifies the gap between awareness and action (Radtke, 2014).

According to the theory of planned behavior, both people's intentions and the capability to take action affect the possibility of performing certain behaviour (Ajzen, 1991). Presenting incentives can either alter people's intention or increase their ability to perform the desired behaviour (Bamberg, 2013). Hence, incentives are considered a promising instrument to not only engage public energy participation but also help bridging the gap between the awareness and the desired action.

5.3.1 Research objective

This research aims to understand how incentives can engage citizens to perform responsive behaviour to energy transition. In particular, how incentives can overcome barriers to energy participation and promote energy participation.

The main research question is how do incentives influence participation in the energy transition in the city of Groningen? More specific research questions are defined as:

- To what extent are citizens empowered for energy participation?
- What are current barriers for citizens to participate in energy transition?
- What incentives are used by energy cooperatives and energy communities to engage citizens in energy transition?

5.3.2 Energy participation

Public participation in the energy transition brings about numerous positive effects.

- First, the acceptance of future change can be fostered because the participants can be informed about the direction of change, such as the implementation or the potential payment for renewable energy (Barnes, 2019).
- Second, policy can be tailored to meet citizens' need which builds mutual understanding and trust between the authorities and the public. This indicates that energy participation might be more effective than a top-down approach to sustainable development (Hawkins & Wang, 2012).
- Finally, individuals are empowered when they are positioned at the heart of energy transition.

As active players in the energy system, the effort from participants can generate a more socially just outcome on a more effective pathway. Energy participation can take various forms, such as attending energy talks, engaging in neighborhood energy projects or generating one's own electricity (Barnes, 2019). Although the Energy Protection Agency (EPA) has endeavored to incorporate citizen involvement into environmental management programs more (Irvin & Stansbury, 2004), energy participation has not been promoted widely for achieving energy transition. This may due to the fact that the public has been often (mis)perceived as a being barrier in the energy transition, unwilling to adopt new technologies or selfishly criticise new developments, as seen in NIMBYism[2] (Ryghaug et al., 2018). This underlines that the efficacy of energy participation is underestimated. More importantly, barriers do exist and impede the public to take sustainable action which reinforces the importance of addressing the barriers properly also looking into the possible mitigation and incentives.

2 NIMBY stands for Not In My Back Yard

5.3.3 Barriers to energy participation

The existence, dynamics and effects of barriers have significant impact on people's actions towards energy transition. Moreover, these barriers can interfere with the development of a sustainable lifestyle, decrease the efficacy of intervention programs, and exacerbate the inhibition to energy participation (Lorenzoni et al., 2007). Therefore, it is essential to not only identify the barriers but also address them collectively to prevent them from subsisting. In figure 5.9, barriers identified from literature have been categorised into external and internal barriers according to an abridged version of the model of pro-environmental behaviour (see section 5.3.5 for more information about the model).

Internal barriers	External barriers
Knowledge gap Misperception Wait and see attitude The lack of motivations Value-action gap Free riding The lack of time or ability NIMBY Nature conservation	Financial concern Policy support No ownership Ambiguous responsibility attribution

Figure 5.9 Overview of barriers identified from literature categorised using the Model of Pro-environmental Behaviour by Kollmuss & Agyeman (2002)

Internal barriers

Barriers present the hindrances to energy participation that originate from personal knowledge, motivations, priority and connection to the environment.

The *absence of motivation* brings about a *value-action gap, free-riding* behavior and less effort invested in energy transition. For instance, although citizens are aware of climate change and its consequences, little action is taken to tackle this issue. Furthermore, some believe they can benefit from energy transition without personal cost since it will proceed with or without their support (Viardot, 2013).

In addition, the *lack of time or ability* and *NIMBYism* are reasons for people to not be involved in sustainable movements (Rogers et al., 2008). Their connection to the natural world prompt *nature conservation* activists to refuse the distribution of renewable energy (Higgs et al., 2008).

The *knowledge gap* impedes energy participation as individuals receive incomplete information regarding energy transition and its implementation (Masini & Menichetti, 2013). Deficit information leads to a

misperception of energy-efficient behavior, where citizens misperceive both monetary and non-monetary costs and benefits to take action (Rogers et al., 2008), or they only follow the inertia to use energy inefficiently (Steg et al., 2018). Additionally, inadequate details and intentions surrounding the energy transition makes people feel insecure about their roles, ability, and responsibilities for a more sustainable society. They tend to underestimate their ability to contribute or even conduct local sustainable projects (Rogers et al., 2008). The *wait and see attitude* is also generated from the knowledge gap in the sense that people prefer not to take action before seeing a tangible outcome (Brummer, 2018).

External barriers

Financial concerns form the main obstacle for people to engage in energy efficient behaviour. The change to a more sustainable lifestyle by switching energy suppliers, adopting energy efficiency devices or investing in renewables is inhibited by high initial expenditure, poor financial resources or low return on investment (Viardot, 2013). The deficiency of *supportive policies* is responsible for the failure of engaging people in energy transition as these policies are often made without meeting citizens' needs and thus fail to alleviate public concerns regarding energy participation (Steg et al., 2018). Furthermore, individuals prefer inaction when having *ambiguous responsibility attribution*. For instance, tenants, having *no ownership* of the property, tend to attribute the responsibility for opting for energy-efficient alternatives to their landlord while citizens are confused about who is responsible for delivering measures for energy transition, the government or themselves (Rogers et al., 2008).

5.3.4 Incentives in energy participation

Defined as specific inducements that attract or repel people toward or away from initiating a certain action, incentives incorporate all types of rewards and punishment (Rosenkranza et al., 2013). By incentivising decision-makers, individuals can be engaged in specific behavior (Steg et al., 2018) and can be encouraged to opt for a socially desired choice (Rosenkranza et al., 2013). In the energy sector, incentives are able to accelerate the energy transition by enhancing energy efficiency (Qian & Chan, 2008), boosting investments in renewable energy technology (Masini & Menichetti, 2013), stimulating renewable energy generation (Zhao et al., 2016), reducing energy consumption (Rosenkranza et al., 2013), and conserving energy (McMakin & Malone, 2002).

Incentives in the energy domain are categorised in financial and social incentives. Financial incentives are mainly adopted to boost technical innovation due to their characteristics as high-risk investments (Zhao et al., 2016). Instruments, such as subsidy, tax deduction, R&D funding, feed-in-tariff or auctions, provide financial support and ensure financial security for energy producers to invest in renewable

energy (Aquila et al., 2017). However, the focus on technology and financing is insufficient to move energy transition forward. Hence, including behavioral and social aspects to promote energy transition was advocated, which triggered the development of social incentives (Masini & Menichetti, 2013). Social incentives can be considered as non-financial incentives that utilise research in the fields of psychology, behavioural and social sciences to induce behavioural change (Rosenkranza et al., 2013). They take the form of product labeling, practical information provision, comparative feedback, commitment strategies or the exertion of social pressure (Steg et al., 2018). In figure 5.10, incentives identified from literature have categorised into external and incentives according to an abridged version of the model of pro-environmental behaviour.

Internal incentives	External incentives
Educational communication Feedback on behavior Commitment strategies Default option	Social norms Peer influence Self image Infrastructure change Financial support Low cost action Part-ownership

Figure 5.10 Overview of incentives identified from literature categorised using the Model of Pro-environmental Behaviour by Kollmuss & Agyeman (2002)

Internal incentives

The incentives in this category mainly deal with strengthening intrinsic motivation and raising awareness of the urgency of energy transition. *Feedback on behaviour* is effective for engaging in sustainable behaviour due to people's desire to act consistently with previous statements or actions (Steg et al., 2018). It is often used in energy-saving programs to provide a limited amount of relevant and targeted information. A *commitment strategy*, also called goal setting, mitigates people's tendency to procrastinate and allow them to act today instead of tomorrow. The pledge can be made to oneself or to the public, which will activate either personal or social norms to impel sustainable behaviour. Moreover, escalating commitment can yield sustained behavioral change. The clever design of the *default option*, such as setting the default to an individual or social optimum choice, can significantly boost welfare. For example, setting the default temperature on washing machines to cold. This setting utilizes individuals' inclination to maintain current options which arose from procrastination or the cost of switching options (Rosenkranza

et al., 2013). *Educational communication* raises the awareness of recipients to the urgency and the links between their behaviour and energy transition. It is usually presented in the form of information session, consultancy hour, advertising or green labeling.

External incentives

This category contains incentives that induce energy participation by giving out social rewards or sanctions, lowering the barriers, or offering more support. *Infrastructure change* provides a supportive environment for individuals to participate in energy transition easily or unconsciously. For example, designing regulation on energy-saving products or providing better public transport infrastructure. *Financial support*, also called pricing policy, is presented as subsidies, rebates, tax exemption or R&D funding. This incentive works well for energy transition since people are highly financially motivated and thesel concerns can be mitigated (Steg et al., 2018). Sharing the ownership of renewable systems increases the likelihood of energy participation since people are responsible for the system (Kalkbrenner & Roosen, 2016). *Low cost action* diminishes the barrier to renewable adoption. For instance, purchasing preferential share of community scale energy projects or reducing the initial cost in renewable energy improves the performance of return. *Social norms* stimulate pro-environmental behaviour by citizens' need to belong to and be accepted by a social group. They are informal rules of behaviour based on widely shared beliefs and have an immediate impact on energy consumption and sustainable effects over months or years. *Peer influence* encourages sustainable behaviour because individuals are motivated to have consistent action with others (Steg et al., 2018). People strongly prefer occupying a high position in the social ranking and taking sustainable action leads to a positive *self image*, which is another motivation for performing sustainable behavior. It can be utilized for energy participation by displaying contributors' names and photos after the contribution (Rosenkranza et al., 2013).

5.3.5 Methodology

This section will discuss the theories and models that were utilised in the study. Activity Theory was employed as a framework for data collection. The ladder of citizen participation and the model of pro-environmental behavior were used for data analysis.

Activity Theory

Activity theory (AT) incorporates the interaction of behavior and consciousness within its relevant environmental context (Jonassen & Rohrer-Murphy, 1999), which is helpful to collect extensive data about human activity in the energy transition, taking into account factors such as personal attitude, contextual factors, and institutional support.

There are six factors in the *Activity System* (figure 5.11), each exerting influence on one another. These interactions eventually affect the object and the outcome of the whole system. The *subject* (1) is the individual or group of actors trying to work toward the object in a specific activity. The *object* (2) is the end product of the activity and it can be a physical or mental product. *Tools* (3) can be both physical and mental. During the development of the activity, the subject interacts with various tools to achieve the intention (Tarbox, 2006). The relationship between subject, tools, and object can be deemed an activity conducted by a subject to attain a certain outcome. We may discover that the underlying *rules* (4), which can be explicit or tacit, and the *community* (5) can influence the activity in a wider context. The division of labour (6) specifies which the roles of the individual members, if the subject consists of a team of people (Tjahja, Yee & Aftab, 2017).

In order to understand the influence of incentives on energy participation, it is necessary to have a clear insight in the factors altering people's decisions. However, the relation between attitudes

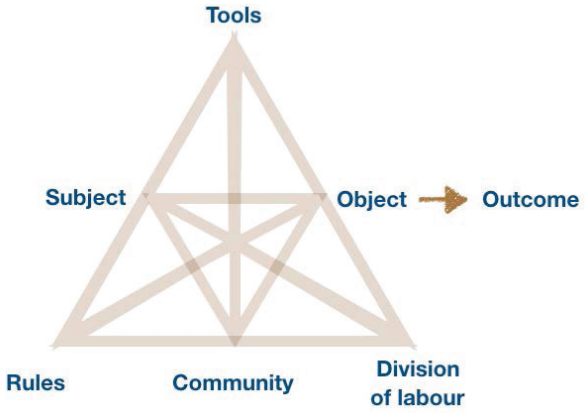

Figure 5.11 The Activity System – adapted from (Engeström, 1999)

and behavior is not so straightforward, implying that other factors exist that prevent people from taking taking sustainable action (Karatasou et al., 2013). For instance, an individual's perception can be influenced by contextual factors (Lorenzoni et al., 2007) or a value-action gap arising from both personal and institutional context (Rogers et al., 2008). Even when people are highly money-driven, influential economic factors are usually intertwined with social, infrastructural and psychological factors (Kollmuss & Agyeman, 2002). These examples signify the importance of including contextual factors when analyzing the means to sustainable engagement. Activity theory can not only map out

local contexts, but also point out possible interactions between incentives, barriers and other factors that can influence energy participation.

The Ladder of Citizen Participation

The Ladder of Citizen Participation is used to identify citizens' influence on the decisions from the local energy associations and the municipality. The model can provide an overview of citizens' power over the contextual factors in energy participation. The ladder consists of eight rungs, with each step representing a different level of citizen involvement (see figure 5.12). Going up the ladder, which is further divided into three phases, participants are given more power in determining the end-product. In the *non-participation phase*, those in power adjust community members' values and attitudes to be in line with them. In the second phase, *degree of tokenism*, the powerless have a voice, but no decision power. The final phase, *degree of citizen power* citizens' increases from partial influence to full managerial power in determining the end product (Arnstein, 1969).

With clear and specific description of stages of public involvement, the ladder is useful for determining the level of citizen empowerment as it enables the dentification of implicit barriers, incentives or other factors, when moving towards the next step.

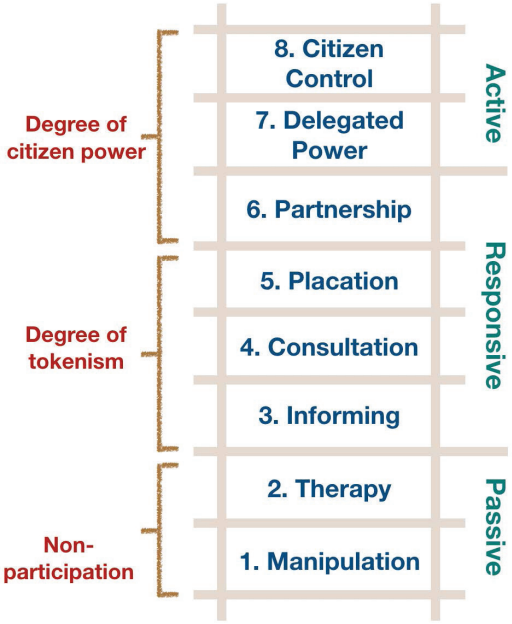

Figure 5.12 The Ladder of Citizen Participation – Adapted from Arnstein (1969).

The Model of Pro-environmental Behaviour

For the purpose of this study, the original Model of Pro-environmental Behaviour has been abridged and revised specifically for categorizing the barriers and incentives identified from the interviews (figure 5.13) and was also used to identify relevant barriers and incentives from literature (see section 5.3.3 and 5.3.4)

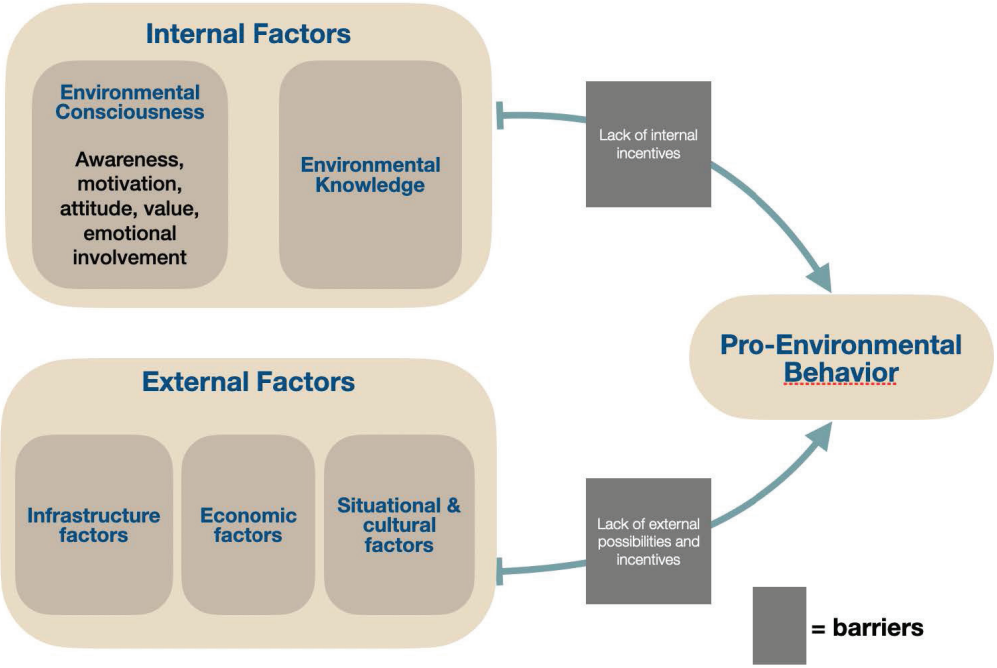

Figure 5.13 The abridged version of the Model of Pro-environmental Behavior – Adapted from Kollmuss & Agyeman (2002).

According to the model, pro-environmental behavior can be influenced by both internal and external factors. The internal factors represent intrinsic stimuli or personal perceptions that can facilitate or hinder pro-environmental behavior, whereas external factors illustrate the constraints from institutional, economic, and social & cultural perspectives, representing the ability or the convenience for people to perform pro-environmental behavior. The model of Pro-environmental Behavior uses concise categories of influential factors to connect with sustainable action or inaction. In addition, it provides the flexibility to include both emotional involvement and contextual impact on pro-environmental behavior (Kollmuss & Agyeman, 2002).

5.3.6 Findings

This section will discuss findings based on nine interviews with representatives from local energy initiatives in Groningen, regarding the level of citizen empowerment as well as the barriers and incentives that they encounter in their practice.

Current level of citizen empowerment in energy participation

The influence that citizens can have on decision-making in local energy cooperatives and communities can be situated at the top of the citizen participation ladder, between rung 7 and 8. In almost all instances, there was a membership system in place with a participative decision-making process (see figure 5.13). In addition, six out of nine respondents mentioned that their respective initiative's actions are determined by demand from the members or neighbourhood residents. However, the influence that citizens can exert on the muncipality's decision-making process is located lower on the ladder, on rung 6.

Seven interviewees stated they have regular meetings with the municipality where they can share their viewpoints, discuss the desired outcome of local projects and the necessary support for implementation. Six respondents emphasised that although they have connections with the municipality, they prefer doing their work independently. One interviewee mentioned that the poor communication with some municipal departments frustrated them. In general, people appear to have some negotiatation power regarding the implementation of project, but the municipality still has the final say. In addition, citizens are reliant on intermediators, such as local associations, to convey their opinions to the municipality.

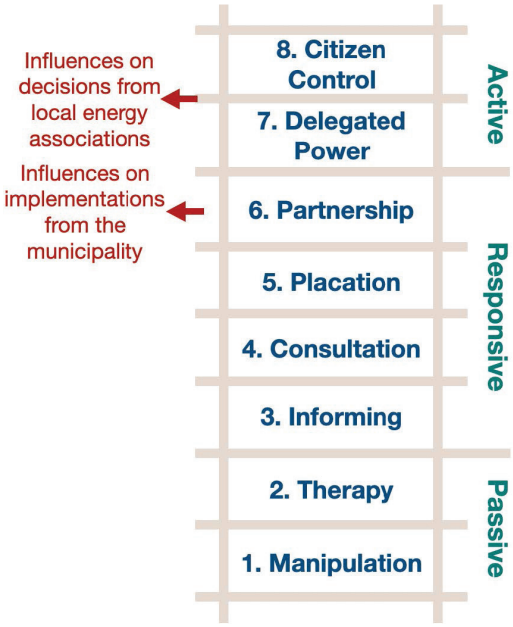

Figure 5.14 The influence of citizens on decision-making within energy initiatives and the municipality, indicated on the Citizen Participation Ladder (Arnstein, 1969).

Barriers hindering citizens' participation in energy transition

This section describes the barriers that were identified from field research. The responses to the interview questions, such as municipal issues regarding energy transition and citizens' resistance to energy transition were later coded into the *contextual factors* and *rules* themes. Consequently, the barriers were identified and categorised into internal and external barriers according to the model of pro-environmental behaviour (figure 5.15) as well as its frequency among respondents (figure 5.16).

Internal barriers		External barriers		
Environmental consciousness	Environmental knowledge	Institutional factors	Economic factors	Situational and cultural factors
Value-action gap Lack of time or ability Lack of motivations Free riding NIMBY Nature conservation Embarrassment	Knowledge gap Misperception Wait and see attitude	No ownership Bureaucracy Technology	Financial concern	Short-term residents Dislike for top-down approach

Figure 5.15 Overview of barriers identified from interviews, categorised using the adapted Model of Pro-environmental Behavior (Kollmuss & Agyeman, 2002).

Internal barriers

Although almost all respondents do realise the urgency of energy transition due to the frequent earthquakes in the region, figure 5.15 shows that a *value-action gap* exists in the form of procrastination or unwillingness to switch to a renewable energy system. Similarly, the *lack of time or ability* was frequently given as a reason for inaction, especially young people or couples who tend to give priority to their personal lives. Additionally, around two-thirds of interviewees indicated a lack of motivation or interest in performing sustainable behaviour. Other barriers from literature, such as *free riding*, NIMBY, and *nature conservation*, were also encountered in the field research. Interestingly, *embarrassment* was the only internal barrier that was only found in the field research; the residents who live in social housing often feel uncomfortable to show the poor conditions of their houses to outsiders, which inhibits them from asking for advice on improving the sustainability of their living environments.

A *knowledge gap* was found in seven out of nine respondents. This occurs when people gain discrepant information about an issue, project or policy, inhibiting them from making a proper decision or taking action. For instance, during the interview, the interviewees were asked with their familiarity with the national *Postcoderoos*[3] regulation. One respondent was not familiar with the policy at all,

3 Under this regulation, members of an energy cooperation can receive a discount on their energy taxes if their electricity is generated locally and sustainably, encouraging those in the same neighbourhood or village to start sustainable energy initiatives.

whereas the rest had already used it as a tactic to encourage energy participation. *Misperception* on energy transition was also found to impede energy participation ("Lots of people are reluctant to switch to new system or do things because they are scared or think [energy transition] is too complicated", "District heating has the name of expensiveness. People don't know why they have to do it and get rid of trustable gas boiler") The *wait and see attitude* was also named by some respondents as a reason to be passive when it comes to energy participation.

Categories of barriers		Barriers	Interviewees								
			A	B	C	D	E	F	G	H	I
Internal barriers	Environmental consciousness	The lack of time or ability	X		X	X	X	X	X	X	X
		NIMBY		X	X	X					
		Free riding					X	X			X
		The lack of motivations	X	X			X	X	X	X	X
		Value-action gap	X		X	X	X	X	X	X	X
		Nature conservation		X		X					
		Embarrassment							X		
	Environmental knowledge	Knowledge gap	X	X	X	X	X	X			X
		Misperception	X		X		X	X			X
		Wait and see attitude			X		X	X		X	
External barriers	Institutional factors	Bureaucracy			X	X		X	X		
		No ownership	X	X		X	X	X	X	X	X
		Technology	X	X					X		
	Economic factors	Financial concern	X	X		X		X	X	X	
	Situational & cultural factors	Dislike for top-down approach				X	X	X			X
		Short-term residents	X				X	X	X		X

Figure 5.16 The frequency of barriers to energy participation.

External barriers

Eight out of ten respondents underlined the ordeal of engaging tenants in energy participation. Some have tried to approach the social housing corporations or private owners of rental houses whereas others neglect the tenants segment altogether. Possible reasons shared by the interviewees include tenants' lack of motivation to invest in the sustainable renovation as they derive few tangible benefits from it. However, when tenants are motivated, they struggle to create an environmentally-friendly living

environment as they have *no ownership* of the property. Furthermore, in Groningen many of the rooftops are owned by social housing corporations, which can hinder local energy associations from utilising them for generating solar power. Subsequently, communication with the municipality is characterised as complicated due to *bureaucracy*, making it difficult for citizens to sustain interest in energy participation. Last, one-third of the respondents pointed out that it is tough to use immature *technology* to renovate energy systems in houses which can be more than a century old.

The field research also demonstrated the existence of financial barriers regarding energy participation, such as the steep initial costs of installing renewable energy systems or the long payback-time when investing in renewables.

In addition, there were also several situational and cultural factors that hindered energy participation. More than half of the interviewees underlined the difficulty to transform *short-term residents* into active energy participants. For instance, students, who account for more than 20% of the population in Groningen, are rarely involved in the neighbourhood events or projects ("If you stay here for only one year then you are not likely to get involved"). The importance of avoiding a *top-down approach* to energy participation was stressed by multiple respondents. The way the Dutch national government has dealt with gas and earthquake issues has mainly resulted in increasing citizens' distrust in the government. One of the local energy cooperatives shared that a bottom-up approach, in their experience, can raise the success rate of realising projects from 10% to 50%.

Incentives encouraging citizens' participation in energy transition

This section describes the incentives that were identified from field research. The responses to the interview questions were later coded into the contextual factors and tools themes. Consequently, the incentives were identified and categorised into internal and external barriers according to the model of pro-environmental behaviour (figure 5.17) as well as its frequency among respondents (figure 5.18).

Internal incentives		External incentives		
Environmental consciousness	**Environmental knowledge**	**Institutional factors**	**Economic factors**	**Situational and cultural factors**
Pro-environmental awareness	Educational communication	Lowering the barriers Part-ownership Compulsory policy	Financial benefit	Peer influence Community pride Empowerment Meeting needs Social norms Quick wins

Figure 5.17 Overview of incentives identified from interviews, categorised using the adapted Model of Pro-environmental Behavior (Kollmuss & Agyeman, 2002).

Categories of incentives		Incentives	Interviewees								
			A	B	C	D	E	F	G	H	I
Internal incentives	Environmental consciousness	Pro-environment awareness	X		X	X		X		X	
	Environmental knowledge	Educational communication	X	X	X	X	X		X	X	X
External incentives	Institutional factors	Compulsory policy				X		X	X		
		Part-ownership			X	X		X		X	
		Lowering the barriers	X		X		X	X	X	X	X
	Economic factors	Financial benefit	X		X	X	X	X	X	X	X
	Situational & cultural factors	Community pride	X			X	X	X	X	X	X
		Social norms			X	X		X		X	X
		Quick wins	X		X			X			X
		Peer influence	X		X	X	X	X	X	X	X
		Meeting needs	X		X	X	X	X			X
		Empowerment	X		X	X	X	X		X	X

Figure 5.18 The frequency of incentives to energy participation.

Internal incentives

Half of the interviewees mentioned that those who care about the environment or transgenerational equity are already investing effort in energy transition by participating in sustainable events or generating their own energy. Local energy initiatives therefore organise activities to intensify residents' *pro-environmental awareness* and encourage them to take further action towards energy transition. In addition, the majority of respondents mentioned that they use *educational communication* to make relevant energy-related knowledge available for residents and engage them to be active energy participants. Educational communication introduces the concepts energy transition, new technologies and the details of energy projects. It also includes activities such as weekly information sessions, consultancy hours, energy coach or an excursion to a solar power park, during which participants are encouraged to exchange their experiences regarding the creation of sustainable living environments.

External incentives

Seven out of nine interviewees pointed out that citizens are inclined to participate in the energy transition when perceived *barriers are reduced*, which are not necessarily limited to financial ones but can include anything that can cause hindrance to take action. Hence, local energy associations have come up with strategies to lower these barriers. For example, giving advice on improving energy efficiency

step-by-step instead of presenting a 'big plan', simplifying technical actions into a more accessible ones or promoting crowdfunding for local energy projects rather than high individual investments. Similarly, *co-ownership* can also encourage sustainable development by citizens becoming part-owners of the relevant implementations. Lastly, *compulsory policies* not only compel people to attain specific objectives but also increases their awareness of the issue ("The city made a plan that in 2035 Groningen has no gas anymore, so we need to make a big transition"). The *efficacy of financial* benefits is agreed upon by most of the respondents; receiving financial support encourages recipients to opt for an environmentally-friendly option rather than the low-cost one.

As indicated in literature, *peer influence* and *social norms* were found to encourage energy participation in the field study. Peer influence is more powerful for the residents in the same neighborhood, as residents tend to have similar living environments and heating systems, which makes it more feasible for them to implement the same type of renovations. Seven out of nine respondents mentioned that *community pride* and *empowerment* are useful incentives for engaging energy participants. Community pride manifests itself as caring about local developments, an interest in working together with neighbours and a higher acceptance of suggestions from familiar people or groups.

Meeting peoples' needs attracts more people towards energy participation, since the outcome is also beneficial for the participants. As one of the interviewees stated, "I'm very very convinced that only if you connect your energy or your CO_2 ambition with the needs and small concerns of the people, then you have a match. Otherwise, don't even try." Likewise, most of local energy initiatives connect individual interests with promoted energy projects or activities to attract more participants. For example, they help residents to identify energy-related problems in the house, such as heat leakage, and provide energy efficiency advice afterwards. The *quick-win* is another incentive identified from field research that might stimulate energy participation. Through presenting successful results or tangible outcomes gained in a short period of time to individuals, residents can be convinced that energy transition is achievable and can feel confident to pursue further action.

5.3.7 Discussion

Although there are opportunities for citizens in Groningen to negotiate with the authorities, a higher level of citizen empowerment would be beneficial to accelerate energy transition (Barnes, 2019). In this sense, to attain energy transition more effectively, citizens need to be empowered to climb towards the highest rung in the citizen participation ladder. Most of barriers described in literature were also encountered in the field research, with three barriers, the value-action gap, the shortage of time or ability and no ownership of properties, coming forward prominently. Additionally, five barriers that were not found in literature, embarrassment, bureaucracy, technology, dislike for top-down approach and short-

term residents were found in the field study. It is notable that the barriers are interrelated. For instance, the knowledge gap can bring about the lack of time or ability, the misperception towards energy transition or the wait and see attitude. Furthermore, when little proper information about energy transition is provided, individuals have less interest in contributing to energy transition. As a result, taking this interrelation into account when designing the mitigations for barriers might increase their efficacy.

The incentives that were found exclusively in the field research, *pro-environmental awareness, compulsory policy, lowering the barriers, community pride, quick wins* and *empowerment*, mostly have a social focus and center on citizens in specific regions. Notably, lowering the barriers not only means reducing financial concern, but also the barriers to taking action. Furthermore, the field research highlighted other incentives, such as *educational communication, financial benefit* and *peer influence*, for energy participation. Apart from the aforementioned incentives, local energy associations also applied other external incentives to attract more energy participants. It is noticeable that most incentives indicated in academic literature have a technical focus, such as *feedback on behavior, default option* and *infrastructure change*, and are aimed at the whole nation, whereas the incentives identified in the field research mostly have a social focus and are aimed at a relatively small target group. It is worth mentioning that local energy associations already adopt different approaches for different groups of citizens, using a combination of incentives instead of individual incentives. For example, first *meeting peoples' needs* to attract the participants to come on board, followed by employing *educational communication* to inform individuals how they can participate in the energy transition step-by-step, and lastly, *lowering barriers* by asking people to do small things first, in order for them to become active energy participants further on.

Local energy initiatives and communities play a crucial role in the energy transition process when it comes to civil empowerment. Firstly, these initiatives attempt to facilitate the energy transition through a bottom-up approach. Secondly, they can negotiate with or exert influence on the municipality. Thirdly, they can construct meaningful relations with local residents. Due to their close connections with the neighbourhoods, local energy initiatives can sense what barriers might hinder energy participation and implement schemes that are effective on a local scale. The findings from this study confirm that incentives can either raise the level of civil energy participation through attracting more active participants or mitigate the barriers to energy participation by inducing people to take sustainable action.

The recipients of incentives are divided into two groups, citizens who support the energy transition and those who experience barriers. The first group can be encouraged to initiate further action by applying incentives pertaining to *environmental consciousness* and *situational & cultural perspectives*. For instance, *pro-environmental awareness, peer influence* or *community pride*. For the second group, both singular and a combination of incentives can be effective since identified barriers were related to both individual issues and the social context. For example, *financial support* and *part-ownership* are helpful to overcome

the barriers of financial concerns and not having ownership of the property. Other barriers such as the *value-action gap* and *short-term residents* can be mitigated by implementing a combination of incentives, such as educational communication, lowering the barriers and quick wins. Consequently, applying incentives can not only raise citizen empowerment in energy transition but also induce more responsive behaviour.

5.3.8 Conclusion and recommendations

Although it is a widely shared perception that energy transition is urgent and necessary, few responsive actions have been taken by the general public so far. This study therefore analysed how incentives can contribute to energy participation from a social perspective. Local energy cooperatives and communities in Groningen were interviewed to collect qualitative data. Data collection was performed using semi-structured interviews based on the Activity Theory framework. This data was then analysed using the ladder of citizen participation and an abridged version of the Model of Pro-Environmental Behavior. The findings from the field study show that there were several local barriers that hinder residents from engaging in sustainable behaviour, most notably embarrassment, bureaucracy, technology, a dislike for top-down approach and the prevalence of short-term residents. Incentives that were shown to be effective instruments for stimulating energy participation in Groningen include pro-environmental awareness, compulsory policy, lowering the barriers, community pride, quick wins and empowerment. These incentives are largely focused on social aspects, are centred on particular areas and can be implemented separately or in combinedt tohe mitigate barriers and induce more responsive actions towards energy transition.

Based on the findings from this study, three recommendations for enlarging the impact of incentives on energy participation in Groningen are proposed:

1. Tailoring incentives to different target groups

Local energy initiatives have already divided citizens into three groups, homeowners, tenants and students, whom they approach in a different way. All of the initiatives interviewed have well-structured schemes to incentivise homeowners, whereas only a few of them have attempted to approach tenants and students. However, both tenants and students form a significant portion of thhe population in Groningen and have different interests and needs when compared to homeowners. Consequently, to boost energy participation, it is suggested to further investigate the interests and needs of these two groups and then develop incentives that are tailor-made for them.

2. Designing and implementing incentives through a collaborative approach
The identified barriers to energy participation in the field research are multi-faceted. Hence, it is impossible to for a single institution to design or implement incentives. Increased and meaningful collaboration between the municipality and the local stakeholders is therefore recommended. For example, as the main facilitator for energy transition the municipality should connect relevant stakeholders, such as local energy associations, social housing corporations, tenants and students to identify their respective preferences, which can be beneficial when designing incentives. Furthermore, a healthy collaboration between the municipality and local energy associations, such as a constructing a platform to exchange experiences regarding the implementation of incentives, can prevent reinventing the wheel and improve the efficacy of incentives.

3. Improving the communication channels between the municipality and the public
Local energy initiatives experience considerable difficulty to receiving necessary support and timely information from the municipality. Hence, by improving communication channels, incentives can be designed and implemented more effectively can result in a wider energy participation.

5.4 Way forward

The previous sections have highlighted several barriers that hinder energy initiatives' efforts to engage with local residents in Groningen. Aside from financial aspects, issues surrounding communication were reported on different levels. One one hand, energy initiatives experience difficulties reaching out to local residents, particularly tenants and students. On the other hand, residents indicate that they receive little information energy initiatives' activities through traditional communication channels. This is exacerbated by the language barrier, as international students, even if they are interested in renewable energy, are unable to participate since the information given will be in Dutch. Similarly, communication between citizens, energy initiatives and the muncipality was found to be complicated, often due to bureaucracy. Enablers or incentives that were considered useful by energy initiatives include taking relatively easy energy saving measuring, resulting in quick wins, strenghtening (existing) social engagement between residents and community pride. In addition, notable factors specific to the context of Groningen were the large population of international students, suspicion towards the (local) government and top-down approaches, and residents' embarrassment of poor housing conditions.
These preliminary findings confirm that within the energy transition process local energy initiatives, occupying a broad band inbetween the (local) government and residents, are essential actors. Due to

their positioning in the middle, they are approachable by citizens from the bottom while at the same time connected to the government situated at the top. Further research efforts in the Making City project will therefore also focus on how to strenghten social relations and improve communication between stakeholders, as well as exploring new ways to co-create and co-design with local residents. The technical aspects of renewable energy, which many energy initiatives focus on, represent just one side of the coin; the social dimension is equally or perhaps even more important, as support from the respective neighbourhoods that these initiatives represent is paramount for these initiatives to be sustainable in the long-term.

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Climate Adaptation: about monitoring, citizens and cafes

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6

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6.1 Introduction

Climate Change Adaptation is the physical and mental process of dealing with the effects of climate change, being more heat, more droughts and more extreme rain events (IPCC, 2014). Within this frame there are numerous projects (both nationally as internationally) that focus on gaining a better understanding of this topic ranging from climate risks assessments, monitoring and maintaining technical measures to stimulating participation and co-creation in policymaking at the micro scale. In all these projects, intensive collaboration between a broad range of stakeholders from practice (municipalities, waterboards, companies), academia (universities and research institutes) and education (students, young professionals) in a quadruple helix setup is required. This method of co-developing helps in generating new (scientific) output that is applicable in practice and educating young-professionals to apply these outputs in their studies and early careers.
This chapter will highlight three of these projects that share a focus on the municipality of Groningen. These projects represent a broad range of methodologies and collaborative processes:

1. Climate monitor for the municipality of Groningen is a direct collaboration between the municipality, the Ministry of Infrastructure and Water and the research group of Spatial Transformations, focussing on assessing and monitoring climate change risks and the implementation of solutions in the municipality of Groningen through literature research.

2. RAAK burgerparticipatie in Klimaatadaptatie (citizen participation in climate change adaptation; hereafter BPiKA) is a national project funded by the taskforce for applied sciences (SIA) and is a collaboration between four universities of applied sciences and seven public partners. The project focuses on collaborative

a. Monitoring
b. Experiences with extreme weather in addition to
c. Increasing knowledge on adaptive measures and
d. Co-creation of climate adaptation on the micro-scale level.

Each of the participating Universities of Applied Sciences is working together with their local governments (the municipalities of Vlissingen, Middelburg, Rotterdam, Leeuwarden and Groningen) to develop a living lab in two neighbourhoods for each city. The overarching goal of this project is developing tools and methods for municipalities to better stimulate citizen-government collaboration in climate change adaptation.

3. KIEM Climatecafé has a focus on international knowledge sharing through so-called climatecafés. The aim of these climatecafés is on knowledge exchange and raising awareness on climate change adaptation through a "learning by doing" interaction between young-professionals, local planning practice and academia. The goal of this project is to further develop the climatecafé methodology and to assess how participating companies could get the most out of these events. Within the span of this one-year project, the goal is to organize two climatecafés in collaboration with Waterprof, a process- and project management company that trains young-professionals in the field of climate change adaptation. The first of these events is the climatecafé in Oldenburg (Germany), focusing on climate change adaptation awareness.

The following paragraphs give an overview of the different methodologies and findings of these three research projects. The first paragraph focuses on the general topic of climate change adaptation and its associated risks. The second paragraph focuses on translating these risks to the micro scale and the need for collaboration in climate change adaptation. The third paragraph highlights how climatecafés can help in finding solutions for local issues through a collaborative workshop approach.

6.2 Monitoring and evaluation

Global climate is changing and this has major implications for our living environment and liveability (Harlan et al. 2011). Rising global temperatures will most likely have impacts on weather patterns, generally resulting in more extreme events such as heat, drought and extreme rainfall. Especially urban environments will be particularly susceptible to these extreme weather patterns due to the high rates of soil-sealing and building-densities, impacting the extent to which these environments heat up and limiting infiltration capacities (J. A. Napieralski and Carvalhaes 2016; Hurk et al. 2014; Harlan et al. 2006).

There are two fields of research that focus on limiting the effects of climate change on our living environment, namely: climate change mitigation and adaptation. Climate change mitigation is the field of research that focusses on limiting the overall temperature increase through mitigating greenhouse emissions (Biesbroek, Swart, and van der Knaap 2009). The other approach, being climate change adaptation, focuses on dealing with the effects of climate change through increasing the carrying capacities of space and individuals (Cartalis 2014). Despite having different foci, both these approaches are required to successfully deal with the global threat of climate change (Klein et al. 2017). However, despite both the extent to which both fields are represented in practice and academia is imbalanced, with mitigation being the larger field and adaptation gaining relatively little attention. While in many urban environments the carrying capacity of space and inhabitants is increasing at a slower pace than the risks associated with climate change, resulting in higher vulnerabilities in these spaces (Klein et al. 2017). Dealing with the risks associated with a changing climate will require a critical re-evaluation of the urban fabric through climate change adaptation to increase urban climate resilience. Climate change adaptation generally focuses on increasing the resilience of the urban system. In this research, climate change adaptation is categorized into two approached, these being: 1) spatial transformations and 2) behavioural change. Spatial transformations in climate change adaptation emphasized the (re-)development of places and the implementation of physical measures to better cope with increasing climatological extremes (Fratini et al. 2012). These spatial transformations tend to emphasize the following principles:

1. Increasing (underground) drainage capacities
2. Storing water in public space
3. Improving the urban green-blue network
4. The application of new techniques and building materials that increases the albedo and reduces heat retention.

Behavioural change in climate change adaptation focuses on increasing the carrying capacity of individuals, communities or other forms of social networks through changes in behaviours (e.g. changing work patterns, increased social monitoring) (EEA 2012).
In order to increase the carrying capacity of space, many Dutch cities are currently in the process of monitoring and evaluating the risks of heat, drought and extreme rainfall within their administrative boundaries. This so-called 'stress-test' serves as the basis for climate-adaptation policies and programs and forms the input for so-called risk dialogues with stakeholders about which actions should be taken to increase climate resilience (Ministerie van Infrastructuur en Milieu 2018). These risk-dialogues should be a continuous process of monitoring, evaluating and sharing information amongst stakeholders. For this reason, the municipality of Groningen is in the process of developing a "climate

monitor" for the city. In this monitor, the municipality wants to share the outcomes of the stresstests in a way that fits with the local context in an attempt to stimulate citizens to take individual action with regard to climate change adaptation.

6.2.1 Research objective and methodology

Sharing information about climate change adaptation is a priority in the development of local climate adaptation policies and sharing this information is a key-component of the Dutch Deltaprogramme on Climate Adaptation. For this reason, the climate monitor of the municipality of Groningen has become one of the impact projects in the eyes of the Ministry of Infrastructure and Water. This impact project is a regional case-study that could serve as an example for the rest of the country and has allowed the municipality of Groningen to collaborate with the professorship of Spatial Transformations to gain insights in the following research questions through desk research:

- Which direct and indirect effects of climate change adaptation should be part of a climate monitor for the municipality of Groningen?
- How can an indication of climatological risks at neighborhood level be given?

6.2.2 Findings and discussion

There are numerous indicators that could give insight in the effects of climate change on the neighborhood scale. These indicators typically fit in the following categories:

1. Direct climatological risks
2. Indirect climatological risks
3. Action perspective
4. Indirect effects of climate change adaptation.

The indicators in the first category are raw outputs of climatological modelling and describe the impacts of extreme precipitation, heat and drought on the living environment. These indicators are often more prescriptive in nature, giving insight in accumulation of water in the environment or the existence of urban heat islands (UHI) (XIAO et al. 2007). In current Dutch planning practice, there is no standard for the outcomes of the analysis which means that the extent to which the indicators derived from these models are comprehensive, is limited. For example, there are numerous ways to assess heat in the urban environment that yield visually similar outcomes. Basic analysis in regards to heat often uses infrared radiation to assess which areas become heated, but have a limited eye for other factors that impact heat (e.g. wind, humidity) while other more advanced analyses can give insight in the physiological equivalent of heat (PET) that gives a direct insight in the ways through which heat can be perceived by individuals (Höppe 1999).

When the effects of direct climatological risks are further processed, indirect risks can be assessed. These indirect impacts are most commonly linked to health and economic effects regarding health, and insights in these effects can give citizens a better understanding in the risks of climate change at the local scale and provide increased alertness with regards to vulnerable populations and places. This adds a sense of urgency or better insights in the potential impacts of the direct risks of climate change (Howes 2018).

Indicators related to action perspectives can be seen as a call to action for citizens. These indicators give insight in potential areas of respite in times of extreme heat, the current actions undertaken by governmental and societal actors to decrease climatological risks and give insight in what citizens can do to better cope with the impacts.

Finally, the indirect effects of climate change adaptation are indicators that can give people insight in the added benefits of climate change adaptation to further stimulate climate adaptation action. An example of this is the benefits greening neighborhoods can bring for local biodiversity.

6.2.3 Conclusion

The impactproject for the municipality of Groningen has concluded that a climatological monitor in itself can be an interesting tool for citizens but monitoring cannot stand on its own. In order to effectively monitor the urban climate in a way that invites other stakeholders to collaborate several aspects should be kept in mind:

1. Offer citizens the full insight in climate change adaptation, being direct and indirect risks and the opportunities for adaptation
2. Monitoring should not be one-way traffic, a monitor should be a platform for citizens to share their own projects and get in touch with local initiatives
3. Giving people insights how they can contribute or how to deal with the effects of climate change gives people an action perspective and stimulate adaptive actions
4. Find a good balance of indicators that can be monitored on the short- and long-term to stimulate citizens to come back to the platform.

6.3 Citizen Participation

Climate change adaptation requires both behavioural and spatial changes and, as a consequence of this, climate change adaptation can be seen as a complex challenge that requires participation of both public and private parties. This is particularly true for the urban environment, where property ownership and resources required for climate adaptation are spread over a large number of stake-

holders. This makes collaboration a key component of successful adaptation, yet the extent to which collaboration is an element of the planning process is limited (Tompkins and Eakin 2012).

This limited application of the principles of stakeholder collaboration and communication can be caused through the process of path dependency (Ekstrom and Moser 2014). Path dependency describes how 'decisions are limited by decisions in the past' (Restemeyer, Woltjer, and van den Brink 2015). Path dependency is often seen as a resistance towards change and a tendency to hold on to 'the way things used to be' (Barnett et al. 2015).

In climate change adaptation, this path dependency for participation can be seen in two fields, spatial and institutional path dependency. Spatial path dependency can be linked to the heterogenous development of urban environment in many western cities that have led to a diversity of spatial design, green patterns and overall land use (Cadenasso, Pickett, and Schwarz 2007). This path dependency can also be seen in the formation of so called 'stream deserts', which are the product of continuous densification in city centres. In the past century, this type of urban design mainly focused on the application of underground infrastructure (e.g. storm pipes and sewer systems) for flood management (J. A. Napieralski and Carvalhaes 2016). This focus on underground infrastructure has allowed for continuous densification of functions and land-usages above ground, enabling further socio-economic development of these spaces (e.g. through housing and infrastructural development) (J. A. Napieralski and Carvalhaes 2016; J. Napieralski et al. 2015; Rees 1992; White 2008). This spatial path dependency has led to a situation where space for climate change adaptation in public space is limited and shared by numerous stakeholders on the urban/neighbourhood scale.

Institutional path dependency in climate change adaptation can be seen through the limited application of collaborative and communicative planning and also through private land-use decisions. The traditional focus of planning has led to a separation of public and private land-use and land-use design in both spaces. In this separation, public space was responsible for providing public goods and services, and private land use was determined by the preferences of property owners, which has led to a relatively high share of soil-sealing in private spaces and limited collaboration between public and private stakeholders in the urban environment (Juhola and Westerhoff 2011; Kullberg 2016; Preston, Mustelin, and Maloney 2013; Wolf et al. 2010; Zmyslony and Gagnon 2000).

Currently, there is an increased interest in methods and strategies that improve participation between public and private stakeholders. It is now broadly recognized that 'Society's climate resilience is ultimately determined by the interplay of public policy and actions undertaken by a range of private actors, including individuals and households' (Agrawala 2011). However, despite there is a clear demand for more participation, the instruments and methods that could lead to increased participation is a

Figure 6.1 Five participating cities

subject that is still under-researched (Bisaro and Hinkel 2016; Georgeson et al. 2016; Wamsler and Raggers 2018).

The goal of the Bewonersparticipatie in klimaatadaptatie (BPiKA) project is to gain a better understanding of how stakeholders at the neighbourhood scale experience climatological extremes and how collaboration of these stakeholders and the central government could be improved.

6.3.1 Research objective and methodology

This research project aims to start-up living labs for climate change adaptation in five Dutch cities (figure 6.1) and gain insights in collaboration on climate change adaptation. The aims of this research are:

1) To collaboratively collect data on the micro climate
2) To gain insights in the governance perspective of collaboration in climate change adaptation
3) To investigate the motivations of citizens to participate in climate change adaptation.

This project is a collaboration between different Universities of Applied Sciences in the Netherlands and includes students in its research. This research focuses on 11 neighbourhoods and uses a combination of

interviews, surveys and GIS-analyses to gain more insight in the spatial and institutional dimensions of climate change adaptation in the local context. After the data collection a co-creation process in workshop format is applied to develop local strategies for climate change adaptation.

6.3.2 Preliminary findings

During the first year of the BPiKA project, a better understanding of the institutional, social and spatial dimensions of the living labs has been the major focus.
Research into the spatial dimension of climate adaptation has shown that current land-use in the different living labs has implications for the extent and methods through which participation can contribute to climate change adaptation. The development and re-development of the neighbourhoods included in the project has led to different fractions of public and private spaces (figure 6.2) and green/grey land-use on the ground level (figure 6.3).

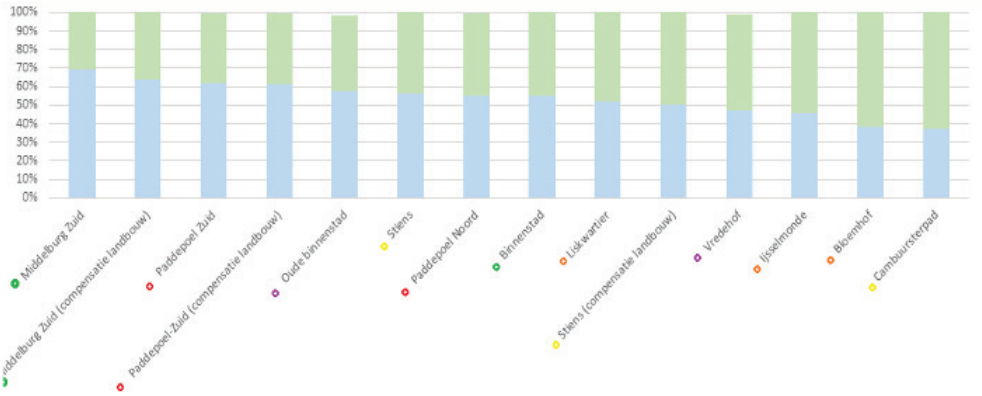

Figure 6.2 public-private space ratio in the 11 neighbourhoods

Over the course of the first semester, a group of students assisted in this research project by conducting stakeholder interviews. The goal of these interviews was to gain insight in the local barriers and opportunities for climate change adaptation. A visual representation of the research outcomes of these students is shown in figure 6.4. In short, the students compared roles and responsibilities of climate change adaptation with a game of table tennis. With different stakeholders passing the ball to other stakeholders to start making adjustments in the living environment and start with the process of climate-change adaptation. All students concluded that there are opportunities for climate change adaptation, but that there is a lack of knowledge on the subject among citizens,

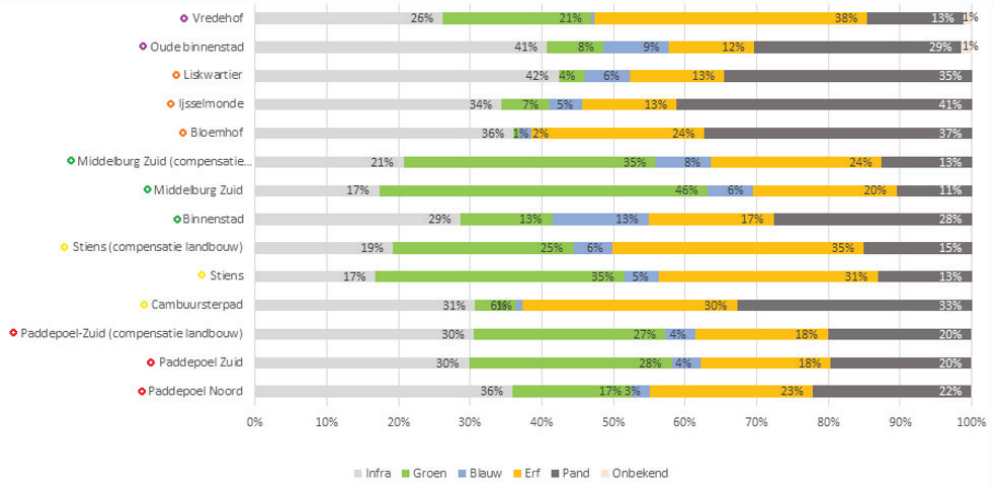

Figure 6.3 Fractions of green and grey land use in the 11 neighbourhoods

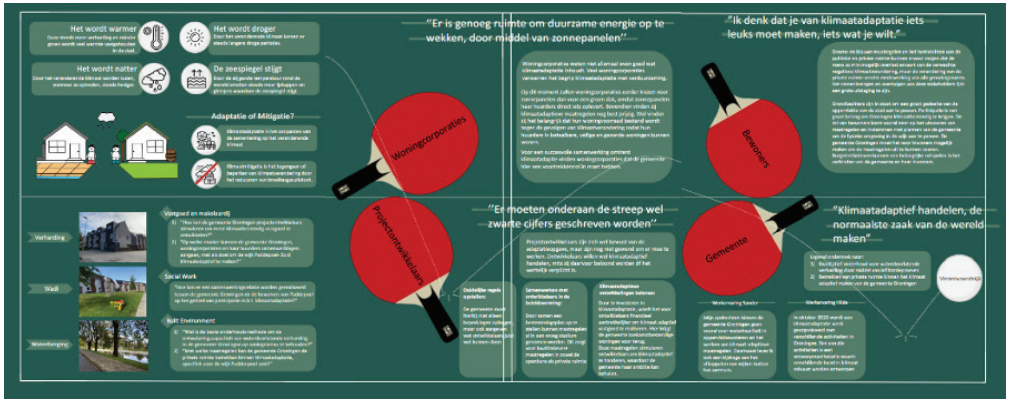

Figure 6.4 Comparing climate adaptation with a game of table tennis

housing corporations and project developers in the neighbourhood. These students have concluded that communication and the inclusion of citizen initiatives can be a key component in stimulating participation of citizens on the neighbourhood.

6.3.3 Further research

In the second year of the project students and researchers will continue to work on determining the spatial and institutional opportunities and barriers for climate change adaptation. This will result in three publications on:

- Spatial heterogeneity and its impact on the implementation on climate change adaptation
- Governmental perspectives on the opportunities and barriers for participation and climate change adaptation
- Citizen initiatives perspective on the opportunities and barriers for climate change adaptation

Furthermore, the project will aim to develop a joint spatial design for a more climate-adaptive living lab and a collaboration strategy between citizens and government. This process will be shaped by using the outcomes of student projects and designs as part of their graduation process at the Professorship of Spatial Transformations.

6.4 Climatecafés

Climatecafés are a field education concept involving different fields of science and practice for capacity building, co-creation and knowledge exchange with regards to climate change adaptation (Boogaard et al. 2020). This approach brings together international knowledge, interdisciplinary experts and local questions in an attempt to generate new knowledge, instruments and designs that could aid the adaptation to climate change. Through this, climatecafés aim to bridge the gap between climate adaptation research and practice, and stimulate the implementation of adaptation measures to reduce urban vulnerabilities to climatological extremes in urban environments (Wamsler, Brink, and Rivera 2013; Klein et al. 2017; Eisenack et al. 2014). Climatecafés host a "learning-by-doing" approach in solving these issues (Dewey 1969). In this approach, local questions are analyzed using methodologies developed by participating researchers and used by participating young-professionals. The aim of the climatecafé from an educational standpoint is to teach participating young-professionals the necessity of gathering local knowledge and working together with other disciplines in order to successfully find solutions for local challenges. Through this, climatecafés work towards building capacity for better top-down and bottom-up collaboration and communication in the field of climate change adaptation. These forms of collaboration and communication are often seen as key components in successful climate change adaptation, yet the extent to which these principles are applied in practice are currently still limited (Roggema, 2013; Colloff et al. 2017; Tompkins and Eakin 2012; Wamsler and

Raggers 2018). Climatecafés aim to fill this knowledge gap through evaluating local climate change adaptation measures and policies during climatecafés and using this input in further academic research. This evaluation with local context could also aid in giving local stakeholders more insight in the factors that impact successful adaptation, which could improve the extent to which the success of one project can be transferred to other projects (Bisaro and Hinkel 2016; Georgeson et al. 2016; Wamsler and Raggers 2018). In conclusions, climatecafés are multi-day, multi-disciplinary workshops that bring together academia, practice and education. The aim of climatecafés is to increase climate adaptation awareness amongst participants. In order to facilitate this, climatecafés work towards tangible results or answers. These outcomes can be applied by local practitioners to increase climate awareness, gain insight in potential opportunities and barriers to adaptation or to decrease vulnerabilities in their administrative areas. The lessons learned from climatecafés are used in academic research to compare policies, measures and instruments in different spatial and institutional settings that in turn can aid in improving knowledge transfer from project to project.

6.4.1 Research objective and methodology

The climatecafé in Oldenburg focused on stakeholder awareness on the broad subject of climate change adaptation in the city of Oldenburg. The goal of the OOWV (local water authority) was to develop strategies that they could use to increase climate awareness amongst citizens and stimulate action. The climatecafé hosted an interdisciplinary and multinational group of students (see table 6.1). A first for this climatecafé was the inclusion of students from the arts as this allowed for group configurations where arts, engineers and environmental sciences could work together towards awareness campaigns and spatial interventions that made the technical problems in Oldenburg visible and understandable for a broad range of local stakeholders.

Table 6.1 Overview of participants

Nationality	Education	Area of expertise
German (4)	Bachelor students (5)	Civil engineering (2)
Dutch (3)	Master students (6)	Ecology (4)
Argentinian (1)		Energy (1)
Bulgarian (2)		Architecture (1)
Slovakian (1)		Arts (3)

In order to gain the necessary information to develop these strategies several types of workshops were used (table 6.2). Students participating in this climatecafé were separated in two groups, with one group focussing on awareness of the OOWV's programs and work and the other group focussing

on making climate adaptation and flood risks visible in the city. During their first day participants formed groups and decided upon a method or strategy to gather data, after which they had two days of field work and design to generate ideas and designs. These designs were then further developed during a design-thinking workshop and presented during a conference by the students.

Table 6.2 Overview over workshop types

Workshops	Method	Workshop aim
Storytelling, Survey, Interviews	Interviews with participants of ClimateCafé, residents of Oldenburg and additional with different stakeholders (government, industry, academia and civil participants) brings multidisciplinary viewpoints together and creates new shared values that benefit Oldenburg to optimize the water system. *UN SDG #17 Partnership for the goals, #4 Quality education, #11 Sustainable cities and communities*	To enhance perception and discussions regarding climate adaptation
Mapping climate adaptation on ClimateScan	Climate adaptations are mapped on the international open-source tool www.climatescan.org *UN SDG #13 Climate action, #11 and #9 Innovation and infrastructure*	To give first impressions of urban resilience projects and examples of existing sustainable climate adaptation in Oldenburg. Climate adaptation opportunities will be discussed and mapped.
Water quality assessment	The (surface) water quality of addressed surface water in Oldenburg is measured by underwater drones with cameras and sensors. *UN SDG #14 Life below water and #6*	To scan water quality in this area, and gain insights into the spatial variability of water quality between different surface water bodies.
Design Thinking	Method to properly frame your research question.	The goal of this exercise is to refine your research question/challenge until it's the challenge you're most excited to tackle.
Rainproof	Developing a Call to Climate Action by using the rainproof toolbox *UN SDG #13 Climate Action*	To raise awareness among different target groups in Oldenburg about climate action.

6.4.2 Findings

The open-ended nature of the climatecafé Oldenburg allowed students the freedom to collect the data they thought necessary for their design question. As the assignments where mostly centered around the topic of participation the students put an emphasis on surveying local stakeholders about their knowledge regarding climate change adaptation, their willingness to act and the opportunities and barriers for collaborating with citizens. Over the course of two days the participants managed to get over 60 responses from a broad range of stakeholders in the city. The results of these surveys can be seen in figures 6.5 and 6.6.

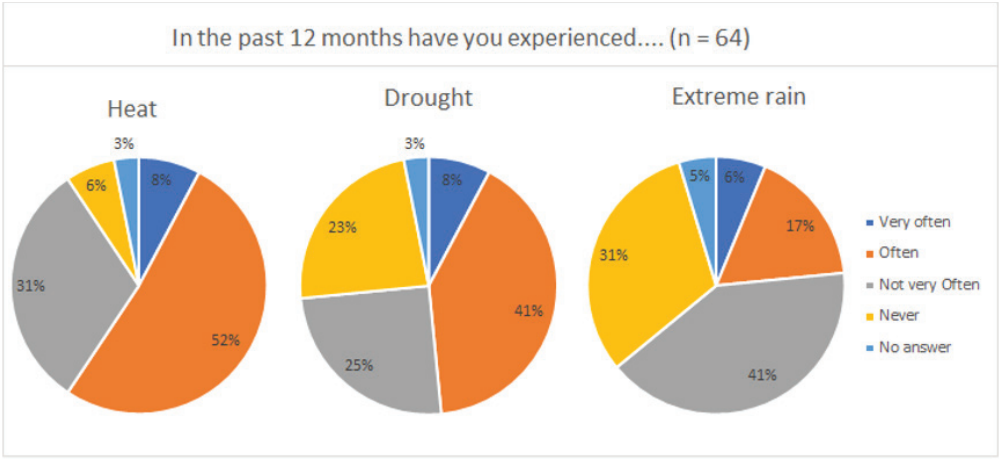

Figure 6.5 Experiences with climate impact

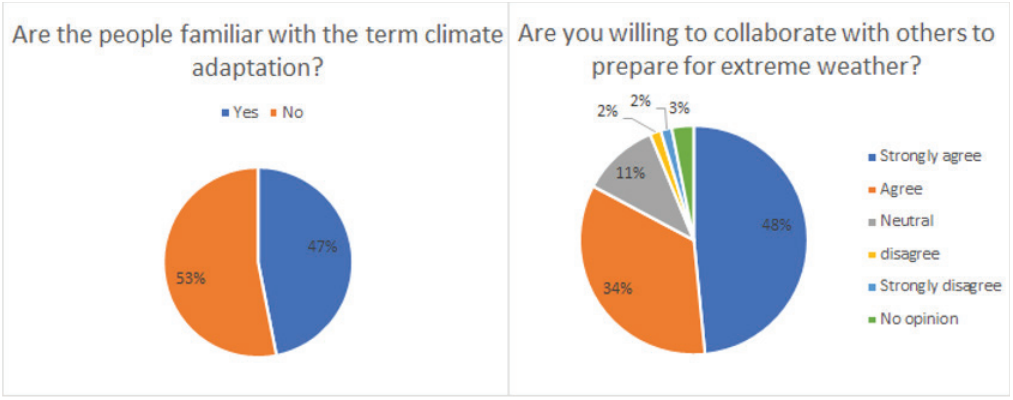

Figure 6.6 Knowledge base and appetite for collaboration

The results of this small survey show that most respondents have experience with heat and drought rather than extreme rain. The focus on the OOWV is currently on extreme rain in the city of Oldenburg which could be seen as a mismatch in interest between citizens and practitioners and highlight the necessity to better inform citizens on the potential risk of rain but also to better connect rain to the topics of drought and heat to stimulate citizen action.

Secondly, the majority citizens that were surveyed had no prior knowledge on climate adaptation. However, the majority of citizens was willing to collaborate with local governments in better preparing for climate extremities. This highlights that despite the term climate adaptation is often unknown the overarching goal of climate change adaptation is recognized and accepted amongst citizens.
With this information the students have made designs that make the problems of extreme precipitation more visible and inform citizens whom they can ask their questions regarding extreme weather. This has resulted in a number of designs ranging from physical objects to be put in space to awareness campaigns in the main shopping centres (figure 6.7).

Figure 6.7 Design propositions

6.4.3 Conclusion

Climatecafés are a method that brings together academia, education and practice in a multidisciplinary workshop. The aim of these climatecafés is to share knowledge on the topics of climate change adaptation, state-of-the-art of adaptation measures and to apply this knowledge to local questions. Participants in climatecafés use a learning-by-doing approach in answering these local questions. Climatecafés offer a broad set of workshops to participants that help in gaining knowledge on the local context and collect data that can be used in future scientific publications.
The climatecafé in Oldenburg has helped the local stakeholder (OOWV) in the development of new strategies and students included in this climatecafé had the opportunity to present their findings to the project team on climate change adaptation. This indicates that potentially the outcomes of this short workshop will be implemented in the future and offers students a good opportunity to connect to potential future employers.

In the near future, the professorship of Spatial Transformation will organise follow-up events that apply the methodologies used in Oldenburg in different areas. The data from these events will work towards a large-n survey in multiple countries that can be used in a cross-country analysis on the opportunities and barriers on climate change adaptation.

6.5 Forward outlook

Climate change will have far-reaching effects on urban societies and requires new strategies and instruments to increase the carrying capacity of urban environments. Climatological risk management and modelling in the past was mainly oriented on the underground infrastructure and technical solutions for climatological management. This has led to a situation where urban development and design could focus on other subjects rather than climate and led to spatial and institutional developments that limited the collaboration between stakeholders. This makes climate change adaptation a complex issue that needs to find ways to break through path dependencies.
Therefore, the Professorship of Spatial Transformations investigates and manifests this transition through different kinds of research:

- The nature of climatological risks
- Climate-information communication
- Opportunities and barriers for climate change adaptation
- Best management practices
- Spatial design and climate change adaptation

Developing and applying innovative methodologies like climatecafés or living labs to stimulate stakeholder participation, knowledge exchange and co-creation of climate adaptive measures will be a key factor linking these different lines of research. It provides the pathway to connect the research activities to partners in practice and education so both academic as societal impact will emerge.

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Bouwtex: building with textile

7

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7.1 Introduction

What if in addition to the traditional building materials, like brick, concrete, wood or metal, textiles could be used? When textile is compared with traditional materials, the qualities that stand out are that it is flexible, sound insulating, lightweight, recyclable, and very adaptable. This could be revolutionary for how buildings are built and used, as it opens up many opportunities. Walls would not be static but could be shaped by individuals according to their needs, would be as comforting as a teddy-bear yet still provide sound insulation from a neighbour having a party, and old clothes would not have to be thrown away but could become part of a new addition to your house. The Bouwtex project aims to find out what is possible if textiles would be used as building materials, and what opportunities it might have for the users. Additionally, for realism, four prototypes of textile walls have been built. The Hanze and Saxion Universities of Applied Sciences collaborated in this project to combine their expertise and design these prototypes, with the help of students and a few companies (Aldus bouwinnovatie) to realise them. In this chapter, the project results are described, first focussing on textile as a building material, followed by how flexibility in use could be beneficial, the descriptions of the developed prototypes, how they work, and lastly, how they could be improved so they work as they were intended to.

7.2 Textile as building material

The possibilities of textiles are nearly endless. Different materials can be used for the fibres, there is variation in how they are weaved, how they are treated, and how they are sewn or combined in other ways (Kumar and Thakur, 2017). Then, it matters how the fabric is attached to other, structural materials. For instance with gluing, where the variation in the type of glue influences the adhesiveness of the material (Ekinci et al., 2017). One of the characteristics of textile is that it is form-flexible. This means that in order for it to function as a building material, it needs some supporting structure. This could come from a treatment of the fabric or from other, more traditional building materials that form a frame. Thus, there are plenty of possibilities but they come with limitations. Students from the School of the Arts 'Minerva', part of Hanze University of Applied Sciences, engaged with this material problem, and came up with surprising solutions.

One way to give synthetic textile structural qualities is to heat it (Kumar and Thakur, 2017). Organza, for example, is one of those synthetic materials that can be given a shape by heating it in a particular way. When the fabric cools down, the shape stays, but can be stretched out again (see figure 7.1). The heating process changes the 'basic' shape state of the material from flat, to whatever shape it is given. To make the shape structural on a human scale, it would be necessary to investigate the shapes the material needs to have to stay strong.

Figure 7.1 Organza changing shape after heating

Sometimes the traditional building materials need to be used for a frame, but this can be done in more ways than the typical rectangular frame between which the textile is hung. Integrating wooden sticks or metal wire in the textile, in this case unbleached cotton, can give structural support depending on how it is folded (see figure 7.2). The unpredictability of what exactly can be made with it, is part of the flexibility of use.

Figure 7.2 Cotton with rounded and straight metal wire frame

7.3 Flexibility in use

It is one thing to explore what textile could do, another topic is to design with textile for a specific purpose. For Bouwtex, first of all the purpose of the design was related to education. Education is at some point important in everyone's life, hence having a good educational environment will benefit practically everyone. However, today's educational environments are often crowded, outdated (building quality and readiness for technology) and unsuitable for adjustment to individual learning needs (De Vrieze and Moll, 2018).

The purpose of Bouwtex was to create textile-based elements that could be used for educational environments, to upgrade the building and make it possible to adjust the environment to these needs. As such, the proposed solutions should be useful for individuals and small groups and be able to be moved to where they are needed. The usefulness was defined by the following three criteria:

- Activity type (individual study-time, use of technology, etc.);
- Increase of indoor environmental quality (soundscape, visual distraction, etc.);
- Flexibility of the object (placement in the space and changing shape).

These criteria were taken into account when designing the four prototypes of flexible textile walls, divided in two interior walls and two exterior walls. Both Universities of Applied Sciences have designed one prototype in cooperation with the associated companies whilst using the ideas from the student work described above.

7.4 Prototypes

In this section the four prototypes that were developed will be described, focussing on the flexibility, novelty, material, and ideas about use. Additionally, several interesting textile walls developed by students are briefly discussed at the end.

7.4.1 The exterior wall

This wall was developed by Saxion University of Applied Sciences, as an addition to existing exterior cavity walls. The main design features are the functioning of the textile panels as a cushion, in which water can be pumped. The panels are fixed to the existing wall with a metal frame (figure 7.3). The function of the water to be pumped through, is extra insulation of the façade. In warm weather the water is heated and pumped through the connected panels, so that the heat does not transfer to the wall. In cold weather, the water would also function as a blanket preventing the cold to get into the

Figure 7.3 Exterior panels on a brick cavity wall

existing walls. With freezing temperatures, the water could be kept moving to prevent freezing of the water. The panels can be added or removed to best cover the existing façade, leaving openings for the windows. That way, this wall can be applied to many different façades, as long as the wall is strong enough to carry the weight of the added textile wall. The textile of the prototype is white, but because it is a textile any image can be printed on it. The size of the panels makes it relatively easy to transport and reuse for other buildings. Because the water is only inserted at the end, the weight during transport and construction is relatively low.

The direction of the water flow through the panels determines its efficiency. Smaller tunnels between the seams, means that less water is needed to fill up the panel, but the pump needs to pump harder to get the water through at the same speed. Air could be used instead of water to reduce the weight, but it is more difficult to pump air through to prevent overheating or cooling compared to water. In some instances, when the desired temperature is not too different from the outside temperature, air could be a sufficient buffer.

The panels could be used for educational buildings, but also for residential buildings, office buildings, and any other building that has an uninsulated brick cavity wall. Therefore, the panels could be used in many situations, but more testing is needed before the actual insulation gain can be calculated.

Figure 7.4 Panels from recycled KLM uniforms

7.4.2 Interior wall from recycled KLM uniforms

This wall (figure 7.4) was also developed by Saxion, for a specific location in an educational building. The location is in the main entry, below the escalators, where sewing machines are placed. Consequently, noise is a problem, as is security. At the moment, building fences are put up to secure the area, but this does not solve the sound problem. Because the space should be accessible, it cannot be completely sealed off all the time, and since the machines are there for the students, they should also be visible. The criteria for usefulness mentioned above all apply in this location.

The developed wall panel consists of a wooden frame on legs, which is covered with a felt-based textile made of recycled KLM-uniforms. The inside of the panel is hollow, and leaves space to add features. For example, sensors, heating or cooling elements or other electronics can be inserted in the cavity. The panels are easy to move and rearrange, as they can be moved across the floor. This allows whoever is using the space to create openings or close the space when necessary. Intermediate options are also available, where the panels could be placed diagonally on the floor so as to create visibility from one direction, but still absorb the noise from the machines.

In this wall the benefits of using textile come from sound absorption, being lightweight, and flexible. They can easily be adjusted to different needs, where the frame could be made slightly bigger or smaller, the fabric could be changed to have different qualities, or smart technologies could be added inside the panel. However, how the panels could be locked together remains to be investigated.

7.4.3 Connected panels and storage panel

The third and fourth prototype were developed by Aldus Bouwinnovatie and were designed for primary schools. The majority of primary schools was built in the seventies, when the educational programme was quite different from what it is now or projected to be in the near future, with technologies becoming a bigger part of daily education (Osguthorpe et al., 2003). The focus has shifted from teaching the same subject all the time in one classroom, towards a way of teaching where smaller groups are taught by the teacher while other smaller groups or individuals work by themselves. In order to do this properly, more varied spaces are needed that can be used simultaneously. Criteria that are most relevant here are sound absorption and flexibility in space. With children working together or alone in silence while

Figure 7.5 Foldable felt

Figure 7.6 Storage panel

the teacher is busy with another group, it is very important that the teachers voice reaches those who need to hear, but not the ones who are learning by themselves and could be disturbed by others' voices. The flexibility in space is important so that the limited space available can be optimised for whichever activity needs to happen at a certain time but can change easily when the activity changes. Often, the individual learning places are put in the hallway, where the storage could be useful for the materials needed. Also, when the hallway is not used, it needs to be freely accessible for all the children to go in and out of the classroom.

The first type of panel that was developed (figure 7.5) aims to close of a small space when needed, but when this is not required it does take up the least possible amount of space. The panel can be folded in and out, since they are connected with the same fabric that is used to cover the frame. This makes it easy to use, from the point where they are attached to the wall, they form a straight line to close off the hallway for a group for example, or to fold it around a desk space to make it an individual workspace while there is still space to walk through the hallway.

The fabric of the panel is made of a type of felt and inside the panel extra acoustic material is placed. The fabric is made out of one type of natural fibre which makes recycling easier compared to combined materials. The fabric can be made to have every colour, from calming blue to the colours of the school. This gives plenty of opportunity to make it fit in any school.

The second type of panel (figure 7.6), developed by Aldus Bouwinnovatie is made of the same fabric, but this time it is wrapped around a sort of bookcase on wheels. The sound absorbing qualities are therefore similar, but instead of not taking up space when not needed, storage space is available. The storage space is accessible on one side, where at the bottom there are big boxes that can be closed, and above there are four bookshelves. Because the panels, or rather the pieces of furniture, are on wheels, they can be moved easily to the side of the wall or be placed next to an individual- or group-workspace.

7.4.4 Green big wall

This panel was developed by the Hanze University of Applied Sciences and envisioned as being a wall that could continue from the inside to the outside. Walls are the clearest way to indicate the beginning and the close of a space. Hence, when a door, or window, are placed in that wall, the space continues and connects to the space behind. Sometimes, it might be necessary to extend a space to the outside, or the other way around, or to open up a space entirely. Contrary to the other panels, this panel was not designed with rectangles, allowing the form of the panel to be more adaptive (figure 7.7).

Figure 7.7 Models of the green panel

The design of the panel consists of bamboo poles holding up the textile (felt), standing in a metal foot. The textile is sewn in such a way that it can easily fold in or out, and bend in almost any (horizontal) direction. The position of the poles thus determines the shape of the wall, which ranges from straight to very curvy angles. As a result, the material and the way it is sewn together have a good sound absorption. Similar to the panels described in paragraph 7.4.3, the basic materials used make it easy to recycle in the future. The bamboo and green felt give the panel a natural feel, which makes the space it is used in to feel more relaxing. The size of the prototype makes it difficult to be moved by one person.

7.5 Functioning of the prototypes

Each of the prototypes was displayed at the end-of-year shows, which took place on the 15th and 16th of January 2020 in Enschede and Groningen respectively. At these shows, focus groups were organised to explore how prospective users would use the prototypes. Both students and professionals were asked questions derived from the usefulness criteria, thus considering how the panels could be used, how they would improve the indoor environment, and how the panel could be adjusted. Each focus group consisted of eight participants on average and lasted about 30 minutes.
The outcome of the focus groups is discussed below.

7.5.1 The exterior wall

The main purpose of this wall is to provide flexible extra insulation for brick cavity walls. The emphasis for this wall lays on technical aspects rather than on aesthetics. The comments made in the focus group reflect on the aesthetics, and made it clear that for prospective users the aesthetics are important. Several suggestions were put forward to improve the aesthetics. For example, printing images on the textile, or changing the panels to a roof-mounted system instead of a wall-mounted system.

Considering the efficiency of the panels, there were some doubts about the insulation gains in combination with the weight of the panels when filled with water. This might limit the applicability to buildings because the existing walls cannot carry the weight of the total system. However, numbers were not provided. One of the requests from the focus group with professionals was to increase the testing and gain more data on how this panel would function in comparison with existing solutions. This might show that this panel has many advantages, which would make people more willing to implement it.

Other added functionalities that were mentioned in the focus groups were air purification, filtering water with algae, add PV-cells, collect rainwater or serve as a sunscreen.

In conclusion, the basis of the exterior panels leaves enough room for further improvement, which could make the panels a good contestant for existing solutions to thermally insulate exterior walls.

7.5.2 Interior wall from recycled KLM-uniforms

These panels were developed for a specific location but could also be used elsewhere. The main purpose was to increase the quality of the soundscape, while the area should be both visually accessible but physically secluded when needed. These are difficult requirements to realise in one panel and this was also a main concern for the focus groups. The relatively mainstream design has left plenty of opportunities to further develop the panels, for example through the use of other colours, adding technology inside the panel, adding storage, replacing a part of the fabric for a transparent one, use the panels for the display of student work, or for lighting features.

Because the panels are relatively small and lightweight, it is easy to move them around and close off the space where the sewing machines are located or, when desired, to open it up. The way the panels are currently designed, they can be used in many ways, however they are not very ‘innovative’. By adding specific features, it would make the panels more novel, but at the same time it might limit a broader applicability. This implies that there is a balance between the amount of flexibility and specificity.

7.5.3 Connected panels and storage panel

The panels that fold in and out and the storage panel are designed for primary schools. The focus group took place in a higher education building with professionals not related to primary schools, which shifted the focus away from usefulness per se. The foldable panel is easily applicable, while the storage panel might cause problems due to the usually limited floor area available in offices. Another issue that came up was in which circumstances someone feels confident that he or she is allowed to move or store things inside a panel, especially when planning to work individually. The wheels that are present in the storage panel do signify that it can be moved, but it is not clear that this is also allowed, let alone when things from someone else are visible on the shelves. However, in public spaces this is a more relevant problem than it is in a primary school.

Concerning the foldable panel, the suggestion is made to come up with a solution making the surface of the panel usable for teaching or display. The improvement of acoustics was clearly noticeable by the participants of the focus groups and was appreciated.

7.5.4 Big green wall

One thing that stands out immediately compared to the other developed panels is the size of this prototype. Because it was originally meant to be able to extend outside the office space, the wall panel is a lot taller than the other panels. In the focus groups the size is interpreted as being meant for big spaces, like entrance halls of public buildings instead of educational buildings. Another issue that comes up due to its size is that it is more difficult to move the panel and that it takes more courage to take the decision to move it. On the other hand, the panel is regarded as a positive element in the space and the participants in the focus groups state they would feel comfortable working next to it. The use of materials, colour, sound absorption and pattern makes the wall feel as a natural element which is thought to enhance productivity. A point of improvement would be to change the design of the metal foot, which seems out of place and makes it look heavy. This would make the wall easier to move and improve the overall look. Furthermore, the panel could be made smaller for smaller spaces, if the sewing pattern of the fabric would also decrease in size.

7.6 Conclusion

The Bouwtex project aims to design walls, which are functional for different activities, improve the indoor environment, and are flexible, using textile-based materials. The biggest advantages of using textiles for the developed walls, were seen in improved acoustics, the constructions being lightweight, and the ease of adjustment.

The reflections from the focus groups on how to improve the prototypes mainly focusses on adding features, such as additional storage spaces, images or colours, lighting, air purification, or charging devices. A more important point for the prototypes is that the participants in the focus groups mentioned that they probably would not move the panels. One of the main goals was to design flexible walls that could be moved according to changing needs, requirements, or circumstances. If people do not feel confident enough to move the wall, it does not matter how flexible the walls are designed. In order to use the walls flexibly it is necessary to either set rules that are known to all users or to visually communicate that the walls can and are meant to be moved.

Before the walls could be brought to the market, it is necessary to compare them with existing solutions. Moreover, the walls should be tested on acoustic properties, because that is one of the main design features and a cost estimation for production is necessary. Furthermore, a choice should be made for developing either different types of walls in the same line with different functions or to make one design that can be used in many situations.

In conclusion, the use of textile in flexible walls can be beneficial for educational environments and possibly in other types of environments too. Especially when the acoustics are problematic using textile for interior walls can be beneficial. Moreover, with limited space available flexible walls make the space they are located in suitable for multiple uses. The walls can be used for different sizes of groups when adjusted accordingly and additional functionalities can further increase productivity. Regarding the exterior wall the improvement of the aesthetics and understanding its contribution to thermal insulation, could extend the lifespan of buildings.

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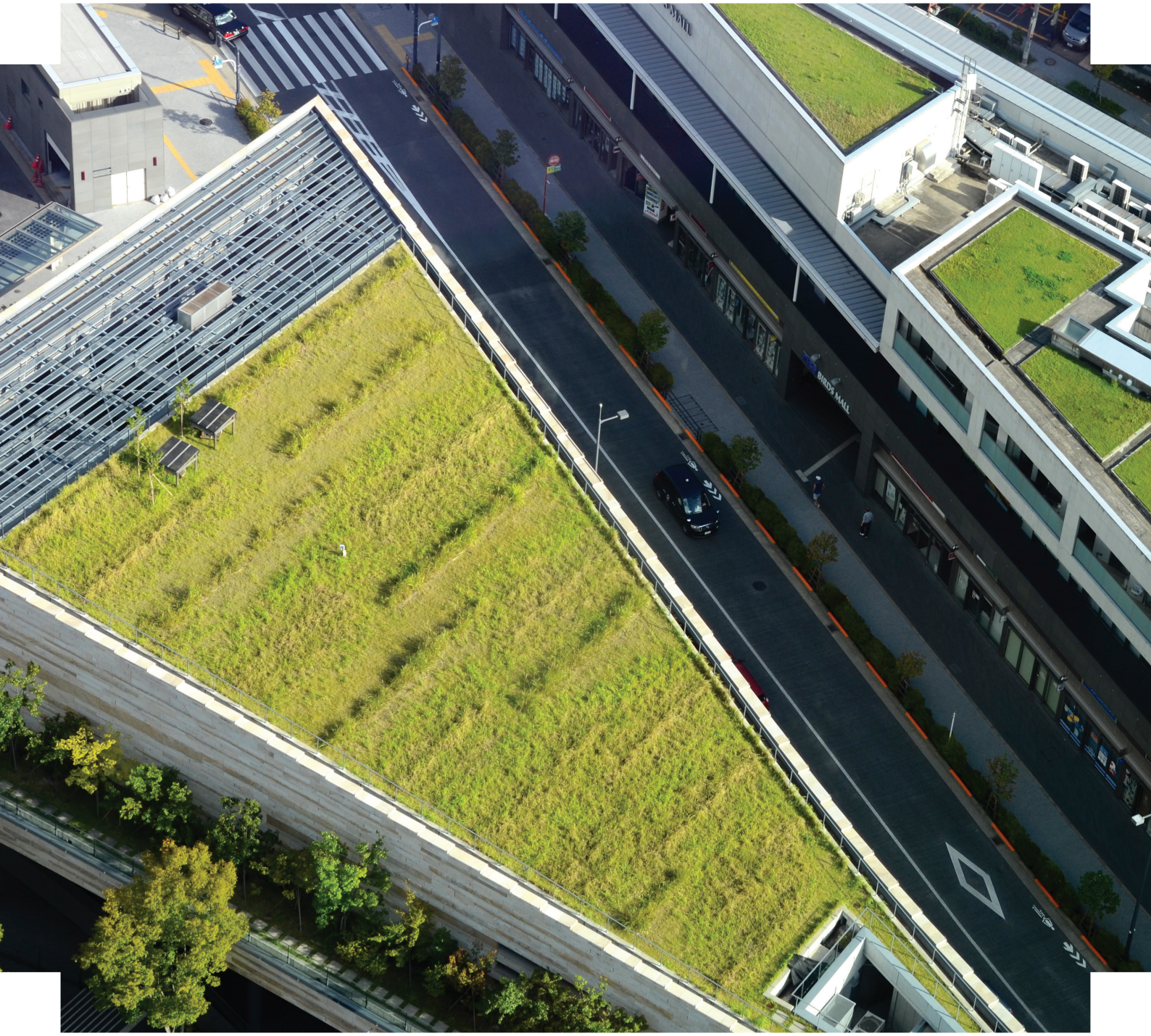
BIRD'S MALL