SENSES Dutch case study: a CO_2-neutral and climate robust Overijsselse Vecht

Final version: January 31, 2021
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The project SENSES is part of the European Research Area for Climate Services (ERA4CS), an ERA-NET initiated by JPI Climate. It is funded by BMBF (DE), BMWFW (AT), NWO (NL), FORMAS (SE) with co-funding by the European Union (Grant 690462). (ERA4CS).

Contents

1. Introduction

1.1 SENSES project and the regional case studies' research question

The main objective of the SENSES project is to develop a climate scenario toolkit to make scenarios more relevant and accessible to range of international decision-makers and stakeholders, including both global and regional stakeholders. The SENSES toolkit has three objectives: (1) the description of goals and attributes of scenarios, such as "climate projections", "climate change impact scenarios", "mitigation scenarios" etc, (2) applying interactive methods based on co-production and (3) novel visualisation techniques that make scenarios more accessible and useful for stakeholders.
To increase accessibility of scenarios at the regional level, SENSES has two regional case-study components (in the Netherlands and in Kenya). Building on the overview of existing and relevant co-production techniques in SENSES (see Deliverable 2.1), this Deliverable elaborates on the methodology and implementation of the "extended science" approach within the Dutch case study. The general starting point is that co-production should yield more robust and socially accountable science, while including diverse knowledge and worldviews. Therefore, besides the SENSES and regional case studies' objectives, each case study has tailored, case-study-specific objectives.

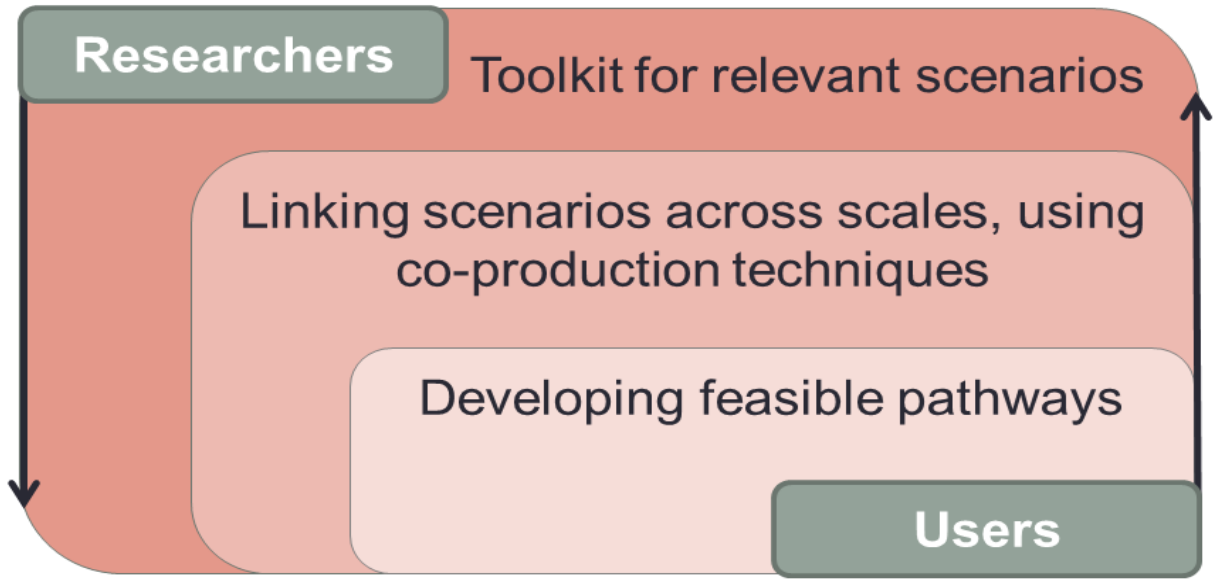


Figure 1: Objectives of the Dutch case study (light pink, inner box), driven by users, and its contextualization within regional case studies' objectives (middle box) and overall objectives in SENSES (darker pink, outer box)

The Dutch case study explores the challenges for the Vecht River (Dutch: Overijsselse Vecht) to develop pathways towards a CO_2-neutral and climate change-robust system. While this report focuses on the Dutch case study, both regional case studies aim at informing regional decision makers about local implications of global socioeconomic and climate change global scenarios, the so-called Shared Socioeconomic Pathways (SSPs), to guide them in developing regionally relevant scenarios. The overarching research question is how important it is to link scenarios across geographical scales, using co-production techniques (Figure 1), and, if so, how could this effectively be operationalized translating, using and extending global SSPs for regional users.

1.2 Dutch case study objectives

The choice of the Overijsselse Vecht as a focus region for the Dutch case study, has several advantages that can contribute to testing and knowledge generation for the SENSES toolkit. Firstly, the Overijsselse Vecht area is a densely populated Dutch delta vulnerable to climate change because of its low groundwater levels (drought) and high discharge peaks (floods) and importance for the highly intensive agricultural sector. Therefore, local adaptation plans and scenarios exist to face these anticipate and adapt to climate change. Secondly, the (national) Dutch mitigation plans, including energy and climate policy for 2050 need to be implemented also locally, but potential trade-offs and synergies are not yet accounted in both national and local future pathways. Thirdly, the Vecht has a long tradition in scenarios and visioning, also using participatory techniques. The current focus for the future is to transform the Vecht river into a semi-natural system to adapt to climate change. However, the methodological integration of drivers at multiple scales is currently still lacking and consideration of scale effects, especially using co-production techniques.
We address the overarching SENSES research question by assessing feasibility of robust pathways at multiple scales and across scenarios. The specific objective of the Dutch case study is elaborated in three sub-objectives and steps as represented in the SENSES Dutch case study work-flow diagram in Figure 2.

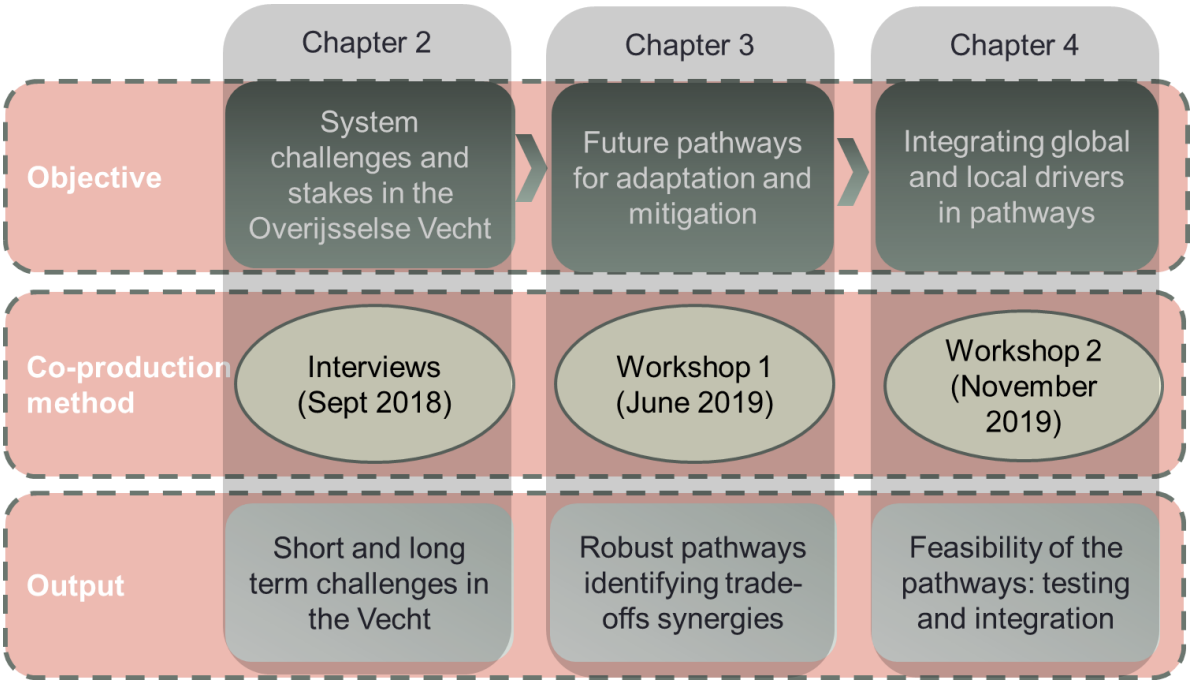


Figure 2: Objectives, co-production methods and output of the SENSES Dutch case-study as presented in this Deliverable

The first sub-objective (Chapter 2) addresses the need to understand current and future systemic challenges in the Vecht. The methodology consists of semi-structured interviews with 19 stakeholders which aim at structuring the nexus between short term and long-term challenges given the (existing) future vision of a semi-natural Vecht. The output is a systemic visualisation of short- and long-term challenges and linkages across drivers for the Vecht.
The second sub-objective (Chapter 3) introduces the context of climate policy and targets at multiple scale to guide the pathways. These pathways are tested for robustness against four "wildcards" representing events consistent with the global SSPs. The pathways are designed to be participatory, discussed and developed in a facilitated workshop. The output is an SSP-robust pathway towards the multiscale vision that addresses the relevant trade-offs and synergies once both mitigation and adaptation elements are accounted for.

The third sub-objective (Chapter 4) tests the feasibility of the robust pathways from Chapter 3 and further integration of global quantitative (what-if) mitigation scenarios and locally-derived solutions (from the LUMBRICUS project). As for Chapter 3, the co-production technique is based on a facilitated workshop. The output if feasibility is tested with.

We conclude (Chapter 5) with a reflection on the implementation of the process and resulting output throughout the three steps of Figure 2. We assess how the identification of short-term and long-term drivers, together with the use of a multiscale vision, facilitated the development of the multiscale pathway using co-production techniques developed in the SENSES toolkit. A core element is that the pathways have emerged to be both "robust" and "feasible". This was the result of both the interaction of stakeholders, but also the visualisation of scenarios according to different goals, types and scales. As part of the iterative process of co-production, the Dutch case study pathway can inform with both its pathway and process further projects, for example both in the region with the SENSES framework.

2. System challenges and stakes in the Overijsselse Vecht

2.1 Study area and current vision: a semi-natural Vecht

The Overijsselse Vecht is the largest of the small and smallest of the largest rivers in the Netherlands. The Vecht flows through the province of Overijssel, located in the east of the Netherlands. The source of the Vecht is in Germany and flows into the Zwarte Water at Zwolle. The Vecht river covers 167 km, covers a catchment area of 3785 km^2 and is a part of the Rhine river basin. In the past, the river has been channelled, as a necessary task to improve flood peaks discharges and to enhance flood safety. Furthermore, floodplains and riparian zones along the river channel were reclaimed for agricultural use. The groundwater levels, river weirs and its floodplain currently accommodate the needs for agricultural demands. These activities have resulted in severe ecological degradation of the Vecht River.

To address this and improve the quality of the river, natural processes are being increasingly prioritized. The implication of shifting the balance from agricultural demand to a towards meeting natural demands of a semi-natural state and therefore, a 'malleable' river is not fully understood yet.

Agriculture is nowadays one of the main pillars of the economy in the region. It determines to a large extent the appearance of the region. Agriculture in the Vechtdal consists mainly of dairy farming and other grazing animal farming; 62% of the area is grassland and 21% is corn. Intensive livestock farming is limited. Of the dairy farmers, the majority (80%) has 50 to 110 dairy cows.

For the future, the province has the ambitions to improve the identity and experience of the area along the Vecht River and to support the economic development of the Overijsselse Vecht Valley. Two major programs have been established - the Vision for the Vecht and Room for the Vecht - to transform the severely modified lowland river into a "semi-natural" state. The Vecht River is managed by two water boards, the eastern part by Vechtstromen and the western part by Drents Overijsselse Delta. Until 2005, the management of the Vecht river was carried out by Rijkswaterstaat.

The four objectives to achieve the 'Ruimte voor de Vecht' vision of a semi-natural Vecht are visualised in Figure 3).

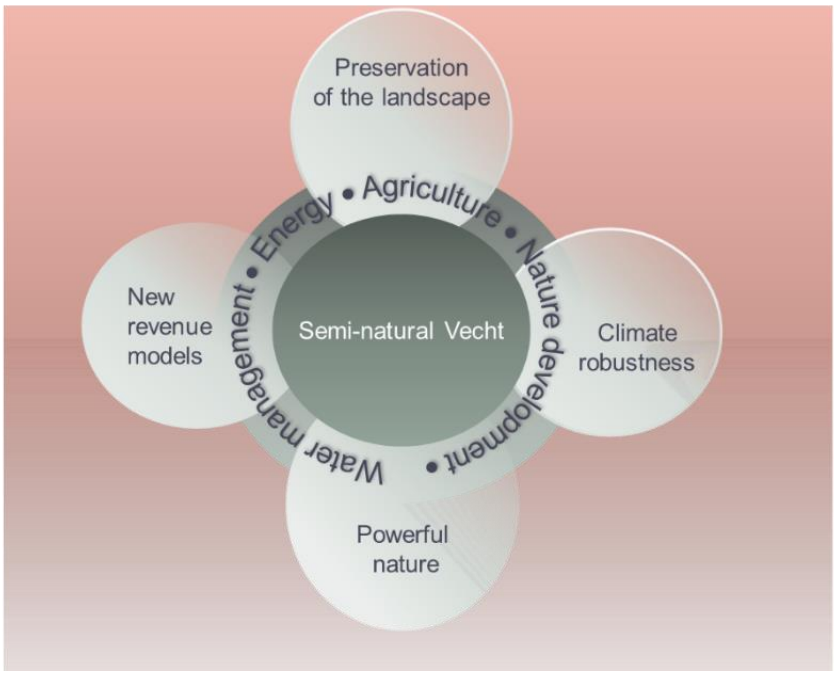


Figure 3: Visualisation of the four challenges around the vision of a semi-natural Vecht. Developed from information on the "Ruimte voor de Vecht" Programme (in Dutch) http://www.ruimtevoordevecht.nl/ . These four challenges are the basis for the development of the integrated in the multiscale vision described in Session 3.2

In order to achieve these objectives, the Ruimte voor de Vecht programme had been funding initiatives by facilitating collaboration between rural estate, nature organisations, inhabitants, entrepreneurs and, of course, the waterboards that manage the rivers. The challenges addressed by the programme are cross-cutting, including climate and water safety, nature and biodiversity, preserve and make agriculture more sustainable and the creation of socioeconomic development.

The Ruimte-voor-de-Vecht based vision describes a semi-natural system: a safe, restored, semi-natural, stable and lively river and a liveable, unique Vecht valley; a coherent and distinctive Vechtdal, where based on the current qualities and area characteristics impulses are given and quality is added in nature, agriculture, landscape, tourism and recreation and culture. The general implementation of such semi-natural system is visualised in Figure 3 and describes a water system that has more possibilities to stream in a more natural way, with elements such as new meanders, removal of fixed shorelines, semi-stagnant waters in flooding areas and secondary channels (ontsteende oevers, poeltjes en nevengeulen in Dutch).

Figure 4: Dutch case study area. Left-hand picture depicts the present and the left-hand picture the current vision of a semi-natural future Vecht river system. Source: Dutch Ministry

The vision therefore connects the river with the Vecht valley. Given the importance of agriculture, the Vecht vision therefore also describes 'we have the task of offering agriculture a perspective for the future in the Vecht valley'. The 'Ruimte voor de Vecht' programme ended in 2018. A new network organisation takes over the program to continue the collaboration in the Vecht area. The plan is to update the current Vecht vision and to develop the Vecht into a 'klimaatas'. This could assist in financing developments that are in line with climate actions and developing a climate robust Vecht.

Particularly the interlinkages between (regional and national) climate adaptation and mitigation plans, as well as the implications of the interlinkages between vision objectives in Figure 2 need still to be understood as a follow-up challenge of the Ruimte voor de Vecht programme. These linkages are the focus of chapters 3 and 4 in this deliverable (development of a new multiscale vision and design of feasible pathways that will be informed by existing knowledge on drivers and adaptation and mitigation challenges in the Vecht), as part of the SENSES contribution to Vecht as a dynamic and evolving case study.

Prior to Chapters 3 and 4, we present an analysis to systematise the current system dynamics of the Vecht. This is analysis is based on a series of interviews designed and carried out according to the expert opinion of stakeholders relevant to the Vecht river-system. Based on the system dynamics emerging from the interviews, both short-term and long-term challenges have been identified as well as state-of-the-art elements of climate adaptation and mitigation pathways.

2.2 Interviews: set-up and stakeholder selection

The semi-structured interviews are designed to gain insights on the current and future challenges for the Vecht, by (1) understanding what the main system drivers in the Vecht and challenges are and (2) by particularly addressing the role of climate change in the Vecht given existing scenarios and climate policies. The set-up is:

(1) System drivers in the Vecht: present and future challenges
    a. Background information
        i. What is the key focus of your organization?
            1. What are the main tasks and responsibilities in your current role?
            2. Which elements of your work are related to climate change?
        ii. Are you familiar with climate services?
    b. Current situation
        i. Factors that impact current situation
    c. Future situation (short and long term)

<< show a list of drivers (STEEP): society, technology, economy, environment, policy>>

i. Do you see certain trends (in water management/agriculture, energy etc…)?
ii. Identify 3 main drivers that impact the region
iii. Which of the factors are important coming 10 years?
iv. Which ones play a role on longer term (50 years)
v. Which ones are uncertain?
<< Explain SENSES project, --> what information from global SSP scenarios are relevant for the region? >>
vi. Do you think that regions outside the Netherlands have a large impact on the socio-economic situation in the Netherlands?

Society	Technology	Economy	Environment	Policy
Demography Lifestyle	Transport Infrastructure Agriculture Lifestyle	Markets International trade Development industry Energy	Climate change Ecosystem services	International policy National policy Local policy

Figure 5: Relevant drivers of change for the Vecht, organized as society, technology, economy, environment, policy (STEEP)

(2) Adaptation and mitigation to climate change in the Vecht: possible solutions, visions and existing scenarios

a. Scenarios

i. Do you, or your organization work with scenarios?

1. If yes, how do you use this information?
2. Do you know the national KNMI, WLO, Delta scenario's?

ii. Do you, or your organization, work with global scenarios?

1. If yes, how do you use this information?
2. Are you familiar with IPCC (SRES, SSP, RCP), ISIMIP, CMIP?

b. Pathways (policies)

>> Introduce existing visions and solutions

i. Which policies are currently important for climate actions?

1. Are you familiar with WFD, Natura2000, climate adaptation plan?

2. Are you familiar with the Dutch climate agreement?

Climate adaptation
- Delta scenario: Climate robust Netherlands in 2050

Climate mitigation
- Klimaatakkoord: 49% by 2030, 90% by 2050

Vecht vision
- Semi-natural lowland, "Vecht identity", recreation, nature and agriculture

Figure 6: Relevant policies and studies for the future of the Vecht

3. Are you familiar with global mitigation scenarios?

ii. Adaptation

1. Which aspects of adaptation are now important?
2. Which aspects of adaptation are important in the future?

iii. Mitigation

1. Which aspects of mitigation are now important?
2. Which aspects of mitigation are important in the future?

iv. What do you think should be the main goal?

1. What should be done?
2. What should be specific target that should be reached?

v. What are the main obstacles to reach climate goals?

vi. What is missing to reach climate goals?

vii. Do you think Netherlands has enough financial and human resources to prepare for climate change?

viii. Do you think the current mitigation plans are feasible?

c. Other

i. Do you have suggestions for successful measures?

ii. How can visualisation of information assist to reach climate goals?

iii. Is there something else you would like to share?
iv. Are you interested to participate in a one-day workshop on this subject?
v. Do you have suggestion of two people I could interview on this topic?

In order to identify the most relevant and experienced stakeholders for the interviews, meetings have been held with experts in local projects involved in the implementation of the semi-natural Vecht vision.
A total of 15 stakeholders have been interviewed between August and October 2018, reflecting the sectoral expertise in current Vecht projects: water, spatial planning, adaptation, nature, energy and agriculture.

2.3 Analysis of system drivers in the Vecht: present and future challenges

1.5.1. 2.3.1 Temporal analysis

Current trends

- In water management
  - *mix of technology and 'nature-based solutions'*
- Governance
  - *importance of system thinking and address problems taking an integral approach*
- Society
  - *on one side 'verамerikanisering' from the society, everything comes down to money*
  - *but also, searching for new ideals. Shift from economic growth to sustainability?*
- Nature
  - *Nature is more valued for recreation --> from production to recreation*
  - *Forest management is more integral*
- Spatial planning / landscape architecture
  - *Energy landscapes and building with nature*
    - *Climate is booming, 6 year ago there was no major role for climate adaptation/mitigation in landscape planning. Now almost everything is related / aligned to climate.*

Main drivers for the region for near future (10-15 years):

- Demography
  - *decrease of population on the countryside + increase of urbanisation*
- Energy transition
  - *Groningen van het gas + space required for energy generation*
- Policies
  - *European & national policies on water management and energy*
- Agriculture
  - *the scale of farming increases*

Main drivers for the region for long-term future (50 years):

- Agriculture
  - *circular agriculture/ high tech developments and/or small-scale nature inclusive?*
- Climate change
  - *Impact on water management, biodiversity*
- Technological developments
  - *Impact on lifestyle, transport, and increase/decrease population in Overijssel)*

1.5.2. 2.3.2 Sectoral analysis

The greatest tension in the area on the landscape is ***agriculture***. Most stakeholders mentioned that changes in agriculture will be one of the main drivers for the region both in short-term and the long-term.

The current form of agriculture is 'simply not right'. "Something" is wrong with the current form, and it has been for a very long time (SH Trendbureau Overijssel). It is uncertain how and in which direction agriculture will change, but it looks that the pressure on current form of agriculture is increasing from different angles: Stakeholders perceive agriculture as one of the main drivers on the long term. Agriculture - and the increased scale of agriculture practices – and nature are no longer in balance in the landscape. This has impacts on both diversity loss and quality of soils is decreasing rapidly.
Farmers should get more knowledge on the soils that could both assist in improving water storage as well as biodiversity. The knowledge of soils is too low (Waterboards, Borgman Beheer)
Stakeholders mentioned that most farmers/companies still look at the short term. The policy changes often, which make long-term visions and investments difficult. In the current economic system, most companies consider investments only interesting if you can earn investments back in 5 years' time. The large-scale farmers that have taken an approach to long term investments - and must pay their mortgages etc - are least flexible to move towards another approach. (BEON, LTO Noord, Landschap Overijssel).
Nature and transition in the energy sector are central in the discussion on spatial planning and space allocation. Allocate areas for potential clean energy solutions (wind / solar / geothermal) instead of agriculture does not seem to be a major problem. The friction comes from the new dynamic between energy vs nature and when in it comes down to impact on nature and landscape experiences (Natuurmonumenten, province). Nature as a recreational service is becoming more and more important. Discussions on bio energy exist but is seen as not financially feasible in the Netherlands (Borgman Beheer, BEON, natuur & milieu overijssel). Certain forms of bio-energy could be interesting, but mainly as a side function (wood from nature conservation) or in combination function (organic farm with chicken and some bio-energy).
Some farmers are looking into 'new businesses' to move for example towards solar panel fields. Some of these farmers lease land from institutions like Natuurmonumenten and want to change from dairy farming towards solar panel fields. Although this organization wants to stimulate clean energy, solar panel fields do not fit in a 'natural area', and they cannot just tell every farmer. "This is ok."
Landscape architecture plays a big role by create 'energy landscapes' to find an optimum between nature experience and energy solutions. This also requires collaboration beyond the local institutions (municipality level) to increase the effectiveness and landscape experience of new energy forms
The energy transition is new for most parties and parties are searching for a new balance on responsibilities and approaches. There seems to be a struggle between top-down and a bottom-up approach. The potential role of 'energy landscapes' is relatively new for the responsible provinces/municipalities. The national government is decentralizing the responsibilities to the lowest level. The decentralization structure is well organized. From national government – provinces – regional areas – municipalities. The decentralization provides a good way to implement energy transitions on a local scale. This shouldn't have to be a problem, but stakeholders working on municipality level mention that they currently do not have yet sufficient knowledge and prevalence for the energy transition They are simply 'too close' to their inhabitants and understand the (e.g. financial/ emotional) impacts from suggested changes to realize a fast 'transition'. Municipalities don't feel they currently have the skills in house, nor the prevalence to implement such changes. Landscape architects foresee an issue that every municipality is reinventing the wheel and the impact on landscape might be large if all municipalities only look at their own area. You will get a very patchy landscape that has a large impact on landscape experiences.
Energy transition can lead to impacts. For example, impact of solar fields on soils, there will be less sun, and decreases quality of the soil. This is a question that needs to be researched.

1.5.3. 2.3.3 Integrated system analysis

The temporal analysis and sectoral analysis are integrated with a semi-quantitative system dynamic approach, so-called Fuzzy Cognitive Map (FCM) approach. FCMs visualise and manipulate knowledge by representing the drivers identified by stakeholders (C) in "boxes" connected through relationships in

"arrows". The arrows directional edges or connections (e) are assigned a weight (eij) which quantifies the relative strength of the relationship between concepts Ci and Cj (Kosko 1986, Kok 2009).
A total of 14 concepts and 4 drivers represent a partial system understanding based on the outcome of the analysis. Climate smart land use is defined as the optimal trade-off between adaptive and mitigative land use for the Vecht, or more concrete, the optimal trade-off between land use for agriculture, nature and energy as indicated during the interviews.
Concepts are in accordance with STEEP categorisation and organised in different colour codes (Figure 7). Arrow size indicate the strength of the relationship with dark blue relations indicating a positive value and light blue a negative value.

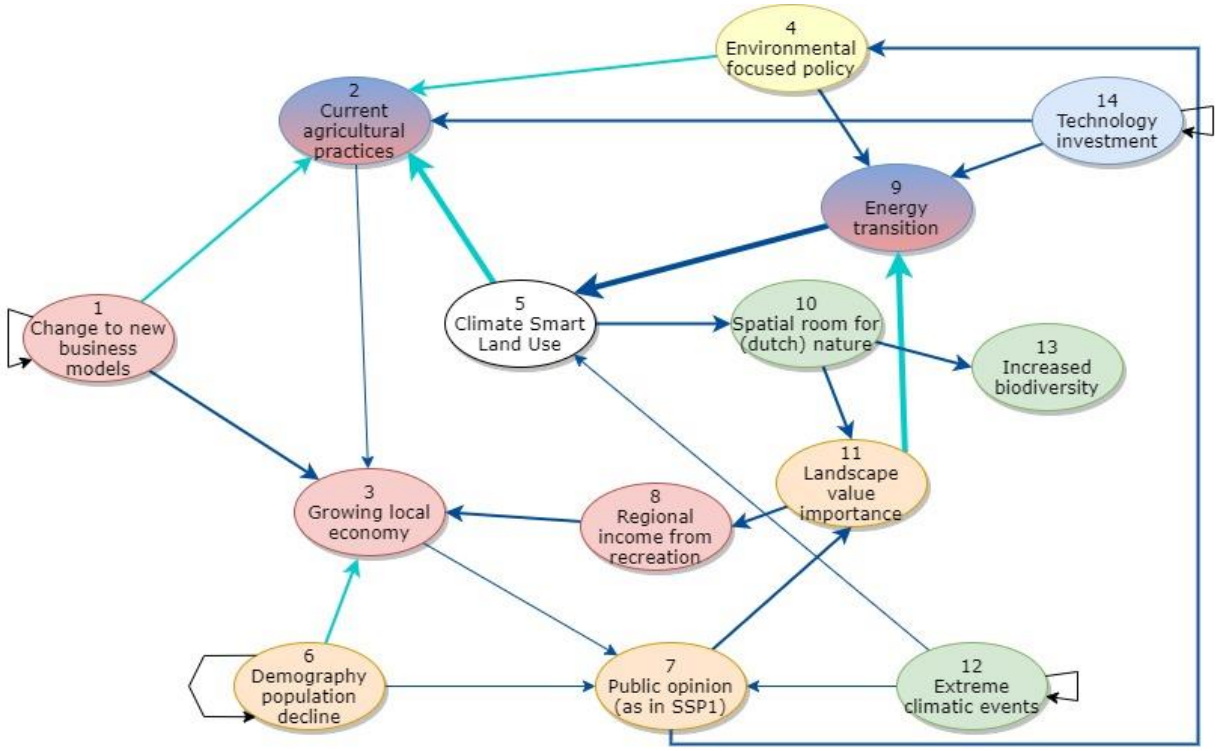


Figure 7: FCM climate smart land use Overijsselse Vecht. Orange ovals represent societal concepts, blue or partly blue ovals represent technological concept, red or partly red ovals represent economical concepts, green ovals represent environmental concepts and yellow oval represent policy concept. Thick, medium and small arrows represent strong, medium and weak relationships respectively. Dark blue arrows and light blue arrows represent positive and negative relationships. The three ovals with an arrow on themselves represent the drivers of the FCM.

The map indicates that a change to new business models, demography changes because of population decline, extreme climatic events and technology investments al influence climate smart land use in an indirect manner (Figures 8 and 9). Climate smart land use is relatively high and largest trade off is with current agricultural practices.

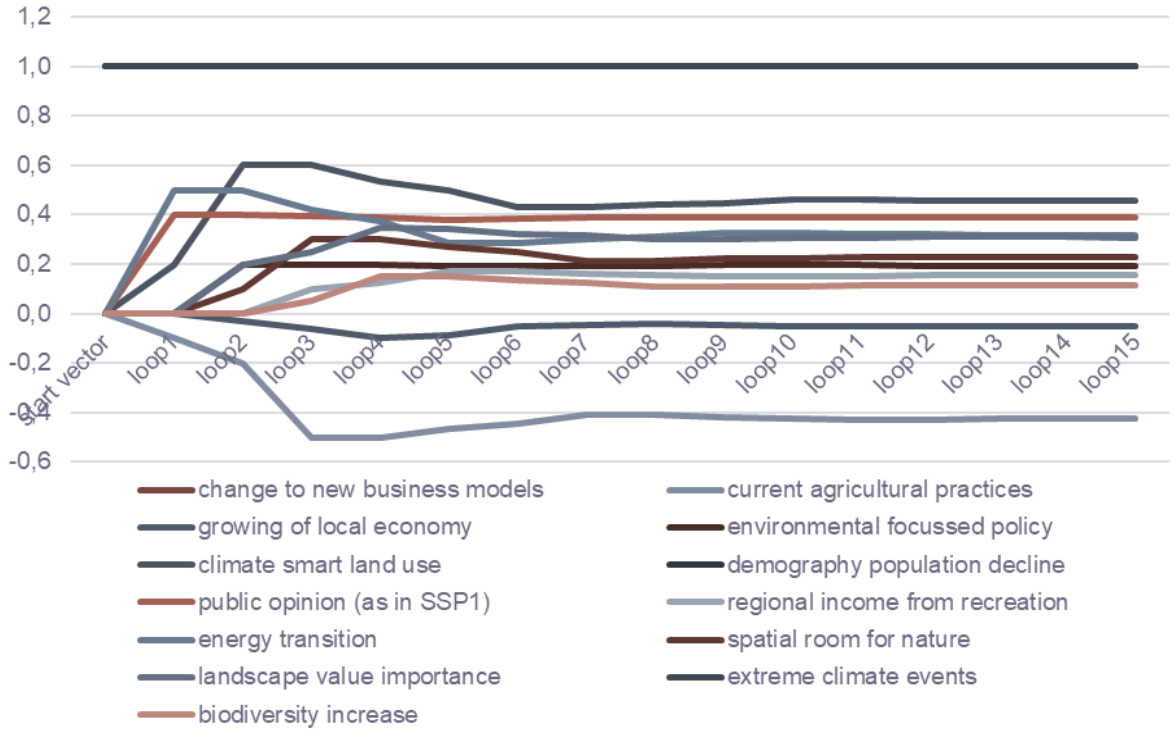


Figure 8: Influence of drivers

We can also indicate what the influences on climate smart land use are for every driver individually (Figure 9). A change to new business models indicate a growing local economy, however current agricultural practices decline. However, demography changes indicate a declining local economy. The occurrence of extreme climate events causes a more 'sustainable focussed (SSP1)' public opinion and an increased climate smart land use. This, however, causes a decline in current agricultural practices as well. Lastly, technology investment increases the energy transition and climate smart land use and does not push other concepts to a negative value.

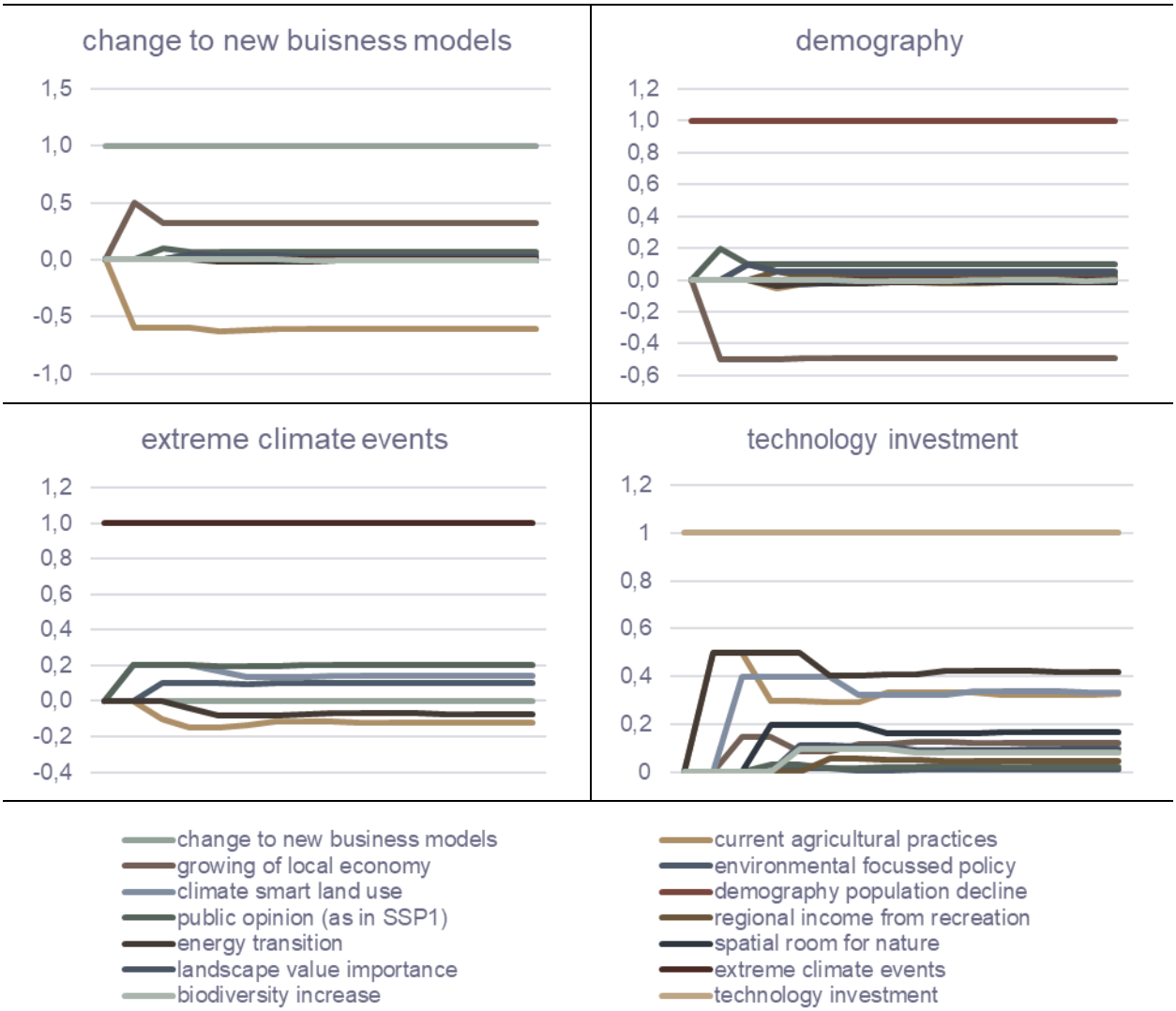


Figure 9: Trade-offs of drivers

2.4 Adaptation and mitigation to climate change in the Vecht: possible solutions, visions, policies and existing scenarios

The system driver analysis in section 2.3 has highlighted that **land and river use in the Vecht is demand driven**. Land use will evolve depending on allocation, priorities and practices in the agriculture, nature and energy sectors.

Uncertainties about trends in these drivers are generally perceived more clearly when addressed with climate adaptation rather than mitigation. The reason is that, while scenarios in the Netherlands are well established (already since the 1950s), they tend to focus on water management (adaptation) planning (Haasnoot and Middelkoop, 2012). Local actors tend to address climate adaptation first because mitigation is perceived as a global problem, too large to address locally. Local advantages of mitigation are not clear, especially if others don`t take actions, while local advantages to adapt are directly visible. Overall, resistance to land use change to mitigation is stronger, particularly due to NIMBY.

Stakeholders identified three possible categories of solutions, that could potentially address both adaptation and mitigation or, at the very least, reduce the risk of trade-offs between the two.

1.5.4. 2.4.1 Possible solutions

Soil was identified as the central element of biophysical-based solution. The starting point can be soil maps, for spatial planning and both mitigation and adaptation. With soil maps it is possible to assess how soils can be used. For instance, soils can be suitable for agriculture and increase water storage capacity or allocated to nature such as reforestation and increase carbon storage. Alternatively, soils can have so little productive value that they could be interesting for solar fields (Figure 10). This could be used as a last step in 'ladder van de zon'. Ladder van de zon describes to first use areas without functions (roofs, old dump areas). Stakeholders emphasized the role of stronger regulation to stimulate farmers to integrate soil management in their practices.

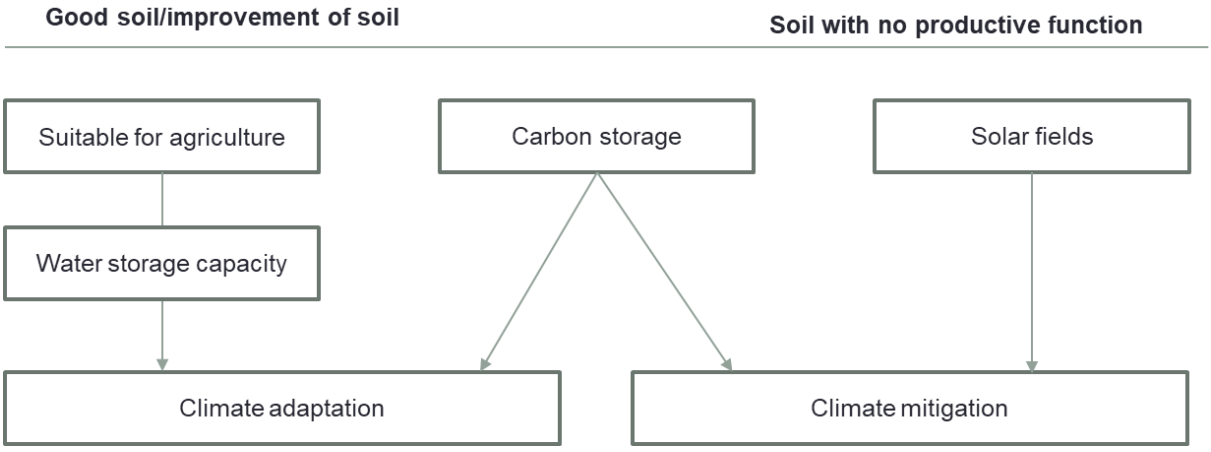


Figure 10: Schematic representation of biophysical solutions for climate adaptation and mitigation based on soil management

Circular economy, and particularly "circular agriculture", was identified as a key requirement to restore the balance in the landscape. If a circular economy is a solution, what does this look like? Various views were mentioned what circular agriculture is, but it is still a vague concept.

The main uncertainties related to the scale, whether circular economies refer to systemic transformation at the farm, landscape, city or national scale.

In order to improve the **natural system**, both the river and its surroundings need to be planned in integrated manner, to avoid trade-offs and conflicts with different land uses (Bureau Strootman and Natuur en Milieu Overijssel, Provincie Overijssel).

Integrated spatial planning means designing and implementing buffer zones around nature. That could translate, for example, into stimulating smalSAcale nature-inclusive farming and organic farming around natural areas around the Vecht river (Natuur en Milieu Overijssel). Large-scale agriculture and farming should be moved farther away from natural areas.

1.5.5. 2.4.2 Vision – "Vision for the Vecht"

Most stakeholders agree with the current vision and the "semi-natural" framing for the Vecht river system already presented in Section 2.1. Generally, agree that a semi-natural Vecht implies moving from the current state to including a river that allows more space for natural processes, is therefore more robust to climate change, and in the long-term weirs are removed from the river to improve natural flows and increases biodiversity.

While there seems to be agreement at first, the vision towards a more natural Vecht, does conflict with water management objectives for farmers (fluctuating groundwater levels) and municipalities (water levels and sedimentation limits increase navigation on the Vecht). The current Vecht vision is focusing on more nature, which is in the middle of competing demands of 1) more space for clean energy generation and 2) finding a balance with water management demands for agriculture**.** Therefore, to achieve the semi-natural "Ruimte voor de Vecht" vision, it is fundamental to ask what the future land use of the Vecht should look like.

1.5.6. 2.4.3 Pathway – "Ruimte voor de Vecht" and stakeholders' perception of pathway development

The 'Ruimte voor de Vecht' programme was named as the main example of an integral, landscape-based approach to achieving the semi-natural Vecht vision. The approach of "Ruimte voor de Vecht" is also highly participatory, involving cooperation among partners, institutes and stakeholders. Stakeholders find it interesting how the river Vecht (described as "line through the landscape") has the function to generate more identity and connections. Stakeholders perceive the current state of nature to be "fragmented" and such a "line" brings connections among the fragments.

The stakeholders' worldviews highlighted some existing friction between the landscape-oriented solutions and vision in the "Ruimte voor de Vecht" program and the reality of its implementation. Because a semi-natural state of the river has influence on the groundwater levels in the basin, the river objectives must fit in the function and objectives of the surrounding landscapes. The main surrounding function is currently agriculture. One of the main drivers behind this divide is that other "Ruimte voor de Rivier" projects had more money and resources allocated than the Vecht had. Buyouts of farmers, citizens and other stakeholders could be established to truly make space for natural areas. Although 'Ruimte voor de Vecht' vision would like to see a similar shift of more natural area around the river, the financial means are not there (Drents Overijsselse Delta).

As identified in the analysis of the drivers in this section, the Vecht river is managed according to demands surrounding its landscape functions, which cause potential frictions, conceptualized in Figure 11. The green arrows indicate the broad direction of the vision, indicating a change towards a semi-natural state. The red arrows indicate the pressure from land use and stakeholders that highlight potential trade-offs.

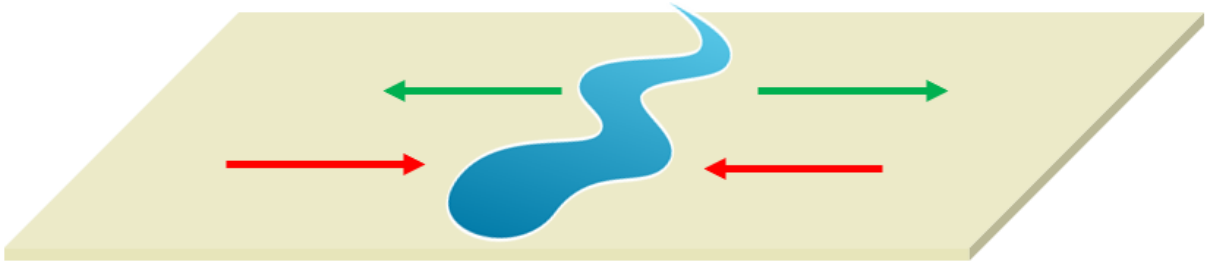


Figure 11: The Vecht vision aims to change the river towards a semi-natural state. This has implication for the surrounding areas. One possibility is to move the surrounding area land use also to meet the boundary conditions given of a semi-natural state, otherwise friction will continue. But what will be the future objectives of the land use surrounding the Vecht? The role of the Vecht river should agree with the surrounding demands

Generally, stakeholders perceive the main friction to be between nature and agricultural use of land. This friction - with changes in groundwater level and potential risks of floods and droughts – is also perceived as not being taken away in this region. To reach a similar goal -without buyouts-, the farmers must join the efforts and adjust to potential changes towards the semi-natural systems. The question remains, whether this is what everyone wants and how.

Stakeholders mentioned several examples of trade-offs and possible obstacles in the development of the pathway towards and even set-backs from the vision.

On the one hand, the governance of the Vecht river is a good working example of a typical Dutch "polder model": stakeholders collaborate, discuss closes and frequent meetings are planned about possible changes and impacts. On the other hand, some stakeholders fatigue is growing, because of excessive meetings and competing objectives. Various contradicting developments are taking place. For example, at the same place, both a sluice is built to increase recreational navigation on the Vecht river, and a 'natural' river is established along the canal to increase biodiversity.

Some stakeholders mention that we are currently further away from the Vecht vision in terms of natural system than where we started 15 years ago. Both the boundary conditions for river depth and the water difference with the weirs is larger. The summer position of weirs is now 20 cm higher than in winter. This indicates an unnatural system.

3. Developing pathways for the Overijsselse Vecht to achieve a multiscale vision

The overarching framework to develop pathways for the Vecht is shaped on the IMPRESSIONS project methodology to develop visions and pathways (http://www.highendsolutions.eu/page) summarized in Figure 9. The framework links the concepts of development pathways, visions and scenarios using participatory approaches. We build on the D2.1 distinction between "normative pathways" and "exploratory scenarios". The pathways are goal-oriented actions and strategies towards a "vision" of what is desirable. The scenarios are plausible exploration of what could happen in the future. In this framework, pathways need to be embedded in these scenarios to be robust across scenarios and in time, i.e. reducing trade-offs between short and long-term actions and strategies.

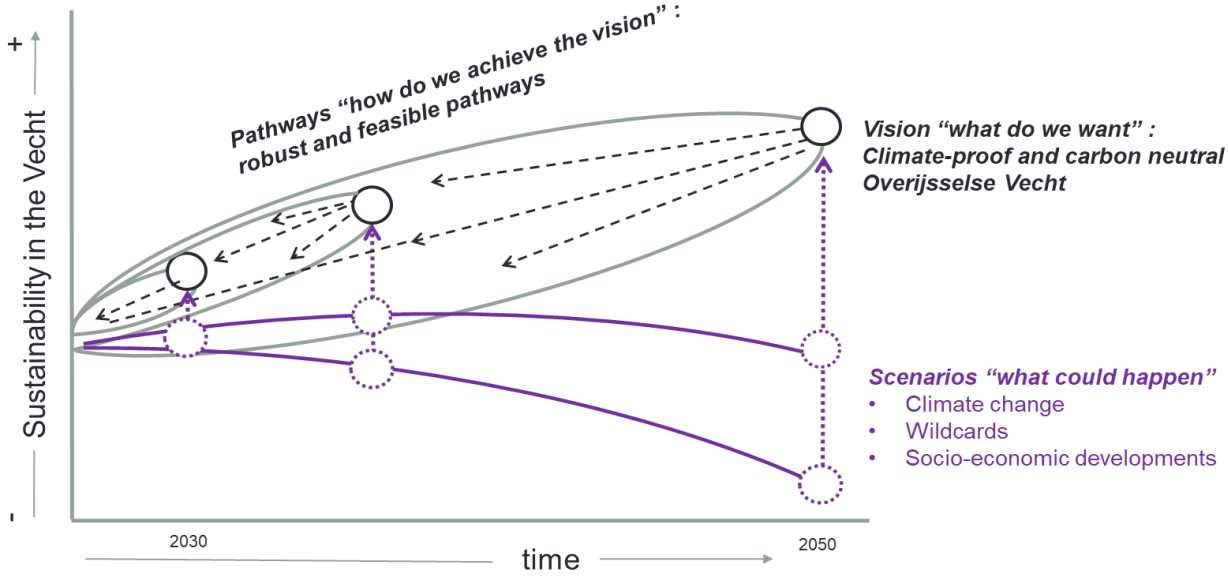


Figure 12: Overarching framework to develop pathways to achieve a sustainability vision in the face of plausible future scenarios

As in the IMPRESSIONS methodology, the vision and future exploratory scenarios are a pre-requisite to develop pathways. However, unlike IMPRESSIONS, a vision and exploratory scenarios existed already, as well as Vecht-specific stakeholder knowledge and therefore we integrated existing knowledge in the process. Crucially, the robustness of the pathways is tested by assessing them against global SSPs in the form of "wildcards".

This integration yielded to the development of a multiscale vision and scenarios developed from existing project and information, rather than with stakeholders in a workshop set-up.

In this chapter we focus on the analysis of the input to workshop 1 (the pre-requisite knowledge) (section 3.1-3.3) as well as the process (section 3.4) and analysis (section 3.5) that led to the adaptation and mitigation pathways for the Overijsselse Vecht.

3.1 Future scenarios for the Vecht

Interviews showed that stakeholders were familiar with national climate, socioeconomic scenarios and regional scenarios from Trendbureau Overijssel. The exploratory regional scenarios from Trendbureau Overijssel, which produces scenarios to think out of the box (D2.1). According to these scenarios and stakeholder knowledge, the key drivers relate specifically to agricultural development as well as trade-offs resulting from alternative nature and energy futures and are summarised in Table 1 and presented to stakeholders as in Figure 10.

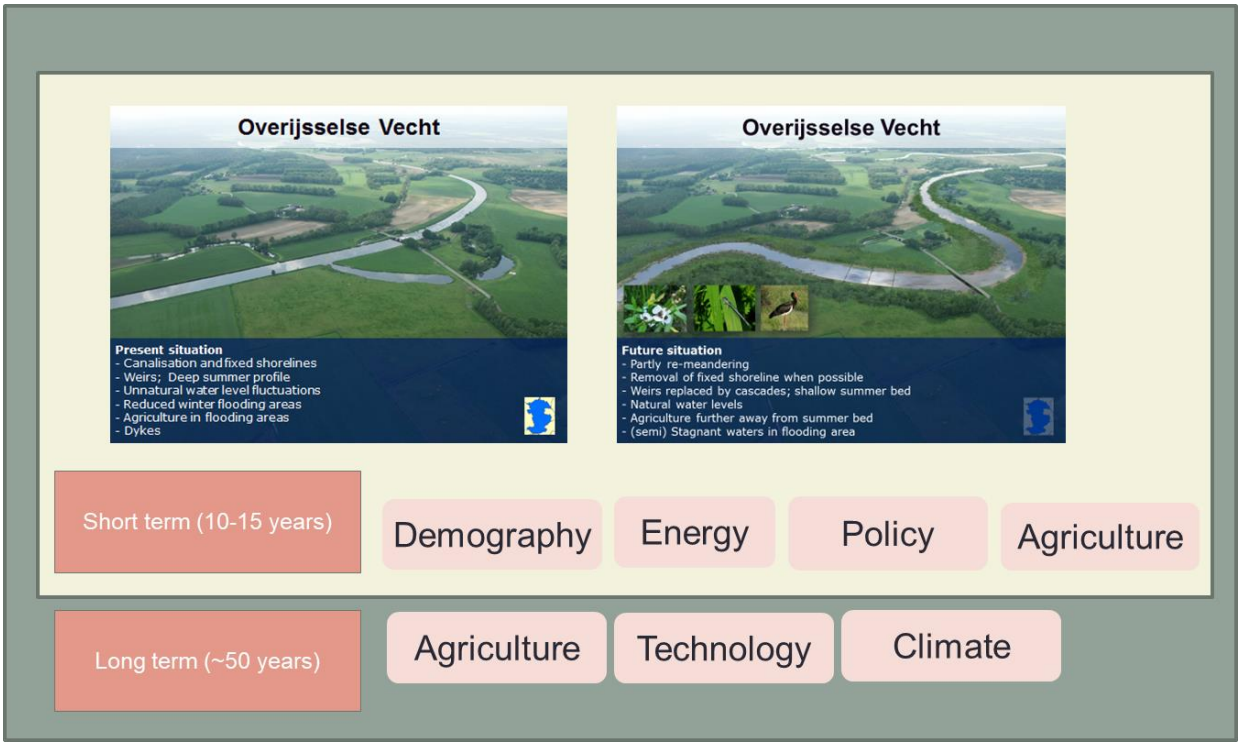


Figure 13: System drivers for the short-term and the long term in the Vecht, according to 16 scoping interviews

For the Vecht, it was decided that developing local versions of the Shared socioeconomic pathways was not needed for several reasons. Firstly, several exploratory studies exist for the region for all sectors mentioned by the stakeholders (including agricultural production, energy, nature and socioeconomic development). Secondly, no stakeholders felt that novel scenarios were needed and, thirdly, stakeholders were not familiar with the Shared Socioeconomic Pathways (SSPs).

Utilising expert knowledge rather than creating novel scenarios, from a methodological point of view, can be justified as well as a more resource-efficient strategy. The STEEP drivers identified in Table 1 were also consistent with the key SSP drivers, therefore making direct applications of global and European SSPs possible.

3.2 Multiscale vision development

A vision describes a desirable state (Wiek and Iwaniec 2014) particularly important to define when trade-offs within a given vision. For example, potential land use and actor trade-offs in the Ruimte voor de Vecht vision demonstrate the difference between the "world that we have" and the "world that we want to have in the future". Visions allow creativity and aspirations to be expressed openly and inclusively about the future state of any defined system or sector of organization (e.g. transport, energy), geographic location and scale (e.g. region, city) or of society. Visions facilitate the consideration of long-term target setting and thus guide the planning and execution of short-term and mid-term actions and strategies.

Creating a vision is an iterative and profoundly participatory process combining preparatory work by the research (expert) team and input from stakeholders. Integrating the knowledge of stakeholders enables the vision to be context-relevant, ultimately serving to guide decisions and actions with clear recognition of stakeholder views. This promotes a feeling of stakeholder "ownership" of decisions related to their interest.

In the SENSES methodology, we adapt the quality criteria from Wiek and Iwaniek (2014) to address the inclusion of potential trade-offs across scales. To this end, we screened Dutch policy documents and policy visions relevant for climate mitigation and adaptation targets. We identified policy targets three levels: local

(Vecht), regional (province of Overijssel), national (the Netherlands). The list of screen documents is presented, their order (shades of blue) and form of analysis (the white bubbles with normative statements for 2050) are conceptually presented in Figure 14.

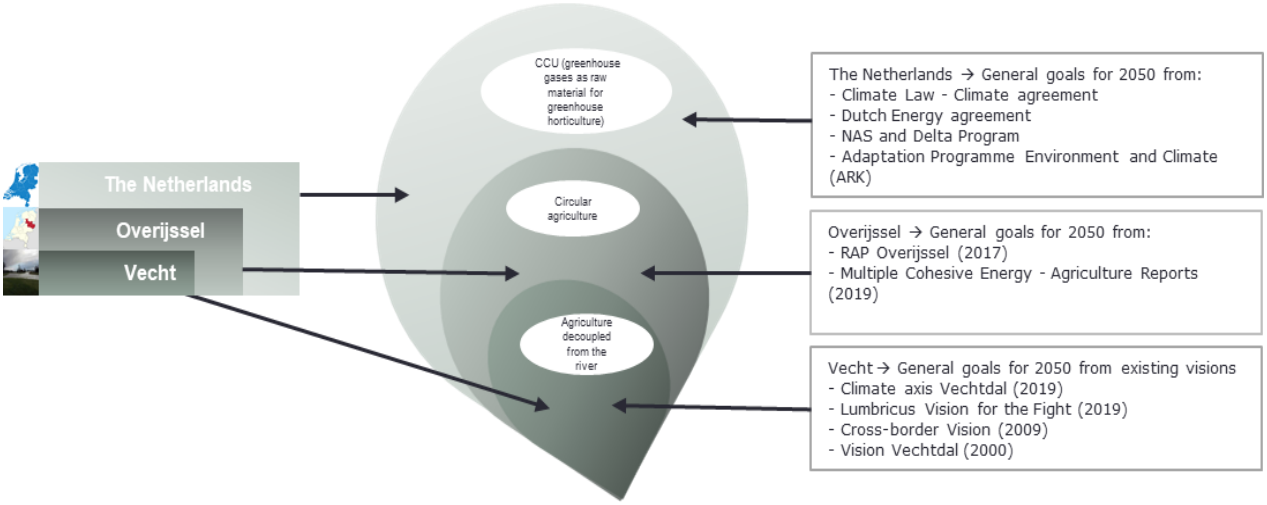


Figure 14: Ranking normative statements (white bubbles) stemming from adaptation and mitigation goals in Dutch policy documents (boxes on the right-hand side) at local, provincial and national levels (shades of the leaf)

The single normative statements from Figure 14 have been further organised within four cross-scale broad themes that address the four challenges of the Vecht identified in the semi-natural vision of the Vecht from Figure 3. The SENSES multiscale vision (visualised on the right-hand side of Figure 15) is integrates the four central challenges of the Vecht in four themes which are cross-cutting from the Vecht to the national level. The vision guides the development of pathways towards a shared future across policy and stakeholders' levels.

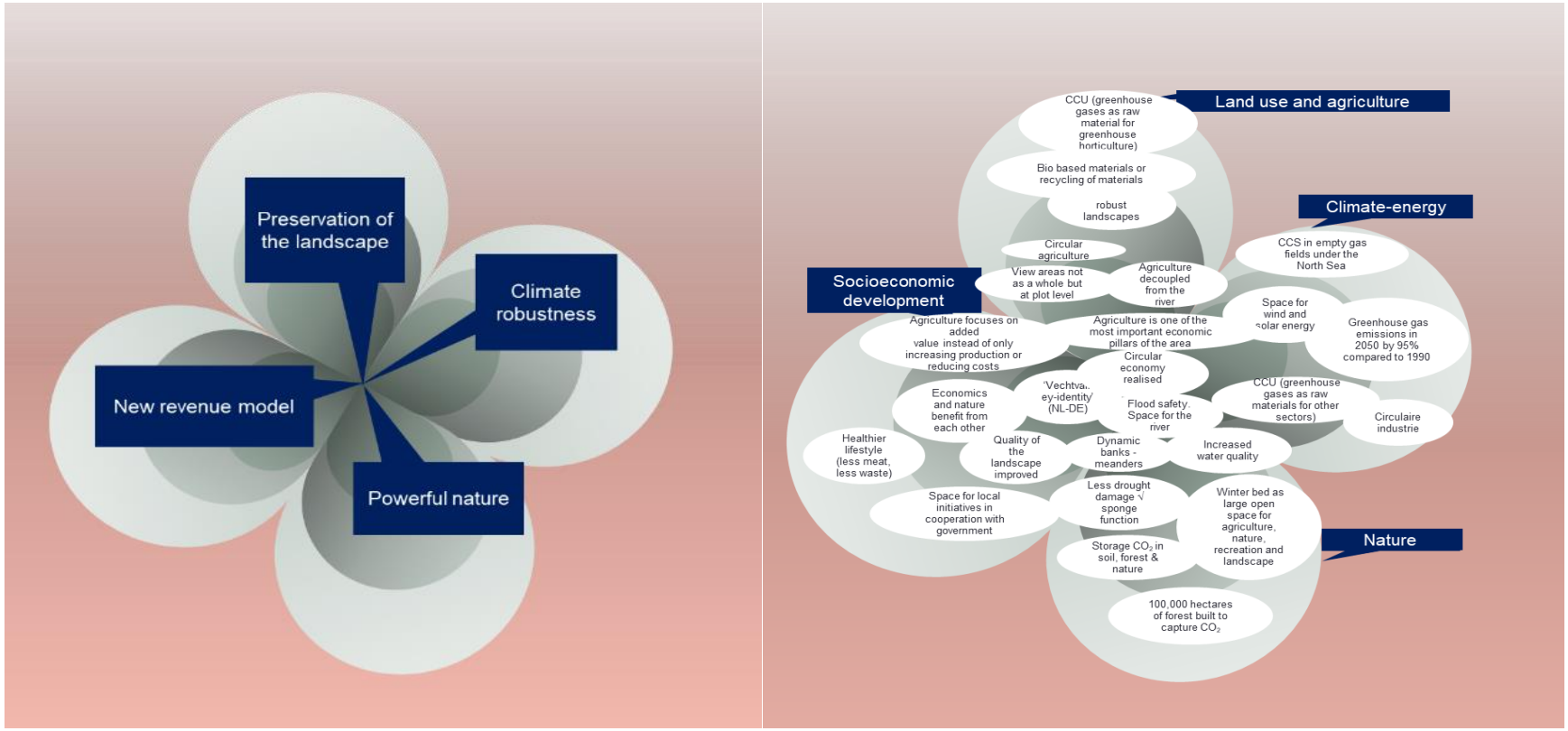


Figure 15: Transformation of four Vecht-specific challenges on the left-hand side, identified in Section 2.1 to a multiscale vision relevant at multiple decision-making levels, on the right-hand side. The multiscale vision organises normative statements (the white bubbles) in four cross-scale themes (land use and agriculture, climate and energy, nature, socioeconomic development) across three levels, from darker-blue-local level to light-blue-national level

3.3 Wildcards developed from the Shared Socioeconomic Pathways

The interviews highlighted that international aspects that could be influential for the Vecht include international (geo)politics, policy (especially at EU level), international trade and broader technological development. While all these aspects have been identified as relevant, their inclusion in current scenarios is lacking or, at the very least, only marginal and very broad.
SSPs therefore have been utilized to integrate those international aspects into the development of the pathways in the stakeholder workshop. The best form chosen form was the one of "wildcards", as trends for these international aspects are covered by the SSPs, at least qualitatively. Relevant trends for the international aspects were translated into Vecht-relevant Wildcards consistent with the SSPs while translated for Dutch societal context.

Figure 16 Conceptual mapping of SSP (Shared Socioeconomic Pathways)-based Dutch-adapted wildcards onto the uncertainty space (challenges to mitigation and adaptation) of the SSPs

These wildcards were introduced to test the action and strengthen them.
Wildcards have been defined as "high impact, low probability events" (Rockfellow 1994). While wildcards have not to be necessarily negative (Cornish 2003), they are useful as an anticipatory tool to prepare and mitigate the effect of catastrophes, such as a worldwide pandemic, (Petersen 1997, Peterson et al. 2003). Wildcards can therefore be useful to test the robustness of strategies and pathways. However, choosing a relevant wildcard is not an obvious choice. "Low probability" could refer to a 1 in 10 chances event to occur

(Rockfellow 1994). But the concept of probability becomes more problematic in an imperfect world of objective and subjective probabilities built on our current criteria based on empirical, historically contingent data or subjective utility functions. Implicit framing effects do not only affect the probabilities themselves but also our understanding of these probabilities (Van der Helm 2006). For example, many events such as the two world wars in the 1990s were considered wildcards only a few decades before they happened (Rockfellow 1994). Such events are also possible, depending on capabilities at a given point in time, and can be judged plausible if the beholder of the argument has a convincing narrative, even if the narrative reveals itself to be fallacious in the future (Van der Helm 2006, Mehrabanfar 2014, Schultz and Burton).

In order to address the uncertainty of future probabilities and subjectivity of perception, we frame the choice of wildcards according to the current understanding of worldviews of future scenario analysis. According to this research, the Shared Socioeconomic Pathways can be mapped onto recurring socioeconomic and behavioural archetypes (Harrison 2018, Pedde et al. 2019), which correspond to a range of worldviews and attitude archetypes. For instance, a preference for sustainable lifestyles and perception of nature as vulnerable is dominant in SSP1, lack of interest in long-term planning and fatalistic attitude in SSP3, rule of hierarchy and rule-based choice (associated to polarised fatalism) in SSP4 and preference for individualistic lifestyle and perception of nature as robust in SSP5 (Thompson et al. 1990, Hunt et al. 2012, Pedde et al. 2019). Furthermore, these archetypes are characterized by sectoral similarities, for instance economic and technological development, across spatial scales. SSP1 and SSP4 are dominated belong green technological development scenario families, although SSP1 diverges from SSP4 by integrating a green lifestyle and focus on equity, SSP3 and SSP5 belong to the socio-technical conventional scenario families although they strongly diverge in their socioeconomic development assumptions (booming in SSP5 vs fragmentation and polarization in SSP3).

Hence, the choice of wildcards need to be plausible within SSP worldviews and high-impact and low-probability within the SSP-consistent societies, as per the definition of the wildcards. To this end, we mapped SSP archetype characteristics against wildcards from the literature (Petersen 1997, Barber et al. 2006) and categorise them into 5 clusters. The mapping in Table 1 shows what wildcards categories the most consistent types of wildcards and creatively develop a narrative for each SSP.

Table 1: Screening of selected wildcards from the literature and categorisation for cross-consistency with SSP worldview (both high impact and probability for each SSP).

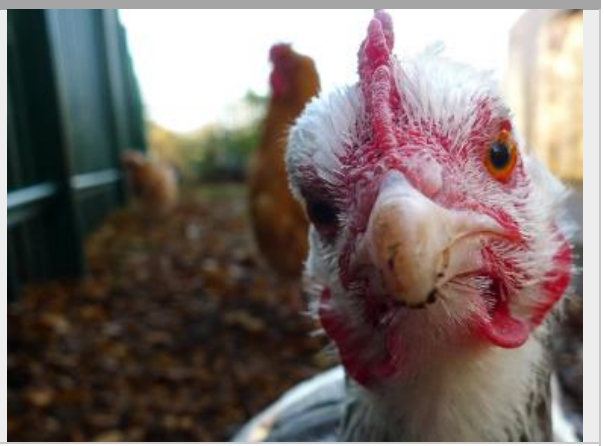
High-impact/Low probability wildcards across SSPs	Category	SSP1	SSP3	SSP4	SSP5
Major asteroid impact	Space				
Human cloning	Genetics				
Collapse of the sperm count	Genetics				
Birth defects are eliminated	Genetics				
Natural disaster/ disease epidemic / worldwide epidemic	Epidemic				
Food disease imports/exports	Epidemic				
Disease epidemics/ Food shortage	Epidemic				
Threat to detonate nuclear weapons	Geostability				
End of cross border hostilities	Geostability				
Sudden War hostilities/ damming of 'shared' rivers	Geostability				
Terrorism cells target western countries	Geostability				
nuclear terrorists attack the US,	Geostability				
US defaults on overseas debt	Geostability				
Communications Satellites breakdown	Technology				
Cold fusion is perfected by a developing country,	Technology				
Shut down of Internet	Technology				
Self-aware machine intelligence	Technology				
Electromagnetic field disrupts global communications	Technology				
International trade sanctions	Intern'l economy				
No-carbon economy	Society				
Altruism outbreak	Society				
US economy fails	Society				
Rise of an American dictator,	Society				
Total	Genetics	2	2	2	3
	Epidemic	**3**	1	1	2
	Geostability	**2**	**5**	**5**	1
	Technology	1	1	**2**	**5**
	Intern'l economy	1	0	0	1
	Society	**2**	**3**	1	2

The dominant categories for each SSPs have been subsequently developed in the form of short narratives for each SSPs in the context of the Vecht and the Netherlands. Importantly the choices of the narratives reflect both the categories of Table 1 as well as the addressing for the vision themes (for contextualisation of the narratives).

1.5.7. Wildcard SSP1 "Sustainability": Chicken epidemics

Chicken epidemics

Event sketch:
On a sunny Sunday morning in Overijssel, Sanne gets up to feed her chickens, as always. As soon as she arrives at the chicken coop there is no movement. All chickens are dead. She looks at the fence or maybe a marten has come through. "Oh," she thinks, "That is how nature works, they must have been eaten." Unsuspectingly, she goes to visit the neighbour. All the chickens are dead there too. "Quite strange". After having made a tour through the living commune, the chickens are found dead everywhere. Also, with her sister, who lives in a residential group in Zeeland, all the chickens are dead.



Impacts:
Most people depend on their own (or in small groups) garden and animals for daily food supplies. The food supply is vulnerable because of the ban on pesticides. The death of the chickens is the first wave, after which it is discovered that crops will no longer generate a harvest.

Most households count on their own food supply. The strong bond in neighbourhoods has led to joint production. After one day all supplies are exhausted and people are forced to look outside their area to get food.

1.5.8. Wildcard SSP3 “Regional Rivalry”: The volcanos from the Canary Islands erupt

Canary Islands volcano eruption

Events sketch:
Kirsten follows the news with interest. Her bed & breakfast in Overijssel is fully booked and all the extra beds that she could find are crammed into the rooms. The minister has just indicated that the Randstad will be evacuated. "And now those Randstadters want to go this way," she thinks, slightly frustrated. "They also benefit from our windmills".
A few hours ago, the volcano erupted on one of the Canary Islands. This causes a huge tidal wave that is coming towards the Dutch coast. All new dike reinforcement projects in recent years are not designed for a tidal wave. After hours of tension, the advice is therefore given to evacuate the Randstad as much as possible and to regard the Randstad as lost.

Impacts:
Overijssel is faced with a huge population increase. This makes land scarce and the housing market exploded. Refugees from the Randstad try to fight for a place with their few possessions.

1.5.9. Wildcard "Inequality" SSP4: The week with no wind

The week with no wind

Events sketch:
Jan puts his hand out of the window, "he still has no wind" he tells his son Piet. The weather has been totally silent for a week. The Netherlands is in the eye of a large hurricane that is slowly weakening but not displaced. It feels sultry in Overijssel and the mosquitoes cannot be hardened. "I hope we will get the fridge back from the municipality soon."

Impacts:
In this world, energy generation is mainly regulated from wind energy from Overijssel. The large green companies are in control of the energy supply and distribution. The power is phased out in phases. Jan is in welfare, and because he is not working for his energy, the first austerity measures are applied to this group of people. The fridges and other steam eaters have already been collected. The large companies that keep the Netherlands stable and move the economy forward have the latest rights to energy, "Otherwise the Dutch economy collapses".

1.5.10. Wildcard "Fossil Fuel" SSP5: Google stopped working

Google stopped working	
Event Sketch: Lisa is on her way to a meeting in her self-driving car. "I should have gone to sleep a bit earlier," she thinks, while slightly indulging in the car. Suddenly she suddenly sees a car shooting to the left in front of her. Less than a second later, her navigation system makes a loud beep and it drops out.	
Impacts: Many systems depend on Google. The shutdown of Google causes chaos on the roads and public transport. Supermarket doors no longer work and people can only reach each other over the telephone, "but then again, who still has call minutes if everything can be done via Google". Paying via Google-pay no longer works, luckily there are people who arrange their payments through other apps.	

3.4 Design of stakeholder engagement process

The stakeholder engagement process is shaped on the STIR approach (Gramberger et al. 2015). Overall, the process is designed to carefully balancing input from analytical material and evidence, while maximising the output from brainstorming and knowledge from the workshop. Both workshop 1 and workshop 2 have been divided in three main parts (Table 2).

Table 2: General process for Dutch regional stakeholder process in Workshop 1 and Workshop 2

Welcome and introduction: SENSES, participants and content of the workshop
Part A/I: Co-production core to achieve workshop objectives *Development/Iteration → input from stakeholders*
Part B/II: Co-production core to achieve workshop objectives *Introduction of scenarios → input from research team and facilitated break-out group discussion on "enrichment" of material developed in step 1*
Part C/III: Integration Additional knowledge and synthesis of Part A and Part B
Closure, next steps and evaluation

3.5 Process in workshop 1 and development of pathways

The first workshop took place on Monday 26 June 2019 in the Bilderberg Grand Hotel Wientjes, Stationsweg 7, in Zwolle. The participant list is attached in Appendix I. The one-day workshop was designed to be time-efficient, given the ambitious goals, yet interactive.

The objective of the workshop was **to link adaptation and mitigation action towards a multiscale vision**, by facilitating co-production across stakeholders active in the relevant sectors and scale. This broad objective was further structured in three sub-objectives that shaped the sessions of the workshop:

1. Identification of the actions for the pathways towards the multiscale vision
2. Testing the pathways with SSP-based wildcards which bring different challenges (external to the Vecht region) related to the sectors relevant to the Vecht (i.e. agriculture, socioeconomic, energy and nature)
3. Defining possible contradictions to turn them into synergies

Table 3 shows which parts were discussed in the workshop day, corresponding to the workshop goals.

Table 3: Co-production core of Workshop 1

Part A/I: Pathway Development *Climate change strategies: Interactive pathways towards a multi scale vision of the Overijsselse Vecht*
Part B/II: Wildcards *Introduction of global scenarios and test of robustness of development paths with "wildcards"*
Part C/III: Synthesis *Further elaboration of development paths to minimize inconsistencies and trade-offs*

The participants were divided into two groups. Group 1 focused on the themes "Nature and climate" and "Energy". This group was facilitated by Simona. Group 2 focused on the themes "Agriculture" and "Socioeconomic developments", facilitated by Kasper.

3.5.1. Part A/I: Climate change strategies: Interactive development paths towards a multiscale vision

The integral Vision was depicted on a poster in 2 different corners of the room: "Multiscale vision for a climate-proof and CO2-neutral Overijsselse Vecht" (Figure 25). To the left of the vision were 3 empty flip-over sheets on which a timeline from NOW to 2050 was depicted.

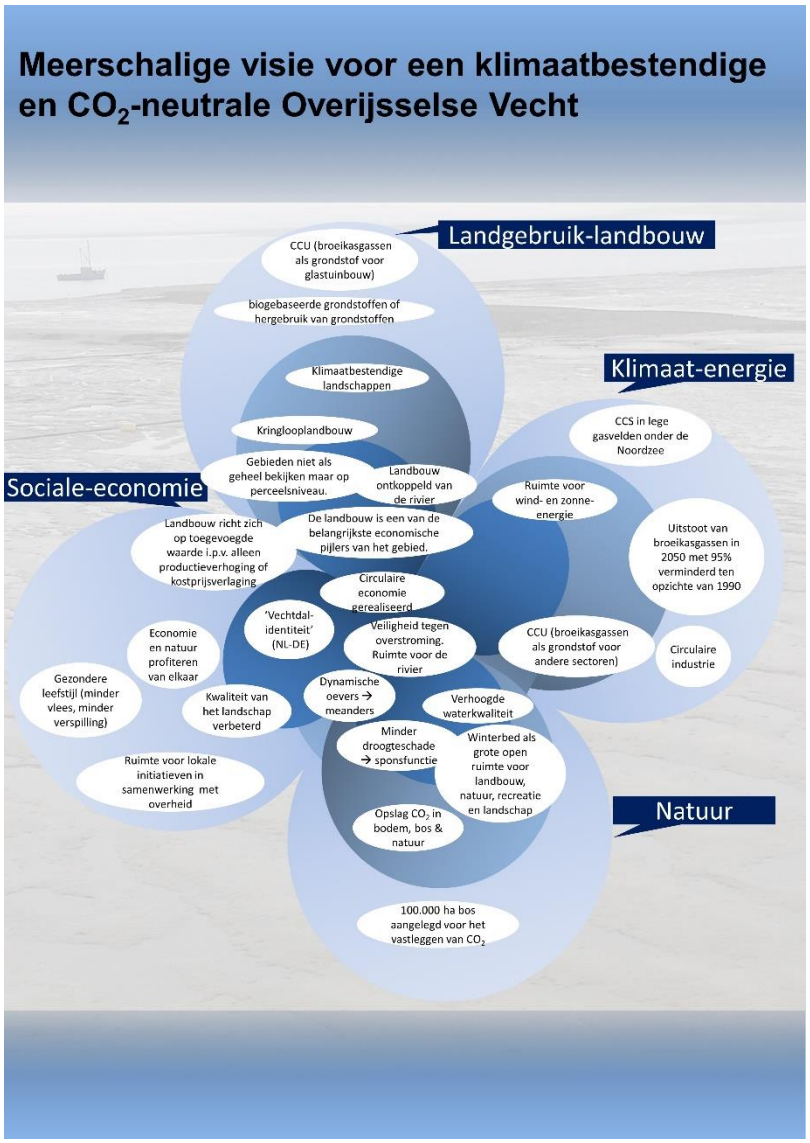
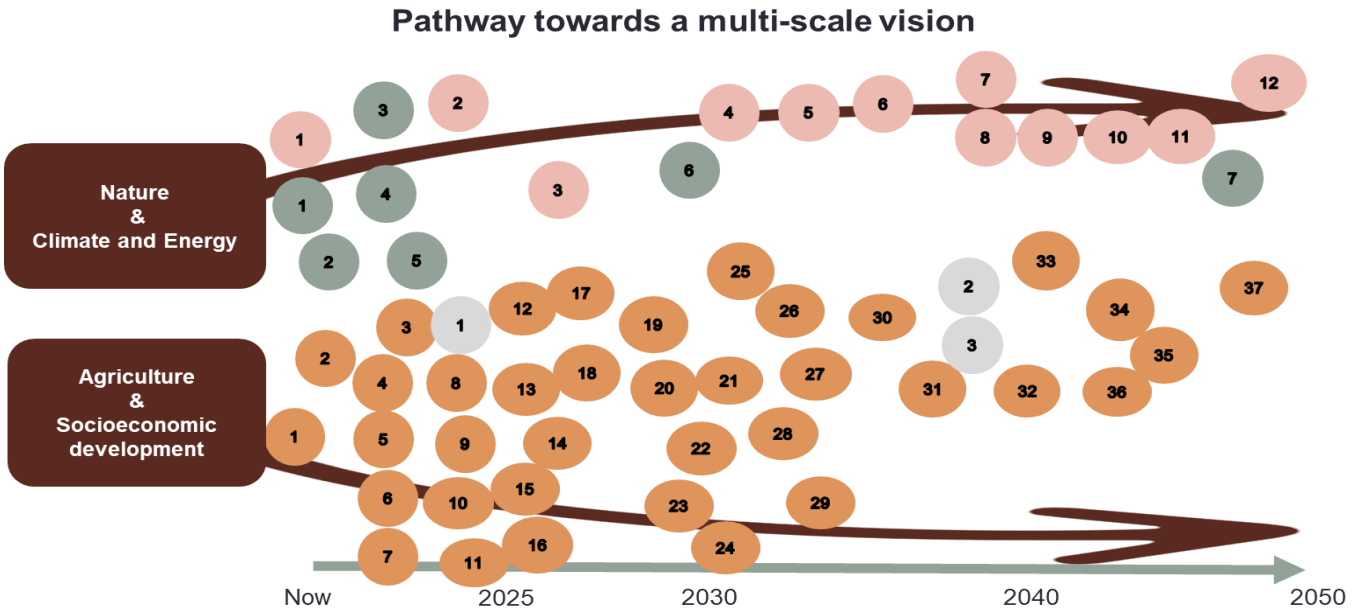


Figure 17: Poster of the multiscale vision of Figure 15 as presented at the workshop

Each participant was asked what measures / strategies were needed to achieve the described vision. These were written down on post-its and placed on the blank flip-over sheets by the facilitator.
Figure/Table 18 shows the overview of the first actions /strategies in the two breakout groups. The pink and dark grey post-its are actions/strategies that have to do with nature & climate and energy (Group NE) and the orange and light grey ones are strategies that fall under the theme of agriculture and socioeconomic development (Group SA).

Figure/Table 18: Pathway Nature and Climate and Energy themes (Group NE) and Agriculture & Socioeconomic development (Group SA)



No	Agriculture	Nature and climate	Energy	Socioeconomic development
1	Possibilities of are not in the picture	More system thinking	"mark" your area Do not limit the definition of the Vechtdal	Cooperations will make sustainability easier?
2	"Payment" of landscape management	New generation farmers	Agriculture is location specific Introduce farmers perspective ecological + energy	Other nature goal -CO2 fixation -different nature?
3	High added value Diversity in business models	CO2 reduction with deciduous trees	Utilize private sector ->All roofs sun → subsidies + permits +/- 2020 Electrify ->management -> agricultural mechanization	Cultivation of biomass? Near Hardenberg?
4	Develop profit model?	Less damage from droughts - Use cultural history - Recover streams/brooks Dismiss goals set by Natura200, these are not feasible anymore	SmalSAcale energy projects, fitted within the landscape	
5	Dairy farming ! Soil-depended or advice regions in health/care	Phase out weirs → dynamic river ≠agriculture ≠N2000	More deciduous forests instead of coniferous forest More CO2 uptake	

6	Agricultural collectives better share values	Nature inclusive agriculture →	Solar panels on roofs	
7	New legislation -%(re)cycle -%regreening -%sustainable energy	Limits on manure and fertilizers → stimulate transition to biological healthy soils	Give up livestock	
8	Break with existing thinking in sectors/system	Better handle with natural dynamics by farmers: crops + type of agriculture Function follows water level Water level does not follow function anymore		
9	Cycle is more than business cycle Question: what is part of this? Man is not only 'company'	Predictability shifts from set water levels to customizable functions (robust/flexible/adaptive)		
10	Adaptive planning	Recreation versus natural Vecht Weirs or no Weirs?		
11	Reduce uncertainty	Water dynamics → less recreational sailing (depth of Vecht) + extreme events		
12	High added value Strengthen … MARKET	Vecht without weirs (natural) versus nature, agriculture Recreation		
13	Overijssel/Vechtdan without fertilizers ..?			
14	Improve financial position of farmers ->take away pressure on extensification			
15	Extensify, lower pressure on soil			
16	Reliable scenarios			
17	Deliver dictates for management			
18	Agriculture as energy producer (roofs)			
19	Climate neutral livestock landscape CO2 in wooden barriers or			
20	Farmer is landscape manager and can do this by himself (frameworks)			
21	Farewell to liquid manure …			

22	Location specific approach: working together cooperation/farmer			
23	Landscape management -water -nature/landscape -biodiversity			
24	Policy based on "strategic recognition"			
25	High added value Business model for sustainability			
26	Combining residual/waste flows			
27	Circular food system -(minerals from sewage system) -residual/waste flows			
28	Agriculture is the 2nd/3rd energy supplier			
29	Economical Overijsselse agenda on SDG's			
30	Extensive/intensive (relation with water safety)			
31	Separation of functions in area Nature Agriculture Living			
32	Integrate upstream and downstream developments			
33	Climate neutral Agricultural history Financial strategy			
34	High added value Internationalising (globalise) Climate-costs			
35	Energy farmers			
36	To better balance Emissions and land use Scale? Fixation Lb/land use			
37	Eliminate GDP			

After the break out session, the groups went back to plenary and the facilitators summarised the main findings to each other.

3.5.2. Part B/II: Introduction of global scenarios and test of robustness of the pathways in the face of "wildcards"

After the lunch break, Simona introduced the global socioeconomic scenarios: the Shared Socioeconomic Pathways (SSPs) in a plenary session. First, the main drivers of the SSPs were introduced and for each SSP, the characteristics of the scenarios were explained. This included the scenarios: SSP1 Sustainability, SSP3 Regional Rivalry, SSP4 Inequality and SSP5 Fossil Fueled Development.

The participants went back int their break out groups and received short summaries of the SSPs together with four 'wildcards' of Section 3.3. The wildcards were used to get the participants into a 'scenario mindset'. The breakout groups discussed how the events on the wildcards could influence their pathways and which additional strategies needed to be taken in order to have robust pathways.

Table 4 show the flip-over notes during this session in the NE group. A separate flip-over was used for each SSP. Subsequently, the pathways are strengthened. The extra noted on the pathways are written down in green on the pathways (Figures 19 and 20).

Table 4: Notes from Group NE for each SSP/wildcards

Group NE			
SSP1	**SSP3**	**SSP4**	**SSP5**
Diversity - in production - in type (for example bananas) - also for nature	Send them to Germany or take them in in Overijssel ->discussion on providing shelter regionally or emigrate to Germany/Belgium/EU (EU does not longer exist in this scenario)	Not using one energy source	Paper backup
Influence of fertilizer etc.	Growth of villages		Low-Tech
Growing lilies is less of a priority because focus of land use is for food production	Attracting businesses		Can we manage the weirs manually
Investing in healthy soils	"are companies going to their business in a vulnerable area or are they moving to Overijssel?"		In agriculture -precision agriculture -robots
Diseases speed up sustainability	We are not going to compensate nature for population increase		Local solar power has less disadvantages ->detach energy system
Less poison with more awareness	Are tourists still coming? Dutch tourists		"smart energy system"
			The energy grit is changing, from large suppliers to everyone generates energy. New infrastructure as a result.

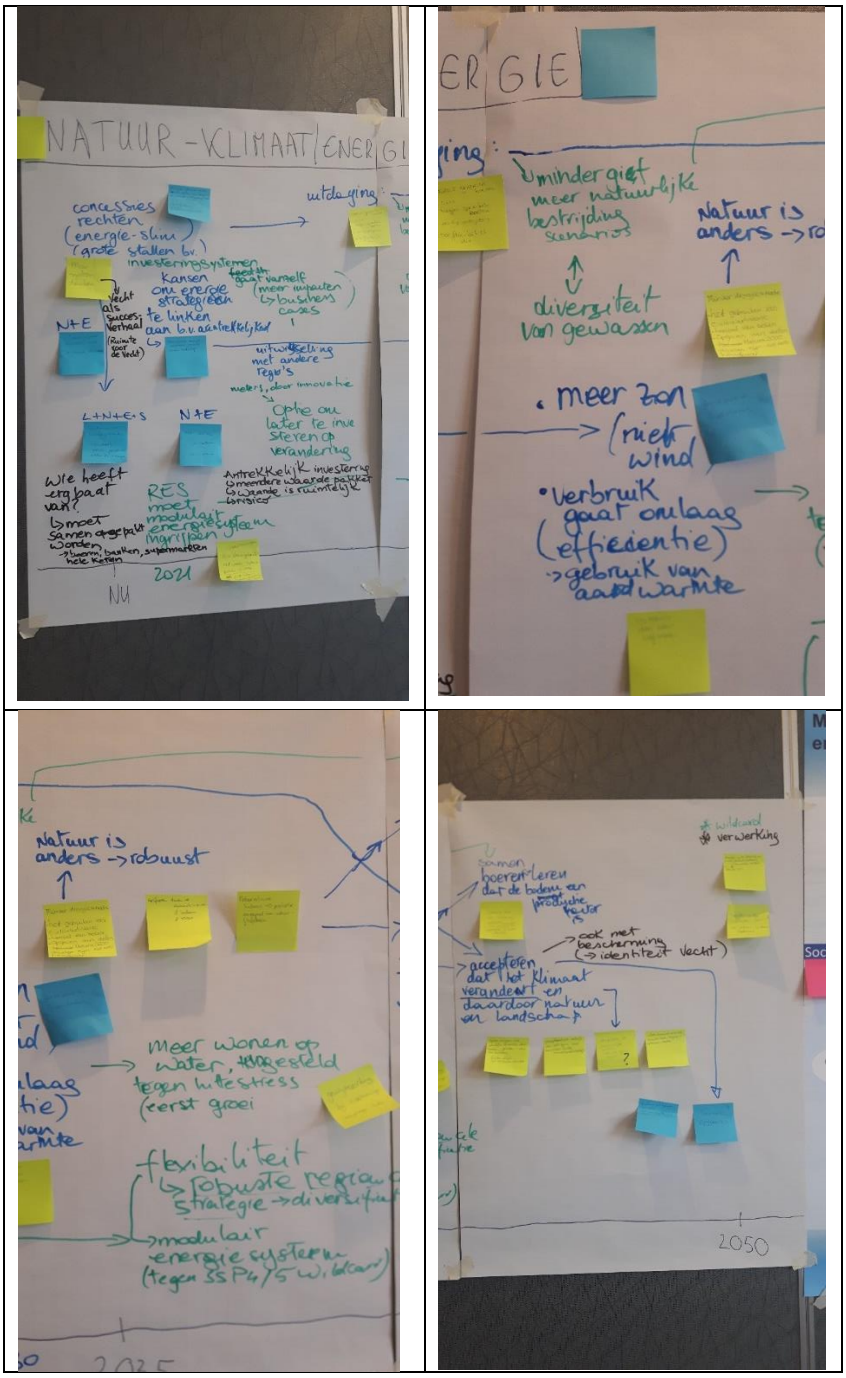


Figure 19: Additions SSPs in Part B/II (GREEN MARKER) from the group NE

Also the group SA also made additions to the pathway based on the SSPs (Table 5). Several flip-overs were used for notes.

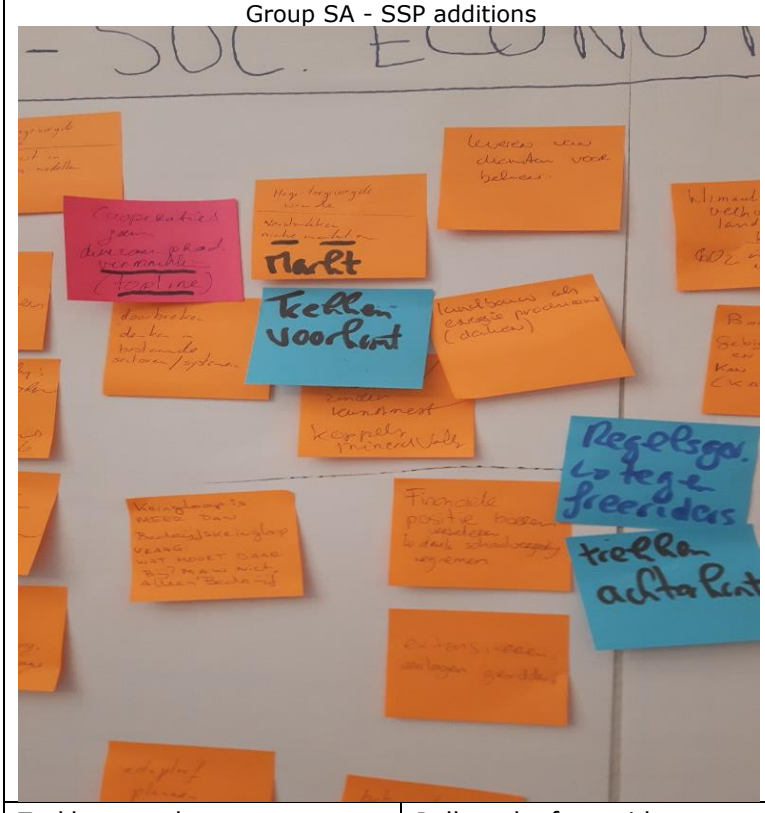
Table 5: Notes from Group SA for each SSP/wildcards

Group SA			
SSP1 (Small is cosy)	**SSP3**	**SSP4**	**SSP5**

Include local markets	International parties/companies (Friesland Campina/Aviko) are important stakeholders. Chain land stewardship/management focus on this		Intensive, high tech, production stables. Pressure to reduce land. New business model
No export, more available land	Big role of companies		Pathway is dead end
Less yield, less available land	High Tech agriculture		Vecht with high dikes
What is plan B? Obturator?	Production		Different additional value
More vulnerable	Battle on phosphorus		Wildcard: pathway is an option
Accepting hunger?	Do we take over grey water treatment -> phosphorus extraction		Farmers a role in healthcare ->closer to nature?
Mentality change as a driver Not market	Agriculture yes, nature no		Ugly Europe, but Vechtdal is a Resort! Villa Vecht
Scenarios resilient	Tsunami: Limited role of government (cf. Katrina)		Chances for the Vechtdal
Lower energy demand			Salvation development not too fast

Group SA added three new post-its on the pathway as shown in Figure 20.

Group SA - SSP additions



Trekken voorkant	Pull on the front side
Regelgeving tegen freeriders	Legislation against freeriders

Trekken achterkant	Pull on the backside

Figure 20: Additions SSPs (BLUE POST-ITS) from the group SA

3.5.3. Parc C/III: Further elaboration of the pathways to minimalise trade-offs

After the alterations made with the use of the SSPs, the groups could share last thoughts and comments on the pathways. In the group SA they have been captured in the form of a conclusive discussion with no changes to the main pathways. Group NE developed some last additions to the pathways with a black marker as shown in Figure 21.

Figure 21:Additions to minimize trade-offs (BLACK MARKER) group NE

3.6 Analysis

3.6.1. Analysis of nature and climate energy development paths

The earth, climate and energy paths are highly coherent, although energy is only indirectly included by land use issues. The energy development path was included as part of the broader land (construction) sector and how it develops policy.

The biggest challenge and opportunity consists of the land use mix for agriculture and nature conservation. The first long-term change is caused by the first shift to a more systemic way of thinking through, for example, changes in concession rights SPSP5. These would stimulate energy-smart and efficient farms. Such a change is reinforced by changes in mentality towards sustainability or the relevant social parties, financing institutions and farmers. Agricultural systems include ecological protection and green energy production. Not only via, for example, solar panels on the roofs, but especially via electrification of the entire system.

In the short term, the change in the agricultural system offers the opportunity to link to various energy strategies, linked to smalSAcale energy projects that fit into the landscape. At the beginning of 2025, various stakeholders reached the agreement that Natura 2000 nature conservation objectives are not feasible. At least not in its current form.

By the 2040s, the nature and development concept of the Vecht radically changed today. The Vecht river system changes into a dynamic system, with "flows" (just like in the past) no "weirs" and dynamic water levels. The agricultural sector is integrated in the natural environment. Mitigative and adaptive action includes the use of nature where possible, such as CO2 due to substitution or coniferous forests with deciduous forests.

In general, variability becomes an accepted principle that encompasses nature and the landscape in general, also in view of the increasing climate change and effects. Part of this adjustment is the fundamental change in the agricultural system. Because limits on manure and pesticides are accepted, healthy soils are fundamental production factors, and this has positive feedback with the overall health of the Vecht and the soil system. Different types of crops are also more suitable for the dynamic fighting system, in which "function follows the level" (and not the other way around). Crucially, this means that livestock farming was abandoned in 2050. It is also accepted that due to its variability, less navigation is possible due to the variable depth and increase of extremes.

NE pathway ➔ Elements reinforced against SSP-based wildcards	**SSP1 ➔ Dependence on local food supply**	**SSP3 ➔ Unexpected population changes**	**SSP4 ➔ Energy supply shocks**	**SSP5 ➔ High-tech failure in a market-driven context**
Changes in concession rights				✓
Mentality changes in the direction of sustainability or relevant social parties, financing institutions and farmers	✓	✓		✓
RES includes Modular energy systems			✓	✓

Accepting variability and increasing impacts - Diversity of crops (less poison, more natural control)	✓		✓	

3.6.2. Analysis of agriculture and socioeconomic pathways

The socioeconomic development path is highly dependent on the agricultural trajectory. The starting point is the farmer as a central player. The farmer and agriculture offer the most important challenge but also the greatest opportunities to achieve the vision.
Regulatory changes are the first steps: new legislation focuses on circular processes, regreening and sustainable energy.
The current pressure for intensification is being converted into a more holistic approach at landscape level, including both sustainability objectives and the interests of farmers.
The focus on the farmer as a factor with limitations is reversed to the farmer as a central factor of a systemic change that goes beyond the farm. New business models with new sources of profit, subsidies for landscape management, niche markets and higher added value are increasing.
By 2030, all these transformations will result in circular systems that replace more intensive production and focus on expansion with efficiency and recycling (e.g., Fewer fertilizer imports, mineral imports recycled from sewage, from and energy production in farms). The agricultural sector is strongly integrated in the energy sector (agriculture is the 2nd and 3rd energy supplier). The agricultural sector also becomes a 'social buffer' for changes in population dynamics (i.e. inflows, depopulation to urban centres) SSP3.
Ultimately, a circulating landscape results in integrated downstream and upstream developments, including in Germany, CO_2 storage and ecosystem functions such as ensuring water quality and biodiversity.

SA pathway Elements reinforced against SSP-based wildcards	**SSP1 → Dependence on local food supply**	**SSP3 → Unexpected population changes**	**SSP4 → energy supply shocks**	**SSP → High-tech failure in a market-driven context**
Focus on the farmer to enable transformation	✓			
The agricultural sector is strongly integrated in the energy sector (agriculture is the 2nd and 3rd energy supplier)	✓			
The agricultural sector also becomes a 'social buffer' for changes in population dynamics (i.e. inflows, depopulation to urban centres)		✓		

3.6.3. Plenary discussion → Cross-pathway analysis

A. Agreements

i. Agriculture and the farmer are at the centre of both development paths. How can we enable the integration of the farmer as a central element for transformation on the paths? Would concession rights be sufficient? How should these be supplemented in terms of legislation and financial mechanisms and by whom? How should ownership of the land change? Is debt a barrier?

ii. Agriculture can be transformed if it is complemented with energy generation. What is the value of different options in the development paths, in particular - Sun panels in the roofs and fields, wind farms, bioenergy crops?

B. Inconsistency

i. Maintaining the income of the farmer is central in the SA development path. The farmer and stability are also iconic of the (agriculture-related) identity of the Vecht. How did this starting point with the NE starting point of acceptance and not a new perception of nature and agriculture with the Vecht as a complete dynamic (and variable) system

ii. "Separation functions" are mentioned in the SA development path. Is this desirable in an integrative multifunctional landscape?

3.6.4. Plenary discussion → Challenges from the SSPs

1. In SA, will the circular nature of agriculture (with emphasis on nutrient inefficiency, less land etc) be associated with extensification? If yes, how can the question and offers be matched?

i. What is the role of the "supplement" and integration of the energy sector, as invented in both development paths?

2. In SA, SSP5 there is a potential mismatch between the local circular economy and the high-tech economic optimism focus of SSP5.

i. What is the role of elements in the NE development path that can be used to strengthen the development path against an SSP5 wildcard? For example, modular energy grid, institution integration, internationalization (see Upper and lower course development in conjunction), BECCS, electrification of the agricultural system integration or institutional links etc

The break out group elements in Part B/II and Part C/III have resulted in systemic changes, visualised as the circles with rotating arrows. The core consists of three sets of actions which fundamentally transform the current land-use and socioeconomic systems to achieve the multi-scale vision in 2050. These actions are cross-cutting, self-reinforcing and time dependent (Figure 22).

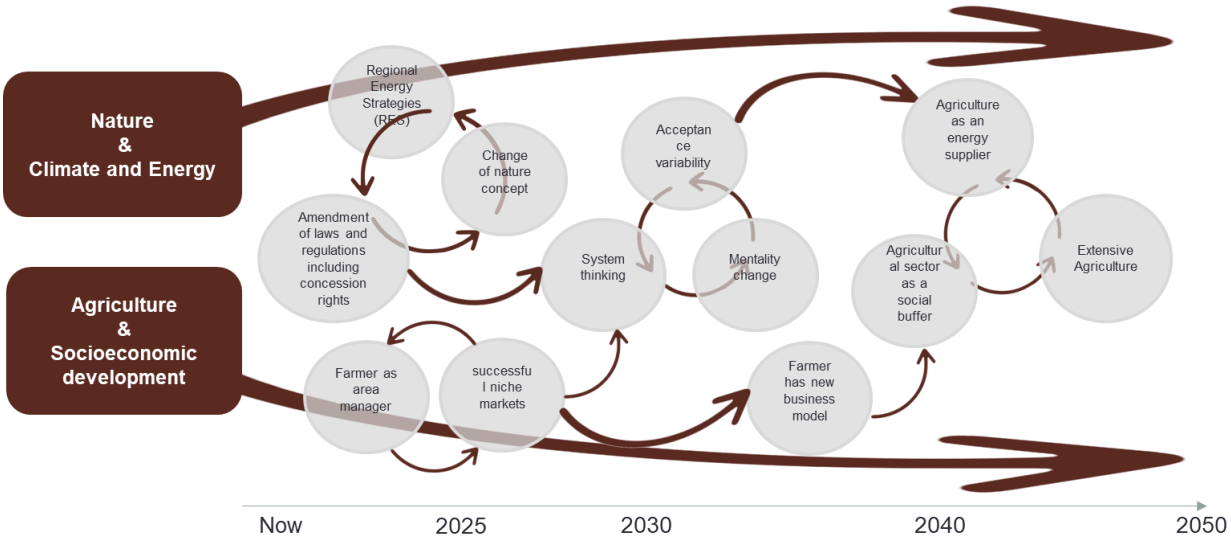


Figure 22: Visualisation of the SENSES pathway for the Vecht including strategies and actions (the circles that link the main strategies in the bubbles) towards the multiscale vision in 2050. The pathway organised across two focus groups, nature and climate and energy, and agriculture and socioeconomic development. These groups reflect the structure of the break-out groups in the workshops

4 Strengthening the feasibility of pathways through top-down and bottom-up perspectives with co-production and scenario visualisation techniques

The adaptation and mitigation pathways developed in Chapter 3 are robust against exogenous socioeconomic developments and events identified by the wildcards. Wildcards have been designed and used to trigger discussions across different perspectives for sake of inclusiveness.

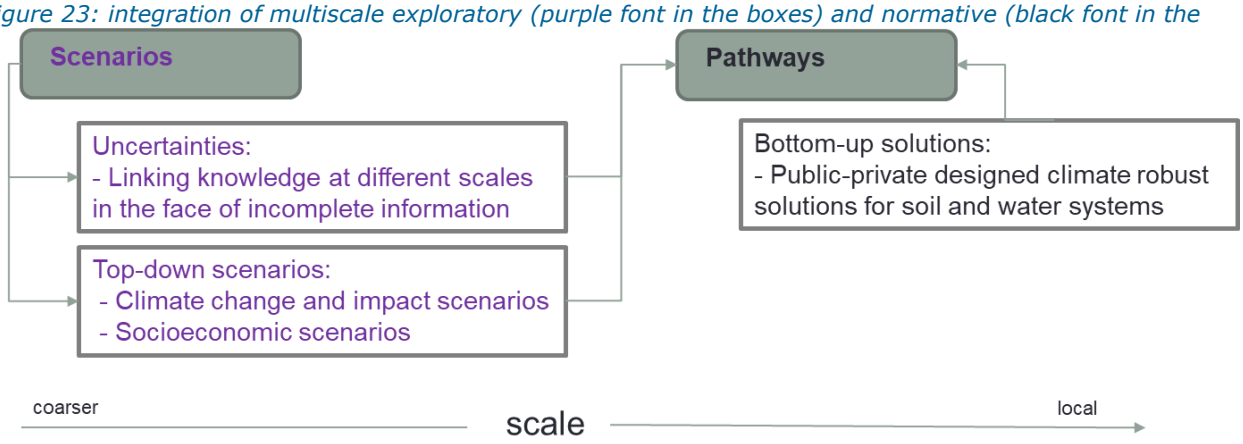
Following van Notten et al. (2003), once the purpose of the scenarios is defined by distinguishing between exploration (what could happen?) and decision-support (what do we want and how?), the process design and scenario content need to be organized according to criteria such as type of data and complexity of the represented system. Such an order is particularly relevant when the integration of knowledge implies diverse type of knowledge to address a complex problem, such as the integration of adaptation and mitigation for the pathways and vision of the Vecht.

Such an integration implies the explicit address of typical scale issues, such as the combination of different types of knowledge ranging from quantitative scenarios intended as computed simulations of biophysical variables to qualitative stakeholder-based implementation plans. While a broad discussion on different purposes and types of scenarios is beyond the scope of this deliverable, it is important here to distinguish between relevant scenario types in terms of complementarity with the robust pathways developed in Workshop 1.

Relevant scenario and pathways types include the integration of top-down and bottom-up knowledge, in both qualitative and quantitative form with a process-driven or consensus-seeking approaches. These types can span from coarser but wide-ranging global scenario simulations to local but potentially narrow assessments of relevant scales (Figure 23).

In this chapter we explain how we use scenarios to strengthen the feasibility of the pathways given uncertainties and properties of complementary scenario products, such as top-down climate and socioeconomic scenarios and bottom-up local solutions.

Figure 23: integration of multiscale exploratory (purple font in the boxes) and normative (black font in the boxes) knowledge to strengthen the feasibility of pathways



4.1 Iteration - Assessing pathways robustness

Before integration of top-down and bottom-up knowledge, the pathways need to be iterated to ensure consistency across the themes of the shared vision. The first step is therefore to consolidate the analysis of Workshop 1 and cross-check the links across the themes divided discussed by two groups of stakeholders in two workshops (Figure 20).

This iteration step is essential in two ways. Procedurally, it ensures buy-in to allow discussions to be focused on the link with top-down and bottom-up knowledge in the second workshop. In participatory processes, it is very common that stakeholder groups do not overlap, hence buy-in is a necessary step to facilitate the participation of stakeholders. Contentwise, the complexity of the pathway entails that linkages across single strategies and actions to be well-agreed from different stakeholders.

4.2 Top-down scenarios - selection and visualisation

Quantitative scenarios investigate computer-based simulations of the most important biophysical processes driven by climate and socioeconomic data. In this sense, these scenarios are "top-down", that is provided to stakeholders as given without integration of participatory elements. The selection of quantitative scenarios is designed to engage stakeholders in "what-if" questions pertaining the pathways that they developed, similarly to the role of wildcards (sections 3.3 and 3.5). Wildcards and scenarios are however conceptually different. As explained in sections 3.3. and 3.5, wildcards are high impact, low probability events with the effect to test the robustness of strategies.

Scenarios describe plausible futures. In the case of "top-down scenarios", these futures consist of trends of drivers at global scales that are relevant for impacts on the pathways. In this sense, the top-down scenarios are an addition to the pathway's overall narrative. This addition has two apparently contradictory effects, depending on the importance of either climate or socioeconomic data. Firstly, it narrows the feasibility of the pathways within what can be consistent with these global drivers. This effect is very common for the use of climate scenarios. For instance, climate impacts resulting from changes in future precipitation and temperature may affect mortality due to more frequent heat waves or crop production. The second effect is to identify robust and feasible actions that were not considered before. This effect explicitly considers the socioeconomic component of the scenario. Both climate and socioeconomic data comes in gridded form

(such as daily gridded precipitation data) and data sets (such as population and GDP trends) and are simulated in Integrated Assessment Models (IAMs).

For the Dutch case study, we have utilised both climate- and socioeconomic-driven impacts visualising climate impact simulations from two IAMs. For climate impacts, we visualise MagPIE results for selected land uses and for socioeconomic and climate impacts and mitigation scenarios we presented IMAGE model runs. In both cases, because of the uncertainties and different simulated processes, results should not be compared to current productions but utilized to compare trends. Hence, for the climate impact scenarios we compare the visualization of MagPIE results with four different global climate models (Gdfdl-esm2m; Hadgem2-es; Ipsl-cm5a-lr; Miroc5) for two Representative Concentration Pathways (RCP2.6 and RCP6.0) For socioeconomic and climate impacts with the IMAGE model with compare across three global Shared Socioeconomic Pathways (SSP1, SSP2 and SSP3).

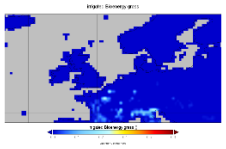
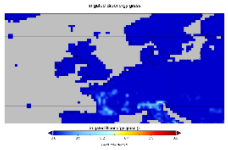
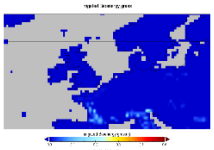
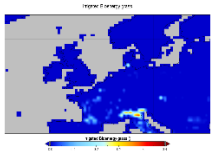
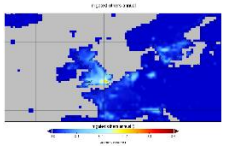
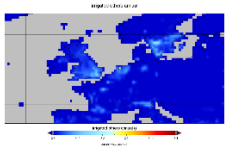
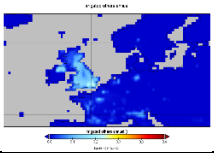
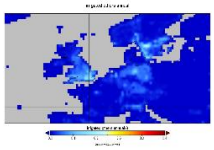
4.2.1. Global climate scenarios

MagPIE is an economic integrated assessment model, based on crop productivity times per hectare. For the Dutch case study, we have selected land use model runs, CMIP6 compliant, transitioning from gridded historical dataset "LUH2 v2g". The data include annual gridded fractions of land use states, all transitions between those states, and associated management layers. In this document we report only the management layers for SSP2 (Middle of the Road socioeconomic scenario) with RCP2.6 and RCP6.0. RCP2.6 is a proxy for a strongly mitigative scenario that is a strong curbing in GHG emissions resulting in a 2.6 W/m^2 forcing likely consistent with a global 1.8°C temperature increase in 2100 compared to pre-industrial temperature, whereas RCP6.0 is a proxy for a low-mitigation scenario 6.0 W/m^2 forcing likely consistent with a global 3.3°C temperature increase in 2100 compared to pre-industrial temperature. Because of the uncertainty in the climate simulations, for each RCP, we show climate sensitivity for four climate models. The selection of 7 out of 15 crops in Tables 4 and 5 was guided by two criteria. Firstly, to show trends for real production of selected temperate crops in line with Dutch latitudes and current climatic and ecologic conditions. Secondly, the selection was also guided by assessing sensitivity to mitigation scenarios in terms of temporal and spatial variability. Temporal variability refers to yearly changes from present to 2050 and spatial variability to present and future grid-based variability within the visualised area.

Coordinates: we zoom in grid-cells which comprise the Netherlands and parts of Europe (visualised area width=38° and height=11°, with 15° grid spacing). The extremes for the arrays are 48,875° N to 53,875° N (Y-axis, latitude) and 3,125° to 7,375° E (X-axis longitude). The area of the Dutch Overijsselse Vecht corresponds to about 8 grid points, in the range 52,625° N to 52,375° N (Y-axis, latitude, 2 grid points) and 6,125° to 7,875° E (X-axis longitude, 4 grid points)

Timescale: graphs are reported for 2050 (36th time step of the model runs, starting from 2015 baseline), unless temporal or spatial variability is detectable.

Table 6: Visualisation of MagPIE modelled impacts for 7 land use variables in North-Western Europe under RCP2.6 in 2050. For each variable we compare the climate sensitivity for four climate models Gdfdl-esm2m; Hadgem2-es; Ipsl-cm5a-lr; Miroc5

RCP2.6	Gdfdl-esm2m	Hadgem2-es	Ipsl-cm5a-lr	Miroc5
Irrigated bioenergy grass				
Irrigated other annual				

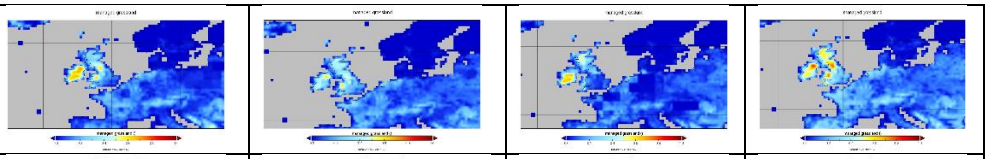
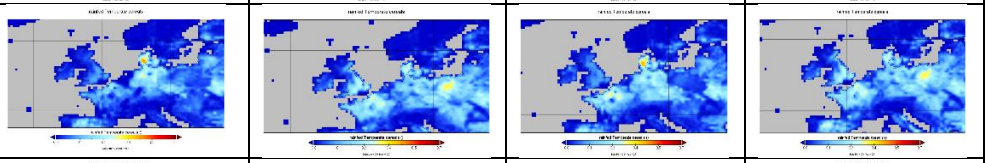
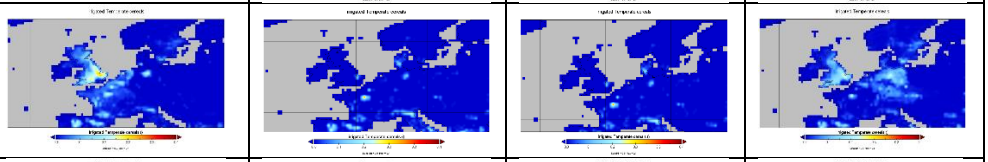
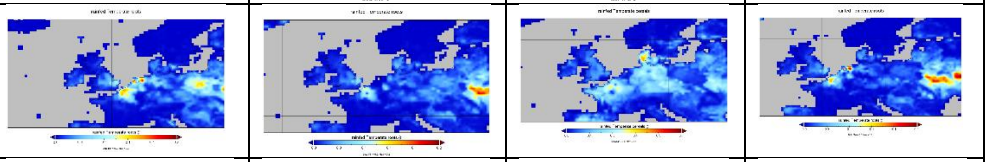
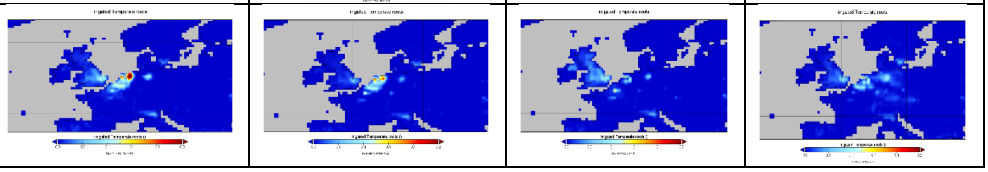
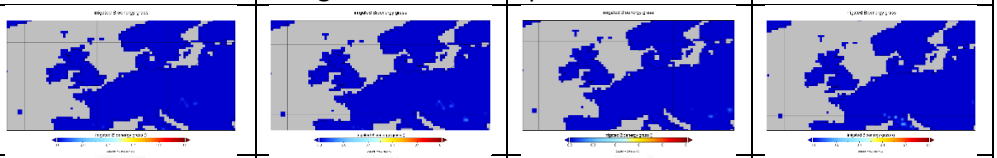
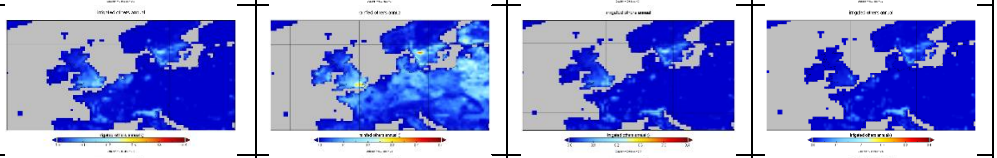
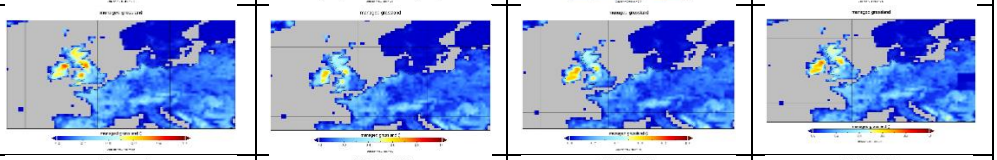
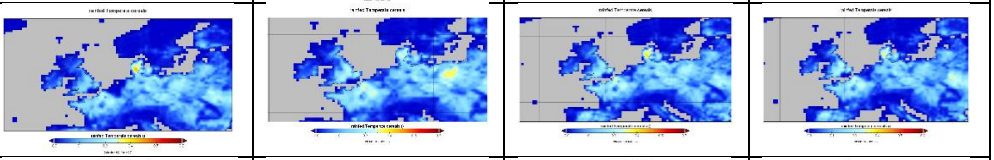
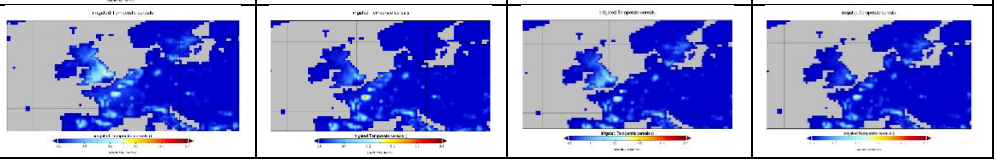
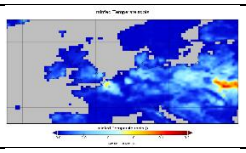
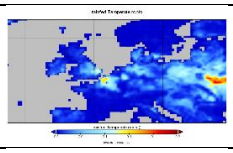
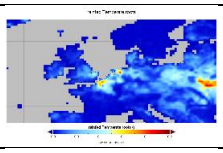
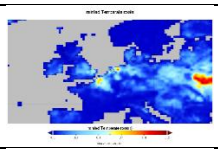
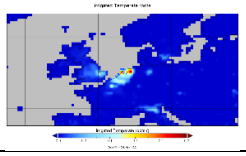
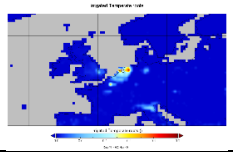
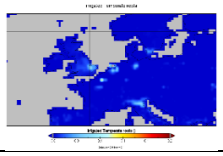
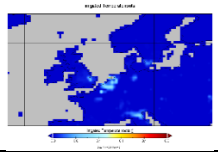
Managed grasslands				
Rainfed temperate cereals				
Irrigated temperate cereals				
Rainfed temperate roots				
Irrigated temperate roots				

Table 7: Visualisation of MagPIE modelled impacts for 7 land use variables in North-Western Europe under RCP6.0 in 2050. For each variable we compare the climate sensitivity for four climate models Gdfdl-esm2m; Hadgem2-es; Ipsl-cm5a-lr; Miroc5

RCP6.0	Gdfdl-esm2m	Hadgem2-es	Ipsl-cm5a-lr	Miroc5
Irrigated bioenergy grass				
Irrigated other annual				
Managed grasslands				
Rainfed temperate cereals				
Irrigated temperate cereals				

Rainfed temperate roots				
Irrigated temperate roots				

4.2.1. Global socioeconomic scenarios – using IMAGE model results to visualise impacts of mitigation measures

IMAGE is an IAM developed by the PBL Netherlands Environmental Agency to explore the long-term dynamics and impacts of global changes from socioeconomic and environmental drivers.
In SENSES, we use IMAGE to visualise mitigation options under two socioeconomic scenarios, SSP1 and SSP2. In other words, unlike the MagPIE results, the results emphasise assumptions on socioeconomic factors at global scale and what these could imply for the feasibility of local pathways.
Mitigation options explored with IMAGE include two main sectors. For the energy sector, we explore renewable energy, energy savings, electrification, CO_2 storage. For the land use sector, we explore (avoided) deforestation, reduction of emissions from agriculture such fertilisers, methane from cattle and manure, bioenergy, reforestation and diet changes.

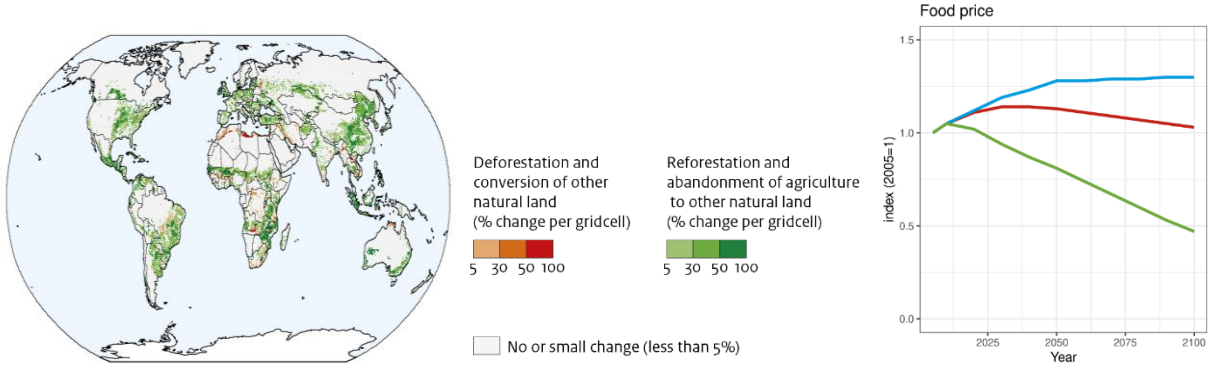


Figure 24: Visualisation of IMAGE model output, in maps (changes in afforestation/deforestation) and in trendlines (changes in food prices)
Except for changes in deforestation/reforestation, we do not visualise gridded for a given latitude, but global trendlines to better compare implicit assumptions across scenarios.

4.3 Bottom-up solutions - the Lumbricus programme

The project Lumbricus is introduced as a local-level programme for climate-robust soil and water systems. As follow-up of the global scenarios, Lumbricus provides a bottom-up perspective, complementary to the top-down scenarios described in section 4.2.
Lumbricus proposes a participatory, integrated approach for river systems together with waterboards and other key stakeholders. Crucially for SENSES, Lumbricus has two test-sites that differ in physical terms (soil, water and land use). However, Lumbricus will contribute to generic solutions and methods designed to be transferable to other locations.
For this reason, we select present the solutions identified in the test-sites to be integrated in the SENSES pathways.
The solutions identified in Lumbricus are specific for the locations ("Proefgebieden") and are targeted for specific environmental challenges. Examples of such solutions are listed below.

1. **Waterpoints** → Rainwater in the garden
    1. Healthy (mosquito-free) ponds, watercourses, canals wadis, segregated sewers, green roofs with sedum (fat plants) → air quality; sub- and above-ground infiltration systems
2. **Subirrigation** Haaksbergen → purified wastewater from the sewage treatment is infiltrated into a corn plot higher water quality
3. **Smart Weir** → purpose of this weir is to hold controlled water in sloping areas. As a result, the weir contributes to the fight against drought.
4. **Worms** → improve soil structures → infiltration capacity is increased, and the superficial discharge is reduced.
5. **Bokashi** → organic waste streams turn into a soil improver by fermentation.

4.4 Stakeholder engagement process (Workshop 2)

The second workshop took place on November 11th, 2019 In the Bilderberg Grand Hotel Wientjes, Stationsweg 7, in Zwolle. The workshop was facilitated by Simona Pedde, Kasper Kok and Lotte de Jong from Wageningen University & Research (Figure 24). A total of 8 stakeholders participated in the workshop. A list of participants can be found in Appendix II.

Figure 25: Second workshop in Zwolle with facilitators and participants

The workshop was an interactive, one-day workshop, divided into three main parts (Table 8). After a brief introduction of the SENSES project and the workshop process, the first part (A/I) looked back at the pathways of the first workshop to find synergies and trade-offs within the pathways by iteration. In the second part (B/II) global scenarios were introduced and the final part (C/II) focussed on local adaptation initiatives. Table 8 gives an overview of the programme.

Table 8: Co-production core of Workshop 2

Part A/I: Pathway iteration *Climate change strategies: Interactive pathways towards a multi scale vision of the Overijsselse Vecht*
Part B/II: Quantitative scenarios *Developing multiscale pathways with the input of quantitative global mitigation scenarios to increase feasibility: land use models IMAGE and MAgPIE*
Part C/III: Lumbricus

4.4.1. Part A/I: Pathway iteration

The stakeholder group divides in two break out groups (BOG). Both groups have the same pathway but the NE group addresses the pathway from a Nature, climate and Energy perspective and the AE group takes the Agriculture and Socioeconomic development perspective. The goal of the first session was to minimize the trade-offs from the first workshop. This is done by adding extra post-it's with measures/developments to the pathways.

Nature, climate and energy: round A/I

First, an explanation in the form of a narrative of the pathways was given: The first thing that has to happen is a change in laws and regulations. If you want to provide energy in the Vecht it has to go via agriculture. A change is that nature comes before agriculture instead of the other way around. From this point of view new strategies are developed. At a certain moment this will lead to a mentality change. It is no longer about keeping the systems and the farmer is not a passive actor but the one who takes responsibility. The river will change during wither and summer. In socioeconomic development, agriculture is key and the farmer stays and plays a central role. The central question is how we can link this will the nature and energy targets.

In Figure 26 and Table 9 the additions to the pathways are displayed. A total of 17 new measures/developments are added. Below the discussion is presented in bullet-points.

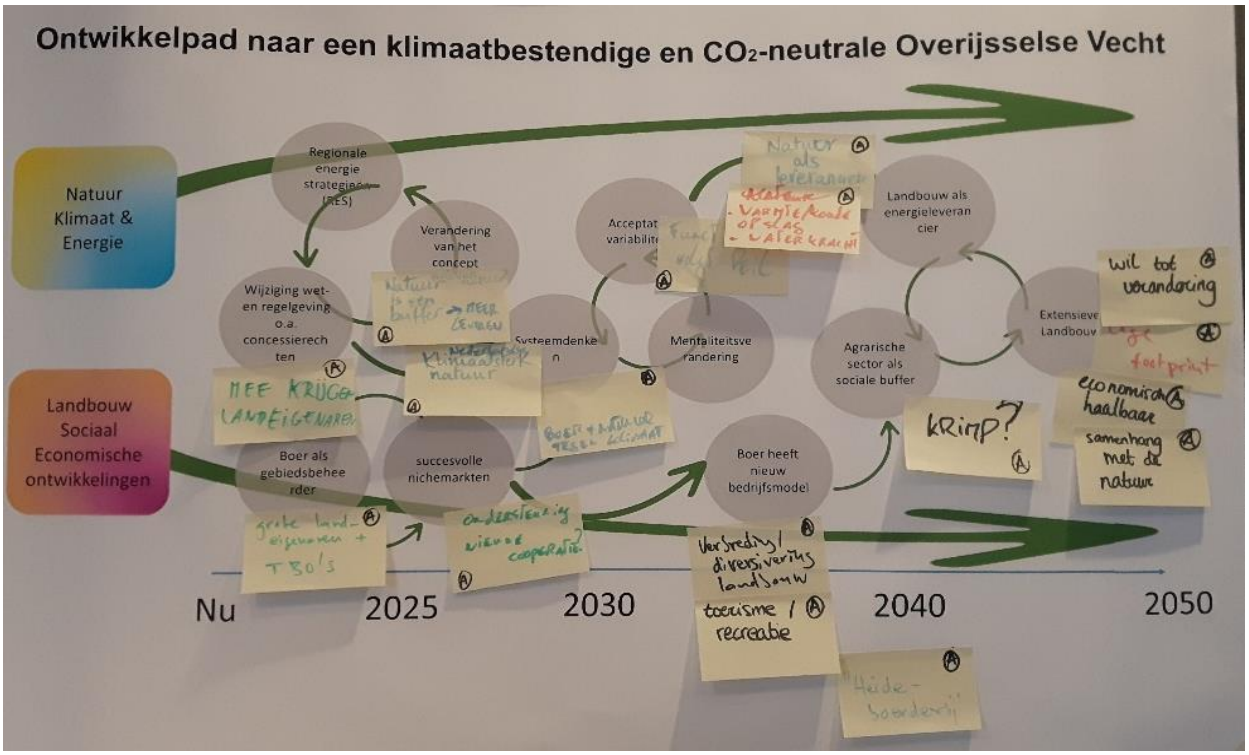


Figure 26: Additions pathway nature, climate and energy round A/I

Table 9: Additions pathway nature, climate and energy round A/I

Round	Additions, measures or developments
A	Get land owners along
A	Big land owners + land management organisations

A	Role of nature? Nature is a buffer → more and experienced
A	Dutch Climate strong Nature
A	Support new cooperations
A	Farmer + nature against climate
A	'Function follows water table'
A	Nature as a supplier
A	Hot/cold storage Hydraulic power
A	Broadening/diversifying agriculture
A	Population decline?
A	"Heath-farm"
A	Will to change
A	Small footprint
A	Economically feasible
A	Connection with nature

Discussion points Nature, Climate and Energy round A/I

- There is a discussion if there are still farmers due to population decline. What do we want? Also in the case of population decline, the pathway should stay strong. Do we attract new farmers to the Vecht? New farmers may want different things, but not everyone wants to be a farmer and also, not every new farmer wants to be a small-holding farmer.
- Near Renkum is a case study (small Vechtdal). There the agriculture has to go. How do you keep the estate (landgoed): Search for different types of agriculture/crops but in a way it fits with nature goals? The land is leased as 'Heath-farm' in which circular agriculture is present. The water table is stable and this is good for biodiversity.
- There has to be a change in the concept of nature. If nature is a buffer against changing circumstances, so if nature becomes important, it should get that role.
- If agriculture acts as energy supplier, solar power and bio-industry are most obvious. If nature has to act as energy supplier, where should we get the energy from? From earth warmth, but how does this effect the soil and how feasible is this?
- What is extensive agriculture? If you do something more efficient on 1 place, more space is available somewhere else (half world, whole world principle). It is positioned as 'if' question. And more complicated: how do we change the production and how do we measure if this production is extensive of intensive.
- How big is the import/export of the Vechtdal? There are a lot of farmers who are affiliated with large chains.
- The question with niche markets is if the market is always close. An example is the kipsterei from the Lidl. How large can a niche market, the market for regional products, be? Not the whole Vecht can be a niche marked. How should the production go?
    - Producing snails?
    - A mix of production:
        - Or: "this is wat we want to produce in the Vechtdal" and you search people to do this (a bit DDR though)
        - Or: "here is the Vecht, please come" how do you reach entrepreneurs? If the circumstances are favourable and the area is attractive for entrepreneurs. The Vecht as entrepreneur region. But you also want to keep nice nature.

- The current farmers may leave, a new generation of farmers will come. The new generation thinks 'this is fun, I'm going to do this' with the help of cooperation and the provinces. So ideas will emerge 'beyond agriculture'.
- What is the extensive agriculture we want to create? Is this based on lower footprint, nutrients, hectares? Again, what is extensive? Answer: a low footprint and economically feasible.
- The challenge is that a minimum of 2/3 of farmers do necessarily want to change.
- We have to think how we can get land tenants (pachters) along, think about the next generation.
- Farmers learn a lot in cooperation-context by working together. In this way they learn about habits and projects and they address each other.
- To go back: did we solve population decline? Maybe it is not such a bad thing if your system is strong. Niche markets should look internationally?
- What is nature? With a change in the concept, nature can be used for purposes: for example water storage. We have to look at 'new nature' with new species. These influence the landscape, for instance different tree types. Climate change is causing forests to change, what you find in mid-France now is coming this way. Also possible, a change of insect population and this could make fruit growing impossible. There are a lot less insects currently. This is also because of agriculture and the use of fertiliser.
- You want to create a stronger nature because you have agriculture which is not helping in increasing the insect population. Now it is farmer and climate against nature and you want to have the farmers and nature against climate.
- Large land owners (Twickel, Staatsbosbeheer) want to collaborate. What is their stake for collaboration? They are the private organisations that want to manage the land of Overijssel. Natuurmonumenten and Staatsbosbeheer want strong nature and forestry.
- Strong nature: robust and climate proof. Staatsbosbeheer manages the 'uiterwaarden'. From the national government, they have these management tasks.
- Tourism and nature are users of nature. The Dutch perception of nature is a park
- You can also say: we have population decline, get out, fence around it -> everyone to Germany
- Preference to get farmers on board.

Agriculture, socioeconomic development round A/I

The SA group added a total of 10 extra measures/developments to the pathway to minimize trade-offs. Figure 27 and Table 10 display the additions.

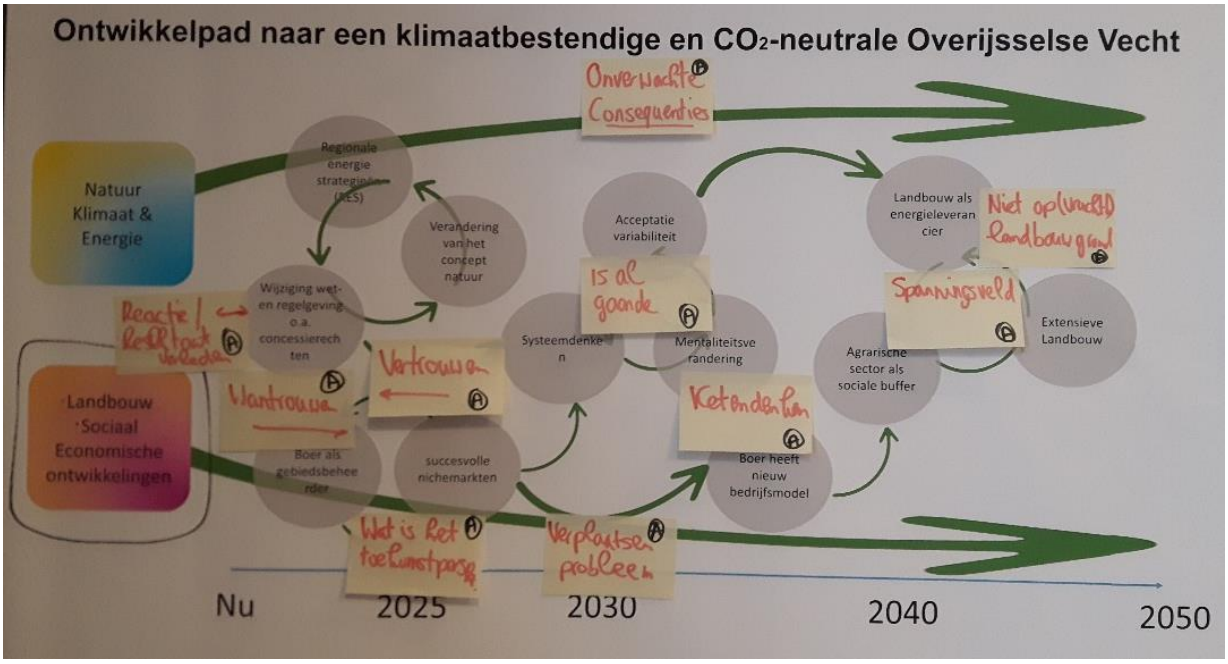


Figure 27: Additions pathway agriculture and socioeconomic development round A/I

Table 10: Additions pathway agriculture and socioeconomic development round A/I

Round	Additions, measures or developments
A	Reaction/Result of the past
A	Distrust
A	Trust
A	What is the future perspective (toekomstperspectief)
A	Unexpected consequences
A	Is already happening
A	Moving the problem
A	Chain thinking
A	Area of tension
A	Not on (fertile) agricultural soil

Discussion points Agriculture, Socioeconomic development round A/I (Figure 28)

It was discussed how the past has an influence on the current state. In this pathway, we start at a certain point without taking the past into consideration. This is unrealistic and that is why it would be better to look back into the past a bit.

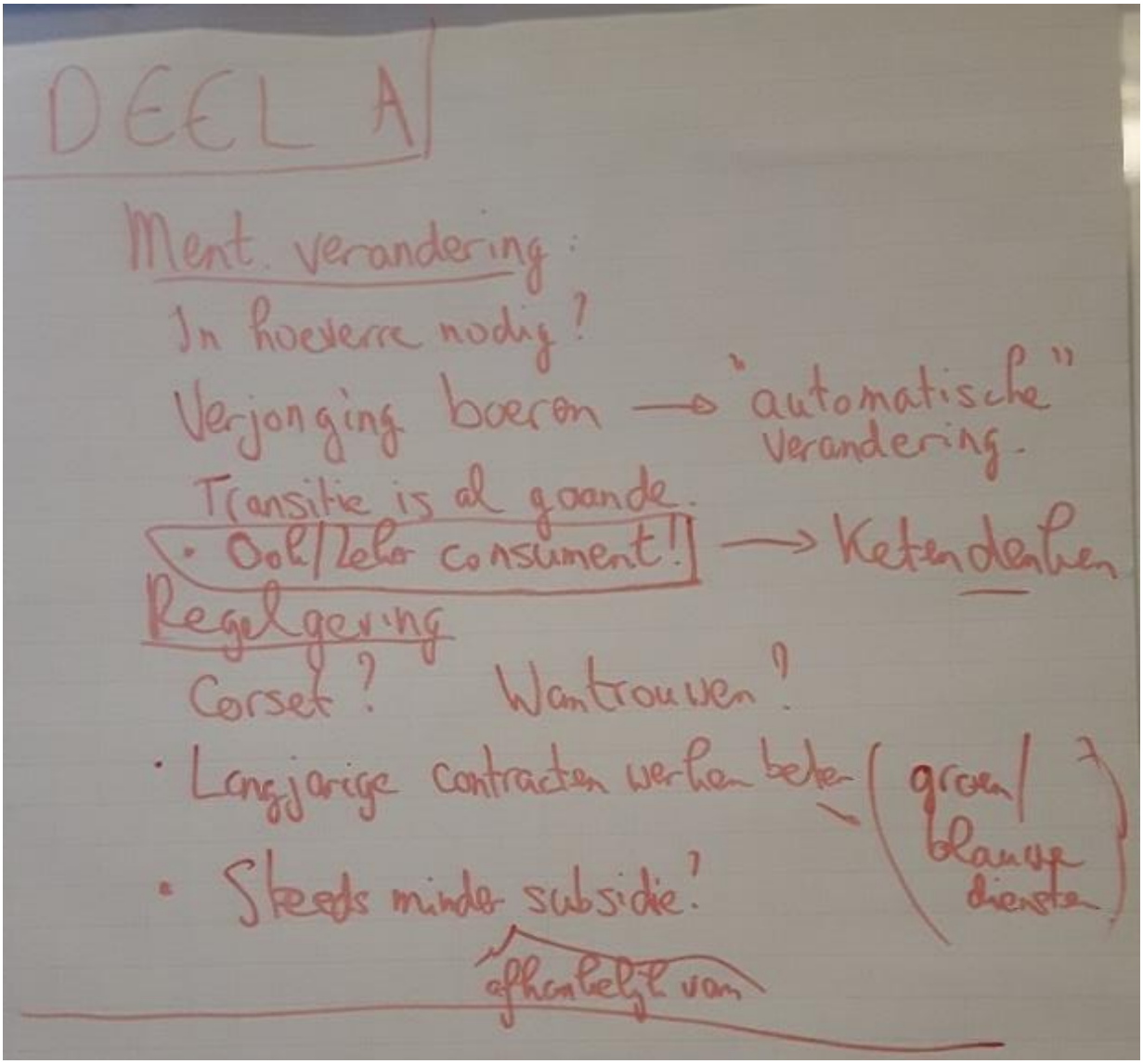


Figure 28: Notes flip-over round A/I agriculture, socioeconomic development

Mentality change:

- To what extent?
- Rejuvenation of farmers → "automatic" change
- Transition is already happening
- Also/Certainly consumer → chain thinking

Legislation

Corset? Distrust?

Long term contracts work better -> green/blue services

Less dependent on subsidies?

4.4.3. Part B/II: Quantitative Scenarios

Global scenarios (SSPs and MAgPIE scenarios) have been introduced by Simona Pedde. SSPs and their translation to Integrated Assessment Models such IMAGE have been introduced by Jonathan Doelman. Certain assumptions exist on population growth and GDP, based on this energy demand and food demand is calculated to determine what influence this has on land use. Alongside, it is explored whether this influences CO_2 emissions and temperature changes. With the (IMAGE) model, interactions of the system can be analysed.
With this model scenarios are made (such as the SSPs) and also scenarios to reduce climate change are made. With this, the SSPs are used as a baseline, when no explicit mitigation policy is existing. This is combined with climate policy to reduce climate change (or to model if the policy is effective according to this model). If we want to reach the Paris goals the carbon emission has to decline rapidly, is the output of the model. The focus in this is the interaction between agriculture and climate mitigation.
The role of agriculture in the climate issues: 23% of the CO_2 globally comes from agriculture and deforestation, so from food production and deforestation (for energy). Negative emissions due to reforestation and stocking bio-energy in the ground also exist. Both measures need a lot of land.
There are different pathways to the 2-degree goal: for mitigation there are land options.
The central question in this is if you can translate these global scenarios to a regional level.

Introduction quantitative scenarios MAgPIE: Simona Pedde.
Click here for presentation.

This model calculates two types of crops: 'managed grassland' and 'rainfed temperate roots' and projects different scenarios.

An example for the use of multiple scenarios it to compare different climate models. If we want to use them on a local level, we have to understand which assumptions are behind these models. There are conflicting scenarios and a lot of uncertainty exists on how these climate models can be downscaled, so how to interpret them on a local level.

The message of these models is: who is choosing the scenario? There are a lot. The given examples are a signal for The Netherlands under a certain scenario. If this is the case, it is necessary to look if the local assumptions fit the context of the global scenarios and the other way around.

Question of stakeholder: how can we find out what (which scenario) is used in, for instance, the klimaateffectatlas? In practice, this is used a lot but how and which model is behind this. Here (in the room) there is no expert who knows what's behind the klimaateffectatlas, but very interesting to find out.

Break out groups quantitative scenarios round B/II

In the second round (B/II) we look at how we can use the knowledge of IMAGE and MAgPIE assuming that:

- Diets will change
- We will mainly use bio energy
- We will use land for mitigation purposes

The group divides in two BOG, this time with different people in each group. Below the additions on the pathways provided by global modelled scenarios.

Nature, climate and energy round B/II

During the second round, 8 additional measures/developments are added. These are displayed in Figure 29 and Table 11. After the brainstorm session a short summary of the discussion points was done.

Figure 29: Additions pathway nature, climate and energy round B/II

Table 11: Additions pathway nature, climate and energy round B/II

Round	Additions, measures or developments
B	Frontrunners together with followers
B	Regional chains (about international import) no import decrease but mainly to make it more efficient
B	More serious to use IJsselmeer as water storage
B	Belgium Germany
B	-agroforestry Connecting multifunctionality with targets Composition reforestation and agriculture
B	Climate buffer → agriculture
B	.. but here everywhere ..
B	Growth…

Discussion points nature climate and energy round B/II

- A different farming model exists. There are frontrunners together with followers. Some farmers, who are more entrepreneurial, give the example for the niche markets and lead the way for new business models. Different speeds exist for regional cycles. If it therefore can be done locally.
- One of the problems of the future will be the water. Recently, there was a serious drought, water availability will decline. How do we mange water services. A lot of solutions exist for the soil but, for

instance, the IJsselmeer is necessary as water buffer. Should we consider this as a serious solution? How is this in Germany and Belgium? The role of nature is clearer because it is a water buffer and therefore important

- There are different speeds on diversity and functionality: multifunctionality means connecting targets. In this cluster, the combination of reforestation and agriculture and using forestry as climate buffer.
- So bioenergy versus reforestation → agriculture (=the forests) are placed to be climate robust and because we look at it from a multifunctional perspective and we have connecting targets.
- The climate is "included in the stakes of agriculture", the people and the nature. This is feasible because we accept to have different speeds."
- So we can have population decline but the landscape is divers so not everywhere, it can also be population growth. Also because of farmers with more entrepreneurial spirits.

Agriculture, socioeconomic development round B/II

In this round, the agriculture and socioeconomic perspective added one extra measure/development "higher energy prices needed" (Figure 30). The notes of the discussion are written down below. As mentioned before, three considerations are taken from the global scenarios: diet change, bio energy and land use for mitigation

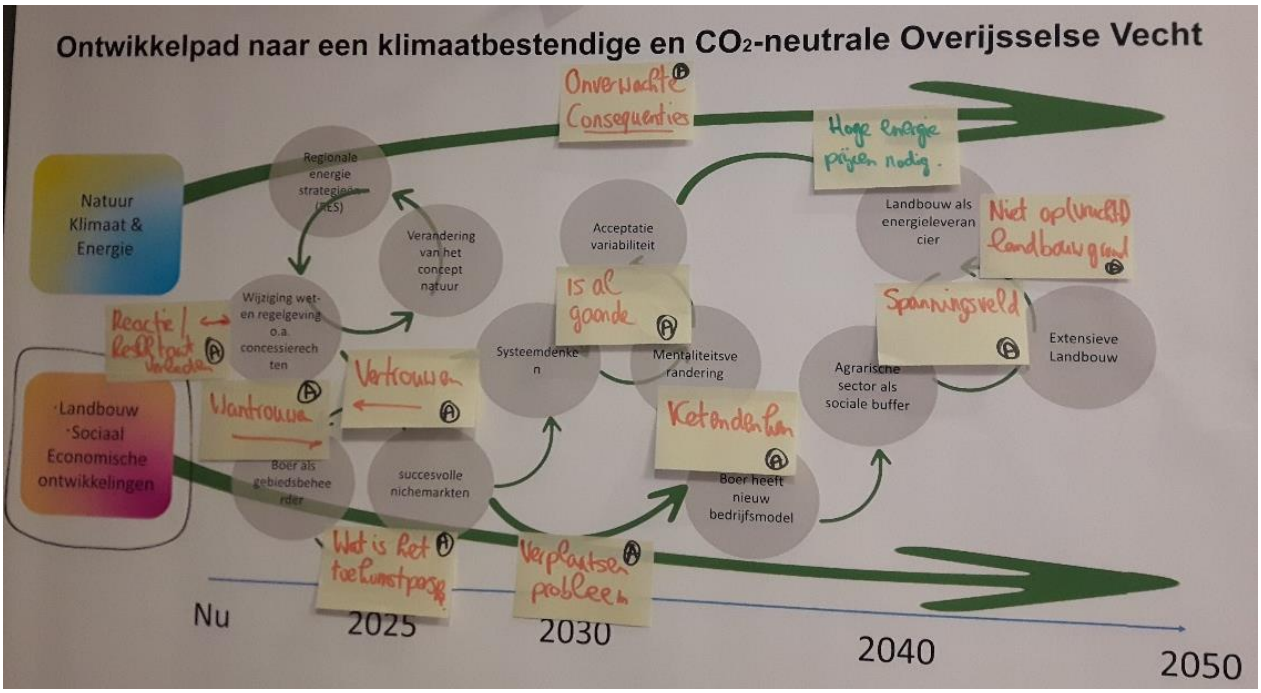


Figure 30: Addition pathway agriculture and socioeconomic development round B/II

Discussion point agriculture, socioeconomic development round B/II

- All farmers change to tofu production. Question in this: "what is the adjustment, what is the farmer?" Is the diet change already going on? What is happening in China and India?
- If more people eat vegetarian, will there be more demand for tofu or more for cheese or different dairy products? With this a successful nice marked is created, this will provide new chances. Because soya is a bit boring, more people will eat nuts? And how much can you earn with this? A food forest (near Nijmegen) yielded a lot, but that is a pilot so not necessarily sure. Walnuts?
- If everyone in the whole world makes regional products, what is the market? There will be less production for export and you earn more for farmer cheese than for normal cheese.
- Are the areas there (for the food forests) suitable? There are areas with only grass. But are there areas where this is possible? How nutritious are the grounds/soils? Originally not necessarily the most fertile soils. You can make productive agriculture by using fertiliser.
    - Can the area handle this? Wat can't they handle?
    - Grass production is good for 'woeste gronden'. Livestock not necessarily. This is not suited for agriculture so then we can use it for nature. More dairy instead of meat

- Or make something useful out of grass, for construction
- If we want more biomass: what if we produce everything from one forest in Europe. But where is the food produced? Also intensively in certain areas.
- We have to think bigger, but what is locally suited? For instance, all people from Spain come here for their holidays to swim in the Vecht. And the milk can go to Spain. All Chinese from Giethoorn to the Vecht.

- Do we have space for biomass and bio-energy? If we have highly fertile agricultural grounds in the Vecht, aren't we making the mistake to put solar panels on this or to reforest them. Biomass provides less income for farmers.
- But if we want 'agriculture as energy provider', we need windmills if we do not consider the other options.
- The question: will you buy out the farmers as a national government or are you giving them subsidies. If you want something like that, do you need a farmer or is it enough to just plant a forest?
- With uncertain prices for the future, farmers are less willing to do long term investments
- Subsidising hydrogen power. But hydrogen costs a lot of energy. But which scenario do you choose?
- What we get from this is that the scenarios pressure the pathways. We want to change and do not exactly know how it is going to be. Think about how you can prepare for the future → communicate this in a better way to the farmers.
- If you want to create space and if you want changes in the system and regulations you have to make sure you can influence that. Maybe you don't need to do everything. What can we do without eliminating everything?
- Thinking from a water perspective: we see more drought. With a large summer drought we don't have grass so this already has been a problem together with ground water table problems. At that time the grass production was a lot lower and now there is a lot of grass.
- Grass is better resistant to these shocks, better than corn or other crops because these are less flexible and drought resistant. Looking at water availability, grass apparently is very flexible. You are looking for the robustness in agriculture.
- Drought has an impact on farmers. That's why you want to increase the sponge function. This is easier in nature than in agriculture. It takes thousands of years to restore peat but this is the best solution.
- Solution: turn around subsidence, one big peat area

4.4.4. Part C/III: Lumbricus

Introduction Lumbricus project: Simona Pedde

Lumbricus is a regional project with the goal "Towards a semi-natural Vecht". In the project the water perspective is dominant. Objectives are that the Vecht should get more space, less weirs and more possibilities to meander.

Water could be a good driver. The reason this area has a lot of farming could be because of the sufficient water availability. Subsequently, water management in The Netherlands is very advanced. The recent drought had a lot of impact. Within Lumbricus drought, soil compaction and water quality have been addressed as main challenges. From this, questions such as "Can a smart weir handle the drought problem?" and "How are grasslands modelled". This has a combined advantage for adaptation and mitigation such as deep routed crops which reduce compaction.

The group splits up again with the goal to include the local Lumbricus project into the pathways.

Nature, climate and energy round C/III

During the last session the groups changed again. In the NE pathway, 7 additional measures/developments are put in the pathway (Figure 31 and Table 12). Below the discussion points are described.

Figure 31: Additions pathway nature, climate and energy round C/III

Table 12: Additions pathway nature, climate and energy round C/III

Round	Additions, measures or developments
C	Who initiates change
C	Investments financial sector Climate risk analysis
C	Top-down with farmers and consumers, facilitate the process
C	Start with parties who have a vision
C	Small pilot garden (proeftuinen)
C	Awareness of soil → towards mentality change
C	Small scale land management with strengthened CO (win win) more CO2 storage more wood

Discussion points nature, climate and energy round C/II

- What is your starting point? Do you start from below and make it bigger, without it becoming a buzz-word? Or the other way around, how can you help people to do something from above. When are you doing enough? This raises the question: "Are targets from above needed?"
- At this moment, the agricultural sector is not yet very ambitious at the climate table (klimaattafel)
- A solar panel has a direct effect because you can see the effect of your measure
- The local solution are not really systematic changes but solutions within the current system
- Soil quality is a key point
- Better crops and more efficient crops with less nitrogen. The dairy sector keeps emitting. So the solutions are just small steps in the system of the farmer as land steward which is also key for successful niche markets and all of this around the concept of change and the concept of nature.
- From here a climate neutral product from the Vechtdal could lead to changing the system
- The small steps in the beginning. If you don't do anything in the beginning you do not get anywhere but you keep 'hanging' in the current system.
- Search for measures you should take anyway. So for a direct problem. Like the unfertile soil of the Vecht. Like in the 80s, fertiliser was causing acid rain.
- What are the parties in this discussion? Now it looks like it is only about the farmers? Parties who should come along are farmers, consumers, land owners and the government (different levels). Who takes the first step and initiate change? Is this big enough?
- Likewise for the climate targets: is it only for farmers? For whom are these climate targets? The majority of the consumers buy the cheapest product so a mentality change should also come from consumers. It's being concluded that this is not possible without regulations.
- You have to do both: top-down and facilitate the farmers to help, then they may want. Also for consumers: from beef stake to parsnip
- Start to talk with parties who have visions.

Agriculture, socioeconomic development round C/III

In the final session of the AE group, no extra measures/developments are added to the pathway. Some additional discussion points, based on the Lumbricus project, are mentioned below.

Discussion points agriculture, socioeconomic development round C/III

- If we assume there is a drought once in three years, there is less yield. Is there a 'tipping point' where we can take this into consideration, perhaps this has an advantage for biodiversity.
- If you come up with this now, for instance herbal grasslands, you cannot be sure it stays this way. Farmers do not know if subsidies remain to come. How can farmers be less dependent on subsidies but still have the assurance for investing? Other things like 'weidemelk' is possible because this was a rapid change. Though, there are more rules for the same.
- A tipping point is when you can get the consumer to pay more for a better product. Within Lumbricus we are looking for a tipping point. Keep on reflecting to reconsider your policy to see if it still works.
- You don't know what will happen, that is why it is better to not only be dependent on the national government. Regional policies and co-operations can help to increase certainty/assurance/safety (zekerheid).
- What are the borders of your system? What is regional? And to what extend should you look to Germany?
- With 'putting a pot of worms' you will not manage, but it is important to get people on board. Because you have the drought problem now which can increase the sense of urgency.
- Whit whom do you start and who is responsible? The Chinese emit but we buy their products so there is a responsibility crisis.

4.5 Analysis

4.5.1. Analysis of part I – Iteration: cross-sectoral links and challenges

The robustness of the pathway is challenged by identifying possible trade-offs and questions across the themes of the vision (Nature, Energy, Socioeconomic and Agriculture). As in Workshop 1, the structure for group discussions was divided between the Nature and Energy (NE) group, and the Socioeconomic and Agriculture (SA) group. The results of the discussion clustered in pathway elements reinforced against SSP-based wildcards are summarized and in Table 4: overall, the SA group addressed and reinforced elements that were discussed during Workshop 1 in the NE group and vice versa (although several points from the NE group reiterated also NE pathway elements).
The transformative element and pathway robustness across scenarios (in the form of wildcards) remained unchanged and were not challenged. Instead, the discussion highlighted what elements needed further elaboration. Fundamentally, *how* the concept of nature, involvement of the farmer, acceptance of variability as well as the use of the sectors for multiple purposes need to change and play out more realistically in the pathways.

Table 13: Pathway discussion elements to achieve vision themes (NE and SA) that have been identified in Workshop 1 as robust across SSPs. The discussion lead to cross-sectoral points: NE groups discussed SA elements and vice versa

Vision themes: **nature and energy (NE)** **socioeconomic and culture (SA)** **Pathway-elements reinforced against SSP-based wildcards**	**SSP1** **➔ Dependence on local food supply**	**SSP3** **➔ Unexpected population changes**	**SSP4** **➔ energy supply shocks**	**SSP5** **➔ High-tech failure in a market-driven context**
Changes in concession rights				Mistrust Resistance to change
Mentality changes in the direction of sustainability or relevant social parties, financing institutions and farmers	Mentality change is part of existing process -> link with past trends and integrate learning and past changes			
RES includes Modular energy systems			Concept of "new nature"	
Accepting variability and increasing impacts - Diversity of crops (less poison, more natural control)	Shrinkage could lead to decreases in agricultural sector		New concept "extensive agriculture	
Focus on the farmer to enable transformation	Involvement of big land owners and their stake in a stronger nature			
The agricultural sector is strongly integrated in the energy sector (agriculture is the 2nd and 3rd energy supplier)	Nature's role contributes to energy supply (transformation from role as buffer, e.g. grassland)			
The agricultural sector also becomes a 'social buffer' for changes in population dynamics (i.e. inflows, depopulation to urban centres)		Some farmers abandon. New cooperatives and exchanges		

From the SA group, the strong changes of transformation that are needed and robust across transformative SSP1, SSP3, SSP5 pathways need to have a clearer link to the past trends and to what is already happening. The main questions include how the mistrust towards these changes affects the pathways and, conversely, how are past transformative changes relating to the mentality change included from trends already in place. The transition is happening in crucial changes in the mentality, such as the regeneration ("verjonging") of the farmers which can be perceived as an automatic change. On the other hand, the aspect of mistrust can also get worse due to a reluctance to constantly changing and increasing rules and regulations and a lack of faith in that rules could bring change.
Both elements linked to the discussion on the concept of "new nature" already discussed in Workshop 1 and robust against the SSP4 wildcard: a stronger emphasis on nature as an "energy provider" in the future can come at the cost of other current functions in the present.
How can we strengthen the link the SA and NE theme, given the systemic change needed to consider farmer stays and remain central in the SA pathway? The NE considerations addressed several SSP1 and SSP4 related elements. Key elements linking SA and NE include resilience in the transformation towards a circular agricultural production (SSP1) as well as towards becoming a fully green-energy powered pathway (combining the nature and energy functions) yet resilient to energy shocks (SSP4). The first step in the discussion was to involve large land owners such as Twickel and Staatsbosbeheer. Natuurmonumenten and Staatsbosbeheer desire stronger nature and forestry and according to this perspective, strong nature means also climate-robust. However, this perspective implies changing priorities for the agricultural sector: agriculture as energy provider means that solar panels and bioindustry would have the priority (also the question that if nature becomes the energy provider, then where does it come from? Water or geothermal and to what extent is this feasible?). Changes in the type of agriculture and extent of the land also means a shrinking (krimp) of the agricultural sector in the pathway, which must remain strong despite of this. Uncertainties include whether new farmers will be attracted. On one hand, rejuvenation will happen inevitably. However, some farms might still go out of business. Average age of farmers may decrease, and their total number and extent might go down as well.
In both SA and NE pathways, the mentality change suggests that new generation of farmers could start by having a stronger tendency to cooperate and connect. They aim at initiating a new way of farming, including strong collaborations and new ways to learn from others Crucial in this change is the notion of extensive agriculture. Extensive agriculture is positioned as a "if' question, dependent on how production is changed and what indicators are used to define extensive or intensive. If extensive means low footprint and economically feasible, niche markets could perhaps look internationally too. The balance would require a new role for nature: the concept if to use nature for objectives, for example to use nature for water retention. This "New nature" has an influence on the landscape, with for example new types of trees. The association with "native" becomes looser also because of climate change. For example, there will likely be similar types of forests to what is now in central France and the insect population might change.

4.5.2. Analysis of part II – Effect of socioeconomic and climate scenarios: from "robust" to "robust and feasible" pathways: Changes in diets; bioenergy; land use as mitigation policy

Adding the perspective of global scenarios resulted in the discussion of top-down uncertainties associated to both socioeconomic and climate change mitigation scenarios. "Feasibility" of pathways accounted for both physical and social constraints. For instance, how droughts might affect productivity as well as changing stakes and conflictual economic and ecological objectives. The challenge that emerged from the process were (1) exploring the local pathways in the face of global scale uncertainties under socioeconomic and physical constraints and (2) adapting the pathways in face of these multiscale issues, for example related to mitigation and adaptation and their trade-offs.

Potential large-scale sudden or slow mitigation, for example associated to dietary changes, biomass and land use for mitigation highlighted the trade-offs of land use for nature and agriculture and stakes of dominant actors in the local economy from present until the vision. Changes in production include uncertainties related to whether dairy or soya will dominate or will grow along niche markets, such more widespread forest gardening (voedselbos) more geared towards local consumption. The choice affects the relevance of production for exports, as in the current system or whether local circular systems will dominate. Another uncertainty relates to whether the soil characteristics are suitable for agroforestry, agriculture, or biomass production (forest or grassland). Increased agricultural land could imply continuous use of synthetic fertilizer. Extending grassland would be perhaps more suitable for the original "woeste grond" – though currently lots of fertile cropland is being exploited in the region. The question, then, would be what activity and land use best work with more grassland. Extending grassland could be suitable from a soil perspective, but in terms of income, converting high-quality cropland for grassland, biomass production, solar parks would result in less gains ("Je schiet jezelf in de voet") for the farmers. An option could be windmills, but that could come at costs of opposition from locals and local government. According to the current system, the question is whether the farmer can be "imposed" by buying him out, or whether subsidies will be used. And in the latter case, whether the farmer would be involved. Other forms of renewable energy, such as hydrogen, are uncertain because of the costs and choice of subsidies. Preparation under such uncertainty should precede communication with the farmer.

In the face of the uncertainty of the future and to strengthen the desired transformation towards the "new concepts" described in Table 4, the starting point for feasibility is to understand how the role of the farmer and farmer business models will develop under deep uncertainty. In the short term, independently of the land use change, there will be frontrunners and followers. Some farmers will be more "entrepreneurial" and will shape the niche markets and set the examples for new business models. As a result, different speeds for regional circular economies will develop and economic development will be strongly locally.

Different speeds landscapes might still entail land use trade-offs might arise depending on the mitigation strategy, for example between reforestation and agricultural development (such as bioenergy) as climate buffer. With multifunctionality, landscape can address several challenges and stakes by linking them in the same landscape.

While multifunctionality was already identified as a robust option, the different speeds of change make the pathways also more feasible. Some sectors may locally shrink, but not everywhere and not at the same time, and reverse their trend towards growth. This implies that both types of farmers "entrepreneurial" and "followers" will be characterised by this shrink-growth variability.

The role of nature, and especially water, was used in both groups. In the face of uncertainty, drought was acknowledged to be an observed trend that will affect the future. While the role of nature is clear as water buffer, main uncertainties remain for droughts linked to the changes in the agricultural sector and provision of sweet water for the population. Solutions could include expanding the role of the IJsselmeer as a waterbuffer or increased cooperation with neighbouring countries. From a water perspective, increasingly frequent droughts affect also the choice for a robust land use, such as grasses that are more flexible and robust against droughts than other crops. Increased droughts also have an impact for the choices that farmers have. Better management of infiltration (sponsfunctie) is more compatible with nature rather than agricultural land use.

4.5.3. Part III – Effect of integrating local solutions in transformative pathways

The introduction of "proeftuinen" solutions from the local project Lumbricus flowed linked to the latest stretch of the part II discussions. They strengthened the perspective of integrating the physical drivers of change, such as droughts and focus on soil and hydrological function in the pathways. They brought up the link between top-down action and bottom-up regulation, and the question of whether one should precede the other. Overall, the local solutions were well fitted within the pathways' actions as specific steps of these

actions. The role of actors, especially the farmer, need to balance the stakes of land use, and transformation towards a new concept of nature and agriculture remained unchanged. The farmer's role is neither
Both SA and NE groups realised that local and physical solutions are suitable in the current system. According to the N/E pathway, the solutions in the proeftuinen could contribute to strengthen the link between agriculture and mitigation (still weak in the local climate negotiations) compared to specific regulations on, for example, solar panels. However, these solutions resulted not to address the systemic challenges but rather the challenge (especially important for SA pathway) of improving soil quality to maintain agricultural production. Particularly, the choice of improving crops, with more efficient harvest with lower fertilizer input, was of robust but not sufficient if the sectors remain unchanged – for instance, if the dairy farms keep on dominate or, even, increase in their activity.
Crucially, such specific solutions need still be embedded within regulations, guided by parties with visions, which facilitate the uptake and change, while complement the consumers' preference for (short-term) cheaper options. In other words, these solutions need to be included in the systemic change, otherwise they remain "hanging" in the current system. For example, improved soil quality and better efficient crop production should be small steps, part of a system that has changed the farmer as integral part of the landscape which, in turn, is part of a successful niche market in balance with changes in the concept of nature.

5 Conclusions

5.1 Co-production with stakeholders to develop multiscale pathways for the Vecht

The design of the Dutch case study fits in the SENSES objectives of integrating users' knowledge with co-production techniques. The Dutch case study has applied diverse co-production techniques to develop feasible pathways through visualization of scenarios and integration of knowledge. Several elements emerged from the analysis of the two workshops.
The co-production process in the Dutch case study was successfully executed. Through multiple means (individual interviews, workshops, expert consultations), we engaged a broad range of stakeholders throughout the process. We yielded new insights on crucial elements of robust and feasible pathways, particularly related to the pivotal role of the agricultural sector and the ways in which it will have to transform itself to reach the (multi-scale) vision. Bottom-up and top-down (modelling) initiatives showed where local opportunities and global constraints and windows of opportunity can be found.
Stakeholder knowledge was assessed throughout the process. Firstly, through the consistency between the literature-based vision of Figure 3 and the temporal dynamics identified in the interviews and the FCM analysis. Secondly, through integration of their knowledge with difference co-production techniques during the stakeholder workshops, also when novel elements have been introduced. Climate mitigation was added to the discussions of improving the situation in the Vecht. While climate adaptation is a familiar concept for all stakeholders in the context of de Vecht issues, climate mitigation grew as an important and complementary vision element that became integrated throughout the development of the pathways. Scenarios have been introduced in different forms (Shared Socioeconomic Pathways, wildcards, Integrated Assessment Model projections) than normally used by the stakeholders. The interviews and workshop evaluation forms demonstrate that stakeholders are very familiar with the concepts of "drivers" (both short term and long term); "climate scenarios"; and "integrated planning" and less with socioeconomic scenarios. Stakeholders overall demonstrated appreciation of the novel concepts, both in the workshop and as inspiration for their work. Stakeholders particularly learnt that successful climate change adaptation and

mitigation needs to explicitly address socioeconomic futures at multiple scales. The use of wildcards and resulting robust pathways proved also effective in conveying complexity of exogenous socioeconomic system drivers at a scale different from the strategies developed in the pathways.
Overall, the successful integration of stakeholder knowledge resulted in an expansion of the originally designed concepts of "robustness" and "feasibility" which is the basis for further development of the Dutch case study. Possible obstacles, however, could be "stakeholder fatigue" due to the abundance of project and stakeholders meeting in adaptation and landscape planning for the Vecht. This element has also likely affected the low participant numbers in both workshops, despite high appreciation rates (Appendices III and IV). The integrated pathways and concepts from the first workshop were easily picked up by stakeholders. The iteration in the first part of the second workshop demonstrated convergence between two very different group of stakeholders. In both workshops, stakeholders could address the integration of the global impact results and LUMBRICUS actions more in-depth, at more advanced level than anticipated. Future development for the Dutch case study should explicitly integrate the role of the actors, their stakes across scale and further exploration of the socioeconomic dimension across scales.
In conclusion, the process showed that co-producing knowledge in a setting where there is a long history of public participation and a large number of existing scenarios, policies, and spatial plans calls for novel methods.
In particular:

1. Climate change scenarios could not be altered as national versions were developed by the Dutch Meteorological institute (KNMI) and were trusted and used
2. Socioeconomic scenarios could not be developed as adaptation plans and policies were already in place. Exploring plausible future outlooks was not a logical step to take. Wildcard and quantitative model outputs were more useful
3. Stakeholder fatigue was an issue. It was relatively difficult to engage all stakeholders that we wanted to involve, also because of the manifold (similar) meetings that most stakeholders were, are, and will be involved in.

The resulting adapted methods, however, can be applied in other high-information cases.

5.2 Difference between robust and feasible pathways

In the process, we developed cross-scale pathways aimed at achieving a multiscale vision to decrease the risk of trade-offs and increase synergies. Two main distinctions emerged between the application of scenarios in the first and second workshop that shaped the objective of developing robust and feasible pathways for the Vecht.
→ Robust pathways = across scenarios, tested by wildcards that represent broad socioeconomic contexts and associated worldviews. The focus was on transforming the current system towards the vision.
→ Feasible pathways = modifying the pathways in the face of uncertainty and incomplete information on how the future might develop. The consideration of top-down and bottom-up scenarios sharpens and narrows the scope by identifying physical and social constraints that were not yet considered as well as single actor winner and losers, implementation→ obstacles and opportunities.
In conclusion, the two-step multi-scale pathway development was successful. Three aspects stand out:

4. It is essential to start with a broadly supported, detailed, and integrated vision to ensure that all stakeholders can recognise their ambitions and to ensure that integrated pathways will be developed.
5. Separation of robust and feasible pathway development. It proved important to separate the discussions on what elements the pathways should contain across a range of plausible futures from discussions how these elements could be realised.
6. Including multi-scale aspects is important. Particularly the feasibility discussions in the second workshops showed how top-down processes lead to a different feasibility check than bottom-up, local initiatives.

Yet, even though the resulting pathways were multi-scale, feasible and robust, they are also first drafts that need further elaboration, particularly related to the feasibility. Short workshops are excellent to integrate multiple opinions and perspectives on different topics across scales, but they are insufficient to elaborate on the details of the feasibility. Follow-up workshops or interviews are necessary.

5.3 Complementarity of scenarios for the development of pathways

The analyses from Workshop 1 and Workshop 2 have demonstrated that the scenarios, presented in different goals, types and scales contribute to develop robust and feasible pathways towards a multiscale vision.

Both qualitative and quantitative scenarios have been used to test the robustness across scenarios and to guide the discussion on uncertainties, identifying and addressing trade-offs across scales. As mentioned in Section 5.4, the different form of visualisation contributed to the complementarity. Beyond their visualisation, qualitative and quantitative scenarios have long been identified as being complementary, for example in the approach of the Story and Simulation (Alcamo 2001, 2008) to balance credibility and creativity (van Vliet et al. 2012).

The application of scenarios in SENSES has resulted in novel properties of scenarios, in relation to developing pathways.

In the process, it has emerged that socioeconomic scenarios, as set of long-term plausible future outlooks, are essential to include when constructing both robust and feasible pathways. They have been underused in the Dutch case study, which is most likely to be illustrative for many more regional/local case studies.

Different types of scenarios need to be considered. Qualitative scenarios (wildcards, stories) are more important when discussing robustness, while a feasibility check demands (also) quantitative products.

5.4 Role of different visualisation tools in the scenarios for communication

Overall, there are an enormous amount of scenario-related initiatives, very often related to climate adaptation, using state-of-the-art climate scenarios and a variety of climate adaptation portals.

The co-production input of both workshop 1 and 2 contained different visualisation techniques to communicate scenarios such as infographics (multiscale vision), pictures (wildcards), graphs (IMAGE), maps (MAgPIE) and videos (Lumbricus). Visualisation techniques are a powerful tool for communicating knowledge and are often used for problem framing, yet the use in the workshops rather framed the solution space in which stakeholders were facilitated. Since the aim of the workshops was to use scenarios and not to develop them, framing the solution space with visualisation techniques facilitated communication of the output of scenarios rather than a discussion about the scenarios or problems.

Different forms of visualisation provided a synthesis of different aspects of a scenario and resulted in different processes and results as discussed in Sections 5.1 and 5.2. Visualising qualitative data stimulated creativity in the process, rather than elaboration on detail scenario-related dynamics as stimulated by scenarios in quantitative forms. We furthermore found that visualising qualitative data is equally practicable as visualising quantitative data. Therefore, visualisation techniques could be interesting for integrating qualitative and quantitative scenario knowledge.

In conclusion, given a wide variety of stakeholders with diverging experiences, expectations, and knowledge, it is important to offer a wide variety of visualisations. The crucial elements of the process (vision, scenarios, and pathways) were all carefully visualised such that they appealed to stakeholders and conveyed the necessary information. An essential division is between visualisation of qualitative and quantitative information. Co-production processes as undertaken here rely heavily of qualitative information and therefore on the visualisation thereof. However, it remains a challenge to convince stakeholders of the value of qualitative information, which gives additional urgency to this side of visualisation.

5.5 Link of Overijsselse Pathways to SENSES regional Toolkit and Lumbricus

The inclusion of bottom-up knowledge resulted to be complementary and resulted in being potentially a two-directional process.
In the first direction, as for the scenarios, Lumbricus knowledge has enriched the pathways. However, while largely the top-down scenarios constrained and narrowed the scope of feasibility, the bottom-up knowledge of these actions was nested within the pathways.
In the second direction, the SENSES pathways provide the context of feasibility for the short- and long-term future of the Lumbricus solutions, providing a much wider context than it is usually considered in for the development of specific solutions.
Even though this conclusion needs further testing in practice, the process of inclusion on the Lumbricus actions in the short term suggests that Lumbricus and SENSES offer complementary knowledge.

5.6 Main messages and lessons learned

We developed a novel method for developing multi-scale pathways in the Dutch case study. In the framing and results, we propose to distinguish between robustness and feasibility, which ensures that both multiple plausible futures are considered, while embedding pathways in the case-study specifics.
The proposed method is applicable in any information-rich setting with existing scenarios and/or pathways.
We identified nuances related to the visualisation challenges of scenarios and pathways in different forms.
Qualitative exploratory scenarios, also in the form of wildcards and cartoons contributed to the making and testing of robust pathways. Top-down quantitative scenarios resulted to be mostly effective in the identification of feasible pathways. Normative elements were added, enriching the pathways with concrete solutions that, in turn, needed to be embedded in a broader context.
Results indicate the pivotal role of the agricultural sector both in climate adaptation and climate mitigation, at present and in the future when the sector will have transformed.
We highlight that considering adaptation and mitigation jointly for the Vecht increases synergies and opportunities. Mitigation measures do not necessarily come at the cost of adaptive measures, as long as the stakes are considered at the appropriate scale.

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Appendix

I WORKSHOP I Invitation and participants

Organisation	Name	Email
Borgman Beheer	David Borgman	david@borgmanbeheer.nl
Climate Adaptation Services	Sandy Hofman	sandyhofland_9@hotmail.com
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Provincie Overijssel	Gerrit Valkeman	g.valkeman@overijssel.nl
Provincie Overijssel	David de Jong	D.d.Jong@overijssel.nl
Provincie Overijssel	Dianne Laarman	GJ.Laarman-Hoogendoorn@overijssel.nl
TAUW	Mark Zandvoort	mark.zandvoort@tauw.com
Trendbureau Overijssel	Annemarth Idenburgh	AM.Idenburg@overijssel.nl
Wageningen Universiteit en Research	Joreen Merks	joreen.merks@wur.nl
Wageningen Universiteit en Research	Jakob Wallinga	jakob.wallinga@wur.nl
Waterschap Vechtstromen	Wim Wassink	W.Wassink@vechtstromen.nl
Waterschap Drents Overijsselse Delta	Bert Kamerman	BertKamerman@wdodelta.nl

II WORKSHOP II participants

Organisation	Name	email
Waterschap Drents Overijsselse Delta	Bert Kamerman	BertKamerman@wdodelta.nl
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Global Center on Adaptation/DWA	Paul Langeveld	paul.langeveld@gca.org
Royal Haskoning DHV	Nanco Dolman	nanco.dolman@rhdhv.com
PBL	Jonathan Doelman	Jonathan.Doelman@pbl.nl
Wageningen University	Anna Keet	anna.keet@wur.nl
LTO Noord regio Oost	Jeroen van de Kamp	jvdkamp@ltonoord.nl

III WORSKHOP I Wrap up and evaluation

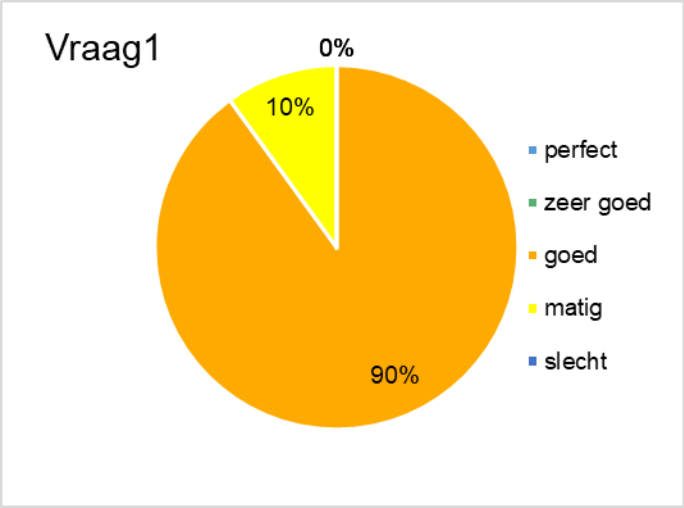
The day ended with the latest additions for the development paths. Participants were then asked to fill out an evaluation form. The evaluation was divided into 8 questions:

1. What appreciation would you give the workshop in its entirety?
2. What appreciation would you give the following parts of the workshop?
    a. Welcome and introduction SENSES
    b. Climate change strategies
    c. Introduction of global scenarios and wildcards
    d. Further development paths to minimise trade-offs
3. Which part did you like best and why did you like it best?
4. Which part could be improved and how?
5. Are you interested in attending a second workshop later this year? This workshop will probably go deeper into the link with the global scenarios and quantitative projections for the Netherlands and the Vecht region.
6. Could global scenarios be useful for your work and if so, what parts of the scenarios?

7. What appreciation would you give the following parts of the workshop?
    a. Facilitator
    b. Length of the workshop
    c. Logistics
    d. Location & Hotel
    e. Catering
8. Are there any further comments or additions you would like to share with us?

Question 1: What appreciation would you give the workshop in its entirety?

The participants could choose from perfect, very good, good, moderate and bad. Of the total (n=10), the workshop was rated 9 times and 1 time moderate. In the form, above question 1. , participant #3 has passed on the following: "I find it difficult to give my feedback in the form below" and under question 1 "I am here at your request, this is especially interesting to me whether the workshop has earned you anything".



Question 1 chart

Question 2: What rating would you give the following parts of the workshop?

    a. Welcome and introduction SENSES
    b. Climate change strategies
    c. Introduction of global scenarios and wildcards
    d. Further development paths to minimise trade-offs

The participants could also choose from the same categories, perfect, very good, good, moderate and bad for the parts a to d. Part a (n=6) has a score of 5 good and 1 very good. For part b (n=9) 1 scores very well, 2 moderate and the rest good. On the part c (n=9) this is the same. Part d (n=8) scores 1 very well, 1 moderate and otherwise good. Most of the participants rated the parts as good (23times) with 5 times moderate and 4 times very good. As a note for his/her slightly lower score for part c, participant #4 passed on the following "-Models ask for some more explanation, as this is not our daily work".

Chart question 2

Question 3 Which part did you like best and why did you like it best?

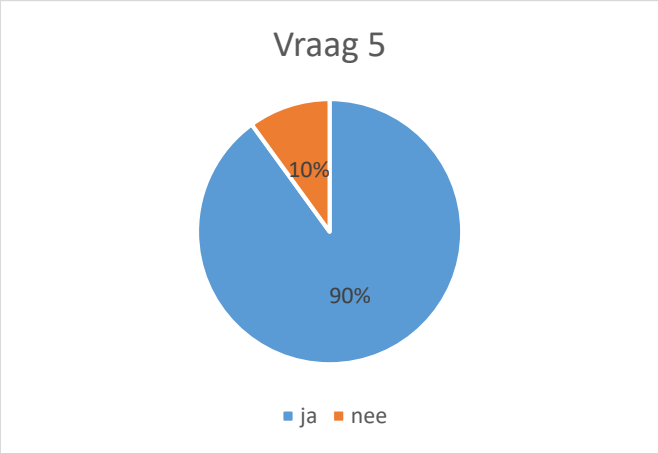
- The further elaboration of good to discuss with each other
- Work out a common development path
- Consistency sufficiently good, not a part that jumped out
- strategy --> more applied
- further elaboration, then everything came together
- Breakout group discussion
- I missed the first part. The whole thing was fine
- Further development paths to minimise trade-offs

Question 4 Which part could be improved and how?

- The introduction of the strategies and how this will have an impact ok local area, so that there are more substantive backgrounds
- Explanation of SSP method; explain the link between mitigation and adaptation
- See 3. All in conjunction
- Wildcards --> detaching from scenarios --> now too vague and difficult to apply
- at the beginning, an example of a climate adaptation development path
- interaction with the other group
- Clearly indicate the goal for each part
- Climate change strategies, I miss some info on what kind of effects are going on in the area

Question 5 Are you interested in attending a second workshop later this year? This workshop will probably go deeper into the link with the global scenarios and quantitative projections for the Netherlands and the Vecht region.

- yes (underline --> quantitative projections for the Fight)
- Yes
- Depends on it
- yes, interested though
- Yes
- Yes, but also try to make it spatial
- Yes
- Yes
- Sure
- No



Question 5

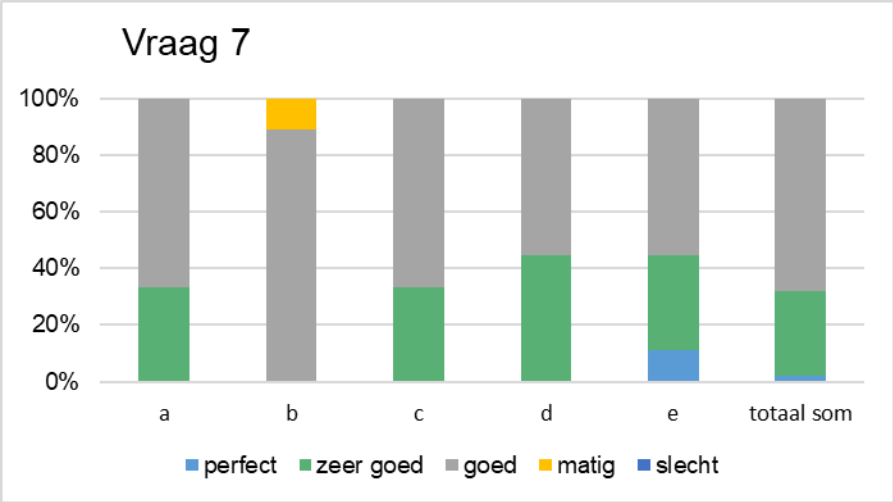
Question 6 Could global scenarios be useful for your work and if so, what parts of the scenarios?

- Now it's hard to estimate how to form a vision
- yes, for long-term course organization
- I find that a tricky one. I don't know how meaningful those scenarios are not direct. But i'm in the mood.
- Not directly. But in terms of strategy determination and insights
- N/a
- yes as a "stress test"
- Yes
- I find it hard to say. For most of the work they are too abstract, but interesting for the Vecht
- Yes

Question 7 What rating would you give the following parts of the workshop?

a. Facilitator
b. Length of the workshop
c. Logistics
d. Location & Hotel
e. Catering

The participants could also choose from the same categories, perfect, very good, good, moderate and bad for the parts a to e. A total of 9 participants filled out the answers. About the facilitator 3 are very good and 6 are good. For the length of the workshop there were 8 good and 1 moderate. The logistics is rated at 3 very good and 6 good. Furthermore, the location 4 times very good and 5 times good. Finally the catering is perfect 1 time, 3 times very good and 5 times well rated. Furthermore a respondent: question 7.2: one part of the day sufficient. Now some long workshop



Question 7

Question 8 Are there any further comments or additions you would like to share with us?

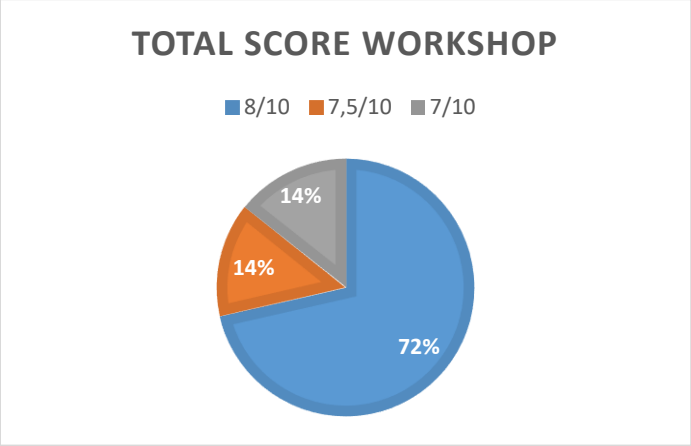
- It's interesting to be on it. Pretty much learned
- Focus on Governance: how to organize development path
- Comes there comes a coincidental Length Clutch
- Great workshop
- In the end, we did come up with an interesting analysis on the policy at this time and the shortcomings in it.

IV WORKSHOP II Wrap up and evaluation

After the workshop the participants were asked to fill out an evaluation form. A few participants send a digital evaluation form later. The form was separated into 6 questions. Seven of the eight participants filled in the evaluation form. Below, the questions and the analysis of the forms.

Question 1: What grade would you give the workshop in total on a scale from 1 to 10?

The mean grade of the workshop is a 7.8. A total of five participants responded with an 8, one responded with a 7.7 and one with a 7.

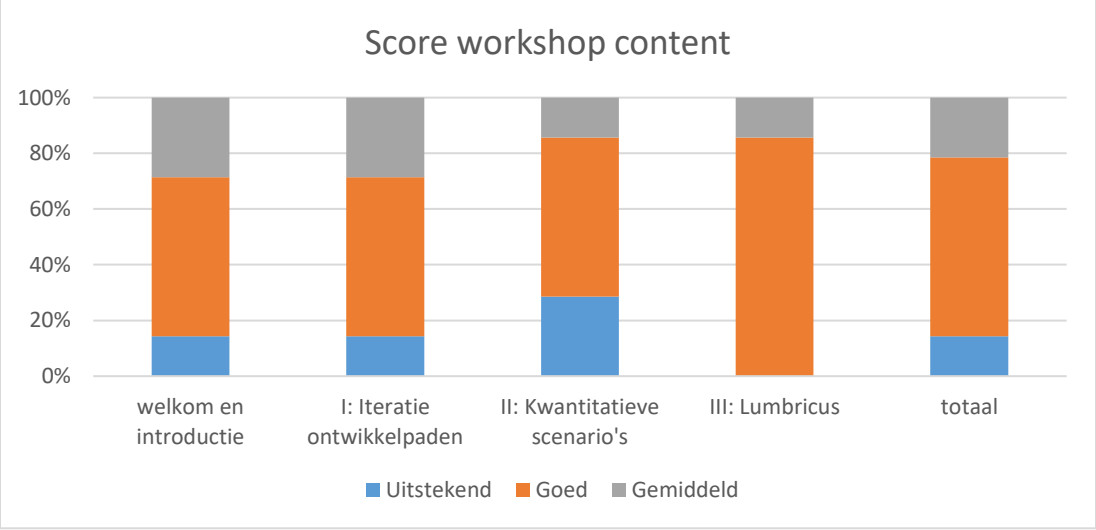


Pie-diagram total score workshop

Question 2: How would you evaluate following parts of the workshop?

e. Welcome and introduction SENSES
f. I: Iteration pathways
g. II: Quantitative scenarios
h. III: Lumbricus

The participants could evaluate the content of the workshop with excellent, good, medium, mediocre and bad for the 4 different components. On an average, the components scored 'good'. Part C/III scored as the highest component of the workshop.



Bar diagram of content scores workshop

Question 3 : Which part did you find best and why?

- Quantitative scenarios → translating global climate scenarios to regional/local

- I found every part good in itself. From my profession I found the Lumbricus part insightful. Practical, implementable measures to do.
- The elaboration/deepening of the developments in the Vechtdal (but also the global developments). Great discussion.
- Discussion provides insights on how to switch between large to small and also in time
- Discussion at the posters
- Part 3, here the different perceptions and topics came together
- The discussion at the posters, very well facilitated and great output. Now important: communicating.

Question 4 Which part could be improved and how?

- Perhaps a concrete case? Now a lot of emphasis on water and agriculture → also other transitions
- I would say a more elaborate introduction, but I wasn't present during the first workshop. So this might be the reason.
- It is difficult to do everything and to explain everything. And scenarios, and pathways, and projects. At the same time, the multiscale is the power of the discussion (see 3)
- Presentations a bit more structured
- Part 2, the link between global and regional scenarios was a bit missing.

Question 5 How would you evaluate following aspects of the workshop?

a. Facilitator
b. Length of workshop
c. Logistics
d. Location & Hotel
e. Catering

Participants could evaluate the facilitations of the workshop with excellent, good, medium, mediocre, and bad for the 5 different aspects. On an average the aspects scores between 'good' and 'excellent'. The logistics part scores highest followed by the facilitator and the location & hotel.

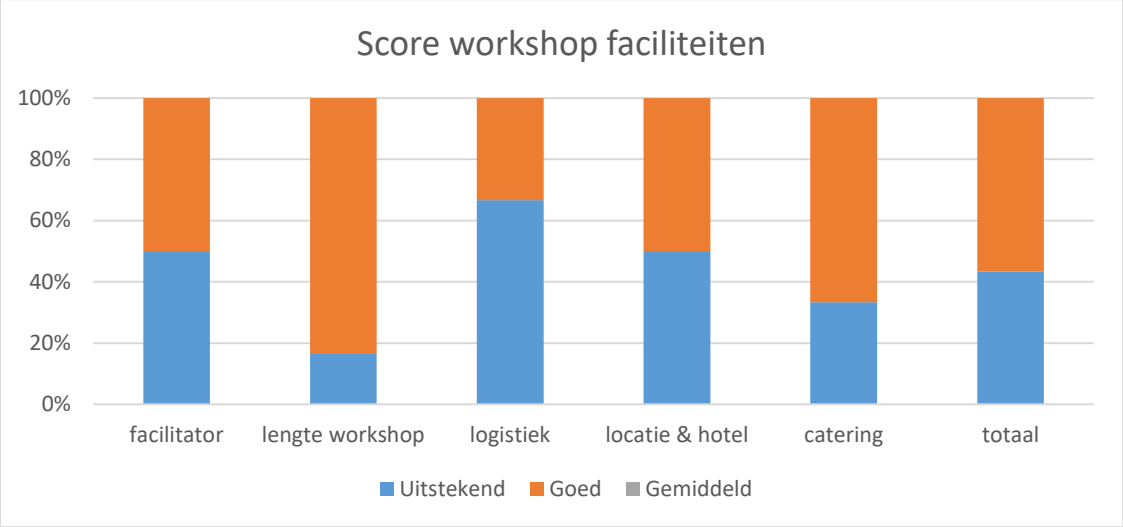


Figure 1 bar diagram scoring facilities of the workshop

Question 6 Do you have any additional comments which you would like to share?

- Keep on going
- Nope, thanks!

Greetings and thanks from Kasper Simona and Lotte!