Are climate boards the future rather than water boards?

An analysis of the contributions of the water boards to the energy transition

Figure 1. Energy transition (AGV, n.d.)

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An analysis of the contributions of the water boards to the energy transition

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Preface

You have before you the final product of my master's thesis, "Are climate boards the future rather than water boards? An analysis of the position of water boards within the energy transition". This thesis was written on behalf of the consultancy and engineering firm WSP and to complete the Environmental and Social Studies programme at Radboud University Nijmegen. It is the result of a long and demanding process, the realisation of which would not have been possible without the necessary support and guidance of some people to whom I would like to express my thanks.

First of all, I would like to thank my guide Mark Wiering. My sincere thanks for your patience and willingness to help, even though I had a hard time working at home during corona. Of course, also many thanks for the exciting ideas and provided knowledge about the research topic and the theoretical basis. I would also like to thank Pieter Westerik, my supervisor at WSP, for the weekly meetings we had. Even though you did not have a background in my field, I learned a lot from you, and I want to thank you for putting me in contact with people who proved to be very useful for my research.

I would also like to express my gratitude to all the people I interviewed and the water boards that completed my survey. Thank you for taking the time and providing me with all your answers and data.

Last but not least, I am very grateful for my friends and family; you know who you are. All the coffee breaks, dinners, walks, and kind words have been beneficial. I am sure you are as happy as I am to present the final version of my thesis to you.

I wish you all a pleasant read

Etiën Hoofwijk

Nijmegen, December 2021

Abstract

The Netherlands is on the eve of a drastic change in energy management. Water boards are all the more aware of the consequences of climate change, but the solution that is within reach is not yet fully exploited: energy transition. In conjunction with my graduation internship for WSP, this study attempts to answer the following central question:

> *"How do the water boards in the Netherlands experience the possibilities and limitations at the macro-, meso- and micro levels to contribute to the energy transition?"*

This central question will be answered using the Multi-Level Perspective (MLP) of van Geels (2000), looking at three different levels: macro (landscape), meso (regime) and micro (niche). The macro-level will focus on major trends, in particular climate change and sustainability. The water boards are placed in the most critical group, the meso-level. The partnerships with other water boards at different scales and with third parties will be examined here. Financial, professional and regulatory resources will also be considered. Finally, the routines and habits will be discussed— the micro-level looks at niche innovations that have been developed by or in collaboration with water boards.

The method used is qualitative and quantitative research. For the qualitative part, ten semi-structured interviews were conducted at four different water boards. These water boards were used as case studies: water board Limburg, Wetterskip Fryslân and Rivierenland. In addition, for the quantitative part, surveys were conducted at 18 various water boards to create an overall picture of the role of the water boards in the energy transition.

The significant trends have caused changes within the regime as the niches. The water boards are implementing measures due to climate change and sustainability. To start with, the objective that the water boards have set themselves to be energy-neutral by 2025. Furthermore, niche innovations also take trends into account, such as installing solar and wind parks to reduce co2 emissions. This is also an obstacle, as the focus on biodiversity has also created implementation problems. The niches also influence the regime, as they allow the water boards to accelerate the energy transition when a pilot study is successful and profitable. The limitation within the niches has to do with participation and support from citizens. Residents must be more involved in pilot studies in the future because it has been shown that this improves implementation. Various findings have been made at the meso-level. For example, there are sufficient opportunities in the areas of cooperation, financial and professional resources. However, all three are location-specific, which means that there are differences between the three case studies. The most significant limitations are experienced in the regulatory resources. Both the dilemma of the strict laws and regulations surrounding the installation of wind and solar parks and the fact that they are not allowed to supply electricity to citizens. The former hinders the water boards in their energy transition. The second ensures that there can be a regime change when a non-profit government body changes to a profit organisation that supplies the electricity.

Another finding that should be mentioned in the discussion is whether the term 'water board' is still comprehensive enough and whether it would not be better to call it a 'climate board' in the future. This is because of the ever-increasing range of tasks for the water boards with the advent of climate change and sustainability. This could cause a regime change for the water boards. An important counterargument is that the core tasks would be neglected precisely because of the broader range of functions.

To gain more insight into the role of the water boards within the energy transition, it is essential to involve other parties in the study by conducting interviews with the water boards' key partners or with people from the Union of Water Boards. Because people with different functions were interviewed in this study, it was sometimes difficult to make direct comparisons. It is also essential to keep in mind the differences between the water boards in terms of financial, professional and regulatory resources. These differ from one water board to another and underlie the speed of the energy transition. To gain a complete picture of the energy transition in the Netherlands, further research can be done into the influence of the same contextual factors on other levels of government, such as central government, provinces and municipalities.

Keywords: *water boards, climate boards, energy transition, multi-level perspective, regime*

Content

1. Introduction to the research

The Netherlands is on the eve of a drastic change in its energy system. To keep global warming to a minimum, greenhouse gas emissions must be reduced dramatically. Water managers are all the more aware of the consequences of climate change, such as heat stress and drought this summer and flooding caused by increasingly frequent heavy rainfall. The water boards want to contribute to energy transition to limit climate change and ensure that regions remain safe and habitable, but to what extent is this possible?

1.1 Research problem statement

The climate conference in Paris in 2015 opened many people's eyes, and it became clear that something has to change in the world. One of the most critical agreements in the Climate Agreement is that the global temperature must not rise by more than two °C, with a maximum increase of 1.5°C targeted. To meet this target, a drastic reduction in greenhouse gas emissions is needed, to which all countries will have to contribute. For the European Union, it has been determined that in 2050 greenhouse gas emissions must be 80 to 95 per cent lower than in 1990 (PBL, 2016). In addition to the Paris Climate Agreement, the Netherlands also adopted the Energy Agreement for Sustainable Growth (Energieakkoord voor duurzame groei) in 2013. This consisted of an agreement between the government and more than forty other organisations, which will work together to make society more sustainable, and thus automatically to make the energy supply more sustainable (SER, 2013). The emphasis in the energy agreement was mainly on energy policy. Despite the Energy Agreement of all the European countries in 2015, the Netherlands was the furthest away from the set target for the share of renewable energy in 2020. Under the European Renewable Energy Directive, it is set that the Netherlands will generate 14 per cent of its consumed energy sustainably by 2020 and 16 per cent in 2023. Notwithstanding the significant progress made in the Netherlands from 5.8 per cent in 2015 (Eurostat, 2017) to 11 per cent in 2020 (VEMW, 2020) generated from renewable energy, the 14% target has not been achieved.

In 2019, The Energy Agreement for Sustainable Growth gradually changed into the 'Climate Agreement' (Klimaatakkoord), as energy policy is an integral part of climate policy. The Climate Agreement is an initiative of the government and builds on the energy agreement, whereby the arrangements are taken over in the Climate Agreement. The essence of the Climate Agreement is to reduce the emission of greenhouse gases (Klimaatakkoord, n.d.). This involves looking at how electricity and heat are generated and used and the emission of greenhouse gases in other sectors, such as agriculture and industry. This broader vision means that more parties are taking part in the Climate Agreement. Subsequently, the Climate Act (Klimaatwet) has emerged from this Climate Agreement. The Climate Act lays down the national climate goals for 2030 and 2050 (Rijksoverheid, 2020). Then the Climate Plan (Klimaatplan), which was created based on the Climate Act, contains the main lines of the climate policy for the next ten years. In addition, the Climate Act addresses the latest scientific insights about climate change, technological developments, international policy developments and the economic consequences. Thus, the Climate Plan contains the national policy, the context in which that policy is developed and the results. In addition to the measures from the Climate Accord, the Climate Plan also contains; policies that follow European obligations, current policies and policies announced in the coalition agreement that is not part of the Climate Accord. As a result, the Climate Plan provides an integrated picture of the government's climate policy for the next ten years (Rijksoverheid, 2020).

CBS mentions several reasons for the Netherlands' low share of renewable energy compared to other countries, including the lack of hydropower plants due to the Netherlands' geographical location (Spijkerboer et al., 2017). Hydropower stands for energy generated from flowing or falling water. The great advantage of this energy source is that the output is stable and predictable, whereas the supply of wind and solar energy can vary greatly (Stowa, 2018). For this reason, hydropower is an essential source of energy worldwide: 70 per cent of all sustainable energy is generated from this source. The main reason that hydropower still plays a minor role in the Netherlands is the slight height differences in the country (CBS, 2017). According to Van den Noortgeate (2016), however, hydropower can make a more significant contribution to the share of sustainable energy in the Netherlands through new techniques and innovative implementation

possibilities. Another advantage of hydropower is that relatively few raw materials need to be extracted for the turbines, and they have a little spatial impact on the landscape. A disadvantage of hydropower plants is that the turbines can harm fish and that fish migration routes can be blocked. Combining sustainable energy with a sustainable ecosystem is, therefore, a dilemma. Besides hydropower, there are several possibilities for recovering and generating power on the land used by water boards. These include aquathermy, energy from the sun, wind energy and biogas.

Aquathermy is a collective for the extraction of thermal energy from surface water, wastewater and drinking water. The temperature of surface water is a promising option for heating and cooling buildings and homes. At least 40 per cent of the buildings in the Netherlands can potentially be heated with aquathermy. This makes it a sustainable alternative for natural gas, and this thermal energy can play an essential role in the energy transition. These technologies are directly connected to the water managed by the water boards and the Department of Waterways and Public Works (Rijkswaterstaat) (Stowa, 2018).

The amount of solar energy generated in the Netherlands is rising sharply each year. There are several options for installing solar panels in the area managed by water boards and the Department of Waterways and Public Works, such as floating solar panels. The sun is the largest energy source for the earth, and 70 per cent of the earth's surface consists of water. This makes floating solar parks worldwide an excellent potential for generating sustainable energy (Stowa, 2018). Another example is the concept of 'sun on dykes'. Water managers are therefore regularly asked by promoters whether they can install solar panels on the dikes.

The Netherlands is made for wind energy because it has frequent and strong winds. Therefore, the potential for generating electricity with wind turbines is relatively large. The most significant advantage of wind is that it comes from a source that never runs out. On the other hand, the supply of energy fluctuates, as it can be windy or windless. The national and provincial governments have made agreements on the distribution of the number of wind farms. Each province designates one or more locations for 'their' wind farms. The larger waters, such as the Ijsselmeer, are also considered. All aspects, such as wind conditions, nature and environmental interests, and the living environment, are considered when choosing locations. In the Netherlands, the wind is currently the largest source of sustainable energy (Stowa, 2018). The number of wind farms is growing steadily, and in the search for space, as with solar energy, the dikes are also being considered.

To achieve the climate targets set in Paris, all 7.6 million homes in the Netherlands must be cut off from fossil fuels by 2050. Nevertheless, gas will continue to be needed as a source of energy in the future, for example, for producing high-temperature heat in industry and heating old buildings. For instance, green gas, produced from sewage sludge, could be an alternative for 'grey' (fossil) natural gas. Water boards are studying how more gas can be made from sewage sludge. In principle, treating household wastewater in a traditional sewage treatment plant costs much energy. Most of the energy consumed is used to aerate the activated sludge in the biological treatment plant. Biogas can be produced by digesting sewage sludge. By digesting sewage sludge, biogas can be made, having energy (Stowa, 2018).

This adds up to a rich pallet of possibilities. However, these possibilities are also accompanied by several barriers. Four general barriers to energy transition can be distinguished: financial, institutional, technical and societal. The most common barrier within the energy transition is the financial barrier because, in many cases, it is difficult to obtain sufficient capital for the required investments (Bomberg & McEwen, 2012). In addition, according to Huygen (2013), legislation and regulations are also a substantial barrier encountered by local initiatives. This mainly concerns obtaining permits and subsidies and the time that this takes. Technological barriers also play a role, namely the lack of technical infrastructure or technical knowledge and experience (Walker, 2008). Finally, there are the social barriers, which mainly concern the degree of support (Bomberg & McEwen, 2012). When these barriers can be overcome, the 21 water boards in the Netherlands could play a significant role in the energy transition in the future, as they have set the goal of being energy-neutral by 2025 (Stowa, 2018).

The water boards currently ensure dry feet, clean water and sufficient water. To this end, they manage around 18,000 km of dykes, 225,000 km of watercourses, 6,175 pumping stations and 325 sewage treatment plants, where 2 billion m3 of wastewater is treated every year. As a result, the water boards, with their expertise, are considered a global example in the field of regional water management (Unie Van Waterschappen, n.d.). Water boards are functional, decentralised administrative bodies responsible for regional water management in the Netherlands. To make their work possible, water boards levy taxes, which they use to finance virtually all of their tasks. This makes water boards very different from provinces and municipalities, which have a general study and depend mainly on the central government for their income.

This study will look at the possibilities, limitations and incentives for water boards to contribute to the energy transition. Regarding the incentives, there will be an emphasis on the different interpretations of the 'energy transition' phenomenon. All this is done in the assignment for my internship at WSP. WSP is a global consulting and engineering firm headquartered in Montreal, Canada. WSP offers technical expertise and strategic advice to clients in the environment, real estate & buildings, transport & infrastructure, water, industry, raw materials and energy. In the Netherlands, 400 employees work at 10 locations throughout the country. They offer an integral service package in construction, infrastructure, energy, water and the environment (WSP, n.d.). It appears that within WSP, there is not yet a clear picture of why water boards are not sufficiently committed to creating an energy-neutral climate. This study tries to make a more comprehensive picture by looking at the role of water boards in the energy transition.

1.2 Research aim and research question

This research aims to make an empirical contribution to the possible role of water boards in the energy transition. The study contributes to the discussion on an energy-neutral climate in the Netherlands in 2050. The emphasis will be on the possibilities, limitations, and incentives experienced by the water boards about the energy transition and how they view the 'energy transition' phenomenon. This focus results in the following research question:

> *"How do the water boards in the Netherlands experience the possibilities and limitations at the macro-, meso- and micro levels to contribute to the energy transition?"*

Answering this research question will be done by answering the following sub-questions:

1. *To what extent do the trends of climate change and sustainability affect the water boards? / to what extent do significant trends affect the water boards?*

2. *What niche innovations are there, and what role do the water boards play in them?*

3. *How does communication between the water boards themselves and at different levels (local, regional and national) with other parties affect their role in the energy transition?*

4. *What financial, professional and regulatory resources do the water boards have (within the energy transition)?*

1.3 Societal and scientific relevance of the proposed research

Societal relevance
Water management in the Netherlands is at the start of a transition. This transition entails a different way of thinking and working for the water managers. The new way of thinking is an integral and sustainable way of water management, creating room for the river instead of restricting it (Koen, 2013). In addition, the water boards have set themselves the goal of becoming energy-neutral in 2025. In addition to their plan, they also want to contribute to the national purposes of making the Netherlands largely energy-neutral by 2050. The water boards have already been working for some time to save and sustainably generate energy. For instance, biogas has been produced from sewage treatment plants for several years now, and locally generated solar energy is used to operate sluices (Stowa, 2018). However, water boards can achieve more with their management areas and assets than they do now. Theoretically, there are

more possibilities, such as installing floating solar panels on a large scale. However, from a technical, economic and social point of view, they are not.

All in all, this necessitates a new way of thinking about water for various parties. These parties include the government, water boards and WSP. Firstly, the government benefits because it has to comply with the requirements of the climate summit, which laid down rules about the maximum temperature increase of 2 degrees. Secondly, the water boards benefit because each has unique characteristics and participates in the energy transition. Thirdly, it is of social interest to the company WSP. This research is being carried out because it is unclear what the intrinsic reason is for the water boards to participate in the energy transition. This research is an attempt to map this out clearly. The energy transition cannot succeed without cooperation between these parties, who hardly know each other (Stowa, 2018). The energy transition requires a form of system thinking and 'stacking opportunities'.

Scientific relevance
A great deal has already been published on individual organisations within the water network, primarily the water boards (Allers and Hoeben, 2010). However, there are hardly any publications on the water network as a whole. This study addresses this gap by looking at all water boards as a whole and what possibilities, limitations and incentives they experience to participate in the energy transition. It is precise because there is a gap in the literature on all the water boards together that it has not yet been identified what the missing link(s) is between the energy transition and the water boards. Furthermore, the literature review has shown that research on institutions involved in water management focuses mainly on water management at the national or supranational level and that water management at the regional level has remained somewhat underexposed (Moss, 2012). This study will look at both regional and national policies through a survey of all water boards and a multiple case study between two different water boards.

Together, these reasons make a knowledge gap concerning the water boards and the possibilities, limitations, and incentives they experience about the energy transition. This research should contribute to solving this. Because it is in a take-off phase, the energy transition forms a suitable framework for analysis into the initiation of significant, systematic changes. This is where the scientific relevance of this research lies.

1.4 Reading guide

The main question formulated above will be answered during this research. In chapter two, the international literature will be discussed first, based on the water-energy nexus. In chapter three, a theoretical framework is established in which this research will be situated. Here, instead, the phenomenon of transitions is explained, and then the three key concepts that underlie the transition theory are explored: multi-stage, multi-level and transition management. The multi-level perspective is central to reflecting the big picture of the study. Next, we zoom in on the energy transition, the water boards and the criticism that has been levelled against transition theory. This is followed by the operationalisation of the macro-, meso- and micro-levels. Finally, a conceptual model is determined. In the fourth chapter, the study's methodology is justified, and the research strategy is discussed in more detail.
The selection of the three cases is also justified and briefly explained—chapter five starts by outlining the role of all the water boards within the energy transition. Next, the following three water boards will be discussed as case studies: Limburg, Wetterskip Fryslân and Rivierenland. Based on this analysis, the conclusion in chapter six answers the sub-question and the main question raised in chapter one. Furthermore, recommendations are made for interested parties, and there is a critical reflection on this conclusion in chapter six. This report ends with a reference list in chapter seven and an appendix with the survey, interview guide, and transcriptions.

2. The water-energy nexus

Water and energy are the world's two most critical and essential resources in the global pursuit of sustainable development in response to the United Nations Sustainable Development Goals. A comprehensive and thorough understanding of the interdependence of water and energy is of great importance (Lee et al., 2017). This will enable a complete understanding of the energy-water nexus, identify where more integrated policy and management strategies and solutions are needed or available, and understand where barriers to such integration exist. The water-energy nexus is increasingly highlighted in the literature as a critical item for future sustainability planning and strategic policy considerations, especially as the two resources are highly vulnerable to the impacts of global climate change. Moreover, a substantial part of the world's population is water scarcity due to climate change. A lack of understanding of the interdependence of water and energy within a system can lead to excessive use and mismanagement of resources (Lee et al., 2017). Several countries have initiated projects to study the extent of their energy-water interdependencies and have outlined future policy guidelines. However, many studies are based on energy systems, partly because the energy needs of water systems (i.e. energy for water) have been less studied, and urban water systems are often managed separately. Even though water and energy security have received noticeably more attention from scientists and practitioners, the interrelationships between the two energy and water sectors are currently insufficiently researched and explored (Marsh and Sharma 2007; Proust et al., 2007).

Apart from being under-researched, water and energy are recognised as vital inputs for modern economies. In recent years, driven by the three imperatives of security of supply, environmental sustainability and economic efficiency, the energy and water sectors have undergone rapid reforms. For a large majority of developed countries, the structure, ownership and regulation of the energy sector have been strongly influenced by the developed management strategies that have been put in place (Marsh, 2008). In the water sector, the continuation of decades of research and the recognition of the importance of freshwater resources (Falkenmark, 2003) have led to the initiation of extensive water reforms. These water reforms emphasise the need for watershed planning and management, a fair distribution between consumptive and non-consumptive uses, pricing that fully recovers costs, and multi-stakeholder participation in governance. There has been an extensive study of water use in the agricultural sector (Molden, 2007). The energy sector has been thoroughly assessed for greenhouse gas emissions and carbon reduction costs of different energy supply options (McKinsey & Company, 2008). Recently, public awareness initiatives have been taken at the consumer and household level to reduce energy and water use. As a result, the use of small-scale renewable energy sources is increasing, particularly among farming communities (Byrne et al., 2007) and individuals (Zahedi 2010).

Since the start of this research initiative in 2008, several international institutions have recognised the importance of the energy-water interaction. These include the United Nations, the World Business Council for Sustainable Development, and individual national governments and multinationals (Hoff, 2011). This growth process is partly responsible for more research into water management is uncovering new insights that can be useful to policymakers, practitioners and scientists in the many relevant fields. For example, it has been shown that by 2035, global primary energy demand will increase by 40% compared to 2010. Water and energy conservation are becoming essential prerequisites for sustainable development globally (Dai et al., 2018).

The most complex challenges for policymakers arise when water and energy are interdependent. Large amounts of water are needed for, among other things, coal mining and the generation and distribution of electricity from traditional and renewable sources. For example, the US energy sector is the largest user of water in the global economy (Carter, 2010). Conversely, energy is needed to pump, transport, treat, and distribute water, particularly in drinking water production through desalination plants and water and wastewater treatment plants (Stillwell et al., 2011). Precisely because the overall water sector is not a significant energy consumer, there are many options for win-win solutions for climate change, energy security and water conservation for governments seeking to reduce national greenhouse gas emissions. Take Australia, where the energy consumption of water utilities is only 0.2% of total energy consumption. Despite this low percentage, higher efficiency gains can be achieved in the water heating part of the cycle. Water heating accounts for 25% of residential energy demand and 27% of greenhouse gas emissions in Australian households, excluding transport (Kenway et al., 2008). This suggests that, at a national

level, a 15% reduction in domestic hot water use or a commensurate increase in the efficiency of domestic hot water systems could fully offset the total energy used by utilities supplying the households in question (Kenway et al., 2008).

Despite the dependency of the two sectors, energy and water policies are, for the most part, developed separately in the existing policy frameworks. This creates a degree of policy fragmentation that leads to misguided developments in both sectors. The growth of desalination plants to combat water scarcity (Pittoc, 2011), the large-scale pumping of groundwater for water supply (Shah et al., 2003) and decentralised water supply solutions such as rainwater tanks (Kenway et al. 2008) are all illustrations of dubious trade-offs between water and energy security. The difficulty is compounded by climate change mitigation policies pursued by national governments and the UNFCCC. These policies favour several water-intensive energy sources and carbon sequestration methods that exacerbate the negative interaction between water and energy, mainly when applied in areas of concentrated and arid. Besides first-generation biofuel production (Opperman et al., 2011), carbon capture and storage technologies (Stillwell et al., 2011) are examples.

Incomplete information on the interaction between energy and water at multiple scales can mean that policy measures designed to increase efficiency in one sector may create additional demand in the other. Conversely, in some cases, the effort for efficiency in one industry has had a positive knock-on effect in the other. For example, showering for less time can drastically reduce both water and energy consumption. Similarly, shifts in production techniques in some private industries to reduce carbon emissions can, in turn, reduce water consumption, even if this was not originally intended.

In many cases, the negative interactions between energy and water are unavoidable. Nevertheless, decisions and resulting policies should be based on sound evidence and use an overall risk assessment. To make informed decisions leading to the integration of the energy and water sectors, a better understanding of the conflicts and synergies between energy and water - and related sectors such as agriculture - is essential, as well as knowledge of the barriers and factors preventing better integration and, finally, of the policies likely to lead to better-integrated outcomes. However, understanding and managing the energy-water nexus means something different for each person. For one person, it may be a footprint of other technologies and production processes; for another, it may be much less quantifiable and consist of the potential impacts of the rapid expansion of hydropower production on biodiversity and ecological health. Nonetheless, as a challenge deeply embedded in the commitment to sustainable development, a complete understanding of the energy-water nexus is essential in any attempt to formulate policies for more resilient and adaptive societies (Newell et al., 2011).

3. Literature review and theoretical framework

Within this thesis, various theories are used. These theories serve as 'spectacles' with which to look at reality. The different approaches give content and direction to the further elaboration of the question and objective of the research.

3.1 Theoretical framework

Transitions
A transition is a fundamental change in the way a social system operates. A transition is a long-term process, varying between 25-50 years, resulting from a co-evolution of, among others, economic, ecological and technological processes and developments at multiple levels of scale (Dirven et al., 2000). During a transition, various products and events at different levels of hierarchy from various domains reinforce each other positively (Dirven et al., 2000). As a result, a transition is often described as a process of the co-evolution of markets, networks, institutions, technologies, policy, individual behaviour and autonomous trends from one relatively constant system state to another. This is simplified in the form of an S-curve in figures 1 and 2. These figures show that a transition trajectory can be seen as a systemic change from slow equilibrium dynamics through a period of fast and unbalanced development leading back to proportional stability (Rotmans, 1994). Between these two equilibrium states is a period of rapid change in which the system experiences a definitive change and (re)organises itself once again.

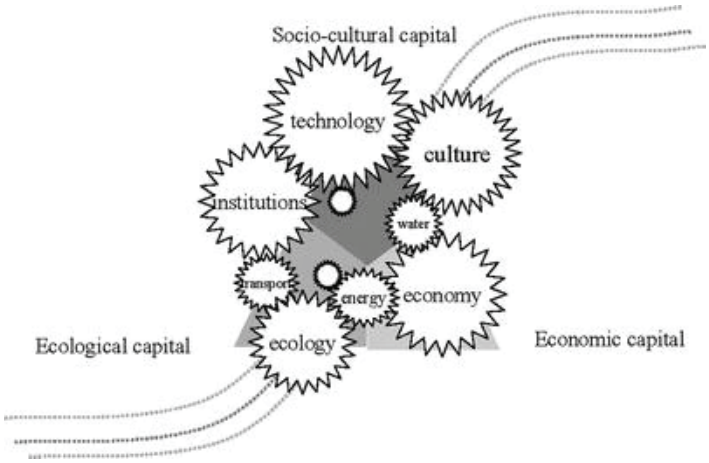

Figure 2. Figurative illustration of a transition as a complicated set of social cogwheels (Martens and Rotmans, 2002)

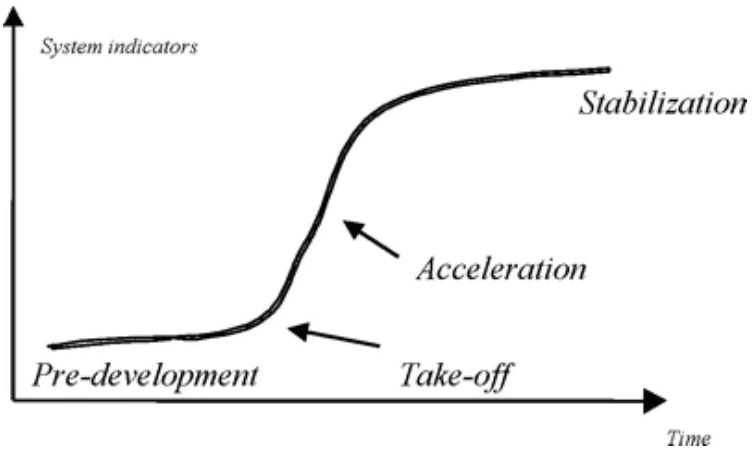

Figure 3. Four phases of a transition process (Dirven et al., 2002)

One of the conditions for creating transitions is that multiple developments in different areas influence each other to reinforce each other positively. Shifts result from slow social changes and short-term fluctuations or developments that abruptly trigger a non-linear response. *Figure 1* illustrates a transition as a complex set of cogwheels interacting. They can easily interlock, but once in a while, the cogs power each other up and move unequivocally in one direction.

Three key concepts are underlying the transition theory: *multi-stage, multi-level and transition management*.

Multi-stage
The multi-stage concept looks at transitions from the point of view of a change, particularly the speed involved. From this perspective, a transition can be described in the following four stages (Rotmans et al., 2000) (f*igure 2*):

1. A pre-development phase of a resilient balance sheet in which the status quo does not change overtly, but changes on the outside

2. A take-off phase in which obstacles are overcome, and the system's situation begins to change
3. An acceleration phase in which visible structural adjustments take place rapidly through an accumulation of mutually reinforcing socio-cultural, economic, ecological and institutional changes
4. A stabilisation phase in which the speed of social change slows down and a new resilient balance is achieved

It should be noted that the speed of change in transitional processes is relative, which makes the definition of system boundaries essential.

Multi-level
The multi-level perspective (MLP) is the second transition principle, characterising the division between functional scale levels on which transition processes occur: macro-, meso- and micro-level. This is based on the theory of Geels and Kemp (2000), who use the classification; niches, regimes and socio-technical landscapes to describe technological changes in socio-technical systems (f*igure 3*).

The MLP, unlike other theories such as Christensen's disruptive innovation approach, broadens the unit of analysis from technological products to socio-technical systems that perform societal functions such as mobility and housing. These systems consist of a mutually bound and co-evolving mix of technologies, supply chains, infrastructures, markets, regulations, user practices and cultural meanings (Geels, 2004). Sociotechnical systems evolve over many decades, and the alignment of these different elements leads to path dependency and resistance to change. Existing systems are maintained, defended and progressively improved by established actors, whose actions are guided by ‘socio-technical regimes’, the semi-coherent set of rules and institutions (Fuenfschilling and Truffer, 2014).

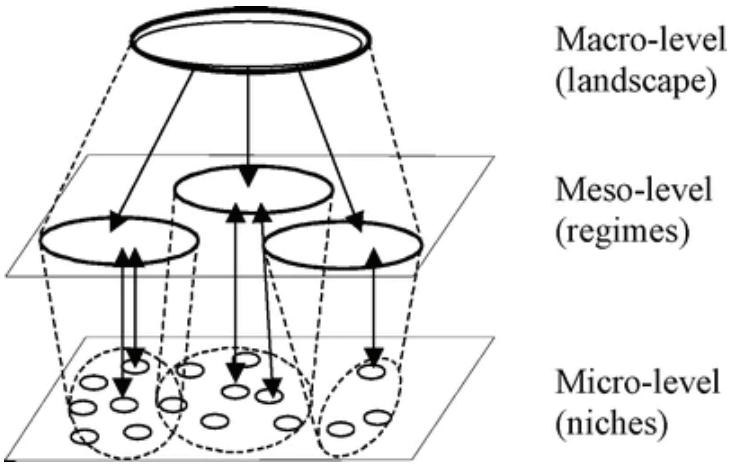

Figure 4. Interactions between landscape, regimes and niches (Geels and Kemp, 2000)

The social landscape is defined at the macro level by changes in macroeconomics, politics, population dynamics, the natural environment, culture, and world views. This level responds to relatively slow trends and large-scale developments that play an influential role in speeding up or slowing down a transition, most of which is immutable. At the meso-level, regimes operate. Regimes are paradigms of artefacts, institutions, rules, and norms formed and maintained to carry out economic and social activities (Berkhout et al., 2004). At this level, power is determined by the dominant practices, rules and shared assumptions, social norms, interests, traditions and belief systems that underpin the strategies of companies, organisations and institutions and the policies of political institutions, which are primarily geared towards maintaining the status quo. In other words, optimisation and protection of investments rather than system innovations. At the micro-level (niche level), individual actors, deviating technologies and local practices are distinguished. As a result of new ideas and current initiatives and innovations, such as new technologies and

social practices (Kemp et al., 1998), both changes and deviations from the status quo occur within this micro-level.

Figure 4 provides an ideal representation of how the three levels dynamically influence each other in revealing socio-technical transitions. Although each transformation is unique, the overall vivid pattern is characterised by changes emerging from the interaction of processes at different levels: (1) niche innovations create internal momentum, (2) shifts at the landscape level create pressure on the regime, and (3) failure to sustain the regime creates openings for niche innovations. The emerging interactions can be further subdivided into several phases, e.g. emergence, take-off, acceleration and stabilisation (Rotmans et al., 2001). Each of these phases can be linked to specific mechanisms (Geels, 2005a).

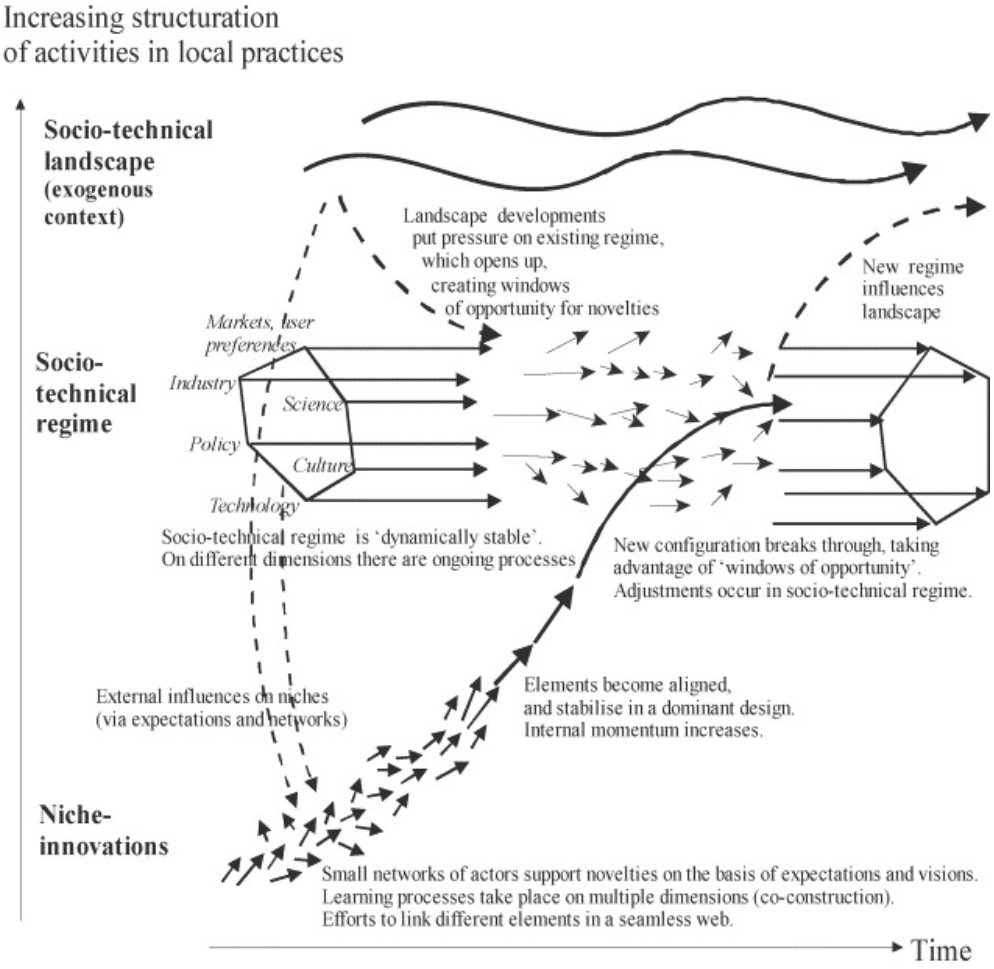

Figure 5. The multi-level perspective on transition (Geels, 2002)

When the multi-level and multi-stage theories are coupled, the following situation emerges.

In the pre-development phase, the regime often forms a barrier to transition. This arises from the regime's tendency to protect the status quo. The take-off phase is reached when there is a transition of developments at the micro and macro levels. The transition between these phases is characterised by ideas or perspectives from different fields coming together to form one new paradigm. Often, a period of polarisation takes place between the old paradigm and the paradigm that lies ahead. Parts of the regime will try to incorporate this new paradigm. This is where the dynamics within the regime increasingly match the ideas and patterns within the micro-level. In this period, the results of an emerging regime are essential, as the results push the regime over the edge into a new regime, as it were. If the results lag, there is a chance that the transition will not take place. In the acceleration phase, the regime plays an enabling role by investing capital, knowledge and technology. The regime changes by finding solutions for the top-down pressure from the macro-level and the bottom-up pressure from the micro-level. As the three levels

reinforce each other, a rapid and irreversible transition occurs, resulting in a stabilisation phase (Van Der Brugge et al., 2005).

Transition management
The third concept of transition theory involves managing transitions, referred to as transition management. Transition management is a process-oriented management philosophy that has its origins in areas such as multi-level governance and adaptive management (Rotmans et al., 2000). Transition management originated from the coordination of multi-actor processes at multiple levels aimed at long-term sustainability. This can be achieved by establishing a joint problem perception and long-term vision, innovation networks and experimental playgrounds.

Transition management consists of four interlinked lines of development that develop cyclically and iteratively:
1. Creating a transition arena (an innovation network), which includes a variety of actors,
2. The generation of complete long-term visions, transition paths and agendas,
3. A steering process based on knowledge development and learning effects and
4. Monitoring and reviewing the transition process. This collective search and learning process occurs in a transition arena, which functions at a distance from the current policy arena (*figure 5*).

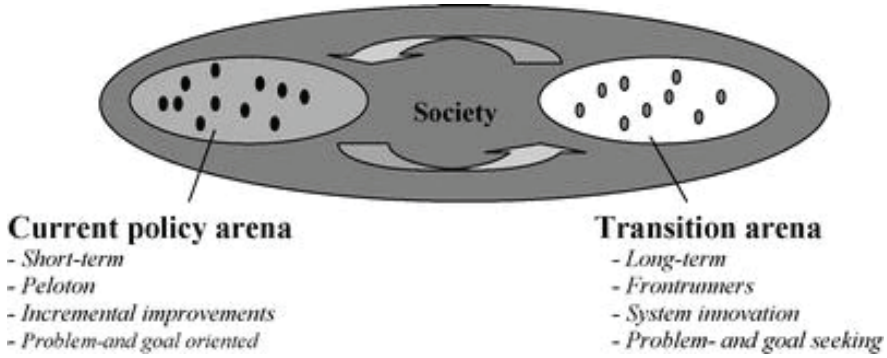

Figure 6. Transition management process (Dirven et al., 2002)

Only when the visions, agendas and experiments are tangible and well-thought-out enough can they be taken up by the policy arena.

In the transition arena, a select group of stakeholders, such as the government and the market, from different groups and disciplines come together to collectively formulate a shared perception of the problem and the future. This is followed by the mapping of transition paths which result in the shared vision of the future. This is done using scenarios, risk and uncertainty analyses and trend analyses. The active dissemination of the network's image and transition paths must lead to a growing group of people joining the innovative web. This network is small and consists of pioneers and visionaries who put effort into carrying out transition experiments. When each member of the network sets up its arena, the vision of the future spreads quickly, and the transition is controlled in this way (Van Der Brugge et al., 2005).

The concepts of multi-stage and transition management are practical concepts when it comes to large-scale mapping transitions. The difficulty of transitions makes it complex to test them empirically. However, they can be used theoretically to explain a transition. Within this research, an attempt is made to identify the energy transition and make recommendations on how this transition can be managed. This theory is selected because it is cited in much of the literature on transitions in water management. In addition, there are few alternatives available.

Energy transition
The energy transition is a transition that looks specifically at how energy is generated and tries to move towards sustainable generation through renewable sources. The current energy transition is not the first energy transition that has ever taken place; there have been several transitions within

the global energy generation. Until the beginning of the 19th century, renewable energy in Europe was mainly based on muscle power from people or animals and wind or water power. The first energy transition to coal occurred in the middle of the 19th century, followed by oil and natural gas (Hölsgens, 2016). Now that it is generally known that the significant source of fossil fuels is finite, sustainable development is needed. The Brundtland Commission defines this sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Van der Hoeven & Horsten, 2010, p. 13), also the definition of sustainability. With the current energy transition, society is trying to use as much renewable energy as possible to reduce CO2 emissions.

The current transition to renewable energy is complicated by the many actors that must be considered, such as politicians, researchers, consumers and businesses (Geels, 2011). Rotmans (2003) sees the energy supply problem as persistent, which has arisen due to 'flaws' in various social systems. These flaws are barriers that prevent the system from functioning optimally. The persistence of the problem lies in the fact that it occurs at several levels, such as the economy, institutions and society (Rotmans, 2003). On top of this, systems with old solutions within old institutions and rules of play have continued to operate for too long. The barriers are partly due to the conservative attitude of institutions and governments (Rotmans, 2003). It is, therefore, not only essential to make a transition. Consequently, it is necessary to change the energy industry and government bodies (Rotmans, 2011).

Water boards
There are currently 21 water authorities in the Netherlands, which, like the other levels of government, have a task for the public good. Their main job is to take care of the water defences and water management, or in other words, the surface water. In the 13th century, landowners started to control the water, such as building dykes or windmills. As a result of these ever-growing projects, the water boards came into being. In passing, the tasks of the water boards were expanded to include water level management, the purification of wastewater and the design and maintenance of waterways (Unie van Waterschappen, 2007b).

The quantity and quality of the water used to be taken care of by different water boards. These two tasks have now been merged because they could not be separated. As a result, 'all-in' water boards emerged that carried out both tasks. The water boards' responsibilities for water quantity and quality cannot be carried out without considering other areas where water plays a role, such as spatial planning. They must coordinate with these other areas as early as possible (Commissie Water en Ruimte, 2010).

The water boards are at the start of a water transition (Rotmans, 2006). According to the Union of Water Boards (2007a), the water boards face significant internal changes and changes to their environment, both now and in the future. Some of these changes are mentioned below:

- **Climate change** - The climate is changing, which means, among other things, that there will be an increasingly regular extreme shortage or excess of water. Large rivers have to drain more and more water, and the sea level is rising.
- **Society is changing** - The water boards have to deal with prevailing social movements. Culture shows signs of an increase in the elderly population and a decrease in the amount of greenery. The water boards have to deal with this in their organisation and their contacts with the citizens in their work area.
- **The method of administration is changing** - Governments are increasingly working together. As such, governance is increasingly becoming a framework with a network of actors rather than a hierarchical structure. Administratively and administratively, water boards must be bold enough to cooperate with their partners.
- **The national context is changing** - At the national level, development can be seen whereby the national government is increasingly moving away from elaborating tasks, i.e. decentralisation. As a result, the national government is losing its workforce and expertise. The national government is also making less and less money available for tasks such as maintaining the primary water defences. Water boards have to adjust their policies accordingly.
- **The water boards themselves are changing** - With the introduction of the Water Boards Act, the water boards must function differently and become more democratic. This means that the water boards must be more accountable and must build up support among the public.

This changing context means that the water boards are faced with unknown and more complicated tasks. An important principle has become to design and manage their water systems in a sustainable and climate-proof way (Committee on Water and Space, 2010). Therefore, their mission is to perform their tasks for and with society, based on a broad interpretation of tasks and at the lowest possible cost. The water boards work together, not just with each other, but also with all those who can contribute directly or indirectly to the realisation of water tasks (Union of Water Boards, 2007a).

3.2 Critical view on the multi-level perspective

However, the Multi-Level perspective, as explained above, has been criticised. This has initiated a discussion on the path that transitions follow. It was questioned whether all transitions would follow the same path. Berkhout, Smith and Stirling (2004) argue that transitions do not follow the same path because every transition has unique characteristics and develops context-dependently. This would mean that the influencing factors of the three levels mentioned above will be different for each transition.

Firstly, the geographical location factor needs to be examined in more detail. The expectation is that location will be an essential factor in determining context. Both water boards will be reviewed whether their unique characteristics (due to location) have caused the influence factors on the regime to differ.

Secondly, the influence of niches needs to be looked at more closely. In MLP, much value is placed on niches to get a transition going. However, niches differ radically from the current regime. This could also mean that niches find much resistance in the current regime (Berkhout, Smith & Stirling, 2004). Pressure coming directly from the macro or meso-level could therefore just as well be the first step towards a transition. The approach must be considered per regime because the regime's state, trends, material environment, and niches may be different. Ultimately, as mentioned earlier, the pressure must be high enough at the meso-level to initiate an eventual regime change.

Thirdly, two factors have an underexposed place in MLP and need to be examined more closely: regime coordination and actors' deliberate use of power tools. Indeed, Berkhout, Smith and Stirling (2004) argue that the factors of the MLP evolve depending on these two factors. Coordination means that transitions will develop differently according to whether there is more or less coordination. A transition can be purposefully steered or not steered. In the latter case, the events are based on chance. This is particularly important for the regime at the meso-level because it is here that the adaptive capacity of the regime must be demonstrated. The second dimension is based on available resources. Resources can appear in several forms on the three levels. Resources can be finance, knowledge (professionalism) or political influence and market power. If the regime itself has little capacity to maintain them, the likelihood of outside alternatives becomes greater. Including these factors in the conceptual model clarifies the extent to which a transition is purposefully managed or whether the transition is a historical confluence of circumstances (context).

Based on the MLP and the criticisms of this model, a definition of the term 'transition' will be drawn up so that there will no longer be any ambiguity about this in further research. This will be formulated as follows: a transition is a whole of (interactions between) unique influencing factors at macro-, meso- and micro-level which influence the current regime and can be steered to a certain extent.

For a transition, this means that there will always be an interaction between developments at the macro-, meso- and micro-level. However, this interaction is unique to each transition because each transition starts under different circumstances. Location is expected to play an essential role in this. Together, the levels influence the current status quo of the regime. The influence of factors is often direct but sometimes has specific conditions. In addition, the result of elements can be steered to a certain extent. For example, an organisation may have sufficient means of power, but only a deliberate deployment of these means will lead to regime change.

3.3 Operationalisation

Various factors can be derived from the MLP. The MLP is taken as a starting point here. This means that the elements are divided into the three levels this model maintains: macro-, meso- and micro-level. Below, per level, some important factors will be selected and explained.

Macro-level
This study assumes that political trends are prominent in water management developments at the macro level. In the past two decades, several guiding policy documents have appeared on water management 21st-century, such as the European Water Framework Directive and Room for the River (Koen, 2013). Therefore, 21st-century water management is seen as an influential political trend. This trend is incorporated into national policy plans, which have to be further shaped by the water boards. This political trend coincides chronologically with the growing awareness of the need to adapt to the consequences of climate change.
Indeed, at the macro level, there was an ecological concern about the imbalance on a global scale between expansive population growth and increasing economic development on the one hand, and the overuse of natural resources and environmental pollution on the other (Van der Brugge et al., 2005). Climate change is therefore also seen as an important reason for policy change. This trend can be seen in legislation and regulations in the Netherlands, such as the Climate Agreement and the Climate Act, to achieve the objective of a maximum temperature increase of 1.5 degrees Celsius. The water boards play a small role at the macro level, so the more significant trend is investigated and implemented through a top-down approach. This research will also have to show whether the trends at the macro level are a confluence of historical events or a deliberate direction.

Meso-level
The regime level is central to the MLP. The two most important characteristics at this level are an organisation's open and closed structure and the network in which the organisation concerned stands. A loose organisation guarantees more opportunities for participation and has access to an extensive network (De Bruijn et al., 2008). This research looks at how the actors form a network or what the power relations in a network are like. This is measured based on partnerships between water boards or cooperation with both public (the state, provinces, etc.) and private parties (the Forestry Commission, knowledge institutions, etc.). Affiliation is expressed in the joint formulation of policy and active participation in each other's plans. This is only possible if the water board gives(innovative) alternatives and receives this space.

Berkhout, Smith and Stirling (2004) supplemented the MLP with the aspect of specific power resources. The more resources an organisation has at its disposal, the earlier plans can be made. An organisation can have multiple types of resources to implement its strategies. This study limits itself to looking at three kinds of resources to overview: financial resources, professional resources and regulatory resources. Financial resources refer to having sufficient funds to get projects off the ground or participate in them. Professionalism is measured by the knowledge that the water board produces itself, in cooperation with knowledge institutes and the support that the water board creates with this. The more professional the organisation, the more support it will generate among citizens and partners. Because of time constraints, this study will only address the water boards' vision of the support base among their partners and citizens. Regulations will be examined based on the Climate Plan and the Climate Agreement.

Finally, changes in routines and habits play a role in policy change. Over time, the water boards will have created certain practices and traditions. This study examines whether these working practices and habits have proven to be resilient. If setbacks are quickly overcome, the water board can get to work on new goals, strategies and active methods (Hoogerwerf and Herweijer, 2008). Habits and routines will therefore be measured against new working practices that the water boards have adopted. In addition, the extent to which these changes provoked resistance will be examined. This research examines how events at both the macro and micro levels change the regime to the water boards. The fact is that separate developments at all three groups are insufficient to realise a transition (Paredis, 2009).

Micro-level
Individual actors, alternative technologies, and local practices are distinguished at the micro-level (niche level) (Van der Brugge et al., 2005). Within this research, the micro-level consists of most innovation factors that arise in niches and manifest themselves in projects that deviate from the norm. These projects often manifest themselves in the form of experiments and products. For the water boards, these inventions will mainly manifest themselves in water projects involving new techniques.

The aspect of innovation is measured using both local and regional projects initiated by water boards or by third parties. Bottom-up' driven projects are an example at the micro-level. The focus will be on how water boards deal with and respond to these innovation opportunities, as they are often not the initiators of these projects. Possibly water boards can use these niche innovations to realise and accelerate the energy transitions.

3.4 Conceptual Framework

The conceptual model is based on the MLP, in which the socio-technical regime or meso-level is central. Within this study, it is investigated to what extent the landscape influences the regime. The possibilities and limitations between both levels are explored. It also examines the extent to which geography influences niche innovations and vice versa. It then examines the impact of niches on the regime and the landscape and what opportunities and limitations this reveals.
It should be noted that in this study, the water boards are placed in the regime. There is internal and external pressure from both the landscape and the niches to ensure a transition within the regime. Based on these internal and external pressures and the relationships between the three levels, it is possible to examine the role played by the water boards in the energy transition. Do they have an essential role to play or not? What opportunities and limitations do the water boards experience in implementing the energy transition? The study will then look at the direct and indirect contribution the water boards make to the energy transition and determine which four phases it currently finds. These questions are answered in this study and represented in abstract form in the conceptual model below.

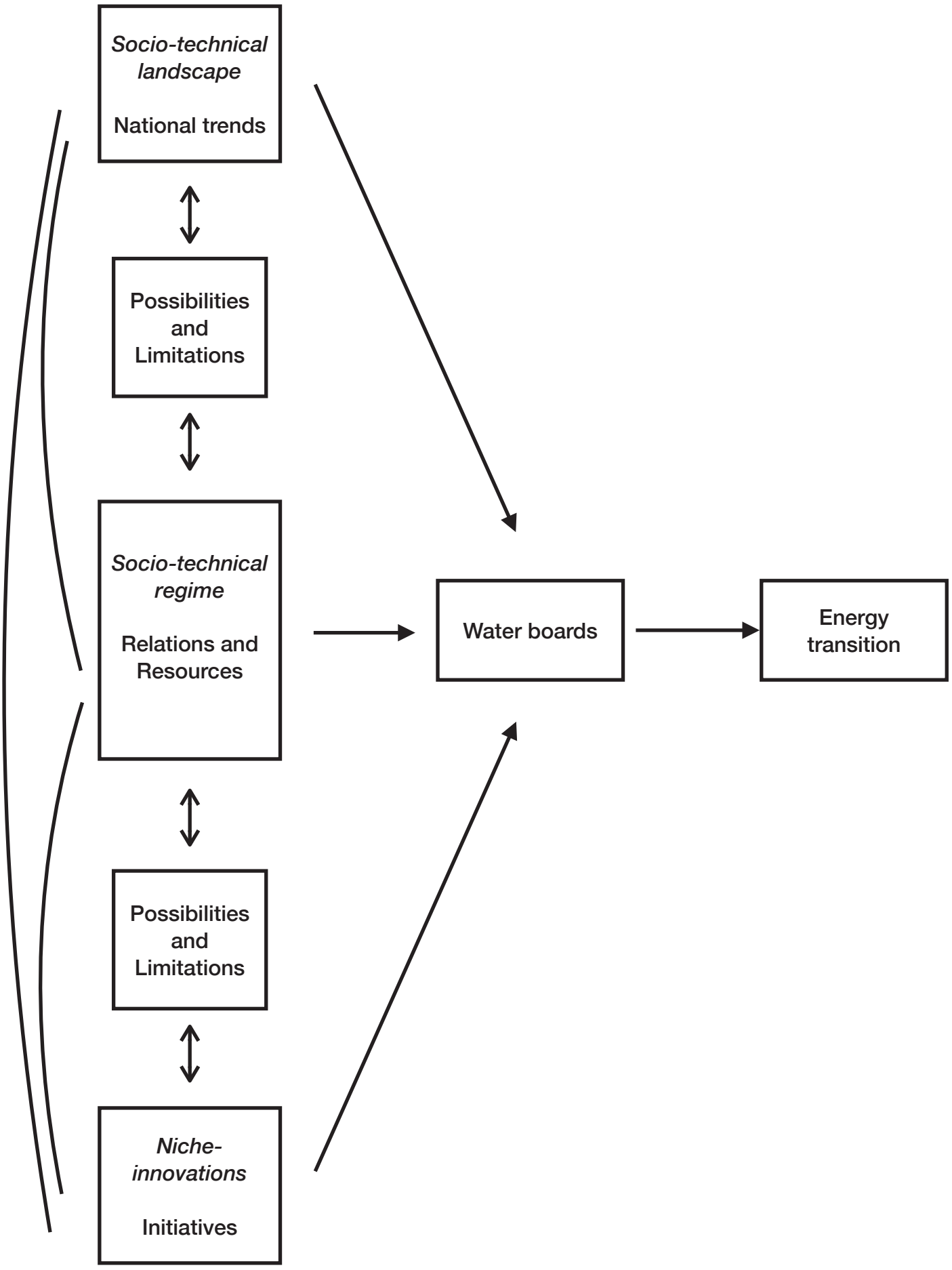

Figure 7. Conceptual model (own design)

4. Methodology

In this section, the philosophical assumptions, the research strategy and methods, data collection, data analysis, and the validity and reliability of the research will be discussed.

4.1 Philosophical assumptions

Four fundamental metaphysical beliefs can be distinguished that can be used to guide research. These four fundamental metaphysical beliefs (Positivism, Post-positivism, Critical Theory and Constructivism) can be described in ontology, epistemology and methodology (Creswell & Poth, 2016; Guba and Lincoln, 1994; Van Thiel, 2014). The ontology distinguishes between realism and relativism in the four fundamental metaphysical beliefs. Realism presents reality as ‘real’, singular and apprehensible, while relativism apprehends truths in the form of multiple, intangible mental constructs that are specific (Guba and Lincoln, 1994). Epistemology attempts to explain the nature of knowledge. Therefore, epistemology can be seen as a continuum between an objectivist and subjectivist approach (Guba and Lincoln, 1994).
An objectivist approach to research believes that findings are accurate or largely true. Subjectivist approaches to analysis believe that results are highly subject to personal interpretation. The final distinction between the four fundamental metaphysical beliefs is made by assessing the methodology, which describes how data are collected. The methodology should be seen as a toolbox, providing the necessary tools to guide data collection (Guba and Lincoln, 1994; Van Thiel, 2014). It is challenging to place this research under one of the four fundamental metaphysical beliefs that can guide research, as it tries to paint a general picture and has several in-depth case studies. Nevertheless, this research is classified under positivism partly because it uses both qualitative and quantitative analysis. The knowledge gained is mainly factual knowledge that can be verified, which is in line with epistemology.

4.2 Research strategy

To answer the research question "*How do the water boards in the Netherlands perceive the opportunities and constraints at the macro-, meso- and micro levels to contribute to the energy transition?*", different research methods were used. The other methods used in this study are desk research, quantitative research and qualitative research. The use of both quantitative and qualitative analysis is called 'mixed methods' (Van Thiel, 2014). First, a survey will be conducted, which falls under quantitative research methods, then the interviews and subsequent transcriptions will be approached using a qualitative approach. This will ensure a comprehensive data collection, which will provide the best answer to the research question. As a result of these different theories, triangulation of data takes place. The use of multiple research methods avoids biases that arise when only one method is used and produces a high-quality study with credible findings and an expected outcome. Moreover, triangulation of data will increase the overall reliability and validity of the study.

The research purpose of this study is both descriptive and explanatory. This is descriptive because the study describes the current literature and knowledge on water boards and the energy transition to form a reliable academic basis for this research. This is explanatory because the emphasis is on finding out the role of the water boards within the energy transition and then giving an overall picture of this for all water boards. Because these different research objectives require different research strategies, the mixed method design best suits them.

4.3 Research methods, data collection and data analysis

Firstly, desk research will be carried out using a literature study. This involves the systematic search for scientific literature and other documents to answer a scientific question (Encyclo, n.d.). The literature forms the background to the research and is essential in this regard.

This research uses a qualitative and a quantitative approach. For the quantitative part, online surveys will be used. In the first instance, the database of the Dutch water boards has been searched for possible surveys that fit with this study. This was the case, for example, in the report by Arcadis: inventory of the contribution to the RES by water boards. This report aimed to provide an overview of what the Dutch water boards have contributed to the draft RES and what this

contribution yields. In addition, the information sought to provide insight into the extent to which this contribution is linked to the water boards' tasks. A questionnaire was sent to all water boards, asking them what role they played and how they cooperated.

4.3.1 Survey

Based on this, I drafted a partly based questionnaire but then focused on the role of the water boards within the energy transition. The questionnaire consisted of 18 questions, 15 of which were closed questions and three open questions. The ratio of many closed questions to the minimal number of available questions has several reasons. For one thing, closed questions are easier and quicker to fill in for the water boards, as they are generally busy. Furthermore, the possibility of comparing the water boards' answers is more accessible, and the respondents are more likely to respond to sensitive issues (Thrusfield & Brown, 2017). The closed questions consist of statements with a Likert scale as the response model, ranking questions, and value questions. This survey aimed to obtain a global picture of the current situation within the water boards about the energy transition.

This questionnaire is sent to all 21 water boards, of which 17 water boards are eventually completed. The data collected from these surveys will provide a statistical basis to build upon. The data has been processed in excel and not in SPSS. This is because of the low number of respondents, so SPSS cannot be used optimally (Baarda et al., 2014). The advantage of data collection using surveys is the relatively large number of research units. This guarantees the high reliability of the results. Since all respondents fill in the same survey, the answers will contain reliable, replicable and quantifiable data. Surveys also offer the possibility of representing a wide range of views (Thrusfield & Brown, 2017). Allowing respondents to substantiate their answers or give examples will try to collect more valuable data. The results of the survey were compared with the climate monitors provided by Arcadis. It should be noted that these are different data sets so that they cannot be compared literally. An attempt has been made to put this into perspective so that they still reveal apparent similarities and differences between my research results from the field and the climate monitors.

4.3.2 Interviews

For the qualitative part, semi-structured interviews will be used, which will give this research more depth. This means that a fixed number of questions will be asked, but at the same time, there is room to ask more questions to obtain more in-depth information. For instance, the interview guide consists of 9 fixed questions, each provided with possible sub-questions.

Within this research, a multiple case study was chosen. Case studies can be divided into single case studies and multiple case studies. One case is investigated in a single case study; two or more points are compared in a multiple case study. There is multiple case study in this study because the water boards Limburg, Wetterskip Fryslân and Rivierenland will be reached. A significant advantage of case studies is that more depth can be created (Creswell and Tashakkori, 2007). In this way, a case study can raise awareness of the energy transition and provide new insights. Another advantage is that different things can be investigated within a case study, such as people, groups, and locations or situations (Creswell and Tashakkori, 2007). A case study can also use data from different sources, such as interviews, observations and documents. These additional data are essential to creating depth in the research.

Organisations/ institutions	Interviewee	Interview information
Water board ‘Wetterskip Fryslân’	X	Date: 1 June 2021 Duration: 24:58
Water board ‘Wetterskip Fryslân’	Y	Date: 9 June 2021 Duration: 31:25
Water board ‘Limburg’	X	Date: 7 June 2021 Duration: 40:18

Organisations/ institutions	Interviewee	Interview information
Water board ‘Limburg’	Y	Date: 8 June 2021 Duration: 32:40
Water board ‘Limburg’	Z	Date: 15 June 2021 Duration: 31:18
Water board ‘Rivierenland’	W	Date: 2 June 2021 Duration: 56:55
Water board ‘Rivierenland’	X	Date: 23 August 2021 Duration: 38:10
Water board ‘Rivierenland’	Y	Date: 25 August 2021 Duration: 28:39
Water board ‘Rivierenland’	Z	Date: 3 September 2021 Duration: 29:48
Water board ‘Hoogheemraadschap De Stichtse Rijnlanden’	X	Date: 8 June 2021 Duration: 29:44

Table 1. Overview of respondents

When all the interviews have been conducted, they will be transcribed. These transcriptions will then be analysed using coding. Coding is analysis because it involves deep reflection on the meaning of the data and consists of several steps (Saldaña, 2014). This coding was done through the program ‘Atlas.ti'.

Coding is used to bring order to the interview data. This process consists of 3 steps (Kendall, 1999):

1. *Open coding*: coding fragments
2. *Axial coding*: compare fragments with the same code for differences and similarities
3. *Selective coding*: develop concepts into a theory and search for exceptions using constant comparison

The first step consists of *open coding*, in which symbolic meaning is given to the descriptive information in the transcribed text (Kendall, 1999). This creates the so-called 'codes', of which there are 39 in my file. Some examples are possibilities, solutions, mutual contact, fragmentation, benefits and advantages.

The second step is *axial coding* or pattern coding. In this phase, the initial codes or data segments will be placed into categories to create a deeper understanding of the text and thus help understand phenomena better. The categories are created by looking for threads that connect the data. This involves comparing the fragments within the 'boxes'. This is an iterative process whereby codes can be split or composed, and new codes are also named. Axial coding provides a more uniform and valid coding (Kendall, 1999). This also creates the code groups, of which there are 21 in my file. Some examples are: possibilities (possibilities + solution), communication (mutual contact + fragmentation) and benefits (benefits + advantages).

When all the categories have been created, and everything has been analysed, the whole thing is fed back into the literature. This is the final stage, or *selective coding*, where no more coding takes place. This method also contributes to the reliability of the study (Kendall, 1999). The primary purpose of the above three stages of coding is to form a theory or a contribution to it. This can then be used in the results chapter.

5. Results

This chapter analyses the general water boards based on the surveys carried out and Limburg, Wetterskip Fryslân and Rivierenland that were interviewed. This is also the structure of this chapter. First, a general picture is painted of the role of the water boards in the energy transition. Then, their role in the energy transition is examined per case, looking at possible obstacles, solutions, and motives. The order of the MLP per case is different from how it was treated in the rest of this study, namely macro, micro and only then the meso level. This makes for better readability as it looks at which trends and niche innovations affect the regime. Together with these results and the general picture presented, Chapter 6 answers the central question, "*How do the water boards in the Netherlands perceive the opportunities and constraints at the macro, meso and micro levels to contribute to the energy transition?*"

5.1 General view

The water authorities were established in the 12th and 13th centuries out of necessity to control the water, which makes them one of the oldest authorities in the Netherlands**.** Water boards have always had an executive committee and are, for the most part, democratically governed. Initially, water boards were socially engaged (Toonen, 2006). Over the past fifty years, much has happened institutionally to the water boards. There has been an increase in scale from 3,500 to 21 water boards, the subdivisions have been merged, and the essential tasks of the water boards have been expanded to include environment-related duties, among others. This made the water boards more autonomous about the provinces, which previously had a great deal of control over the water boards (Havekes, 2009).

However, the societal character of the water boards is increasingly disappearing. This is evident, among other things, from the low turnout for water board elections, making it increasingly difficult to safeguard democracy. The institutional importance of the water boards is also coming under increasing pressure. According to Toonen (2006), the water boards are of constitutional significance and should continue to exist as autonomous administrations. Centralisation has allowed the water boards to carry out more significant works. This is important for institutional safeguarding so that water boards will always have sufficient resources to carry out these more extensive works and maintain dikes.

The last development is the institutional lock-in created by a vicious circle of dyke raising and sea-level rise. The system is currently at a critical level, but according to the OECD (2014), the water awareness of Dutch citizens is often zero. This is a change since water boards have traditionally been controlled by society. To combat this institutional lock-in, the Union of Water Boards concluded a Climate Agreement with the national government in 2010 on behalf of the water boards in the Netherlands. This agreement sets out the ambitions of the water boards regarding climate change, energy consumption and several other sustainability targets up to 2020. Despite the measures, the water boards are still in an institutional lock-in that attempts to resolve in the future through treaties such as the climate agreement. Partly due to climate change, this situation will persist for the time being. Global warming is causing the water level to rise, so the water boards will have to continue to raise the dikes, among other things.

Because of their function as regional water managers, the water boards are confronted with the consequences of climate change like no other. In recent years, they have made various efforts to achieve a more climate-friendly water sector and a safer Netherlands. The water boards have laid down sector-wide climate ambitions in the EU and the national government's 2010-2020 Climate Agreement.

For mitigation, the agreements are laid down in the Green Deal Energy that the Union of Water Boards concluded with the central government in March 2016 (duration 2016-2018). The European Green Deal is a programme of the Von der Leyen Commission to combat climate change. The Green Deal must ensure that Europe reduces its CO2 emissions by 55% in 2030 compared to 1990 to become the first climate-neutral continent by 2050 (Rijksoverheid, 2018). The European Union should then no longer contribute to global warming through the emission of

greenhouse gases. The most significant four benefits are no pollution, affordable, safe energy, more intelligent transport and high-quality food (Europese Commissie, 2019).
A roadmap has been drawn up containing many measures to ensure that the EU becomes climate-neutral by 2050. The European Green Deal affects all sectors of the economy, especially transport, energy, agriculture and infrastructure, and ICT. Significant investments are needed to achieve the objectives. An additional investment of approximately 260 billion euros per year is required to achieve the goals (klimaat.be, 2019).

To meet these investments, the Commission proposed the Sustainable European Investment Plan. It is the investment fund of the Green Deal, providing various policy instruments and initiatives to meet the necessary sustainable investments. The aim is to leverage public investment and attract private finance through the EU's financial instruments. The investment plan consists of three main goals (klimaat.be, 2019):
- *Finance*: putting €1 trillion of sustainable investment in place for the next decade
- *Facilitation*: developing a supportive framework for private investors and the public sector
- *Practical support*: tailor-made assistance for public administrations, private and public projects

The Green Deal Energy further tightens up the agreements in the SER Energy Agreement (2013). It extends the Multi-annual Agreements on Energy Efficiency Improvement (MJA3) from the treatment plants to the entire water board. The goal was 40% energy neutrality in 2020. The ambition for 2025 is 100% energy neutrality, including investments by third parties on water boards' premises. These ambitions are laid down in the Intergovernmental Programme (IBP) signed in 2018 by the national government and the umbrella organisations of municipalities, provinces and water boards. The agreements made in the SER Energy Agreement and the IBP have been adopted in the Climate Agreement 2019 (Unie van waterschappen, 2019).

Main lines of the Union - Government Climate Agreement 2010 - 2020:
- 30% more energy-efficient and economical work between 2005 and 2020
- 40% self-sufficiency through own sustainable energy production by 2020
- 30% reduction in greenhouse gas emissions between 1990 and 2020
- 100% sustainable procurement by 2015
- The water boards reduce CO2 emissions from transport kilometres in work and home traffic

The climate agreement signed in Paris in 2015 has brought about a turnaround. It has created a unity that is binding on a global scale, with 195 countries in the world participating. This has led to significant changes at the macro level, such as the realisation of the importance of the two-degree limit and the fact that every country must measure their targets once every five years against the scientific knowledge of climate change and increase them if necessary.

The green deal is a consequence of the climate agreement, where the goal is to reduce greenhouse gas emissions. Like this goal, it affects everyday life. Firstly, it is a social transition. Companies and citizens face several decisions that affect how people live, move around, eat, and earn money. These are generally not easy choices, and businesses and citizens also depend on each other and the government.

At the meso level, the water boards reduce CO2 emissions by generating biogas and installing wind turbines and solar panels (Unie van Waterschappen, 2019). Currently, the water boards are already producing almost 120 million cubic metres of biogas from sewage sludge. In addition, they make their wastewater and surface water available to heat residential areas as an alternative to natural gas (aquathermy). At a micro level, this has an effect because local energy cooperatives, where they can fit it in, can use water board land for sustainable energy projects. In this way, the investments remain within the region and the local population benefits from them. The construction projects of the water boards are also increasingly circular and climate-neutral, as is the regular maintenance of the water system. Finally, the water boards carry out wetland mitigation measures - if an area so requires - to reduce greenhouse gases and increase biodiversity (Unie van Waterschappen, 2019).

Since the climate agreement was drawn up, much progress has been made, but new problems have also come to light, resulting in some recommendations. This chapter presents the main conclusions on the progress made by the water boards in achieving the climate goals imposed.

The findings are also a good guide for the individual water boards in steering policy and projects in energy conservation and renewable energy.

5.1.1 Energy - working more efficiently and economically

Conclusion: the target to improve energy efficiency by 2% per year (30% over 2005 - 2020) was amply achieved. In the MYA plan period 2009 - 2019, an improvement in the energy efficiency of 3.7% per year on average was realised.

The Long-Term Energy Efficiency Agreements (LTA) goal to achieve 30% energy efficiency in the 2005-2020 period was amply achieved.
Up to and including the reporting year 2017, the energy efficiency improvements resulting from energy-saving measures were only monitored for treatment management. From 2017, the other tasks will also be included in the MYA monitoring (Unie van Waterschappen, 2019). Consumption figures are not available for all business units for all years between 2009 and 2014. Therefore, indicative values have been used to determine the energy efficiency of the water board as a whole.

Energy efficiency relates to both energy saving and the use of renewable energy. In 2009 - 2019, an incremental efficiency improvement of 40.8% was achieved, which amounts to 3.7% per year. 1.9% per year was achieved through process and chain measures and 1.8% through renewable energy generation. This does not include the purchase of renewable energy (an average increase of 2.7% per year).

5.1.2. Sustainable energy production

The following pie chart shows the sources used to generate this renewable energy:

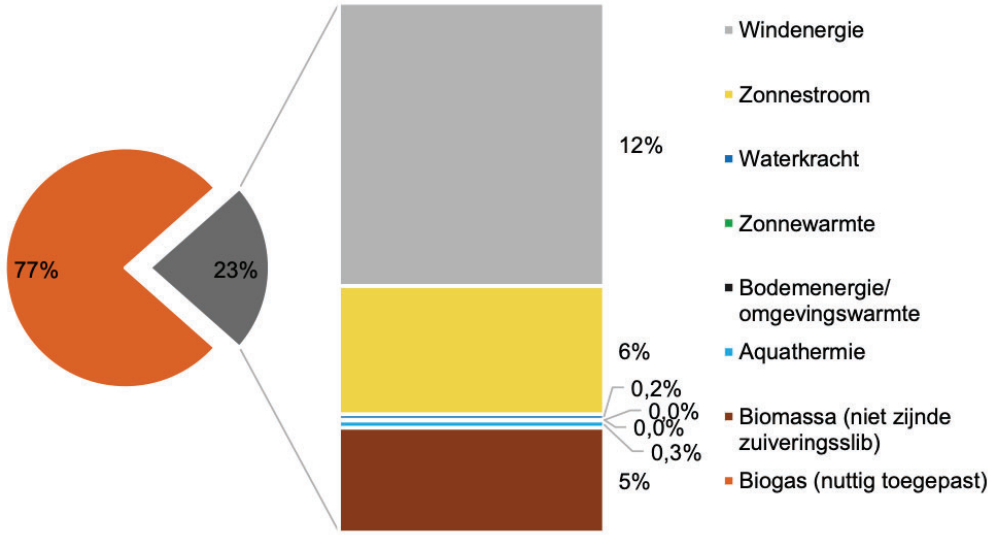

Figure 8. Distribution of sustainable energy generation (Unie van Waterschappen, 2019)

Figure 7 is in dutch. From top to bottom, the following renewable energy sources are listed on the right: wind energy (grey), solar power (yellow), hydropower (dark blue), solar heat (green), soil energy/ambient heat (black), aqua thermal energy (light blue), biomass (brown) and biogas (orange).

The largest share of sustainably generated energy comes from biogas from sewage sludge (77%). This high percentage of biogas is mainly due to biomass, as biogas can be made by fermenting wet biomass. That is why biomass is explicitly stated in brackets as 'other than sewage sludge'. Wind energy is the next largest source (12%). In addition to the water boards' generation of sustainable energy, another 501 TJ (5.3%) was generated by and for third parties on the water

boards' premises. The share of energy generated by and for third parties on the premises of the water boards will also be included in the goal of 100% energy neutrality in 2025.

The Climate Monitor (2019) asked what concrete plans are currently known in energy efficiency and sustainable energy generation to see whether the sector is on course to meet the 2025 target. The process efficiency measures that have now been stated amount to approximately 160 TJ. Despite the water boards' continued efforts to reduce energy consumption, it is expected that they will be confronted in the future with a more excellent purification task, for example, due to the removal of medicine residues or an increase in hazardous waste. This may lead to a rise in electricity consumption in the future.

My survey asked the following question: *"Please rank the following renewable energy sources used by water boards from most common to least common".* This required ranking the following five options: wind energy, hydropower, solar energy, geothermal energy and biomass. Below in table 1, you can see the order of ranking of renewable energy sources that each water board has filled in, from most common to least common. To compare this with the climate monitor, I have made a pie chart showing in percentages how often a specific renewable energy source has been placed in the first place by a water board.

Water board	Renewable energy sources
Aa en Maas	1. Biomass- 2. Solar energy- 3. Hydropower- 4. Wind energy- 5. Geothermal
Amstel, Gooi en Vecht	1. Solar energy- 2. Biomass- 3. Hydropower- 4. Wind energy- 5. Geothermal
Brabantse Delta	1. Solar energy- 2. Wind energy- 3. Biomass- 4. Hydropower- 5. Geothermal
De Dommel	1. Wind energy- 2. Biomass- 3. Solar energy- 4. Hydropower- 5. Geothermal
Hollandse Delta	1. Biomass- 2. Solar energy- 3. Wind energy- 4. Hydropower- 5. Geothermal
Hoogheemraadschap de Stichtse Rijnlanden	1. Biomass- 2. Solar energy- 3. Wind energy- 4. Hydropower- 5. Geothermal
Hoogheemraadschap van Delfland	1. Biomass- 2. Wind energy- 3. Solar energy- 4. Hydropower- 5. Geothermal
Hoogheemraadschap van Rijnland	1. Biomass- 2. Solar energy- 3. Hydropower- 4. Wind energy- 5. Geothermal
Hoogheemraadschap van Schieland en de Krimpenerwa	1. Solar energy- 2. Wind energy- 3. Hydropower- 4. Biomass- 5. Geothermal
Hunze en Aa's	1. Biomass- 2. Solar energy- 3. Wind energy- 4. Hydropower- 5. Geothermal
Limburg 1	1. Solar energy- 2. Wind energy- 3. Hydropower- 4. Geothermal 5. Biomass
Limburg 2	1. Hydropower- 2. Solar energy- 3. Biomass- 4. Wind energy- 5. Geothermal
Limburg 3	1. Solar energy- 2. Biomass- 3. Hydropower- 4. Geothermal 5. Wind power
Noorderzijlvest	1. Biomass- 2. Solar energy- 3. Wind energy- 4. Hydropower- 5. Geothermal
Rijn en Ijssel	1. Wind energy- 2. Biomass- 3. Solar energy- 4. Hydropower- 5. Geothermal
Rivierenland	1. Hydropower- 2. Solar energy- 3. Wind energy- 4. Biomass- 5. Geothermal
Rivierenland 2	1. Biomass- 2. Solar energy- 3. Geothermal 4. Wind energy- 5. Hydropower
Vallei en Veluwe	1. Biomass- 2. Solar energy- 3. Wind energy- 4. Hydropower- 5. Geothermal
Wetterskip Fryslan	1. Solar energy- 2. Biomass- 3. Hydropower- 4. Wind energy- 5. Geothermal
Zuiderzeeland	1. Solar energy- 2. wind energy- 3. Biomass- 4. Hydropower- 5. Geothermal

Table 2. Overview of ranked renewable energy option per water board (Survey results)

Like the Climate Monitor, my survey shows that the water boards consider biomass (42%) the most commonly used sustainable energy source (see Figure 8). This is because biogas in the Climate Monitor also refers to biomass originating from sewage sludge. This is closely followed by solar energy (37%). It should be noted that my survey only looked at how often a particular renewable energy source was in a specific place. This is, in some cases, a big difference with the figures from the Climate Monitor, such as solar energy, which is only used for 6% to generate renewable energy. Geothermal energy plays no role in either case, however.

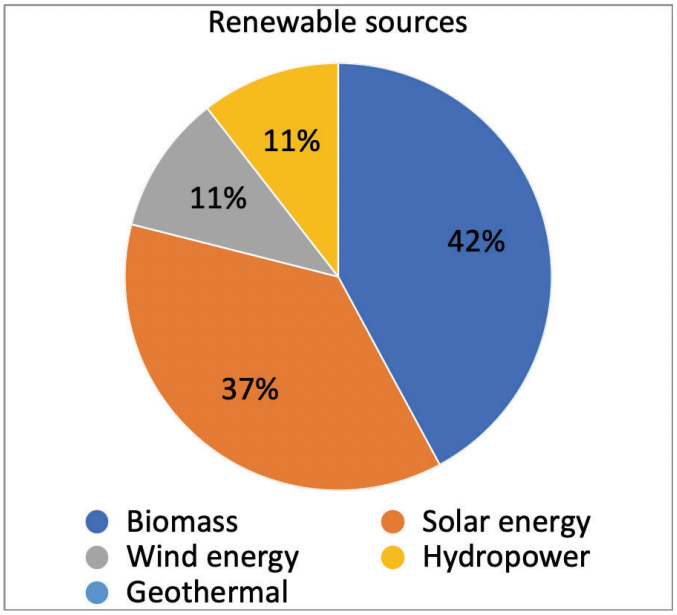

Figure 9. Renewable energy sources recognised by water boards as their most important renewable energy source (Survey results)

For up to and including 2025, the water boards have stated 123 planned renewable energy projects with a total volume of 4,465 TJ (Unie van Waterschappen, 2019). Most of the projects (83) aim to generate solar power (67% of the total projects). After solar power, wind power is the most frequently mentioned application (14 projects, corresponding to 11% of the total number of planned projects).

When looking at the total expected amount of generated energy per technique (see figure 9), wind energy makes by far the most significant contribution (about 2,345 TJ, corresponding to 53% of the total expected amount of generated energy). After wind energy, solar power makes the most significant contribution to the total anticipated amount of sustainably developed energy (about 1,155 TJ, 26% of the total expected amount of generated energy).

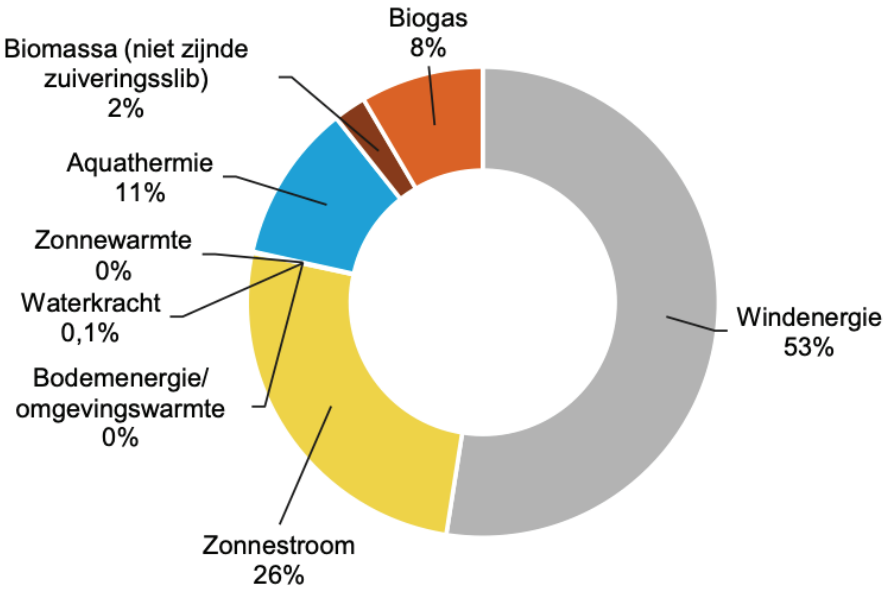

Figure 10. Share of expected new Renewable Energy projects 2020-2025 by technology (Unie van Waterschappen, 2019)

Figure 9 is shown in Dutch. Chronologically clockwise, the following renewable energy sources are shown: wind energy (grey), solar power (yellow), hydropower (not visible), solar heat (not visible), ground energy/energy heat (not visible), aqua thermal (light blue), biomass (brown) and biogas (orange).

Water board	Potential renewable energy sources
Aa en Maas	1. Biomass- 2. Solar energy- 3. Wind energy- 4. Hydropower- 5. Geothermal
Amstel, Gooi en Vecht	1. Hydropower- 2. Wind energy- 3. Solar energy- 4. Geothermal- 5. Biomass
Brabantse Delta	1. Biomass- 2. Wind energy- 3. Solar energy- 4. Geothermal 5. Hydropower
De Dommel	1. Wind energy- 2. Biomass- 3. Solar energy- 4. Hydropower- 5. Geothermal
Hollandse Delta	1. Wind energy- 2. Biomass- 3. Solar energy- 4. Hydropower- 5. Geothermal
Hoogheemraadschap de Stichtse Rijnlanden	1. Biomass- 2. Solar energy- 3. Wind energy- 4. Hydropower- 5. Geothermal
Hoogheemraadschap van Delfland	1. Biomass- 2. Wind energy- 3. Solar energy- 4. Geothermal 5. Hydropower
Hoogheemraadschap van Rijnland	1. Solar energy- 2. Wind energy- 3. Hydropower- 4. Biomass- 5. Geothermal
Hoogheemraadschap van Schieland en de Krimpenerwa	1. Solar energy- 2. Wind energy- 3. Hydropower- 4. Biomass- 5. Geothermal
Hunze en Aa's	1. Biomass- 2. Solar energy- 3. Wind energy- 4. Hydropower- 5. Geothermal
Limburg 1	1. Wind energy- 2. Hydropower- 3. Solar energy- 4. Geothermal 5. Biomass
Limburg 2	1. Wind energy- 2. Solar energy- 3. Hydropower- 4. Biomass- 5. Geothermal
Limburg 3	1. Wind energy- 2. Solar energy- 3. Geothermal 4. Hydropower- 5. Biomass
Noorderzijlvest	1. Solar energy- 2. Wind energy- 3. Biomass- 4. Hydropower- 5. Geothermal
Rijn en Ijssel	1. Wind energy- 2. Biomass- 3. Solar energy- 4. Hydropower- 5. Geothermal
Rivierenland	1. Solar energy- 2. Hydropower- 3. Wind energy- 4. Biomass- 5. Geotherma
Rivierenland 2	1. Biomass- 2. Wind energy- 3. Geothermal- 4. Solar energy- 5. Hydropower
Vallei en Veluwe	1. Hydropower- 2. Biomass- 3. Wind energy- 4. Solar energy- 5. Geothermal
Wetterskip Fryslan	1. Solar energy- 2. Biomass- 3. Hydropower- 4. Wind energy- 5. Geothermal
Zuiderzeeland	1. Solar energy- 2. Biomass- 3. Wind energy- 4. Geothermal- 5. Hydropower

Table 3. Overview of ranked potential renewable energy option per water board (Survey results)

The following question was asked in my survey: "*Rank the following renewable energy sources for the water boards shortly from most potential to least potential*". Again, the following five options had to be ranked: wind energy, hydropower, solar energy, geothermal energy and biomass. Above in Table 2, you can see the ranking of renewable energy sources that each water board filled in, from most potential to least potential. To compare this with the climate monitor, I have again made a pie chart showing in percentages how often a specific renewable energy source was put in the first place by a water board.

As far as the expected returns per renewable source are concerned, these are pretty similar to the results of my survey (see Figure 10). Wind energy is expected to play the most significant role in the future (53%-32%), followed by solar energy (26%-32%). Geothermal energy is also not expected to play an essential role in the energy transition for the time being. However, the most significant difference is between the two. According to the Climate Monitor, there is a large gap between the expected energy generation by wind energy and solar energy. At the same time, in my survey, the water boards think this will be the same. It also appears that the difference between the use of biomass (and biogas) in the future is again significant, 8% to 26%. According to the Climate Monitor, hydropower will play a minimal role while playing a considerable part (11%).

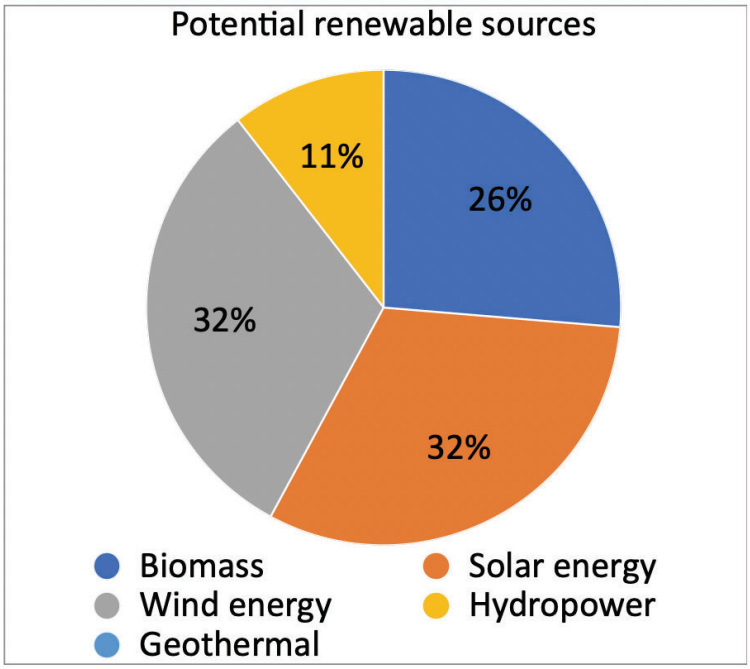

Figure 11. Renewable energy sources are likely to be used by the water boards soon (Survey results)

Conclusion: The Climate Accord Union and State 2010 - 2020 and the SER Energy Accord agreed to be 40% self-sufficient through own renewable energy production by 2020. In 2019, 40.3% of the energy consumption in the sector came from self-generated renewable energy.

The sector had already achieved this target for 2020 in 2019. In 2019, the sector's renewable energy production was equivalent to 40.3% of the total energy consumption. The industry is busy realising and researching opportunities for sustainable energy generation (Unie van Waterschappen, 2019).

The water boards themselves are investing in biogas production through sludge fermentation at the sewage treatment plants and in energy from wind, solar, and aqua thermal sources. In addition, the water boards also seek to cooperate with third parties, for example, by making their land available to third parties for the installation of solar panels and wind turbines. The generation of sustainable energy by making assets available to third parties equalled 5.3% of the energy consumption of all water boards in 2019.

Figure 11 shows the percentage of sustainable energy generation for each water board. A distinction is made between age by the water board on its site, generation by the water board outside its place, and generation by and for third parties on the water board's site.
For the 40% energy generation target in 2020, only the quantities generated by the water board itself count. Earlier it was shown that the percentage at the sector level is 40.3%. The figure below indicates that some water boards have already achieved the 40% target. The proportion of energy generated by and for third parties on the premises of the water boards is also included in the ambition to achieve 100% energy neutrality in 2025. At the sector level, this percentage is 45.6%. Some water boards are already well on their way to achieving this percentage.

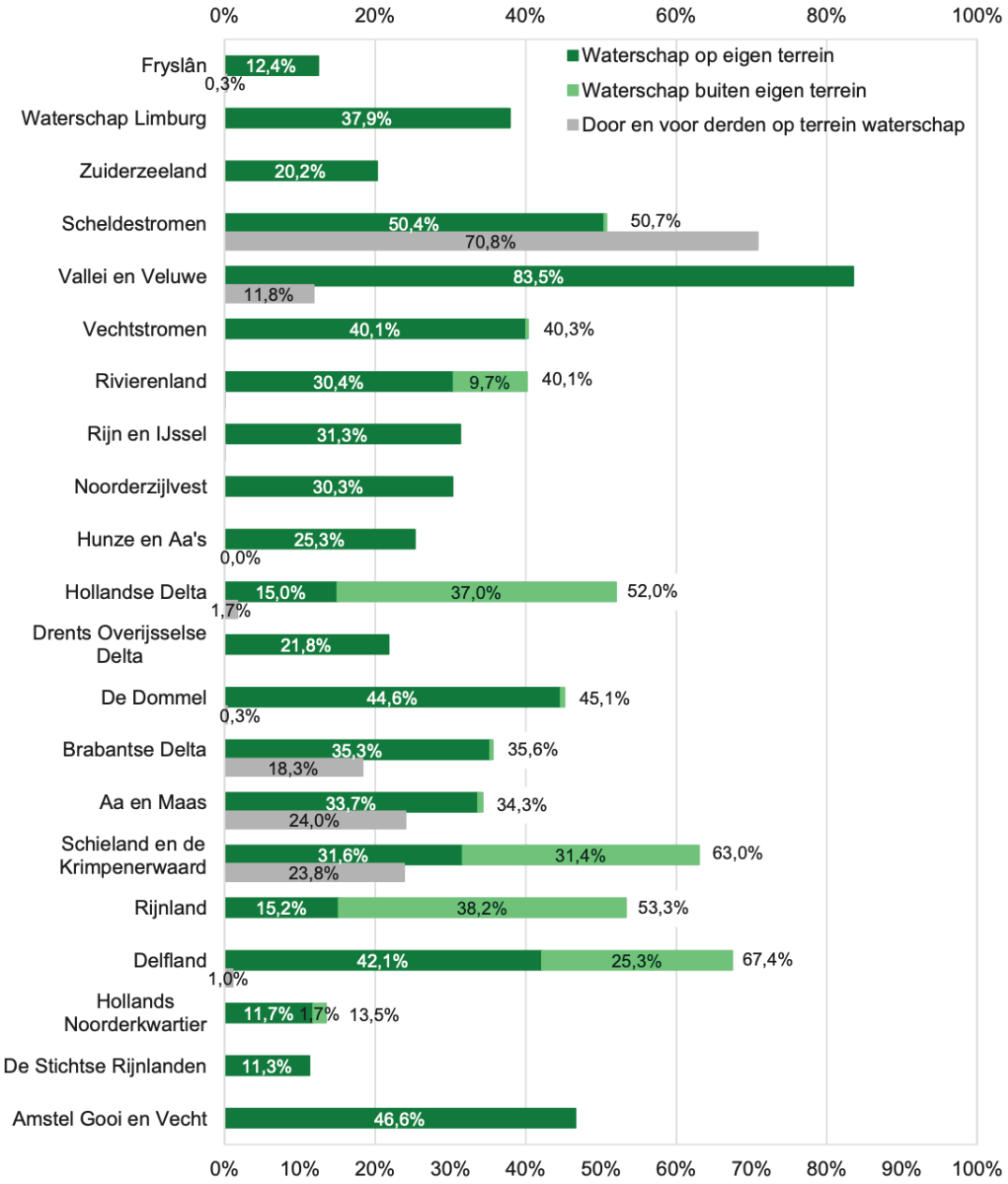

Figure 12. The extent of renewable energy generation by water board as a percentage of the water board's energy consumption (Unie van Waterschappen, 2019)

Figure 11 is also in dutch. All 21 water boards are listed on the left. In the figure, dark green stands for 'water board on own property', light green for 'water board outside own property' and grey for 'by and for third parties on water board property'.

Figure 11 clearly shows the differences per water board concerning the generation of renewable energy. There are some front runners, with 'Vallei en Veluwe' as the number one. What is striking about this is that they also generate all their sustainable energy on their land. Some water boards that are lagging, such as ‘De Stichtse Rijnlanden’ and ‘Fryslân’. This may have various causes, such as institutional restrictions on the siting of wind turbines in Friesland (interview, employee water board) and the shortage of land in Utrecht to install wind turbines/solar panels (interview, employee water board). In the following chapters, the situations in the water boards of Limburg, Fryslân and Rivierenland will be discussed in more detail.

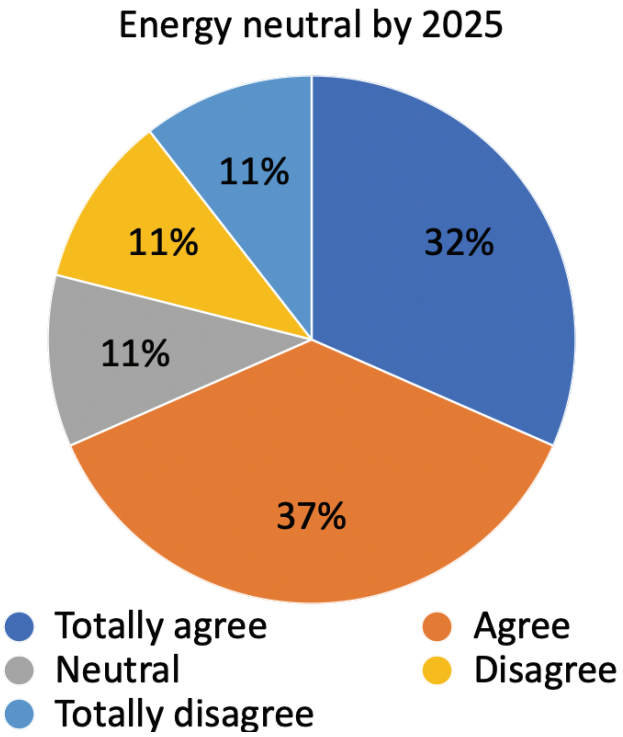

Figure 13. Percentage of water boards that think it will be possible to be energy-neutral by 2025 (Survey results)

In my survey, I presented people with the following proposition: ‘according to the 'Klimaatmonitor Waterschappen’, the water boards will be energy neutral from 2025. To what extent do you agree that this is feasible?’ The majority of the water boards think this is feasible and in line with the current course. The goal of generating 40% of energy from renewable sources by 2020 has been achieved, and they are on track to achieve the purpose of 100% energy-neutrality by 2025. However, the question is whether this is feasible for all water boards. With the excellent addition, the future will have to tell that the water boards in question, such as Fryslân, can also generate their sustainable energy elsewhere or have it caused by a third party. This will probably be necessary to achieve the short term, but the water boards themselves must generate their sustainable energy in a long time.

5.1.3 Future perspective

All 21 water boards in the Netherlands have their views on their role within the energy transition in the future. The water boards generally agree that they will retain their facilitating role as government bodies, with more attention to 'driving' the energy transition. This is made possible by investigating new possibilities and seeing their potentials, such as aquathermy and the installation of floating solar panels. This is in addition to the solar and wind energy that is currently used.

What is also interesting is the possible change from a water board to a climate board. The term 'climate board' came up so often in interviews with the respondents that it has been given a separate heading (interview, employee water board). The core tasks of the water board are the purification of wastewater, the management of dikes and the regulation of water levels, with the climate inextricably linked to these tasks. There would be more attention for themes such as energy transition, biodiversity, and climate change in a climate board. The performance of the core tasks mustn't suffer under themes such as energy transition. This is one of the reasons why some respondents are sceptical about a climate board.

5.2 Water board Limburg

Water board Limburg is currently dealing with significant changes in Limburg related to climate change and the energy transition. This chapter gives a brief outline of the trends and the urgency of a joint approach. It also describes what water board Limburg wants to achieve in the coming period and then links this to the transition theory.

One of the most critical challenges in 2021 is climate change. Emissions of greenhouse gases are not yet decreasing. The future scenario in which the average global temperature will have risen by three or more degrees by 2100 is becoming more and more realistic. This leads to wetter winters, drier summers and heavier rainfall. This has consequences for water quality and quantity. Periods of drought have a significant impact on water quantity and quality (Waterschap Limburg, 2015). More substantial rain leads to more frequent and more extreme floods in the Meuse and the brooks. To protect the Meuse Valley (Maasvallei) from flooding in 2050 by the applicable standards, many kilometres of flood defences must be strengthened during the planning period, sometimes in combination with river widening (Waterschap Limburg, 2021).

The upcoming period is also the final phase of the current European Water Framework Directive, which states that the water system must be in order by 2027. This requires ecological, hydrological and geomorphological restoration of surface waters and the preservation or restoration of their physic-chemical status (Waterschap Limburg, 2021). This requires a significant effort by the water board and all sectors that impact water quality. Emerging substances such as medicine residues and microplastics bring new challenges.

In addition, the transition from fossil fuels to sustainable forms is also a difficult task for the water board. Water board Limburg is working towards its energy and climate neutrality. The energy transition makes it possible to combine social goals, including those of water management. Society will also take steps towards a circular economy in which raw materials are no longer wasted in the coming period. Water board Limburg is contributing to this by gradually converting its sewage treatment plants from fixed concrete structures to flexible modular systems. In this way, energy and raw materials can be optimally recovered, and purified water of the desired quality can be supplied.

Limburg is experiencing an increase in the elderly population, resulting in decreased wastewater supply and increased concentrations of medicine residues in the water. Due to the shrinking population, significant urban expansions are no longer an option. Densely built-up old neighbourhoods are changing into more spacious residential areas with space for greenery and water. The leisure economy is growing, and the demand for attractive recreational areas (Waterschap Limburg, 2015). This is increasing pressure on space, making it more difficult to acquire land to construct waterworks. This pressure also grows in the subsurface due to cables, pipes, soil heat, and cold water storage.

Finally, a government with a broad base is essential for the Netherlands to keep up with the world economy. Economic growth is no longer evident, and therefore neither is tax revenue per government. For each government task, no more than one tier of government can set the framework, and another can implement it. Some studies are left to society itself. From an efficiency point of view, deregulation remains a political and social desire (Waterschap Limburg, 2015). At the same time, humanity has high expectations of the government. This calls for the more intensive cooperation between governments and partners.

5.2.1 Macro (landscape)

Climate change
It has long been known that the climate is changing, and water board Limburg is already preparing for this. However, climate change seems to be happening faster than expected, and one weather record after another is being broken. This is probably a harbinger for the future. Extreme rainfall and extreme drought present both the environment and the water board with a tough challenge. Adapting the water system to a more extreme climate is a significant operation. This means streams, dams and watercourses, and water management in cities, businesses, nature reserves and agricultural areas. In other words, the ball is in everyone's court (Waterschap

Limburg, 2021). To stay one step ahead of climate change in the future, it is now time to have the plans ready and start implementing them. That is why climate adaptation thinking and doing is the basis for all water board Limburg's work and expects its partners to do the same. This climate-adaptive thinking, which has arisen from climate change, is reflected in the regime, such as the joint design of climate-adaptive urban and rural areas and tackling the main water problems.

Sustainability
Water board Limburg has also identified sustainability as a spearhead. Its activities, buildings, and installations work on saving and generating energy, limiting greenhouse gas emissions, limiting material use, and closing cycles. Water board Limburg also asks this of its suppliers and contractors, whom it selects partly based on their sustainability efforts. For example, Limburg purchases sustainably, only accept fair trade and considers people far from the labour market. This is again the result of the trend in the landscape and is expressed in the regime.

Water board Limburg is committed to national climate and energy targets. The 2019 Climate Act commits the Netherlands to a 49% reduction in CO2 by 2030 and 95% by 2050. Like other water boards, water board Limburg has committed to the Green Deal Energy target of being energy-neutral by 2025 and is working on arranging the necessary financial coverage. The Raw Materials Agreement includes the objective of making the Netherlands circular by 2050. For water board Limburg, the interim targets are 100% circular procurement by 2030 and 50% less use of primary raw materials. Circularity is also about everything they design, build and purchase. The materials must be produced in a socially responsible way, and the components must be reusable. Material and value retention is paramount in the design. An opportunity in maintenance is to use the clippings from flood defences and watercourses for practical applications by offering them to neighbouring owners (Waterschap Limburg, 2021).

Respondent X from water board Limburg said the following: "*We have to work on less warming. But you just notice that the pressure on the ground, on the soils, is increasing. You are in RES, aren't you... In the regional innovation strategy, we talk about five transitions; energy is one of them, circularity is the other, agriculture and food is one of them, climate adaptation is one of them and health. So you see, it is a chain. So when you say, do well in something of that energy transition. People are bothered by the cast shadow of a windmill, then that's the moment, or see all those panels causing farmland to shrink. This shrinkage, in turn, affects the food supply. We also have to think about how to feed 8 billion people. It is chain thinking, and then, of course, every link is one, and what do you think is the most important. The broader thinking is... I think you see more coming (interview, water board employee)*". This shows that people are looking at more prominent trends such as climate adaptation and circularity, and according to person X, this will only increase in the future. This macro idea even influences a smaller scale, such as installing panels that can reduce the amount of agricultural land. In this example, the landscape influences niches.

'Climate board'
Because of these macro trends, the question within the water boards is whether the name 'water board' still covers the scope sufficiently. Respondent Y had the following to say about this: *"There is an increasing debate as to whether water boards still have the right name and should not instead be called 'climate boards'. Because of course we are constantly confronted with the problem of the climate. That also provides much support for our contribution to making a good move in that direction. To become climate robust, because then we will have tackled the consequences, but one of those things is to reduce our CO2 footprint, consume less energy and raw materials, and become circular, that kind of thing. Those are all things that are in our sustainability policy for the water boards. Therefore, it is logical that the minister, when concluding Green Deals, should also take a close look at the water boards. They are generally large organisations after all (interview, employee water board)"*.

Finally, respondent Y said the following: "*I think the water boards will eventually turn into climate offices. In the future, we will talk less about water as our problem and more about how we can be climate-proof. In terms of content, I think that is the future of the water boards, that we will be much more broadly involved in these matters. Not specifically with energy, but simply in a broader*

sense with everything to do with sustainability, water quality and the preconditions needed to do that well (interview, water board employee)". These two quotes show that the macro trends of climate change, circularity and sustainability resonate in the thinking of the employees of water board Limburg. As a result, according to respondent Y, the water board will be called a climate board in the future, with a more comprehensive range of tasks. This could shift from an old regime (water board) to a new regime (climate board). This could have significant consequences for the future as it affects all three levels of the MLP. For example, climate boards will start outsourcing tasks involving niches because of the broader range of functions. In addition, the legislation and regulations for a climate board will have to be tightened up in comparison with a water board. Finally, more attention can be paid to climate change and sustainability, accelerating the energy transition.

5.2.2 Micro (niches)

Individual actors, alternative technologies, and local practices are distinguished at the micro-level (niche level) (Van der Brugge et al., 2005). Within this study, the micro-level consists of most innovation factors that arise in niches and manifest themselves in projects that deviate from the norm. These inventions will mainly manifest themselves in water projects with new techniques for the water boards.

Hydropower is thought to be a real option in Limburg because of the difference in altitude within the province. However, only two waterways are an option, the Niers and the Ruhr, which meet the capacity and discharge requirements. However, there is also biodiversity that may cause problems. There are, in fact, watercourses that have other priorities when it comes to biodiversity and making them suitable for migratory fish. What used to be the most normal thing in the world is no longer possible because of all those weirs (interview, water board employee). Due to the increased attention paid to biodiversity, specific niche innovations find it increasingly difficult to get off the ground. This problem in the niches comes from the landscape. It also affects the regime, as fewer pilot studies can be conducted to interest all water boards about the energy transition.

Another solution could be green gas. At present, part of the sewage sludge is fermented to produce biogas, which is then used to produce electricity for the plant's use. But if you look at it from a pure energy point of view, it is more interesting to upgrade that biogas to green gas and supply that to homes or a company that uses gas (interview, employee water board). This supply of green gas as a niche innovation may lead to a regime change since water boards will then change from a government body to a for-profit organisation. As a result, the laws and regulations will also have to be changed within the regime.

A concrete niche project is the following. At the Venlo, sewage treatment plant of water board Limburg, a continuous thermal pressure hydrolysis plant and a sludge digester have been operating since 2012. This technology halves the volume of dewatered sludge and generates sustainable energy. The sludge from the Venlo, Venray and Gennep sewage stations is sieved, mechanically thickened, hydrolysed, digested and dewatered. The water board then uses the biogas to heat the sludge and provide electricity for wastewater treatment without energy surplus. About 65% of the biogas is used in the combined heat and power plant to produce electricity and heat, and 35% of the biogas is needed to produce steam.
Furthermore, it has been possible to dewater the sludge to 28.5% dry matter instead of the 22% they used to have. The combination of degradation and better dewatering resulted in halving the amount of sludge that needs to be disposed of (Stowa, 2018). This niche project has partly ensured that the energy transition is going well for water board Limburg, which impacts the position of the water board within the regime.

5.2.3 Meso (regimes)

The meso-level is central to the MLP and, therefore, also to this research. In the first instance, the power relations within the water board will be examined. This is measured based on partnerships between water boards or public and private parties (De Bruijn et al., 2008). Cooperation manifests itself in the joint formulation of policy and active cooperation in each other's plans.

Mutual contact with water boards
As regards mutual communication, opinions are divided within water board Limburg. This is partly due to the different functions of the respondents. For instance, respondent X said the following: *"We have several committees at the water boards, water system, water chain and emissions. All those committees. We meet there, but there are also all kinds of meetings in between. It's not always about energy and climate, but all sorts of related things (interview, employee water board)".*

Respondent Y has no structural coordination with other water boards, apart from webinars exchanging experiences. He also says the following: *"We can achieve this fairly autonomously, this energy neutrality of our own... Yes, it was once thought up by the national government that the water boards should be partners (interview, employee water board)"*. He doesn't see the point of working closely with other water boards because he thinks they can manage it independently.

Finally, respondent Z said that the water boards did cooperate, but this could be improved: *"Yes, we are in the union a lot as an umbrella organisation. We also have these committee clubs. Yes, there is cooperation, but it could be better, as we have found out ourselves… The first time I attended a national meeting, there was a lot we didn't know about each other. In the sense of, oh, you're working on the same thing as me. Oh yes, Delfland is a bit further on, they already have their drones, and they already have air plans and whatnot. Yes, they are improving a lot. So on the renovation platform, all the innovations are listed there as well. So it is much easier to reach each other and learn from each other. So, there is room for improvement, but we are making progress (interview, employee water board)".*

So as far as mutual communication is concerned, water board Limburg is working on it. The water boards don't see each other as competitors; they can learn something from each other. If another water board has developed something good for water board Limburg, or vice versa, they can take it over from each other because there are no patents on it.

Contact on a local, regional and national level
According to respondent X, there is also sufficient communication with the partners, the province and other government organisations such as the Directorate-General for Public Works and Water Management (Rijkswaterstaat). As far as communication with citizens is concerned, there is still room for improvement here. According to respondent X, there is a big difference in implementing projects when communicating with citizens than when this does not happen. The projects are much easier to get off the ground (interview, employee water board).

Respondent Y thinks that the cooperation between the different levels of government is not evenly distributed. According to him, it is mainly 'their party'. This is also in line with the following quote: *"The province, water board and energy company are full partners. But the direction is mainly in the hands of the municipality. If you look at the choices that are made, they are mainly in the hands of the municipalities. They deal with spatial planning together with the province. So when it comes to choosing a location, where to go and where not to go, we as a water board don't have anything to say about it. Our energy neutrality is a drop in the ocean. We use 2% of all energy; I think that's quite a lot, 2%. But then again, it is a relatively small player (interview, employee water board)"*. Referring back to the theory which investigates the power relations within a network (De Bruijn et al., 2008), respondent Y said that the role of water board Limburg could be described as minor.

The citizens are only involved when it becomes mandatory, such as when applying for permits. This will probably increase in the future once the Environment Act has been adopted. Then, as an initiator, they will have to coordinate with the environment, which is good. As respondent X also said, it will ultimately benefit the environment in the long run.

According to respondent Z, the water board is heard by the government. Even though they are a smaller club of 21 water boards and used to always function in the background within the board. Respondent Z also said the following about multiple helix collaboration: *"Within the triple helix, it is about the government, companies and knowledge institutions. But you hear much more about the multiple helix, which also includes the social groups. The broad mix may cause delays, but on the other hand, you also get more support (interview, employee water board)"*. The multiple helix

collaborations mean communication between four layers, with the positive effect of strengthening support. For example, the environment is essential to a water board, involving the government, the business community and knowledge institutes, and associations such as a walking club. They also want to be involved in the thought process to do something with a particular area. People are becoming more vocal (interview, employee water board). So, according to respondent Z, there must be good communication at the local, regional and national levels.

Contact with other companies

Apart from mutual contact with the water boards and communication between different levels of government, there is also the possibility of setting up projects with other companies. This is also the case in Limburg, where 'Waterleiding Maatschappij Limburg' (WML) participates in the 'Zuidenwind' cooperative where windmills are now being built. Water board Limburg has received nothing but positive feedback on this (interview, employee water board). In this way, they are going to compensate for their energy consumption by installing wind turbines. The cooperative has allowed residents to participate in this project, which has accelerated the process.
It is a big win when you work with the neighbourhood. The water board knows that from their projects, and especially when implementing the RES.

This is an example of direct cooperation with a cooperative. Another possibility could be indirect cooperation. *"When setting up an energy project with solar fields, you can fill an area complete with solar panels and put a fence around it. This causes the grass to die off and results in a bare plain, where dust clouds can form when it is windy. However, this can also be arranged differently by making it more spacious, whereby it is made accessible to walkers, for example. You could also manage the greenery between the panels ecologically to be beneficial in terms of biodiversity. You could even organise activities there. If you organise it that way, it's much easier to get people on board than if you turn it into some sort of industrial estate (interview, employee water board)".*

Berkhout, Smith and Stirling (2004) supplemented the MLP with the aspect of specific power resources. The more resources an organisation has at its disposal, the earlier plans can be made. These power resources are divided into financial resources, professional resources and regulatory resources. Financial resources refer to having sufficient resources to get projects off the ground or participate in them. Professionalism is determined by the knowledge that the water board produces itself, in cooperation with knowledge institutes and the support that the water board creates with this. Finally, regulation is assessed based on the laws and regulations within the water board and what barriers they experience.

Financial resources

Regarding the financial picture, water board Limburg has made agreements, and a structural amount has been reserved for sustainability and innovation, says respondent Z (interview, employee water board). In principle, the project to become energy-neutral must also be cost-efficient. This is not about +1/-1 percentage, but it must be the case that the business case is balanced in principle, and the calculations show that this is possible. However, it is often not apparent to the board when something is profitable or not. The board often asks: *"How can it be that if I install solar panels, they will have paid for themselves in seven years, and if the water board installs them, it will take between 12 and 15 years? And then I say that we buy energy in such quantities because we set a completely different price than you and I do privately. Of course, that is important for the business case (interview, employee water board)".* This is how respondent X describes the misconception that installing private solar panels is comparable to installing solar panels at a water board.

According to respondent Y, making the water board energy-neutral could also provide an excellent financial business case by keeping money from an energy project in the long run. Furthermore, as a government, the water board can, of course, borrow and invest money reasonably quickly, with which you can set up significant projects. If they also start to pay for themselves in the long run, that is only an extra incentive (interview, employee water board).

Based on the above data, it can be concluded that water board Limburg has sufficient financial resources to get projects off the ground or participate in projects as long as they pay for themselves shortly. This also allows them to continue investing in niche projects, which in the long

term may have a positive impact within the regime because new techniques can accelerate the energy transition.

Professional resources
At the moment, there are enough people within water board Limburg. They have sufficient knowledge about the energy transition because the treatment plant is partly a technological company. It is essential to keep the ability within the company. Another option is to hire someone from the market when necessary. This is not a problem, but it will probably cause a bottleneck in the future. This is particularly evident in the RES, where there are not enough available people for the tasks that the municipalities have to perform in the field of the energy transition. To solve this in the future, respondent X believes that education should be the main focus. This encourages people to play a role in the energy transition in the future in terms of technological knowledge.

This does not yet play a significant role within water board Limburg as far as support is concerned. This is mainly because they do it mainly on their land. The moment they start working more with wind/solar energy and collaborating with cooperatives like Zuidenwind, this will become a more significant issue. But thanks to good communication with stakeholders, this has been kept within limits so far. This does not mean that there is no growing social opposition to wind turbines and solar fields. They are also beginning to organise themselves more and more, it is noted within the water board. More clubs and associations are forming vehemently opposed to the whole energy transition, or at least to these kinds of projects. At the very least, this could cause delays and perhaps even cancellations in the future.

Besides good communication, local ownership is one way to counter this. With this, you give people a chance to buy themselves into a particular project and feel ownership as well. It also plays on sentiment, as respondent X emphasises: *“Yes, we are the ones who are suffering, and the profits are going to Vattenfall and Norway, to the big boys, and we are the ones who are suffering. That you can undermine that sentiment and demonstrate that the profits stay in the area (interview, employee water board)”.*

Another problem that has recently arisen in connection with energy neutrality is that the transport capacity of the networks throughout the country appears to be insufficient. As a result, not every project involving sustainable generation can be connected to the network. *“We had planned some solar fields near the wastewater treatment plants, and a few of them cannot go ahead for the time being because there is no connection capacity. So there you see some delay. One of the things we need to do is to get that transport capacity in order as quickly as possible (interview, employee water board)”.* To solve this, substantial investments and professionals are needed, among other things.

Regulatory resources
An internal problem within water board Limburg is sometimes the conservative attitude of employees. For example, they are wary of all kinds of legal constructions with parties and cooperatives in energy projects. They are rather critical about this, which regularly causes them to put the brakes on (interview, employee water board).

Besides the internal barrier, there is also an institutional barrier. According to respondent Z, governance can be complex. This is because they are not always on the same page when consulting with the board. For example, they often look at different schedules, workforce and the preconditions that projects must meet. Sometimes decisions are postponed, which costs much extra time. But when a crisis arises, a crisis organisation steps forward so that decisions can be made quickly. To ensure that water board Limburg can become more decisive, an emergency law, for example, could be an option (interview, employee water board). You can steer for that, and the means and instruments are already there. It is often not popular and politically desirable, but that way, you can get started.

Furthermore, the water board attaches excellent value to the province of Limburg. A beautiful, safe and healthy living environment is of paramount importance here. However, if you reason purely from the urgency of climate change, where fossil fuels have to be phased out, respondent Z would almost say: "*throw all the rules overboard so that we can get started as soon as possible*

(interview, employee of water board)". The Environment Act has already made it easier to carry out projects, but there is still a lengthy procedure beforehand. In addition, the RES is mentioned as an extension of the Environmental Management Act. The fact that Limburg, for example, has only two RES regions, despite the significant differences between them, shows that this is conducive to the implementation of energy transition within the water board. This is partly because fewer consultations need to take place. After all, fewer RES regions are involved. So, in general, water board Limburg would like the government to act more decisively within the energy transition so that steps can be taken more quickly.

Finally, changes in routines and habits play a role in policy change. Within the water boards, specific exercises and practices have developed over time. This research examines whether these have proven to be resilient. The water board can start working on new goals, strategies, and practices (Hoogerwerf and Herweijer, 2008).

Routines and habits
One notices that energy transition is nowadays implied as a routine within a water board. For example, the following has been agreed: *"within the 2 RES regions, we have agreed that this dossier will primarily be handled by our subsidiary water board company Limburg (WBL). And also that it is substantially to be gained there as well. So we are also working on the energy transition, to become energy neutral by 2025 (interview, employee water board)".* The commitment to energy neutrality is a breakthrough within habits and seeing opportunities for profit on business cases.

Water boards have the task of ensuring safe dikes, dry feet, clean and sufficient water. Nowadays, however, you can no longer simply say: *"yes, put in that stream, and that's it (interview, employee of water board)".* The theme is also biodiversity. Water board Limburg also hears that from the ecologists: 'the ecosystem doesn't stop at the quay'. It is a broader perspective, and a water board should do that more often. They are water managers and can also accelerate the energy transition through water purification processes, sludge processing, fermentation, and methane. They can also provide assistance or issue permits to companies. These days, the water boards are a government body and the owner of a piece of business, under the motto 'practice what you preach' (interview, water board employee).

5.3 Water board Wetterskip Fryslân

Wetterskip Fryslân is confronted daily with themes such as the climate, availability of energy and raw materials, land-use intensity and the changing relationship between citizens and government. In addition, technology and digitalisation are becoming increasingly important. All these developments put pressure on the feasibility and affordability of water management (Wetterskip Fryslân, 2016).

Wetterskip Fryslân has translated its environmental ambitions into recently adopted policy plans such as Safety Plan II and the plans for the Water Framework Directive. In recent years the water board has also worked on parts of the Delta Plan, such as Safety, Freshwater and the IJsselmeer. Measures arising from this are included in the new WBP (Waterbeheerplan) and implemented in the coming years.

The coming decades will see a scarcity of fossil fuels and raw materials such as phosphate. At the same time, the production of sustainable energy and the reuse and recovery of raw materials will increase. Wetterskip Fryslân wants to contribute to a biobased economy (Wetterskip Fryslân, 2016) by developing from an energy consumer to an energy producer in the next ten years. To this end, they already use sewage sludge for energy and raw material recovery. They can extract phosphate from wastewater and sewage sludge to serve as a raw material in the production process. With biorefinery, Wetterskip also wants to remove raw materials and energy from biomass.

Wetterskip Fryslân considers it essential to stimulate and facilitate innovation. Recent water issues demand new solutions in which innovation creates a culture of continuous improvement. Moreover, innovation can lead to more being achieved with the same financial resources. In the field of innovation, the water board focuses, among other things, on sustainability cycles and the

optimisation of wastewater treatment, based on the annual Innovation Plan (Wetterskip Fryslân, 2016).

The time of an all-powerful government is over. This is due to developments such as deregulation, cost reduction and expertise. The water board still manages the water system and the water chain, and citizens also expect the water board to do this. Another significant development is the rise of the participation society. Wetterskip Fryslân anticipates this by involving residents early in developing visions and plans, such as through 'The Dialogue' in the Greidhoeke (Wetterskip Fryslân, 2016).

Wetterskip Fryslân strives to keep the user functions (agriculture, nature, urban areas) at the current level. However, this requires continuous measures. As a result, water management costs will increase in the future, confronting landowners with higher prices. In the long term, this will most likely be exacerbated by a shrinking population. To limit the increase in costs, choices must be made about how Wetterskip Fryslân manages the water system. If bottlenecks are always tackled in the same way as in the past, this will lead to an increasing level of investment, high capital costs and permanently high costs for management and maintenance.

5.3.1 Macro (landscape)

Climate change
In December 2015, Wetterskip Fryslân confirmed its commitment to the Paris Climate Declaration, aiming to be a climate-neutral organisation by 2030 (Wetterskip Fryslân, 2016). Wetterskip Fryslân is in good shape when it comes to changes in the weather, such as extreme drought or precipitation. Safety Plan II showed that the storage basin system could cope well with excessive water levels in the current situation. However, there may be local constraints, particularly in areas where the dykes are below the required height. By deploying storage pumping stations and water storage and temporarily buffering water in the sub-systems, the water level in the storage basin can be managed without causing flooding (Wetterskip Fryslân, 2016). In general, Wetterskip Fryslân can maintain the target level of surface water in the storage basin and sub-systems for a long time, even under dry conditions. In summer, fresh water is brought in from the IJsselmeer. In the higher, sandier areas, water can also be supplied under dry conditions by pumping up water. However, persistent drought can have detrimental effects in specific subareas (Wetterskip Fryslân, 2016). For example, the surface water in the northern arable areas is salinated by saltwater seepage and saltwater discharges. The water board combats this salinisation by actively flushing. As a result of this macro trend climate change, Wetterskip Fryslan has taken several climate-adaptive measures about extreme drought and heavy rainfall, which are visible at the meso-level.

Sustainability
The primary goal of the water chain is to protect public health and the environment. Wetterskip Fryslân wants to use raw materials, residues and energy as sustainably and efficiently as possible. Thinking in cycles is the starting point. The water board makes sustainable purchases, uses green energy, limits its CO2 footprint and enables practical application or recovery of residual products. The effects on the environment, society and finances are all weighed up. The purification task does not stand alone but is the last step in the water chain. To increase the efficiency and sustainability of the purification task, Wetterskip Fryslân takes the entire chain into account and works together with water chain partners (Wetterskip Fryslân, 2016). Agreements have been made about this in the Fryslân Administrative Agreement on the Water Chain.

"*The realisation that we are now mopping up the water with the tap open is getting through to Wetterskip Fryslân, which means that the urgency of becoming energy-neutral is also increasing. If you want to turn off the CO2 tap, you have to become more sustainable*", says respondent Y (interview, employee water board). Until last year, there was always a multi-year agreement on energy that mainly became energy neutral. But now, there is a shift from energy neutrality to CO2 neutrality. The goal of energy neutrality is still essential, but there is an increasing focus on becoming climate neutral, with CO2 as the starting point. This shows that they are also concerned with climate mitigation. Wetterskip Fryslân also sees a role as a climate partner of other parties; they share it because they are involved in aqua-thermal energy.

'Climate board'
Furthermore, respondent X would like to see Wetterskip fryslân move towards its role as a climate board: *"That we focus less on ourselves and more on working together with society to achieve sustainability. Of course, it is nice to have your own house in order, but you should avoid competing with others because you want to build a solar park somewhere. It would be better to look at how we can support others in their energy transition, for example, by supporting aqua thermal systems and heat networks (interview, employee water board)".*

In contrast to respondent X, respondent Y was less inclined to support a climate board. *"Playing a prominent role in energy transition and circular transition, as well as mitigation and adaptation, are not the main tasks of a water board. An energy board will have to take on these tasks per RES. This functions socially in the same way as a water board, only about all parts of the energy transition. Meander, for example, could play a leading role in this. What I see in the RES at the moment is that you're dealing with administrators who have added energy as a sort of hobby. And they're not well enough versed in it, so they can get it wrong now and then. And that would be less if you had directors who are specialised in, or have a background in, energy matters'. This kind of situation can then be prevented (interview, employee water board)".*

5.3.2 Micro (niches)

According to respondent X, you also see more niche innovations by people who want to erect wind turbines themselves, such as the one near Menaam. Often, this is also on the land of a water board, and this is how citizens come into contact with the water boards (interview, employee water board). However, this is still being hindered. For example, a citizen very much wanted to upgrade his wind turbines. But the province then said: *"that's fine, but then you have to hand in 3 wind turbines (interview, employee water board)".* The municipality decided, but there are still restrictions, such as a wind turbine not exceeding a peak height of 100 metres. As a result, it is no longer a profitable option for citizens. This shows very clearly that niche innovations can be severely hampered by the laws and regulations coming from the regime.

A more concrete example is the water clean project in Sneek. Housing corporation Elkien, the municipality of Súdwest-Fryslân, DeSah BV, the province of Friesland, Wetterskip Fryslân and StOwa are working together on this. The research is about a sustainable and innovative decentralised sanitation system in the new housing estate Noorderhoek. Here, household wastewater from 200 houses is collected and treated locally. The project combines energy production (biogas), water savings and the recovery of fertilisers, which is in line with the circular economy. In addition, heat is recovered from wastewater, and organic kitchen waste is co-fermented to produce more biogas. The role of Wetterskip Fryslân is to supervise the construction and management and contribute to the research of the clean water system in the Noorderhoek district. Wetterskip Fryslân wants to promote innovation and sustainability in the water chain by participating in this project. The sustainability and energy analysis has now shown that the local sanitation system could, with further optimisation, score about 200 per cent better than the current conventional sewage treatment. This is possible thanks to the biogas and the heat recovery from the effluent via a heat pump. This is a condition for the system to have sufficient scale: preferably more than 1,500 inhabitants (Stowa, 2018). This niche innovation can significantly impact the regime to improve the energy transition when implemented on a larger scale.

5.3.3 Meso (regimes)

Mutual contact with water boards
In terms of mutual contact with other water boards, there is a consultation with all the water boards in the Netherlands once every three months. Wetterskip Fryslân wants to be involved as much as possible in the knowledge development of other water boards so that they can only use this knowledge. These contacts intend that the wheel is not reinvented more than once. Wetterskip Fryslân also has a more intensive connection with the three northern water boards. The CO2 performance ladder, for instance, is currently the subject of intense debate (interview, employee water board).

"*Every water board also feels that to some extent they have to go it alone. There is always something of healthy competition. As a water board, you always want to, well, stand out from the rest (interview, water board employee)*". Despite the cooperation between the various water boards, there is still a culture of 'every man for himself. According to respondent X, people still think they have to achieve things independently, which indirectly benefits the energy transition. If this were not the case, people would be inclined to pay less attention to innovations or progress in their energy transition.

Contact on a local, regional and national level
Within the RES, Wetterskip Fryslân cooperates a lot with other authorities. However, respondent X did say the following: *"But if you limit a province, you also tend to work against each other. Maybe we could work together a bit more on that (interview, employee water board)".* It's very contradictory because in the RES, it's all about cooperation, and that's why Wetterskip Fryslân can think along with the others. They also believe along with the transition visions of the municipalities. But as far as policy openings are concerned, they can be made better in the future. Mainly because the province of Friesland completely overlaps with the water board, it could be more beneficial if Wetterskip Fryslân would cooperate more with the province (interview, employee water board).

There is good communication about the organisation of the water boards via the union of water boards and small expert groups, an energy team and a circularity team. For example, through the RES, there are 20/30 colleagues involved in all kinds of 'clubs' that consult with all municipalities, provinces and NGOs (interview, employee water board). This leads to the most diverse things, from granting permits to aquathermy, policy development of topics, to CO2 pricing.

Wetterskip Fryslân also tries to involve citizens in projects. So far, many solar panels have been installed on sewage treatment plants, and those are generally not the most excellent places to be, so most people have no problem with that. But Wetterskip Fryslân is now also preparing to renovate the most significant part of the dike on the northern side of Fryslân, and a natural area process is underway. Much consideration is being given to the opportunities for residents and biodiversity (interview with water board employee). Wetterskip Fryslân is trying to involve society in this process.

Respondent Y felt that citizens were not sufficiently involved: *"I even have the idea that Wetterskip Fryslân, in particular, is increasingly withdrawing into a small island and when a citizen comes up with an initiative, we find it very difficult, even though they communicate by opening water board offices to the public (interview, employee water board)".* Within Wetterskip Fryslân, it is essentially a question of lack of time. People simply don't have the time to do both the tasks they have to do for the internal organisation and additional functions on the outside. A package function is a possible solution to this problem in the future.

Contact with other companies
The climate agreement now stipulates 50% participation in energy initiatives. Of course, one of them is much discussed, the first wind turbines of a local farmer in Menaam. Friesland also has many energy cooperatives that want to install wind turbines. *"If the water board has the space for a wind turbine, why wouldn't an energy cooperative want to be part of that and organise the turning area (interview, employee water board)?"* Respondent Y asked himself this question. However, the legislation and regulations mean that this has not yet been an unqualified success.

Financial resources
According to respondent X, Wetterskip Fryslân is financially hampered. Several years ago, for example, the water board had to increase its rates because they cover a vast area with only a few inhabitants. As a result, the farmers occupied their area with tractors for two weeks (interview, employee water board). This shows that they could be better off financially. To solve this, Wetterskip Fryslân must account for what they intend to do with the residents' money to create more awareness. Furthermore, subsidies from the government also help to avoid this kind of problem in the future. Respondent Y believed that the obstacle was not the financial aspect because the Dutch Water Board Bank (Nederlandse Watererschapsbank) was prepared to provide excellent financing at an acceptable rate (interview, employee water board).

You also notice that now that electricity prices are rising, generating energy is becoming more profitable. So there are financial advantages to investing in the energy transition, certainly for a water board like Wetterskip Fryslân, which faces economical challenges. According to respondent Z, He has the impression that 'his water' board is somewhat hesitant about this (interview, employee water board).

Professional resources
"*Technically, there is sufficient knowledge within our water board. Despite this knowledge, there is a small-scale problem around the network congestion because Wetterskip Fryslân cannot just connect solar fields to the public network (interview, employee water board)".* Outside of this problem with the network, there are plenty of opportunities in the future in the province in terms of new techniques or techniques that continue to develop to meet the energy transition demands, such as sludge digestion and biogas.

Within Wetterskip Fryslân, much consideration is given to the inhabitants and the responsibility they want to exert. Imagine if a piece of land were filled with solar panels and Wetterskip Fryslân were to step aside. Would the residents be grateful, or would they think their water board is doing what it should? The role of the board is also under scrutiny. The administrators are somewhat further removed from the work than, for example, the national government. They still have to be convinced, as it were, of why it is so essential to make the water board more sustainable (interview, water board employee).

Although the citizens are considered, there is still opposition from residents regarding solar fields and wind turbines. Because it is primarily forbidden to place wind turbines in Friesland, no action is taken. Here the politicians listen to society because they do not want it. The situation is becoming more and more relaxed so that it is not yet clear what the majority of the province of Friesland thinks of projects involving solar panels and wind turbines. In general, most people want to become more sustainable. Still, hardly anyone wants a wind turbine in their backyard or the Not In My Backyard (NIMBY) principle (interview, water board employee). By financially compensating the neighbour with the proceeds of a wind turbine, this problem may be solved in the future.

Regulatory resources
Wetterskip Fryslân still has a long way to go to achieve its goal of the energy transition. This is partly due to the strict laws and regulations in the province of Fryslân. For example, no wind turbines may be built, and regulation in force does not allow more solar panels to be placed on agricultural land just like that. Even though Wetterskip Fryslân is a province with lots of space and wind, the possibilities are becoming more limited. This is frustrating for respondent X, but there is also understanding for the measures: *"That is only logical, you don't want to build up your landscape and then think: was that the smart thing to do? At the moment, when there is no alternative, it is difficult (interview, employee of water board)".*

The possibility of installing solar panels on water purification plants is being investigated. Other options such as sustainable sludge processing or biogas, which produce less in net terms than a wind turbine, are also being considered (interview, employee water board). In addition, the processes involved are also very long, which means they will probably not be realised before 2025.

Because the legislation and regulations are so strict, Wetterskip Fryslân is not on schedule concerning the objective of being energy-neutral by 2025. Interestingly, according to respondent Y, opportunities were missed in the past. In the past, the province was not so strict about wind turbines and solar panels, so that at the time, a more significant battle could have been fought by installing both options. Respondent Y said the following about this: *"I tried to persuade the water board to cooperate in wind turbine initiatives. But the water board thought that was far too exciting and progressive (interview, employee water board)".* This would not have been financially disadvantageous.

A solution to the institutional problems could be to show more political courage. For example, both respondents got the impression that the organisations were willing but that the water board

was holding back because they were rather conservative and shy of controversial projects. This ties in with the fact that they agree that Friesland is a rather conservative province anyway, where the agricultural sector is predominant (interview, employee water board). The bottleneck here is also that the use of agricultural land is controversial.

Based on the above data, legislation and regulation are the biggest obstacle for Wetterskip Fryslân to become energy neutral.

Routines and habits
"You notice that the energy transition is becoming more and more commonplace within the water boards, including Wetterskip Fryslân. The goal of being energy-neutral by 2025 is taken seriously, and it is also seen as something they cannot avoid. This is because the water board experiences first-hand what the limited climate change has done to them so far and what they can expect in the future. That growing awareness reinforces the routine of including the environment in decisions. So we are working hard on that, that's the part they call 'putting our own house in order. Because, that part of us, becoming energy neutral, to just go for it (interview, employee water board)". This does include not only energy neutrality but also climate neutrality. In the cooperation with contractors, you also notice that there is much focus on carrying out projects in a more sustainable way, such as avoiding fossil fuels. This was previously unthinkable, from which you can conclude that it is deeply rooted at Wetterskip Fryslân.

There is, however, a side note due to the institutional limitations in Friesland. Partly because they are so constrained to become more sustainable, you also notice that not everyone within the water board is singing from the same hymn sheet. This is also evident because respondent Z thinks the water board will no longer take on future energy transition and circularity tasks. This shows that energy transition will not remain a habit but rather a short-term thought.

5.4 Water board Rivierenland

The task of Rivierenland is to ensure safe dikes and a balanced water system. This includes a proper fulfilment of the role as regional water specialist, practical cooperation with other parties and an eye for the social added value of the work. In addition, the new policy and its new frameworks are taken into account and previous strategic choices for the long term. To realise the relevant ambitions, new developments are anticipated, and strategic alliances are formed.

With some 550 kilometres of river dykes, Rivierenland is considered the 'dyke water board' of the Netherlands, which will present plenty of challenges (Rivierenland, 2016). This gives plenty of challenges for the coming decades (Rivierenland, 2016). For example, Rivierenland accounts for various developments such as subsidence and rising sea levels in its flood protection measures. Rivierenland is working on water-robust spatial planning and ensures adequate crisis management to limit the consequences of flooding. This has led to actions being taken in the urban area to prevent flooding. These measures also contribute to improved water quality. Additional measures will be taken to achieve the clean water targets, mainly focused on combating water shortages in dry summers and ensuring climate-proof urban areas (Rivierenland, 2016). Besides the measures for clean water, Rivierenland is also focusing on further strengthening the water chain. This will include reducing emissions with sewage treatment to a reasonable level and no longer viewing sewage merely as a waste product but as a potentially valuable source of raw materials and energy for reuse.

Rivierenland works closely with other water managers and partners and various universities and knowledge institutes (Rivierenland, 2016). Rivierenland uses all this knowledge to develop new insights that they can quickly apply, sharing their knowledge with other parties. This creates a good balance between receiving and transferring knowledge, a win-win situation.

Rivierenland also wants citizens to be aware of the risks and to use these as a basis for making decisions. When citizens are involved, the water board can carry out its tasks better, and at the same time, support is increased. Citizen participation helps Rivierenland in many ways to improve plans and projects, so they can better respond to the wishes of citizens and companies. Residents are intensively involved in many projects, such as dyke improvement projects

(Rivierenland, 2016). In the future, Rivierenland wants to make even more use of the opportunities for citizen participation.

Furthermore, the Rivierenland water board pays much attention to the common interest. For example, social goals are taken into account when formulating plans relating to the energy transition. In this way, together with other government partners, they can better coordinate goals and measures.

5.4.1 Macro (landscape)

Climate change
Rivierenland wants to organise the regional water system in such a way that it can cope with extreme rain and drought. Especially since the risks of flooding are high in the urban area. In anticipation of this, Rivierenland has already taken many measures to absorb the increase in precipitation, such as constructing or widening 85 kilometres of nature-friendly banks and adapting various pumping stations. It is also possible to adjust water level management in situations of extreme

In addition, more extended periods of drought and reduced river water supply leading to a shortage of clean water are also considered. Moreover, the effect of a heatwave in an urban area is extra-large because heat is retained. Intensive land use is another factor. Combining these two developments will increase demand for fresh water in the years ahead, while the supply from the rivers will decline. In the future, this could lead to a water shortage in the Netherlands and damage to agriculture, nature and shipping (Rivierenland, 2016). Despite the favourable location of the Rivierenland water board, which means there is sufficient water intake from rivers, the water system in the belt area is under pressure. It is essential to look for innovative solutions in the future.

Sustainability
Rivierenland, like all water boards, strives for sustainable energy use. They want to use as little energy as possible, generate as much energy as possible and buy the remaining power in a greenway. This can be achieved by recovering raw materials and creating a climate-proof city that can withstand future climate extremes. The ambition is to be energy-neutral in 2025, and to achieve this goal, Riviereland is structurally working on a more sustainable execution of its tasks. Energy-saving and reduction of greenhouse gas emissions, sustainable energy generation and limiting the consequences of climate change are central to this.

Energy production is mainly based on energy from wastewater. Rivierenland wants to take essential steps to transform wastewater treatment plants into energy factories and reduce the energy used in water level management. In addition, it is looking for opportunities to generate energy from the sun and wind on its sites (Rivierenland, 2016). Furthermore, Rivierenland will investigate new possibilities to increase their energy production and make their energy use more sustainable. The starting point for investments is that they must pay for themselves within ten years.

'Climate board'
Opinions are divided within Rivierenland regarding the role of a climate board instead of a water board in the future. Respondent X emphasised that the core business was water safety and water purification. In addition, sustainable thinking is now being added to the purification of water and the operation of dams, in response to which he said the following: "*In the future, it will not be a climate authority straight away, but that is where we should be heading. Then the question is, should we do all this ourselves in the future or should we leave it to the parties who know more about it or are we going to develop ourselves in this area (interview, employee water board)?"* This shows that he had his doubts about the role that the water board would play in the future but that they should strive to play the role of climate board. This would include a regime change when it becomes a climate board instead of a water board, with tasks being outsourced to niche organisations.

Respondent Y had a very different view of the role of the water boards in the future: *“Well, I think that in X number of years, I don't dare put a figure on it, that the water boards will no longer exist. I think the vast majority of things can be done by Big Data (interview, water board employee)".* The water boards will eventually be subdivided by the provinces, which means that their role will decline in the future. In this context, big data refers to a large amount of data that results from the increasing amount of recorded and available data. According to respondent Y, when connections can be made between the various data, the energy transition and climate change will be easy to solve. In this situation, trends can even be resolved in the future in the landscape, where big data is seen as a bigger picture instead of a water board that manifests itself in the regime.

Respondent Z also addressed the importance and motivation of the primary task of water and dyke management, looking at other issues such as energy transition. "*I think it's a good thing that at some point, because of the land you have and the water bodies, you produce more energy than you use yourself and make that available to the environment. But to immediately refer to that as a climate society, well... I don't know; I find that difficult (interview, employee water board)”*, said respondent Z. He foresees a facilitating role for the water boards in the future, but producing is a different matter. It is essential to look beyond the core tasks of the water boards because there is increasing attention for sustainability issues and biodiversity.

5.4.2 Micro (niches)

One of the many pilots that have been started in Rivierenland is the installation of floating solar panels on the water storage near the sewage treatment plant in Weurt, Nijmegen region. This is done in cooperation with the consortium innOZOwa, which stands for innOvative Solar PV (solar panels) on water. The Rivierenland water board, TU Delft and two companies cooperate in this pilot project to realise solar parks on water, where highly effective use can be made of the available water area. Ultimately, the innOZOwa consortium aspires to create more opportunities for water management through innovations (Stowa, 2018).

Furthermore, since 2016, the rivierenland water board has been using a technology developed by eQa-projects. They have started implementing this technology at a weir in Ommeren. The goal of this eQa weir was to have it operate energy-neutral. Over the years, the design has been dramatically improved, and in 2018 it was concluded that much more electricity could be generated than is needed for the weir. This surplus is stored in batteries or fed back into the grid (Stowa, 2018).

“*Storage, that could be an option, but you could also say, for example, that we are going to set up a cooperative whereby citizens, people who live in the vicinity, can participate in the energy consumption (interview, employee water board)”.* This is not yet possible due to the legislation and regulations in the Netherlands, but respondent Y said this is certainly a possibility for the future. When this does become an option, there will be a regime change. The water board will then change from a non-profit government body to a for-profit supplier of energy. This regime change will also impact the niches, as the water board will then have a different task package to deliver energy.

Another niche innovation to increase support is the following: *“by, for example, making toilets available at events such as the Four Day Marches. We could also put up a solar panel and some flyers. And when people come here for a tour, we don't just show them the purification facilities; we also show them a purification facility with an adjacent solar park (interview, employee water board)”.* In this way, the public becomes more involved in the energy transition and gets a better idea of how it works within the water board. This can increase support among people interested and take a tour and people who use a toilet with advertising. Through such innovations, indirect and direct communication takes place, thus contributing to public support. This niche innovation contributes to the energy transition within the water boards by increasing support, noticeable within the regime.

5.4.3 Meso (regimes)

Mutual contact with water boards
Cooperation between the water boards has become easier over the years, according to respondent W, partly because there are fewer and fewer of them, down to 21 at present. This also makes it easier to divide up subjects and tasks, which is what happens in practice: "*That one party focuses more on a particular subject. You can just divide up certain research tasks or policy-preparing tasks a little among yourselves. Then, with 21 parties, if you have four subjects and you can divide them up over four groups with five water boards, you see in practice that this works very nicely (interview, employee water board)".*

Respondent X concurred: "*We know how to find each other (interview, employee water board)*". However, there were also drawbacks to working together: "*It's not that we have to work together. The more we work together, the more delays there are sometimes. I mean more with procurement and things like that (interview, employee water board)".* There are more procedures to go through when working together, making it take longer than when you do it alone. Furthermore, most of the water boards have their ways of implementing plans, which is why cooperation should not be intensified, according to respondent X., Especially because Rivierenland is already fairly advanced in terms of the energy transition, which means that they mainly share knowledge rather than gathering or collaborating. Another comment is that each water board has its qualities and procurement policy. For example, one water board may opt for solar energy and another for wind energy, making partnerships more complex.

According to respondent Y, however, the cooperation could be better. This mainly had to do with the triangular relationship between the Rivierenland water board, other water boards and the Union of water boards: "*That is always a triangular relationship. We have contact with the Union of Water Boards, and the Union of Water Boards has contact with another water board. I don't see that collaboration, really with water boards, maybe the other colleagues do, but I don't see that no (interview, water board employee)*". The direct cooperation between Rivierenland and another water board is something he misses. He only sees communication with other water boards through the union of water boards, not directly between Rivierenland and other water boards.

As regards the exchange of knowledge and objectives between the water boards, there was a great deal of coordination in the cooperation, according to respondent Z. "*But apart from that, I feel that everyone is having their party. And you can ask yourself if that's a bad thing. I mean, water board boundaries are often, well, water boundaries. The borders of the Rivierenland Water Board are main rivers. So we are not looking for cooperation with other water boards (interview, employee water board)*". According to respondent Z, despite the exchange of knowledge, every man is still for himself, which is not bad.

Contact on a local, regional and national level
"*There is sufficient contact with the government, but we do need the SDE subsidy to realise sustainable projects (interview, employee water board)*". Here, respondent W said that there was contact with the government but mainly of financial importance. Cooperation with citizens is more intensive. They are involved in landscaping solar and wind energy in good time, often from the preliminary stages to create regional support.

Respondent X noted that the water board is mainly left to its own devices. He thinks that the government should inform the municipalities better about specific projects relating to sustainability: "*The government could do more to make that clear to the municipalities so that we don't keep getting these questions. That we have to defend ourselves, so to speak, in certain... permit applications (interview, employee water board)*". Apart from the fact that the government could inform the municipality better, respondent X emphasised the importance of not being dependent on a large government. Contact with citizens was OK, with only those who would be affected by a solar farm, for instance, being spoken to. Nevertheless, it is essential when communicating with citizens to become more aware of the energy transition in the future. The citizens who are directly affected by a solar park and the surrounding regions to increase support for and awareness of such projects.

Respondent Y also felt that the water boards were mainly left to their own devices. He gave the example of the termination of the Multi-annual Agreements on Energy Efficiency (MJA3). This has resulted in the water boards having to meet all kinds of new obligations and be accountable to some different parties, which has made the implementation of the energy transition more difficult. As regards communication with the public, they are informed but not directly involved. One option could be: "*People who live in the neighbourhood, they can have a say in energy consumption. They can get it cheaper from us, and we still get more back than they do. But the law is still set up in such a way that that can be very difficult, that you selectively give people advantages, and we as a government must not do that. I think that the national government and the Lower House could come up with a much better arrangement (interview, water board employee)*". Regarding communication at the local, regional and national level, respondent Y felt that there was still plenty of room for improvement.

"Yes, when it comes to solar panels at treatment sites where there are no houses in the vicinity, the involvement of citizens is, of course, very minimal. But when it comes to locations for wind turbines as a pilot study, citizens are closely involved. So that certainly happens, but it depends on the location and the impact (interview, water board employee)", said respondent Z about citizen involvement.

Contact with other companies
Regarding collaboration with other parties to increase their share of the energy transition, respondent W was somewhat sceptical. "*Where the union of water boards also includes projects by 3rd parties that take place on the water board's site, the water board counts them as its sustainable production. That 3rd party can then also attribute itself as its sustainable energy production, and the water board does the same (interview, employee water board)*". A reason besides compensating the energy consumption, is that Rivierenland also wants to help other parties with their sustainable energy goals: "*If parties from outside come to us with the question; is this water board site available or can we do a pilot or something? Then we are willing to discuss it to see if we can combine it or find something for it (interview, employee water board)*". Respondent W is more in favour of generating at least as much sustainable energy as they consume themselves, which comes down to energy neutrality. Rivierenland is also in favour of this, but at the moment, not enough is generated by its means. Rivierenland, contrary to water board Limburg and Wetterskip Fryslan, works relatively much together with third parties. This ensures that one of the water boards within the regime is on the right track to meeting the requirements to become energy-neutral by 2025.

Another option, according to respondent Y, could be to set up a cooperative with residents: "*That could be a win-win situation. The biggest financial gain comes from not supplying energy back to customers but using all the generated power. If you do that, you don't have to buy energy. So then you have earned back your purchase price; avoided purchasing, we call it. But of course, there are... But there are peaks at every location when we generate more than we use, so you have to feed that back. They can get it cheaper from us, and we still get more back than they do (interview, water board employee)*". However, this is not possible at the moment due to legislation and regulations, as you would be putting certain population groups at an advantage who would have the opportunity to join such a cooperative.

Financial resources
According to all four respondents, Rivierenland has sufficient financial resources to achieve its sustainability goals. Respondent Z said the following in this regard: "*I think in terms of money that's not the obstacle. It is, of course, also a critical issue for the water board. Still, in itself, the business cases do show that eh.... with these new energy sources and self-generation, you can recoup the investment in the long term (interview, water board employee)".* The only possible obstacle was mentioned by respondent Y: *"Financially we do not have any problems yet. But now I don't know what will happen with that; the container price will rise. So what is going to happen with that, I don't know. I think it won't be too bad (interview, employee of water board)"*. The massive increase in the price of containers that have to come from overseas is due primarily to covid-19. As a result, construction materials are also rising sharply. This increase in the price of

containers may have consequences for the energy transition in the future, but for the time being, there are no financial obstacles for Rivierenland.

Professional resources
According to all four respondents, the technical knowledge and possibilities are present within the Rivierenland Water Board. Respondent Z said the following "*Technically, yes, especially the research into solar panels on dikes and water, not everything is known about that yet. But it's all technically possible, provided there's raw materials, technology and supply. That is, of course, also a new issue (interview, employee water board)*". So Rivierenland is not experiencing any obstacles to this.

Despite having sufficient knowledge, respondent Y felt that the subsidies on wind turbines and solar panels, for instance, meant that innovations that could have more impact were hardly considered. Even though solar and wind energy is sustainable, they do not yield enough profit; in his opinion: "*Every solar panel that we install as a water board, private individuals or any other company that does mean well, that is of course always a bonus. That is something, but that is peanuts... that is nothing (interview, employee water board)*". According to him, this could cause the energy transition to eventually grind to a halt, resulting in consequences for regimes and niches. According to him, this could cause the energy transition to finally come to a standstill, resulting in implications for regimes and niches. There is less investment in niche innovations by water boards, as they are content with solar panels and wind turbines. This ensures that fewer niche innovations are created, and the regime has more money left over for other things.

Opinions are somewhat more divided about the support for the energy transition within the Netherlands. Respondent M felt that there was sufficient commitment among management and citizens to sustainability.

According to respondent X, support for biodiversity is in question. "*Nature organisations have a great deal of social influence in politics, which means that you have to pay extra attention to incorporating biodiversity properly. This has not yet led to any concrete obstacles, but it is slowing things down (interview, employee water board)".* Even though rivierenland has a policy on this, the nature association finds it insufficient at the moment. There must be good communication at the front end to ensure that it does not become an obstacle. Rivierenland also tries to do this by quickly visualising what is possible with the environmental manager. As an organisation, Rivierenland wants to show the environment that it is working on energy transition and biodiversity. By doing so, people become more and more aware. This awareness, together with pointing out the necessity of using, among other things, IPCC reports, helps to increase support. The recent floods in Limburg have also made people realise that the climate is changing (interview, employee water board). In this situation, biodiversity, a trend originating in the landscape, has consequences for the regime.

For example, support for energy transition is not limited to what the immediate surroundings think of a wind turbine. Citizens are often open to wind turbines as long as they benefit from them. According to respondent W, It is often a political game: *"We have a fantastic potential project where the immediate environment says 'bring on those turbines'. But local politicians and even administrators within our water board say we don't want those things. They do have the authority to grant a permit, but they withhold it from their political constituencies so that they will be elected next time (interview, employee water board)*". This problem is deeply rooted and not easily solved. However, it is too easy to say that the energy transition will be accelerated if it is solved.

Regulatory resources
All respondents questioned the government's approach to the role of water boards in the energy transition. Respondent X, for instance, said the following: *"If you have such a RES, you should say that it would be straightforward to issue a permit for it. Otherwise, you would not designate that RES area. You just have to say, yes, we've already decided that once, so the Board shouldn't have to think about it anymore. Only that it is constructed in a certain way as they had conceived it (interview, employee water board)*". Once it has been decided what a RES area is, there shouldn't be so many more restrictions.

This ties in with what respondent Y said: "*Laws and regulations, you do have to comply with laws and regulations, so there is a lot of red tapes involved. So I'm doing much reporting. Yes, it takes time. Is it useful? Yes, but I think it should be done much quicker (interview, water board employee)"*. Respondent Y also mentioned the option of supplying power to residents. However, the law is still framed so that it can be tough to benefit people selectively. This selective advantage manifests itself because people living in the village can get cheaper electricity than people living in the surrounding villages. This is something Rivierenland, as a government body, should not selectively provide people with power. The government should come up with better regulations here (interview, employee water board).

Not only should they have better regulations, but they should also take more control, according to respondents W and Z, by steering more towards the realisation of solar and wind energy and allocating it. "*The national government should take the lead and not leave this to regional energy strategies, municipalities, provinces, etc. because they often have too many different interests (interview, water board employee)"*. This will not always be to the liking of residents or municipalities, but it should be possible to compromise with good information and consultation. There is also much pressure on land because the Netherlands is a small and entire country. However, this is difficult to achieve because of the government's decentralised path, as the respondents know.

Routines and habits
Since the energy transition, there has been a difference in the routine and habits at the Rivierenland Water Board. According to respondent W, there is an intrinsic motivation within the water board to do something about the greenhouse effect, but people do not feel obliged to become energy-neutral. There is also the realisation that sustainable energy production is cheaper in the long term and is therefore financially attractive (interview, employee water board).

The same applies to the concept of biodiversity, which is recurring more and more frequently, according to respondent X: "*Of course, we have locations where there used to be sewage plants, which we now use to build solar parks. Now we also have biodiversity, of course. Then we start having discussions about how many per cent you want to layout. While I say, fill it all up and put a hedge around it, and we're done. Now it also has to be landscaped, while there used to be a purification plant there. We decided together that this land was meant to be used for solar parks. Biodiversity shouldn't be the leading factor, because then... I'll soon have a field, so to speak, that I'm laying half of and which is no longer profitable (interview, employee water board)".* Yet, like the other respondents, respondent X knew better than anyone that biodiversity was here to stay. The national focus on sustainability themes and biodiversity is proliferating, which means that Rivierenland can no longer look only at its core tasks.

However, respondent Y does think that the staff should start thinking differently. An example of this is the following: "*We have pumping stations that determine the water level, and there are, for example, three engines. Suppose the level rises, then we can turn on one of them. But you can also switch on all three so that the water level is up much more quickly. That takes more energy, but it takes less time. However, they often say: 'well, if we just switch on one engine, it may take two days. Normally, they would say: 'we'll turn on all three and then the water will be up to the right level quickly'. The energy consumption is then much higher instead of letting the engine run at, say, idling speed and then pumping the water away at your leisure for two days. Then you have, say, 1/5 of the energy consumption instead of turning everything on. Such things, I think, we are at that point. That the thought, the way of working, must be different. We are building solar parks; we are implementing all these energy measures, which also takes time. But I think the employees can achieve the largest part of the efficiency (interview, employee water board)*". This shows that people are aware of the consequences of the energy transition, such as whether to switch on three engines or one or how much time this will take. However, this should not be at the expense of their primary task, such as keeping their feet dry.

6. Conclusion

This chapter concludes the research based on the theoretical framework and the analysis. Based on the assumptions made before the study, work will be done towards answering the main and sub-questions. This is followed by recommendations for follow-up research and a reflection on the design and implementation of the study. The main question of this study is, "*How do the water boards in the Netherlands experience the possibilities and limitations at the macro-, meso- and micro levels to contribute to the energy transition?"* To answer this question, the four sub-questions must first be answered.

6.1 Findings

1. *Sub-question: To what extent do climate change trends and sustainability at the landscape level affect the water boards?*

The climate is changing, and this affects the thinking and actions of all 21 water boards. Extreme rainfall and drought are significant challenges for the water boards. Adapting the water system to a more extreme climate is a large operation. The goal is to stay one step ahead of climate change in the future. Therefore, atmosphere adaptive thinking and action are essential for all the water boards' work now. It should be said that circularity is also a trend that has been addressed. However, this trend is still in the early stages within the water boards. They are first concentrating on achieving the energy transition targets, whereby they must be energy-neutral by 2030. Only then will they look at implementing circularity, which is the order in which most of the water boards are tackling it. Biodiversity is another trend that plays a role within the water boards and is discussed in this study. It is not enough, however, to pay extra attention to it in this conclusion.

For the water boards of Limburg, Wetterskip Fryslân and Rivierenland, climate change has specific consequences. Water board Limburg focuses mainly on the joint design of climate-adaptive urban and rural areas and water conservation. Wetterskip Fryslân concentrates primarily on situations of extreme precipitation and drought. Rivierenland wants to organise the regional water system in such a way that it can cope with these extremes. These are all specific and place-based strategies to counteract climate change, resulting from the general trend of climate change. In other words, the landscape has a significant influence on the regime. The Netherlands has traditionally been involved in climate adaptation. But the new climate action targets, with which the water boards have set themselves the goal of being energy-neutral by 2025, have also created much interest in climate mitigation. This shift from adaptation alone to adaptation and mitigation is a consequence of the climate change trend. This change in thinking is reflected in the transition theory because other decisions need to be made. Not only does the landscape influence the regime, but it also influences the niches. For example, water boards have traditionally invested a lot in niche innovations to protect cities from flooding. Nowadays, preservation of biodiversity and reduction of greenhouse gas emissions are also considered.

Another critical trend is sustainability. Water board Limburg is working on saving and generating energy in its buildings, installations and activities. Both water board Limburg and Wetterskip Fryslân want to use raw materials, residues and energy as sustainably and efficiently as possible. Wetterskip Fryslân is also looking at the entire chain and is working with its water chain partners to make its purification tasks more efficient and sustainable. Rivierenland's goal is to use as little energy as possible, to generate as much energy as possible and to buy the remaining power in green. Here, too, the landscape has a significant influence on the regime. For example, the water boards are currently pursuing a sustainable energy policy. They are looking for ways to save, recover, generate and sustainably produce energy. This causes processes, such as the purification of water to be viewed differently. Furthermore, just like the trend of climate change, this has consequences for the niches. For example, the water boards are looking at solar and wind energy to accelerate the energy transition.

As a result of climate change and sustainability trends, a new discussion has arisen within the water boards. This is whether the term 'water board' is still all-encompassing and whether it would not be better to speak of a 'climate board' in future. The water boards are constantly having to deal with climate issues and sustainability policy. They, therefore, have a broader remit,

with water safety or water treatment as core tasks and the preservation of biodiversity and circularity as pillars. This wider remit for a possible climate board could change the regime for the water boards. For example, the rules within the regime will be adjusted because a climate board will also supervise biodiversity. In addition, more technical knowledge will be needed within a climate council. Finally, more financial resources will have to be made available to finance all the themes. Many respondents see this as a fait accompli and think that this is the future of the water boards because they have experienced it firsthand and can no longer ignore the critical trends. When this situation occurs, the water boards, or climate boards, can play a more significant role in the energy transition. However, there are also voices contrary, such as playing a prominent role in the energy transition. Still, mitigation and adaptation are not the main tasks of a water board. There is a feeling that the core tasks can no longer be carried out optimally with the additional functions.

2. *Sub-question: What niche innovations are there, and what role do the water boards play in them?*

Each case study has its own specific innovative pilot studies. One niche innovation is that a continuous thermal pressure hydrolysis plant and a sludge digestion plant are in operation at the Venlo sewage treatment plant of water board Limburg. This technology halves the volume of dewatered sludge and generates sustainable energy. A successful niche innovation of Wetterskip Fryslân is the 'Waterschoon' project in Sneek. Here, use is made of a sustainable and innovative decentralised sanitation system in a new housing estate. The project combines energy production (biogas), water savings and recovery of fertilisers. Rivierenland uses several concrete niche innovations, such as installing floating solar panels on the water storage near the sewage treatment plant in Weurt. Rivierenland also makes use of a technology developed by eQa-projects to make the operation of a weir energy-neutral. This currently generates so much electricity that it is stored in batteries or fed back to the grid. Another option could be for the water board to supply energy to consumers. However, this would change the role of the water board within the system, from a government body to an energy producer. This is not yet an option due to legislation and regulations but could be in the future.

These developments within the niches accelerate the energy transition. The water boards are partly responsible for this because they seek partnerships with parties to meet their wishes in terms of the energy transition. This is an interaction between the regime and the niches. For example, water boards provide companies with knowledge and financial resources to start up a niche innovation. If successful, this will positively affect the water boards because their contribution to the energy transition will increase, as will their role. There is interaction not only between the regime and niches but also between the landscape and niches. Many niche innovations are increasingly taking biodiversity into account, which is a consequence of the stronger trend of climate change. In this way, a change in the landscape is responsible for a change in the niches.

3. *Sub-question: How does communication between the water boards themselves and at different levels (local, regional and national) with other parties affect their role in the energy transition?*

The water boards of Limburg, Wetterskip Fryslân and Rivierenland are generally satisfied with the mutual communication with other water boards. The water boards do not see each other as competitors but can learn something from each other. If a water board has successfully carried out a pilot study, other water boards can use this knowledge for their purposes because there is no patent on the projects. This interaction within the regime has positive effects on the niches. Since not many people are working on the same subject this way, it is easier to divide tasks and thus focus on a particular topic, such as climate adaptation. This can be outsourced to niche organisations. The cooperation is particularly positive by water boards lagging on energy targets, such as Wetterskip Fryslân. They can collect knowledge from other water boards and apply it to their areas, thus accelerating the energy transition.

The downside of cooperation can also be that the closer the cooperation, the more delays can occur due to the many procedures that have to be gone through. Another side note is that each water board has its qualities and tendering policy. For example, one water board may opt for solar

energy and another for wind energy, making cooperation more complex. Despite the cooperation between the various water boards, there is also a culture of a one-person show because they still feel they are left to their own devices.

Regarding cooperation between the different layers, water board Limburg is moderately satisfied. The government hears people at the national level, and multiple helix cooperation is being implemented, strengthening support. However, there is still a substantial difference in implementing projects when there is communication with citizens than when this does not happen because the projects are much easier to get off the ground. Wetterskip Fryslân works a lot together with other authorities within the RES. Despite increasing involvement, citizens are still insufficiently involved in decision-making, mainly due to a lack of time. Rivierenland is self-supporting mainly, with some consultation with the government only from a financial perspective. At the local level, cooperation is more intensive, with citizens being involved in time with the integration of solar and wind energy to create support. However, this only applies to citizens who are directly involved.

In general, the water boards are mostly left to their own devices. However, introducing the RESs within the regime has launched an excellent initiative to improve contact between the different layers. This has led to improved communication and projects involving the water boards, municipalities, and citizens at the governmental level. Partly because of the increase in support, there has also been an increase in professional resources. Within the regime, therefore, the RESs have had mainly positive effects. They have also improved communication with niche innovations and indirectly contributed to change within the landscape, namely, an acceleration of the energy transition.

Finally, there is also cooperation with other companies. Water board Limburg also makes use of this; for example, 'Waterleiding Maatschappij Limburg' (WML) participates in the 'Zuidenwind' cooperative where wind turbines have been built. These wind turbines compensate for the water board's energy consumption. The cooperation has been very positive, partly because Zuidenwind allowed residents to participate in the project. Cooperation with other parties is a lot more complicated for Wetterskip Fryslân. They want to cooperate with energy cooperatives, but the legislation and regulations surrounding solar and wind parks prevent this at the moment. Rivierenland is critical when cooperating with other parties to increase their share of the energy transition. For example, there are several cooperatives in place to compensate for their energy consumption. However, within Rivierenland, they strive for energy neutrality by generating as much sustainable energy on their land as they consume themselves because there is not enough self-generation at the moment. In addition, Rivierenland also wants to help other parties with their sustainable energy goals. This could also benefit residents, who can profit from the proceeds by donating a piece of land. However, this is currently not possible due to legislation and regulations because you would be favouring certain population groups that would have the opportunity to join such a cooperative.

Within the MLP, obstacles are mainly experienced in the laws and regulations concerning cooperation with third parties. The water boards would like to cooperate with cooperatives to offset their energy consumption, but this is partly hindered because a water board like Wetterskip Fryslân does not build solar and wind parks. There is still room for improvement here to accelerate the energy transition within the water boards.

4. *Sub-question: What financial, professional and regulatory resources do the water boards have (within the energy transition)?*

Water Boards Limburg and Rivierenland have sufficient financial resources at their disposal. Partly because a structural amount has been reserved for sustainability and innovation, they can start projects or participate in projects, requiring that these be earned back in the short term. This has positive consequences for niches since money can be invested here, ultimately affecting both the regime and the landscape. The niche innovations that pay for themselves in the short term can be implemented at all water boards, with the ultimate result that the energy transition can be accelerated. Wetterskip Fryslân, however, has fewer financial possibilities. This is partly due to the declining number of inhabitants in Fryslân, as a result of which the water board tax per person is rising. However, this does not happen proportionally so that the income does not drop

dramatically. These financial resources change the playing field within the MLP. Water boards Limburg and Rivierenland have more financial resources to support or start niche innovations, accelerating the energy transition.

Moreover, the three water boards involved currently have sufficient technical knowledge regarding the energy transition. It is essential to keep this knowledge within the organisation because it could become a bottleneck in the future. It is already apparent that there is tremendous pressure on employees with this expertise, which will only increase in the future. Education is an option to prevent this from becoming a problem. It is also essential to renew knowledge to explore new possibilities, such as solar panels on water. This knowledge can be applied within one's regimes but also exchanged with different niches through cooperation. Using new techniques within the water boards can also have consequences on a macro level because other countries can take over technological knowledge. At present, this knowledge-sharing is mainly taking place within the regime between the various water boards.

Within the three water boards, efforts are being made to increase support among residents by involving them more in projects and collaborations with other companies. Despite these efforts, citizens still have a great deal of resistance to solar and wind farms. At the moment, these parks are still relatively small-scale, making the problems manageable. As the pressure on the energy transition increases and water boards take more drastic measures, this can lead to more significant issues. These may manifest themselves in delays or even the cancellation of projects. This has consequences for both the regime and the landscape since projects can no longer get off the ground and therefore cannot be implemented within the water boards, thus preventing them from contributing to the energy transition. This is why constant communication with all the parties involved is essential to become aware of the importance of the energy transition. To increase support, the water boards must therefore look for niche innovations that affect the public.

The most critical barrier is perceived by the water boards of Limburg, Wetterskip Fryslân and Rivierenland to be the regulatory instruments. For example, strict laws and regulations prevent Wetterskip Fryslân the construction of solar or wind parks. This has financial consequences as well as for the speed at which the energy transition is taking place. It also prevents the water boards from supplying energy in addition to storing energy. Nowadays, niche innovations generate so much power that not all of it can be stored in batteries. One solution could be to supply power to residents. However, legislation and regulations do not allow this because it favours people who happen to live near a wind turbine. This would also bring about a regime change since the water board would then change from a non-profit government body to a profit organisation. Furthermore, the laws and regulations concerning biodiversity will continue to increase in the future, with the landscape influencing the regime. This will continue to complicate the implementation of wind and solar parks.

In general, the RESs have improved communication between municipalities, citizens and the water boards, making it easier to carry out pilots, among other things. However, it would help if there would not be so many restrictions once a RES area has been established, such as the many administrative actions and obtaining permits. All three water boards would like to see the government act more decisively in the energy transition by steering more towards the realisation of solar and wind energy and allocating them. This would enable faster progress to be made. Within the system, the water boards should have better legislation and regulations for the energy transition. This would allow more niche innovations to emerge and rectify the divisions within the water boards of the regime.

The main research question of this research is:

> *“How do the water boards in the Netherlands experience the possibilities and limitations at the macro-, meso- and micro levels to contribute to the energy transition?”*

The findings were explained, and the theoretical frameworks were applied to three water boards: Limburg, Wetterskip Fryslân and Rivierenland. It is not surprising that there is no unambiguous answer to the main research question since transition theory is not unequivocal and is open to interpretation. Transitions do not follow the same path, as each change has unique characteristics

and develops context-dependently. Factors from all three levels influence the energy transition; macro-, meso- and micro.

At the macro level, two major trends can be distinguished: climate change and sustainability, which affect all water boards in the Netherlands. Clear targets have been set for CO2 emissions in 2030 and 2050, with the water boards pushing these targets forward to 2025 to be energy-neutral by then. This ambition shows that they take the trends seriously and want to accelerate the energy transition—these trends coming from the macro-level influence both the meso- and the micro-level. For example, at the meso-level, much effort is being put into climate adaptation measures. Still, the preservation of biodiversity and the reduction of CO2 emissions in production processes through the installation of wind and solar farms are also being considered. At the micro-level, innovations that could contribute to the energy transition are being considered. Thus, because of the trends at the macro level, there are many opportunities for the water boards to contribute to the energy transition. The limitations lie mainly in the preservation of biodiversity during the energy transition.

As a result of the trends, a discussion has also arisen within the regime about whether the term 'water board' is still all-encompassing and whether it would not be better to call it a 'climate board'. Partly because more attention is being paid to biodiversity and climate mitigation, the tasks of water boards are being expanded. These subjects are inextricably linked to the working area of the water boards, which is one reason why climate boards have been set up. This could bring about a regime change for the water boards themselves. An important counterargument is that the main functions, such as water management and purification, can no longer be carried out optimally because of these side tasks.

Shifts are also visible at the micro-level. The energy transition has led the water boards to focus more on niche innovations. As a result, more money and workforce are being invested, with positive consequences. This creates several opportunities at the micro level for water boards to accelerate the energy transition, such as a project within residential areas that combines energy production, water conservation and fertiliser recovery. In this way, there are several opportunities for the water boards at the micro-level to contribute to the energy transition. However, these differ from one water board to another as each area has its assets. As a result, the limitations are also area-specific, such as the strict laws and regulations that, at the micro-level for Wetterskip Fryslân, mean that hardly any solar panels or wind turbines may be built. The biggest problem at the micro-level is participation and support from citizens. Residents must be more involved in pilot studies in the future because it has been shown that this improves implementation.

At the meso-level, several facets are considered. The water boards are generally satisfied with their collaboration with other water boards at multiple scales and third parties. This provides plenty of opportunities to contribute to the energy transition. For example, the cooperation between water boards allows them to gain knowledge from each other and apply pilot studies that have been completed successfully. The three case studies experience minimal communication with the government, which means they are mainly left to their own devices. The RESs positively contribute because they involve the municipalities more in projects, which means that tasks are realised quickly. There are also several successful partnerships with third parties that have contributed to the energy transition. The limitations experienced by the water boards within the cooperatives are mainly the minimal role played by the government and the fact that close cooperation with other water boards slows down some processes.

The financial resources are different for each water board, but there are sufficient possibilities for each to contribute to the energy transition. Think of investing in niche innovations or technical knowledge. It must be said that Wetterskip Fryslân has fewer financial resources than the other two cases, partly due to the shrinking population in their area. As a result, they have fewer opportunities to invest in niche innovations. Furthermore, the three case studies possess sufficient technical knowledge about the energy transition, but this knowledge must continue to develop to keep up with the trends. Other water boards may adopt this knowledge, or even different countries, impacting the meso- and macro-levels. The water boards are also trying to increase support for the energy transition. This is done by involving them more in projects and letting them participate. Despite this progress, there is still a great deal of resistance to the siting

of solar and wind farms, which leads to delays. To contain this in the future, the regime needs to look more at niche innovations to balance both parties' interests better.
The most significant limitations at the meso-level lie in the regulatory instruments. This applies to all three case studies. For example, Wetterskip Fryslân is not allowed to build solar. Wind parks and Rivierenland produce such a large amount of electricity that they would like to supply it to residents. However, this is not possible because they would arbitrarily prioritise people who live near a windmill. This would also result in a regime change as the water board would change from a non-profit government body to a for-profit organisation. All this is the result of strict or limited legislation and regulations. This is mainly because the energy transition is still in the start-up phase of the multi-phase process and has not yet resulted in a complete regime change that can be successfully implemented at all three levels.

6.2 Recommendations

The research theme is relatively young, and therefore this study has an exploratory character partly. The energy transition at both the national and regional levels is in its early stages. This experimental character has helped me grasp the subject and understand its constructs concerning the water boards.

To gain more insight into the structures of networks in transitions, further research can be done into the actors within the network of the water boards. This study focused mainly on the findings of the water boards themselves. The study can be supplemented with external interpretations of the policy changes, for example, by conducting interviews with the main partners of the water boards or with people from the water board union. It is also essential to continue to look at the differences between the water boards in terms of financial, professional and regulatory resources. These differ from one water board to another and are at the root of the speed of the energy transition. This must be straightened out in the future so that each water board has the same tools to achieve its energy transition.

To obtain a complete picture of the energy transition in the Netherlands, further research can be done into the influence of the same context factors on other levels of government, such as central government, provinces and municipalities. Especially since the macro-level power has proven to be large and does not differ per water board, it is interesting to do follow-up research into the factors that steer political trends in water management at the macro level.

To get more confirmation on the role of context in which policy changes take shape, water boards with other environmental characteristics than those that emerged in this study, such as height differences in Limburg, could be studied. It is also interesting to talk to citizens directly involved in niche innovations to see what they think of these innovations and the pros and cons. This will also allow you to look now at the support base, which will most likely become increasingly important in the future.

6.3 Reflection

This section will reflect on the research process, including its limitations, the choices made, and how this influenced the direction of this research. It can never pretend to provide one true answer to the research question. Painting a complete picture is essential and was pursued, but it isn't easy to achieve. Several reasons will be discussed. First, I will reflect on my position in the research field. The covid-19 situation was still present during the research, which caused me to be less physically present at my internship at WSP. This also caused a delay in my thesis and the fact that I had less motivation to work structurally on this research, especially during the summer period.

The MLP is a widely used theory in studies related to transitions and the water-energy nexus. It was a valuable theory for this research because it could be used as a basis, and from there, the indicators are set out. It was essential to make a clear distinction between the three levels so that there was no overlap between the hands. This made it possible to see which macro-level trends and micro-level innovations affect the water boards at the meso-level. Furthermore, the energy transition is still in the initial phase, or more precisely in the take-off phase, and is entirely under development. Efforts have been made to keep abreast of new developments in the field and to

include this further information. However, it is possible that by the time the findings of this study are read, recent developments have taken place that may shed a different light on the data found.

By using both qualitative and quantitative methods within this research, a survey and semi-structured interviews, I was able to gain more insight into in-depth opinions and perspectives of respondents in addition to a general picture. The survey was sent to all 21 water boards, of which 17 eventually completed the survey. Although not all water boards completed the survey, an excellent overall picture of the role of the water boards in the energy transition was sketched based on the 17 water boards. This picture is supplemented with information from the climate monitors. In the results chapter, a comparison is made between my findings and those of the 2019 climate monitor. It must be said that this comparison needs to be nuanced, as different indicators are used. This makes the comparison skewed in a particular point of view, which has been mentioned, however. An advantage of the survey was that it had an enormous scope with quick results. A disadvantage was that the answers were sometimes difficult to interpret because I could not explain the questions. Semi-structured interviews were held with four water boards, three of which eventually became a case study because several interviews could be held with these water boards. In connection with covid-19, all of these took place online. A significant advantage of conducting interviews is that you have room to ask more questions and obtain more detailed information. At the same time, a disadvantage is that the information obtained can be coloured for various reasons. Partly because some subjects are sensitive about giving an honest answer, whereby it has to be said that every respondent felt so at ease that he made some critical statements. A solution to this is to keep my respondents anonymous. These findings then had to be interpreted. I tried to do this objectively and based on the theories described in chapter 3.

Conducting a multiple case study with three different water boards was both an addition and a limitation to this research. Interviewing people with other functions for each water board proved helpful, as they each had different views on the energy transition and their role as a water board in it. This gave me insights that I could not have formulated on my own. For instance, I noticed that each water board has its assets but also its limitations. However, the fact that I interviewed people with different functions for each water board did make the comparison process more difficult. It should also be mentioned that I conducted other numbers of interviews per water board. More interviews per water board with people with the same functions would have added value to this research. Also, interviews on different levels, local, regional and national, could have added value to this research because it would have been easier to link the field to the transition theory. There are still many dots to connect with the role of the water boards within the energy transition that have remained underexposed. However, due to the limited resources and time for this research, these had to be delineated. Finally, the data from the interviews and documents had to be translated from Dutch to English. A possible consequence of this is that specific nuances in answers may have been lost. I have tried to avoid this as much as possible.

7. Time planning

March	April	May	June	July	August	September	October	November
Research proposal (12-3)	Start emailing potential respondents / make interview guide	Start emailing potential respondents / make interview guide	Start interviewing/ transcribing/ coding	Working on results	Doing some extra interviews	Doing some extra interviews	Processing feedback	Processing feedback
Exam ARM (25-3)	Start with finding surveys about water boards or construct surveys	Start with finding surveys about water boards or construct surveys	Analysing survey results in excel	Working on methods	Transcribing/ coding interviews	Transcribing/ coding interviews	Finishing results	Finishing conclusion, abstract and finalise
Expanding the theoretical framework	Expanding the theoretical framewor	Expanding the theoretical framewor	Start with the analysis/ empirical research			Processing feedback	Working on conclusion	Submit final version
						Working on results		Present findings to WSP
								End internship

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9. Appendix

9.1 Survey

1. Names welk waterschap vult u deze enquête in?

2. Rangschik de volgende hernieuwbare energiebronnen die door de waterschappen worden gebruikt van meest voorkomend naar minst voorkomend.

3. Rangschik de volgende hernieuwbare energiebronnen voor de waterschappen in de nabije toekomst van de meest potentiële naar de minst potentiële.

4. Stelling: momenteel wordt er door de waterschappen optimaal gebruik gemaakt van de mogelijkheden om energieneutraal te worden.

5. Volgens de 'Klimaatmonitor Waterschappen' zullen de waterschappen vanaf 2025 energieneutraal zijn, in hoeverre bent u het ermee eens dat dit haalbaar is?

6. Stelling: binnen de waterschappen leeft er een eenduidige definitie van het begrip 'energietransitie'.

7. Wat zou er volgens u, indien nodig, moeten gebeuren om de energietransitie binnen de waterschappen te versnellen?

8. Stelling: grote trends zoals klimaatverandering hebben veel invloed op de waterschappen.

9. Stelling: binnen de waterschappen denkt men vooral aan de lange termijn i.p.v. aan de korte termijn.

10. Waardeer de volgende barrières die kunnen optreden bij het implementeren van maatregelen ten aanzien van de energietransitie van meest voorkomend naar minst voorkomend.

11. Stelling: de beste manier om de energietransitie te versnellen binnen de waterschappen is het verhogen van de waterschapsbelasting.

12. Stelling: de waterschappen worden voldoende aangemoedigd door de overheid om zich extra in te zetten op het gebied van de energietransitie

13. Stelling: wet- en regelgeving zorgen ervoor dat lokale duurzaamheidsinitiatieven vaak niet gerealiseerd kunnen worden.

14. Stelling: binnen de waterschappen is er voldoende ruimte voor burgerparticipatie.

15. Stelling: waterschappen beschikken over voldoende technologische kennis m.b.t. de energietransitie.

16. Stelling: er is voldoende samenwerking tussen de verschillende waterschappen.

17. Stelling: er is voldoende afstemming tussen de waterschappen en andere overheidslagen (gemeenten, provincies, etc.).

18. Hoe ziet u de rol van de waterschappen op het gebied van de energietransitie in de toekomst voor zich?

9.2 Interview guide

Eerst even een korte introductie over mezelf. ik ben Etiën Hoofwijk en ik ben 26 jaar. ik heb de bachelor geografie, planologie en milieu afgerond aan de Radboud Universiteit en ik volg momenteel de master 'global environment and sustainability', ook aan de RU. Ik loop momenteel (afstudeer) stage bij het advies- en ingenieurs bureau 'WSP', waarbij ik onderzoek doe naar de rol van de waterschappen bij de energietransitie. Tegelijkertijd zit ik in de laatste fase van mijn master en schrijf ik mijn mijn thesis. De thesis schrijf ik in opdracht voor mijn afstudeerstage. Hierbij ga ik voornamelijk kijken naar de mogelijkheden, belemmeringen en drijfveren (incentives) van de waterschappen met betrekking tot de bijdrage aan de energietransitie. Vandaar dat ik ook bij u ben uitgekomen, wegens uw …. Ik heb een aantal vragen voor u, in de hoop dat deze mij zullen verder helpen met mijn onderzoek. Zou u het erg vinden als dit gesprek wordt opgenomen?

1. Zou u uzelf even kort kunnen introduceren ?

2. Bent u bekend met het begrip 'energietransitie', en zo ja hoe zou u het begrip beschrijven/ uitleggen? Sluit dit aan bij het idee van de energietransitie binnen de waterschappen/het waterschap waar u voor werkt?

3. Wat vindt u de belangrijkste taak van de waterschappen? En sluit dit aan bij het beeld dat het volk heeft over de waterschappen, denkt u?

4. Welke hernieuwbare energiebron wordt het meest gebruikt binnen uw waterschap en waarom?

—> En op welke hernieuwbare energiebron moet uw waterschap zich meer/minder richten?

5. De waterschappen hebben zichzelf als doel gesteld om in 2025 energie neutraal te zijn, is dit haalbaar?

6. Wat zou er volgens u, indien nodig, moeten gebeuren om de energietransitie binnen de waterschappen te versnellen?

7. Is er voldoende draagvlak over de milieu gerelateerde maatregelen binnen uw waterschap? En denkt u dat dit draagvlak ook geld voor de bevolking?

8. Welke barrieres, mits die er zijn, ervaart u bij het implementeren van nieuwe maatregelen t.o.v. het klimaat?

—> hoe zouden deze barrieres verholpen kunnen worden denkt u? (Denk aan bijv. Verstrekken van subsidies/ betere samenwerking)

9. Vindt u dat er momenteel voldoende samenwerking is tussen de verschillende waterschappen?

—> En is er voldoende afstemming op lokaal, regionaal en nationaal niveau?

—> of zou dit beter worden wanneer de waterschappen door een centraal orgaan bestuurd worden?

10. Hoe ziet u de rol van de waterschappen in de toekomst voor zich?

Dan wil ik u ten eerste hartelijk danken voor uw tijd en uw antwoorden. Met uw antwoorden kom ik zeker verder met mijn onderzoek. Mocht ik nog een dringende vraag hebben, zou ik u dan nog mogen contacteren via de mail? En verder had ik nog een laatste vraag; kent u toevallig nog iemand die werkt voor een van de waterschappen en kennis heeft over de energietransitie, en open zou staan voor een soortgelijk interview?

Als u interesse heeft in het eindresultaat, dan kan ik u mijn thesis zodra die af is altijd sturen via de mail.