MASTER THESIS

REGIONAL ENERY TRANSITION IN THE NETHERLANDS: FROM STRATEGY TO EXECUTION

The added value of transition scenarios in the gap between strategy development and implementation of regional energy strategies

MILOU DE VRIES

DECEMBER 2024

TU Delft

REGIONAL ENERY TRANSITION IN THE NETHERLANDS: FROM STRATEGY TO EXECUTION

The added value of transition scenarios in the gap between strategy development and implementation of regional energy strategies

By

M.Y. (Milou) de Vries – 4945816

To obtain the degree of Master of Science at the Delft University of Technology, faculty of Engineering and Geosciences, Construction, Management & Engineering

Graduation Committee
Chair: Prof. dr. P.W. (Paul) Chan
TU Delft First Supervisor: Dr. M. (Martijn) Leijten
TU Delft Second Supervisor: PHd Candidate H.D. (Hazal) Kaya

Graduation Company
APPM Management Consultants
Company Supervisors: Gijs Eikmans & Bernice den Haan

[1] An electronic version of this thesis is available at http://repository.tudelft.nl/

TU Delft

appm management consultants

[1] Cover photo: AI generated

PREFACE

“Regeren is vooruitzien”
“To govern is to look ahead”

This well-known and timeless Dutch expression, summarises the essence of the topic of this Master Thesis, which investigates the added value of looking ahead in the context of regional energy transitions. As the world struggles with climate change and strives toward sustainable energy systems, the ability to anticipate as well as shape future developments is a necessity for policymakers, advisors, and engineers alike. This thesis explores the crucial role that transition scenarios play in shaping and implementing regional energy strategies in the Netherlands. As such, it aims to bridge the gap between theoretical frameworks for energy transitions and practical implementation, providing both regional decision-makers and industry professionals with valuable insights for shaping the future energy system.

The topic of energy transition sparked my interest quickly after starting my bachelor’s degree in Technology, Policy and Management at TU Delft. For me, this topic has the perfect balance between engineering substance, organisational complexity and social relevance. During my bachelor’s degree, I learned about it from a governance perspective, whereas in my Master’s degree, I was able to add a more practical and pragmatic layer to my knowledge on the topic. This thesis topic therefore perfectly reflects and integrates the knowledge I have acquired during my studies at TU Delft.

Many people have supported me during the writing of this thesis, and I would like to express my gratitude to them through this preface. First, the members of my graduation committee, for their precious feedback and often (even if it only dawned on me later) crucial advise. In addition, to all the people at APPM, and Bernice and Gijs in particular, for your practical knowledge and connections with the RES, brief sparring moments to structure my thoughts, valuable feedback sessions and moral support at the office in Rotterdam. This project would also not have been a success without the support of my boyfriend, family and friends. Thank you for enduring my down- and upsurges in this process and always keeping me motivated to push forward with the project.

Finally, I would like to thank my grandpa, who unfortunately passed away during the writing of this Master Thesis and whose biggest wish it was to see me graduate. Grandpa, thank you for your endless interest and support of my education and for always believing in me.

Milou de Vries
Rotterdam, December 2024

EXECUTIVE SUMMARY

Globally, efforts are being made to transition energy systems from a fossil fuel based one towards one based on renewable energy. This transition is often seen as a very complex or even wicked problem (Schwab & Diaz, 2023; Jakimowicz, 2022; Haukkala, 2019) due to its long-term orientation and the sociotechnical paradigm it takes place in (Kopfmüller et al., 2021), in combination with the fact that there is no consensus on the urgency of the problem and a lack of tailor-made solutions available (Loorbach et al., 2008). This complexity calls for innovative approaches in steering this process.

In the Netherlands, this is done by means of a national program regional energy strategies (NPRES). In their regional energy strategy (RES), regional parties are tasked to make choices on the regional implementation of the national energy transition goal of producing 35 TWh of on-land renewable energy by 2030. In 2021, the program got off to a promising start as all 30 regions established their RES 1.0. However, as the program is shifting from strategic direction towards the implementation phase, many regions are struggling to realise their set ambitions.

In literature, the of use scenarios to formulate strategies aimed at initiating sustainability transitions is well regarded as they have the ability to broaden as well as narrow our thoughts about the future. However, little attention is given to the relation between the use of scenarios for strategy development and the implementation of those strategies. In addition, most scholars consider transition scenarios for unprecedented scales, neglecting the regional perspective even though this scale is very relevant for the implementation of energy transition ambitions.

Therefore, the objective of this research is to find out how transition scenarios can be used in regional energy strategies in such a way that they contribute to the implementation of those strategies. This objective is reflected in the main research question:

How can transition scenarios contribute to the implementation of regional energy strategies in the Netherlands?

This question is answered by applying a multiple case study approach, investigating and comparing two substantially different RES regions in the Netherlands; RES A and RES B. RES A being a large, highly urbanised and centrally located region, whereas RES B is a smaller, less urbanised, border region. In both cases, the practical application of transition scenarios in the development of their regional energy strategy is evaluated and the current challenges and driving factors in the implementation phase are identified. The practical application of transition scenarios is mapped against the existing literature on the use of scenarios in the energy transition, then compared to point out dysfunctionalities and opportunities on the use of transition scenarios within the regional energy transition. In addition, the identified challenges and driving factors in the implementation phase present important topics to consider when using transition scenarios. As such, the research combines both inductive and deductive research elements.

The theoretical background of this research is established by means of a literature review on transition management and scenario planning and their applicability in regional energy transitions. Data collection in the cases consists of a document analysis combined with semi-structured interviews with practitioners in the regional energy transition. To better understand the role of transition scenarios in the overall process of creating and implementing regional energy strategies, the findings are put in context of the regional characteristics including the organisation

of the regional collaboration, the process of strategy development and the established regional energy strategy.

For the analysis of the case data, a novel framework which operationalises important concepts for the practical application of transition scenarios is established. The framework considers the concept of scope for transition scenarios as well as their procedural and result functions. The scope of a transition scenario approach is determined by the time and place of application as well as the timeline considered for the future states and the system boundaries of the future states. Result functions of transition scenarios are determined by their ability to deal with uncertainties and complexities, either internal or external. The procedural functions relate to the value created in the process of developing and evaluating the transition scenarios and is as such determined by the way stakeholders have engaged in this process.

The analysis of the two cases shows that transition scenarios have demonstrated their value as tools to support the implementation of regional energy strategies in the Netherlands by addressing complexities and uncertainties. They play a dual role: as a means to bring people together and as a way to guide decisions through a structured exploration of the future.

In RES A, the application of transition scenarios predominantly supported the implementation process through procedural functions. By adopting a participative approach, the scenarios raised awareness among stakeholders, enhancing their commitment to the energy transition. This participative process also improved the stakeholders' knowledge of the subject, increasing their sense of urgency regarding the transition. Additionally, the scenarios facilitated the integration of diverse knowledge and perceptions about the regional energy system. Through an engagement strategy that encouraged interaction among stakeholders, the scenario development process fostered mutual learning and networking. This cooperative environment contributed to stronger regional cooperation and stakeholder commitment, which are both identified as critical driving factors for implementing regional energy strategies.

The resulting scenarios provided further value through their result functions. The use of narrative descriptions and spatial maps helped stakeholders visualize potential futures and understand the spatial impacts of different strategies. These tools stimulated discussions, provided insights into trade-offs, and included impact assessments on aspects such as renewable energy potential, economic implications, and landscape preservation. This facilitated decision-making and supported the justification of strategic choices, which is particularly valuable in the context of long-term renewable energy projects that require alignment among various actors in politically charged environments.

Conversely, in RES B, the benefits of transition scenarios were less pronounced. The exploration process lacked out-of-the-box and critical thinking due to a relatively closed approach that limited stakeholder involvement. The exclusion of practitioners and insufficient interaction among stakeholder groups hindered the development of practical, feasible strategies. Additionally, the fragmented approach across subregions resulted in integration challenges, undermining the overall effectiveness of the scenarios. This highlights the importance of a well-organized process, with clear goals, shared assumptions, and early planning for integration, to avoid similar pitfalls.

Spatial mapping emerges as a promising innovation, allowing regions to visualize energy strategies in the context of their unique landscapes. Maps illustrating the spatial impacts of different energy strategies can be effective in supporting integral decision-making by enabling spatial trade-offs. For a densely populated country like the Netherlands, where space is scarce

and precious, this spatial perspective is essential. As such it is recommended as one of the focus areas for future research, considering its integration with existing scenario techniques.

Limitations to the findings include the consideration of two cases in the Netherlands, favouring a

This research underscores that transition scenarios contribute significantly to stakeholder management in transition processes. By fostering awareness, commitment, and cooperation, procedural functions play a pivotal role. Result functions, meanwhile, enhance decision-making by clarifying trade-offs and aligning visions for the future. For even greater impact, transition scenarios should address external factors, such as economic or policy changes, to improve the robustness of strategies. Normative approaches, focusing on actionable steps, can further strengthen implementation by identifying dependencies and enhancing stakeholder agency.

Finally, the effectiveness of transition scenarios depends on tailoring their application to the specific spatial and temporal context. Early in a transition process, procedural functions such as awareness-building and network creation are crucial, requiring engagement with strategic, high-level stakeholders. At later stages, practical feasibility and sectoral integration become more important, necessitating input from operational stakeholders. Future applications should therefore carefully define the scope of the transition scenarios to maximize their contribution to regional energy strategies.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

GLOSSARY

NPRES	National Program Regional Energy Strategies, a program rolled out in the Netherlands for the operationalisation of energy transition goals on a regional scale. The program divides the country into 30 RES regions. NPRES is also an organisation which facilitates and coordinates the program at the national level.
Region	A geographically distinguished area as well as a scale of governmental organisation. In the Netherlands this scale fits in between the local level (one municipality) and the provincial level. Contrary to the provincial level, a region refers to a collaborative agreement between parties whereas a province is a formal administrative division.
REP	Renewable Energy Production, the production of renewable electricity from renewable resources such as solar radiation or wind.
RES	Regional Energy Strategies, regional collaboration framework in the Netherlands, aimed at achieving national climate goals by translating them into actionable regional plans. In this research the term 'RES' is used to refer to the regional strategy plans as well as the so-called RES regions.
RET	Regional Energy Transition, the transition of the energy system from one based on fossil resources towards one on renewable resources on a regional scale.
Scenario	Coherent, internally consistent and plausible description of possible future state.
TM	Transition Management, a governance framework that aims to guide and facilitate complex societal transitions, typically focusing on sustainability or innovation.
Transition scenario	In this research, the term 'transition scenario' refers to the use of scenarios for the purpose of onsetting a transition process with the aim to contribute to a sustainable future/sustainability targets.

1 INTRODUCTION

1.1 INTRODUCTION

Energy plays an important role in the development of a sustainable society (Kaygusuz, 2007; Kopfmüller et al., 2021). As energy is a necessity for almost all activities within our society such as building, living, mobility and working, it is essential the energy system is functioning well and sustainably at all times. Currently, our energy system is still the biggest contributor to greenhouse gas emissions. Within the EU, the energy system was responsible for 77% of the total greenhouse gas emissions in 2019 (Europees Milieuagentschap (EEA), 2023). The energy system can thus be seen as both the lock and the key towards a sustainable society. An efficient transition towards a sustainable energy system is therefore crucial.

Globally, efforts are being made to transition energy systems from a fossil fuel based one towards one based on renewable energy. This transition is often seen as a very complex or even wicked problem (Schwab & Diaz, 2023; Jakimowicz, 2022; Haukkala, 2019) due to its long-term orientation and the sociotechnical paradigm it takes place in (Kopfmüller et al., 2021), in combination with the fact that there is no consensus on the urgency of the problem and a lack of tailor-made solutions available (Loorbach et al., 2008). This complexity calls for innovative approaches in steering this process.

In literature, scenarios are generally seen as a promising tool for accelerating, steering and realising transitions (Berkhout et al, 2002; Pregger et al, 2020; Sondeijker et al, 2006) as they are able to both focus and stretch people's thinking about possibilities for the future (Berkhout et al, 2002). Within the governance framework of transition management, Sondeijker et al. (2006) suggest that they can be used on a strategic level to provide direction into transition pathways and help shape a long-term perspective for short-term action. Wiek et al. (2006) additionally argue that scenarios and scenario construction can fulfil different functions in transition management such as representing future system knowledge, forming the basis for strategy building, integrating qualitative and quantitative data and involving relevant actors. Pregger et al. (2020) urge that when using scenarios for strategy development within the energy transition, it is important the scenarios reflect the socio-technical character of this transition.

Although scholars frequently highlight the use of scenarios for strategy development, limited attention is given to how this process relates to the implementation of these strategies. The translation of strategies into operations is also known as the 'tactical gap'. O'Brien and Meadows (2013) already acknowledge this gap in the context of scenario planning in business development and suggest that after scenario development, a process of scenario orientation must be used to let those executing the resulting strategy familiarise with the scenarios. In addition, most scholars consider transition scenarios for unprecedented scales, neglecting the regional perspective even though the regional level is essential for the use of renewable energies since on this level national political goals are harmonized with implementation activities.

In practice, transition scenarios have been used to develop Regional Energy Strategies (RES) in the Netherlands. The National Program Regional Energy Strategy (NPRES) in the Netherlands is an important pillar in achieving the goals concerning the energy transition set in the Climate Agreement. The program consists of the development of a Regional Energy Strategy (RES) in each of the 30 appointed regions within the Netherlands (NPRES, nd). The RES regions combined have a quantitative goal of achieving a production of 35 TWh of renewable energy from on-land wind and solar PV systems by 2030. In most RES regions, a first version of a strategy program consisting

of potential locations for solar PV or wind farms has been established by making use of scenarios. However, as the program is shifting from strategic direction towards the implementation phase, regions are struggling in the implementation of these strategies as evidenced in the RES monitor, a yearly report drawn up by Planbureau voor de Leefomgeving to evaluate the progress of the RES (Matthijsen et al., 2023).

Clearly, the potential of scenarios for stimulating transition processes is well-known. However, how this relates to the translation of these strategies into execution is still underexamined. This thesis will therefore focus on investigating the role of scenario planning in the gap between strategy development and implementation in the context of the regional energy transition in the Netherlands.

1.2 Context: RES as part of the Energy Transition in the Netherlands

The energy transition in the Netherlands is a result of many policies and agreed ambitions on various governmental scales. On a European level, the Paris Agreement (2015) set the scene with 196 nations agreeing on the ambitious goal to aim for climate neutrality in 2050 with intermediate targets for 2020 and 2030. These goals have been translated into national goals which are defined in the Climate Law (2018) and Climate Agreement (EZK, 2019). To achieve these goals, the Dutch government has rolled out different programs that should contribute to steering the energy transition on a national, regional and local level as well as throughout different sectors. The National Program Regional Energy Strategy (NPRES) is responsible for operationalising the goals for on-land renewable energy production. Figure 1.1 illustrates the cascading effect of goals from an international towards a regional scale.

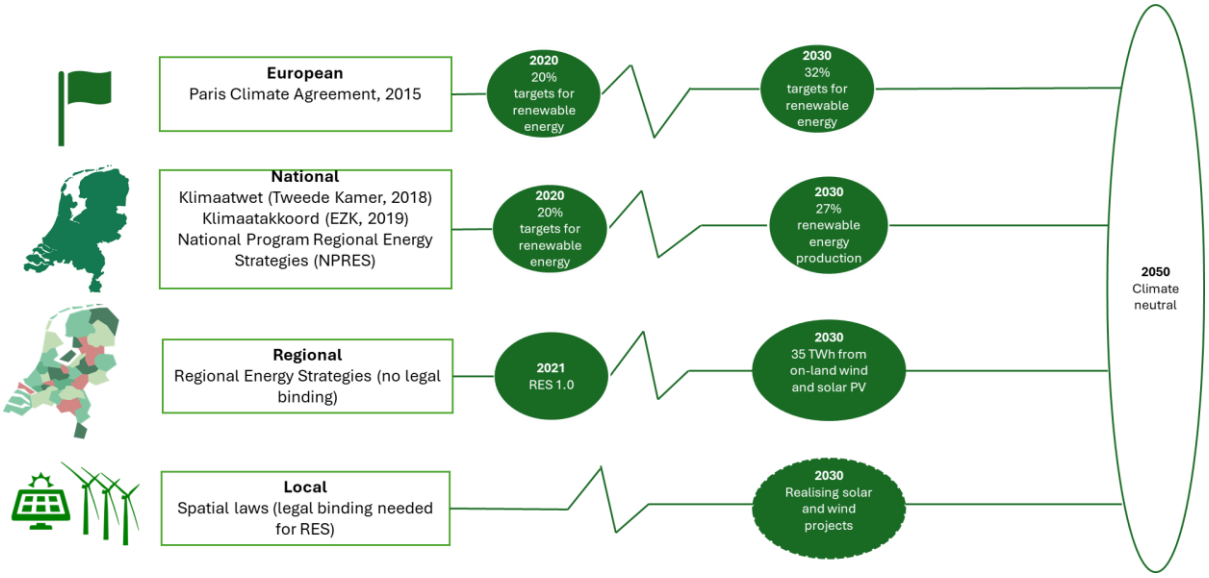

Figure 1.1: Cascading effect of sustainability goals (Own illustration, inspired on de Vries et al., 2019)

As part of the NPRES, the Netherlands is divided into 30 so-called energy regions defining the boundaries of regional collaboration. In each region, representatives of the province, waterboard and municipalities collaborate to develop a Regional Energy Strategy (RES). This is done in consultation with relevant regional stakeholders such as the local community and businesses. The program started with the establishment of a draft RES in 2020, followed by the RES 1.0 in 2021 after which a recalibration document of the RES needs to be delivered every 2 years. The RES is an administrative agreement between the governmental parties involved, but is itself not legally binding but states a commitment to effort from the governments involved. Plans for new renewable energy projects are thus not legally binding until they are acknowledged in spatial laws

of municipalities or provinces and granted a permit. This requires strong collaboration with and also proactive behaviour from municipalities even though the official responsibility for the RES is with the region.

Since the start of the NPRES in 2019, the regions have developed a draft and first version of the RES which includes an ambition of renewable energy from on-land solar PV and windmills the region is aiming to produce by 2030. The ambition is made up of three types of renewable energy projects; existing projects, pipeline projects, which are projects that are in the process of obtaining a permit and funding, and ambition projects. In the first phase of the program, the 2030 goal of 35 TWh seemed very feasible as a total potential of 52,5 TWh by 2030 was offered in the draft RES that were delivered in 2020. Since this first offer however, the RES regions have faced a multitude of problems.

Crucial for the realisation of renewable energy projects in the regions, is the need for considering and balancing multiple objectives. Amongst the objectives is efficient land use since space is limited in the Netherlands, both above and below ground, and many other projects require space such as housing, businesses and infrastructure. On top of that, also social acceptance and ecological considerations need to be taken into account.
Furthermore, a lack of grid capacity causes uncertainty about connecting potential renewable energy projects to the grid. Grid operators are tasked to enlarge the grid capacity in accordance with the future need for grid capacity, but this is a time consuming process and with the current scarcity in resources and lack of knowledge on how much grid capacity will be necessary depending on future demand and production patterns, uncertainty exists about where and when this will happen (Netbeheer Nederland, n.d.; DPG Media Privacy Gate, n.d.). New renewable energy projects should thus hinder grid stability as little as possible. But this is not always in line with the preferred options of regions. Solar projects for example can be more efficient in terms of space use (by placing them on roofs) and have a higher social acceptance as most people don't want a windmill in their backyard, yet they put more stress on the electricity grid because their peak production doesn't align with demand patterns.
As a result of these complexities and uncertainties, few ambition projects are turning into pipeline projects, as concluded in the latest RES monitor, a yearly report drawn up by Planbureau voor de Leefomgeving to evaluate the progress of the national program regional energy strategies (Matthijsen et al., 2023). Apparently, the regions are facing difficulty in translating their strategies into concrete projects.

This stagnation in the development of new renewable energy projects is putting stress on the achievability of the 2030 goals. Meanwhile, the urgency for domestic REP has only increased since 2019. As a result of the decommissioning of the natural gas fields in the Dutch province of Groningen there is a stronger dependence on foreign fossil resources. Simultaneously the Russian invasion of Ukraine has created a surge for energy independence. As a consequence, geopolitical considerations, energy security and climate goals are all at stake in the success of the RES. It is thus key the RES regions find a way to translate their ambitions into concrete projects.

1.3 PROBLEM STATEMENT

As stated before, energy regions in the Netherlands are experiencing problems with the implementation of their previously established regional energy strategies. This indicates that there is a gap between the strategy development on one hand and the implementation of those strategies on the other.

In literature, scenario planning is considered as a promising tool for use in strategy development in the context of sustainability transitions such as the energy transition. Within the regional energy

transition in the Netherlands, the context is characterised by a complex multi-actor setting with varying perceptions and interests. This requires systemic thought on how to use scenarios in order to engage the right actors, create support and stimulate decision-making in such a way that the resulting strategy spurs action.

So the question remains **how** transition scenarios can be used in order for it to contribute to the implementation of regional energy strategies.

1.4 RESEARCH OBJECTIVE

The aim of this research is to contribute to understanding the issues RES regions in the Netherlands are experiencing in realising their energy transition strategies by exploring how the process of strategy development relates to the current implementation. Specifically, what role transition scenarios play in this shift from strategy to implementation.

The scope of the research is defined by focussing on the use of transition scenarios in the context of regional energy strategies in the Netherlands. The regional energy strategies also concern the heat transition, but in this thesis the focus is on renewable energy production from on-land wind and solar PV. Empirical data is collected by making use of regional (RES) cases in the Netherlands.

The intended result of the research is a set of recommendations on how transition scenarios can be used within the dynamic and complex context of the regional energy transition in the Netherlands, specifically aimed at turning strategy into implementation. These recommendations will be applicable for use on a regional scale and process-oriented rather than content-oriented. This is investigated by looking at cases from the regional energy transition in the Netherlands that are currently dealing with difficulties in translating their goals into action.

1.5 RESEARCH QUESTIONS

Based on the stated research objective, the following research question is proposed:

How can transition scenarios contribute to the implementation of regional energy strategies in the Netherlands?

In this research, the term ‘transition scenario’ refers to the use of scenarios for the purpose of onsetting a transition process with the aim to contribute to sustainability targets.

This main research question is answered by making use of four guiding questions.

1. What are key factors to consider in the application of transition scenarios for regional energy strategies?

First, it is important to understand the key factors to consider in the development and use of transition scenarios for regional energy strategies. The aim here is to understand the different ways transition scenarios can be used as well as what is important when considering their application in the regional energy transition. This question will be answered by means of a desk study consisting of a literature review and document analysis.

The literature review uses the key words “transition management”, “(transition scenarios” and “(regional) energy transition”. Transition management literature offers an interesting multilevel framework that considers the translation of goals on a strategic level towards project implementation on an operational level. As such it will contribute to the understanding of steering

in the (regional) energy transition. Literature on scenario planning provides varying applications of scenarios for transition purposes. This will give insights into the state of art of transition scenarios approaches and the most important factors and processes related to the use of transition scenarios. Finally, understanding what is important from a regional perspective is important as this research focuses on regional cases.

2. How have transition scenarios been used in the development of regional energy strategies?

After understanding the dimensions of transition scenarios, it is important to investigate how they have been applied in the context of developing regional energy strategies in the Netherlands. This question consists of two parts, understanding how transition scenarios have been used and understanding their role in the process of developing regional energy strategies. This is done with a comparative analysis of the process of developing regional energy strategies and the practical application of transition scenarios in two RES cases in the Netherlands. In this analysis, the focus is on figuring out to what extent transition scenarios have been used, how this was done and what role the scenarios have played in both strategy development and implementation.

3. What is the perceived effect of the practical application of transition scenarios in regional energy strategies?

As this research takes place in retrospect of the practical application of transition scenarios in the two cases, it is also relevant to consider what practitioners viewed as the effect of the transition scenarios. This is done by means of the interviews, collecting different views on the perceived effect of the use of transition scenarios as this shows what they have contributed in hindsight.

4. What challenges and driving factors influence the implementation of regional energy strategies?

The final question focuses on what happens after the strategies have been created. In order to understand how transition scenarios can contribute to implementation, it is crucial to grasp how this implementation proceeds. To see how transition scenarios can actually contribute to the implementation of regional energy strategies, an understanding of current challenges and driving factors in this process is needed. By linking these challenges and driving factors to ways transition scenarios can be developed or used, the question of how transition scenarios can contribute to the implementation of regional energy strategies can be answered.

1.6 RESEARCH APPROACH

To answer the proposed research questions, a qualitative research method will be employed as the context dealt with in the research is highly complex and dynamic. This will be done by making use of a multiple case study approach and interviewing. By doing so, context-dependent knowledge will be generated which according to Flyvbjerg (2001, 2006) is essential for human learning as it allows feedback from the studied reality. Two cases are selected in order to limit a case specific bias and be able to compare the relative effectiveness of different approaches. Before diving into the cases, a theoretical base is established by means of a literature review. This research approach enables learning from theory as well as from practice and as such combines deductive and inductive research aspects.

How this is approached in this research is reflected in the following two questions.

A. How **have** transition scenarios contributed to the implementation of regional energy strategies in the Netherlands?

The first question aims to learn from current practices of using scenarios in the regional energy transition. This is done by investigating to what extent transition scenarios or similar approaches have been used in the regional energy strategies in the Netherlands and how this has influenced the ability to implement the strategy. In order to answer this question, involved stakeholders in regional energy strategies are asked about:

- The way transition scenarios have been used in coming to their Regional Energy Strategy (e.g. goal of the transition scenarios, the type of scenarios, the formation process)
- Experiences of involved stakeholders (benefits, difficulties)
- Results: How has this helped in the implementation of the strategy?

B. How **can** transition scenarios contribute to the implementation regional energy strategies in the Netherlands?

The second question is focused on how current practices of using scenarios in the energy transition can be improved by coupling insights from literature with the current challenges and driving factors in the implementation of regional energy strategies. This is done by employing a literature review to gain more insight on the existing theory of managing the energy transition and how scenarios can play a role in this. In addition, current challenges and driving factors in the implementation regional energy strategies in the Netherlands are identified in the case study.

A more detailed description of the applied methodology for this research can be found in chapter 3.

1.7 THESIS OUTLINE

The remainder of this report is structured as followed; the next chapter presents the chosen methodology for the research. Chapter 3 dives deeper into the existing literature, with a review of the relation between transition management and (regional) energy transition as well as the cross-pollination of scenario planning and the (regional) energy transition. Chapter 4 uses these findings to present the framework that will be used to analyse the empirical data. Chapter 5 introduces the selected cases by means of a case evaluation. In chapter 6 and 7 the results are presented and discussed. Chapter 8 finalises this report with conclusions and recommendations.

2 THEORETICAL BACKGROUND

To establish the theoretical background in which this thesis research positions itself, a literature review is employed. The results of this literature review are presented in this chapter. The goal of this literature review is to grasp a better understanding of the existing knowledge on the topic of transition management and its applicability on the regional energy transition in the Netherlands as well as the practice of scenario planning and its relation with strategy development in energy transitions. The first paragraph (§2.1) considers literature on transition management and how it relates to the regional energy transition, the second paragraph (§2.2) discusses the use of scenario planning in the regional energy transition and the final paragraph (§2.3) investigates the cross pollination of scenario planning and transition management in literature. The chapter finishes with a summary of key takeaways (§2.4).

2.1 TRANSITION MANAGEMENT & REGIONAL ENERGY TRANSITION

2.1.1 Transition Management: Background & definition

Transition Management (TM) is a prescriptive, complexity-based governance approach that seeks to orchestrate systemic change in large, societal systems by integrating insights of transitions research with principles of governance and policy planning (Hoppe & Miedema, 2020). TM is part of a wider field of transitions research and distinguishes itself from other transitions research by focusing on how actors can influence transitions processes rather than understanding transition processes (Loorbach et al., 2017) .

Central in transitions research is the understanding of transitions as the process of shifting from one system state to another through non-linear systemic change (Van der Brugge et al., 2005; Grin et al., 2010;) and the consideration of a multilevel perspective (MLP) (Rip & Kemp, 1998; Geels, 2002; Smith et al., 2010). Rotmans et al. (2001) suggest that four distinct phases of a transition can be identified, the pre-development phase, the take-off phase, the acceleration phase and the stabilisation phase. These phases follow each other up over time as shown in figure 2.1.

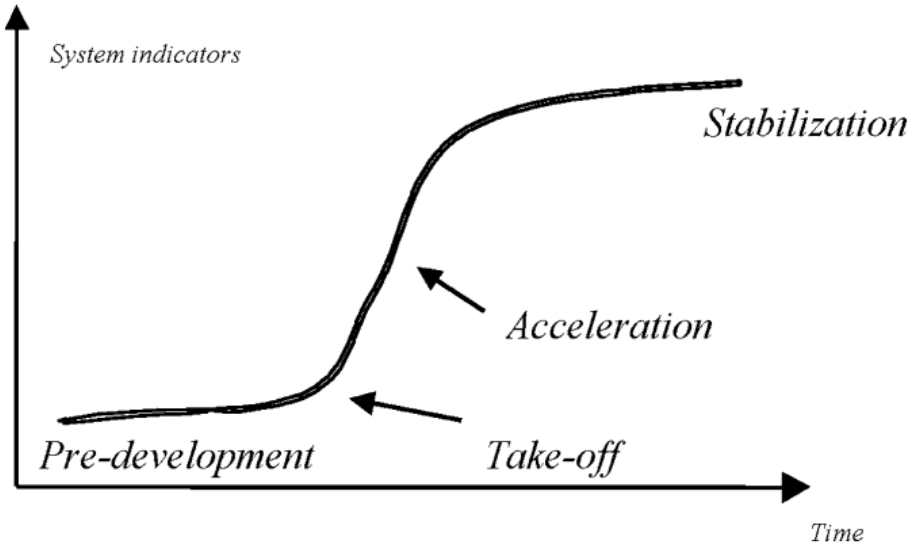

Figure 2.1: The four phases of a transition (Rotmans et al 2001)

Geels & Kemp (2000) use MLP to describe sociotechnical transitions (such as the energy transition) as the shifting from one to another sociotechnical regime as a result of interactions

between processes in the regime, niche innovations and the sociotechnical landscape. In MLP, the sociotechnical regime is understood as all institutions, routines and actors within a technological system. Innovations occur within technological niches outside of the regime and can only influence the regime when they are carried and developed through small networks. The sociotechnical landscape is beyond the direct influence of niche and regime actors. Geels and Schot (2007) utilise MLP to identify different pathways through which transitions can come about, depending on the timing and the nature of interactions between the regime and niche innovations and/or the sociotechnical landscape. The multilevel perspective and the transition pathways are shown in figure 2.2.

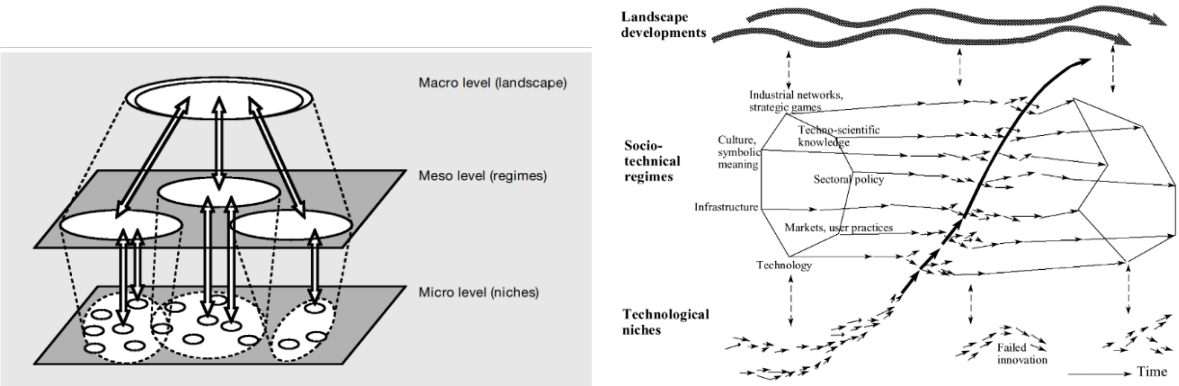

Figure 2.2: The multilevel perspective of sociotechnical transitions (Geels & Kemp, 2000; Geels, 2002)

Although lessons can be taken from MLP as the current Dutch energy system can be seen as a sociotechnical regime which is transitioning towards a new regime by means of multilevel action and therefore MLP has the ability in helping to understand the trajectory the Dutch energy transition is on, this theory doesn't provide tools for steering the transition in a dynamic context.

Rotmans et al. (2001) however, use the multilevel perspective to propose transition management as a new management strategy for public decision-makers and private actors in which long-term thinking, a multi-actor, multi-level and multi-domain perspective are central concepts with a focus on learning-by-doing and doing-by-learning. After this first introduction, transition management is further elaborated as a new mode of governance to deal with sustainability problems by Loorbach & Rotmans (2006) who suggest an important role for governments to stimulate the sustainable development by establishing and organising so called transition arena's where important players of both markets and planning come together to envision sustainable futures, mobilise actors and execute experiments. Loorbach (2010) translates the approach into a prescriptive governance framework with four different types of governance activities that aim to actively steer change into a desired direction. The framework and a categorisation of the different levels is shown in figure 2.3.

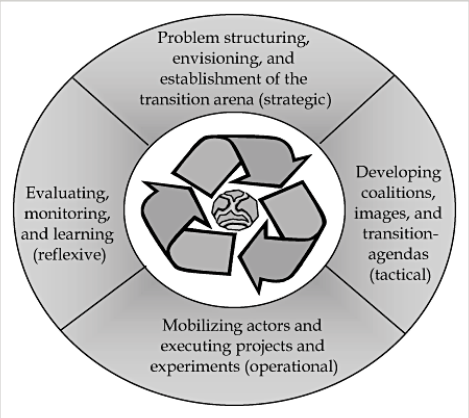

TABLE 1
Transition Management Types and Their Focus (Loorbach 2007)

Transition Management Types	Focus	Problem Scope	Time Scale	Level of Activities
Strategic	Culture	Abstract/societal system	Long term (30 years)	System
Tactical	Structures	Institutions/regime	Mid term (5–15 years)	Subsystem
Operational	Practices	Concrete/project	Short term (0–5 years)	Concrete

Figure 2.3: Transition management framework (Loorbach, 2010)

Transition management distinguishes a strategic sphere (transition arena) where problem structuring and envisioning takes place by a small group of so-called frontrunners, a tactical sphere where coalitions are formed and transition agendas are set, an operational sphere where projects are executed and lastly a reflexive sphere where monitoring and evaluation takes place to feed back into the transition arena. Each sphere has its own set of "tools"; the strategic sphere has the transition arena as a means of collaboration between frontrunners, the tactical sphere uses backcasting to establish transition pathways, the operational sphere organises transition experiments and the reflexive sphere uses monitoring and evaluation tools.

For this research, transition management is an interesting approach as it considers the translation of goals from a strategic level towards projects on an operational level. The cyclical structure of the framework suggests a clear order of the four activities, which in their turn each take place in a clearly defined sphere. Perhaps this rigid framework can provide policymakers with the much needed clear guidelines for dealing with the complexity of steering sociotechnical transitions but it could also create unjustified high expectations of their own ability to bring about systemic change as the reality of transitions often is much more disruptive and anticyclical. This management paradox of aiming to control something that is in itself uncontrollable is also reflected in Rotmans et al. (2007) where critique on the transition management approach is discussed.

2.1.2 Relevant applications and new directions of Transition Management

The transition management framework was developed simultaneously with its first application as the framework was adopted in 2001 by the Dutch government to kick-start the Dutch energy transition. Loorbach et al. (2008) reflect on this practice of transition management in the Netherlands and propose five energy transition management principles:

- Approach the energy system as a complex adaptive system in its environment
- Deal with uncertainties
- Approach the transition as a multi-actor problem solving process
- Stimulate new combinations
- Be reflexive in the management approach

Furthermore, they suggest that based on the historical development of the Dutch energy system, the energy transition back then in the Netherlands was still in the pre-development phase, but possibly near take-off. Therefore, the focus was mostly on the strategic level which took place on

a national scale with the development of a vision document Energy and Society 2050 as the main output. Given that more than a decade has passed and many developments in the energy transition have taken place such as the setting of ambitious goals and targets, the various policies employed to demote fossil fuels and promote renewables and the increasing share of renewables in the energy mix, one could argue that the transition in the Netherlands has shifted to the late stages of the take-off phase or the beginning of the acceleration phase. This leaves the question whether in this new phase of the transition, the lessons drawn on experience in earlier phases are still applicable. Figure 2.4 illustrates the rise of the energy transition in the Netherlands by showing the mix of domestic energy production over time, including a prediction until 2050.

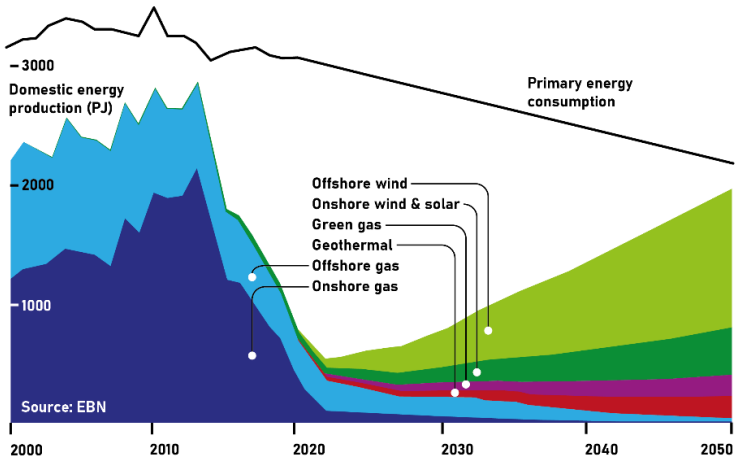

Figure 2.4: Mix of domestic energy production in the Netherlands over time (adaptation from EBN, 2023)

This discrepancy is recognised by Loorbach & Rotmans (2010) who draw lessons from four cases where transition management is applied and suggest it as one of the main topics for future TM research. Markard (2018) compares the differences between the early stages of the energy transition and the reality today and concludes that the new phase of acceleration brings about significant new phenomena such as the interaction between multiple technologies, the need for sector level performance (to ensure grid stability) and the integration of adjacent sectors such as transport and the built environment (due to the electrification of these sectors). Markard et al (2020) also note that very little transitions research is focused on this acceleration phase and identify five related challenges such as an increasing level of complexity in governance due to the interaction between different scales and the increasing resistance of incumbent actors who are being threatened for the first time. Löhr & Mattes (2022) in turn suggest that for the German wind sector, acceleration has been traded for stagnation and investigate actor strategies to understand how this stagnation emerges. They find that in the German wind energy sector, both incumbents and challengers are dealing with enormous uncertainty and identify four actor strategies to deal with this. The strategies are categorised into geographical diversification, cooperation, merger and take-over, business field diversification and exit. A similar stagnation can be recognised in the regional energy transition in the Netherlands.

Thus, a large part of the existing TM research and applications of the approach consider energy transition in a pre-development phase and therefore have a stronger emphasis on activities on the strategic level. As the energy transition is now shifting towards the acceleration phase, activities on the tactical and operational level are becoming more important.

Another aspect to consider for the applicability of TM literature is the scale of application, as this research is focused on the *regional* energy transition in the Netherlands. When looking at scale, most of the TM research and applications is focused at a national level or sectoral level and more recently also on cities (i.e. Wittmayer & Loorbach, 2016; Frantzeskaki et al., 2018). Frantzeskaki

et al. (2012) for example consider the application of the transition arena and transition experiments in the construction sector. Kern & Howlett (2009) consider the influence of transition management on policy mixes on a national scale and conclude that incoherence, inconsistency and incongruence exists in the Dutch energy policy. Meadowcroft (2009) similarly reflects on the influence of national politics on the application of transition management for the Dutch energy transition and highlights the fact that implementing sustainability goals requires the enumeration of many political choices in the same direction which can be rather difficult in the political arena of competing interests and ideologies, power plays and persuasion. Meadowcroft (2009) therefore concludes that *"the everyday work of transition management must engage with operationalizing general goals, opening up some options, and closing down others."*

A study that does consider TM on a regional scale is the case of Parkstad Limburg by Loorbach & Rotmans (2010). They argue that in regional applications of TM, informal aspects such as team dynamics and empowerment are at least as important as formal ones, in regional applications especially because regional players tend to have more of an emotional connection to the subject. In addition they urge that including the right actors in the process in the right way is crucial, both frontrunners as well as regime actors. Lastly, from the experience of the multiple cases it becomes clear that process and substance are always intertwined in transition processes and that the analytical structure behind transition management has proven to be a good standard for designing a process approach.

Hoppe & Miedema (2020) also note that little attention is given in literature to the regional scale of energy transitions even though this scale is very relevant as most renewable energy projects transcend the scope of one municipality but are insignificant for provincial or national governments. Furthermore, they studied the governance of regional energy transition (RET) in the Netherlands using insights from transition theory, transition management and network governance. Their conceptualisation of RET governance as multilevel network governance is shown in figure 2.5. Additionally, they identified important factors that determine governance in the regional energy transition such as structural characteristics of the region, network composition, actor characteristics and external factors which they applied on a RET case in the Netherlands. Relevant findings here were that RET governance in general is challenging as a leading actor with formal mandate to govern is absent, regional energy transition isn't necessarily a political priority and regions remain dependent on the actions and support of higher tiers of government.

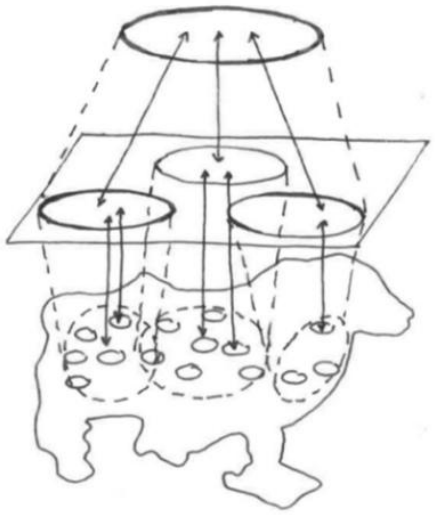

Figure 2.5: Conceptualisation of multilevel network governance in the regional energy transition in the Netherlands (Hoppe & Miedema, 2020)

Lutz, Lang, et al. (2017) also considered a regional perspective and develop typologies for regional energy contexts by identifying relevant contextual factors for renewable energy implementation and using these factors to identify groups of similar regions in Germany. Their framework for analysing contextual differences in regional energy systems considers the 'natural context' and 'socio-economic context'. They state that the natural context determines the potential supply of renewable energy and the socio-economic context determines the demand for renewable energy as well as important societal characteristics for the implementation of regional energy transition strategies. The natural context therefore includes factors such as mean annual wind speed and mean annual radiation, whereas the socio-economic context includes factors such as economic strength and population density. In Germany, they identify 9 types of regional energy contexts such as the 'urban south' and the 'rural north'. They urge that the different contexts in different regions is essential to inform regional energy transition strategies.

In another study, Lutz, Fischer, et al. (2017) mapped governance-related driving factors that were encountered by regional actors in Germany who wanted to implement renewable energy projects. In total, they point out 19 driving factors for the successful regional implementation of renewable energy, divided over four categories; planning and process, exchange and participation, actors and networks and economic circumstances. Amongst their findings was the relevant notion that a driver for implementing renewable energy projects is a comprehensive and well-structured process for the planning of renewable energy projects whilst paying attention to process management, i.e. carefully choosing milestones, ensuring mutual understanding and trust and organising engagement. Unlike the results of their literature review, they found that in practice public participation, heterogeneity of information channels and informal networks are less important.

To sum up, transition management literature helps to understand the complex, multilevel, multiphase transition process in which Regional Energy Strategies (RES) in the Netherlands are established and provides guidelines for how steering in such contexts could work. Important takeaways are also the relevance of the consideration of a regional perspective and the need to understand the specific challenges present in the acceleration phase of the energy transition.

2.2 SCENARIO PLANNING & REGIONAL ENERGY TRANSITION

2.2.1 Scenario planning: Background and definition

Scenarios and scenario planning are methods for future thinking and as such part of a larger, heterogenic body of futures research, which has its origin in the 1940's, when it was used for military strategic planning, and gained popularity in the 1970's in corporate strategic planning (Berkhout et al, 2002). Back then, the oil crisis of 1973 contributed to this resurgence of interest in scenario planning as it highlighted the possibility of significant and unforeseen shifts (Godet, 1987). Today, the climate crisis again creates uncertainties about the future and a need for long term planning, highlighting the importance of futures thinking for policy planning and strategy development, for example in the energy transition (Söderholm, 2011). Scenarios present a heuristic tool for foresight, enabling participants to envision possible futures in order to improve decision-making and strategy development (Berkhout & Hertin, 2002). Furthermore, scenarios are coherent, internally consistent and plausible descriptions of possible future states (Hertin et al, 1999). They are widely used in many different organisations as they are thought to have great potential to support strategic thinking in a number of important ways such as sense-making, norm creating and strategic choice (Burt & Van der Heijden, 2008).

Over time, many different types of approaches for future thinking have been developed from 'simple' scenario exercises to extensive integrated energy modelling approaches. In addition,

many different ways of developing and using scenarios exist and they can also be employed for various reasons. The next paragraph describes a selection of these approaches and their applicability for the regional energy transition.

2.2.2 Different scenario approaches

A first distinction in the types of existing scenario approaches can be made by using the work of Berkhout et al. (2002) who distinguish between three types of scenarios; extrapolatory or predictive approaches ('forecasting') take past trends as starting point for the future, normative approaches ('backcasting') consider a single state vision for the future and explore pathways of change and decision points that might lead towards it, and lastly exploratory approaches use variables to generate alternative futures in a so-called 'possibility space'. Additionally a distinction can be made between quantitative and qualitative scenarios, where quantitative scenarios make use of formal modelling as in- and output and qualitative scenarios make use of intuitive logics and more narrative information as in- and output, for example from stakeholder participation (Söderolm et al., 2011).

Berkhout et al (2002) consider scenarios as 'learning machines' for climate change impact assessment and highlight the need for including socio-economic change when modelling future worlds. They consider an exploratory approach to create four socio-economic scenarios that can be used in climate change impact assessments. Söderolm et al. (2011) review energy scenarios for governing the transition to low-carbon futures. They state that scenarios are useful for low-carbon transition processes (such as the energy transition) only if they can inform current decisionmakers. Based on their review they conclude that existing energy scenarios consider a lack of politico-institutional factors and are made for an unprecedented, mostly global scale at which transitions can't be effectively governed. They suggest that a closer synthesis of quantitative and qualitative aspects could be promising when using scenarios for governing transitions as qualitative methods offer more opportunities to include politico-institutional factors and quantitative assessments make sure to ensure narratives are consistent with proposed targets. Scenario approaches that use both quantitative and qualitative methods are known as integrated approaches.

Different scholars consider integrated scenario approaches for use in the energy transition. First, Pregger et al. (2020) recognise that a lack of socio-economic factors in quantitative energy scenario approaches effects the robustness of decisions made based on them. They explore the possibility to establish sociotechnical scenarios of the German energy transition by using an integration of algorithmic storyline construction (cross impact balancing) and quantitative energy scenarios created using simulation models. Their attempt shows that the integration of quantitative energy models and qualitative storylines can be challenging, as different techniques exist for both, varying degrees of integration and coupling are possible and it requires integration of knowledge from two very different disciplines. Furthermore, Kopfmüller et al. (2021) suggest an approach which combines socio-technical scenarios with a sustainability assessment tool to support decisions in the energy transition. Moreover, Weimer Jehl et al. (2020) provide a state-of-the-art analysis by comparing studies that consider socio-technical energy scenario construction. Their analysis indicates that no standard approach exists as each project has different objectives and motivations, but they note that best practices for different types of projects could be established. In addition they found that although some of the techniques used to construct socio-technical scenarios are verry effective, they require a lot of work. Lastly, Naegler et al. (2021) observe that different energy transition scenarios offer different results in terms of decarbonisation strategies. Therefore they aim to identify robust findings by reviewing

multi-sector energy scenarios of the German energy system and analysing their qualitative differences and commonalities. Their findings include that there is surprisingly little consensus on what the German energy system in 2050 could look like and that due to a lack of consistency and transparency in the documentation of used scenario approaches there is also little traceability of where these different results come from. The lack of transparency in existing scenario approaches is found alarming as most of the study results influence the public debate on energy policies.

Guivarch et al. (2017) discuss developments in scenario techniques for energy and environmental research, focusing on an increased ability to deal with complexity and uncertainty. They identify an increased interest in approaches that use story-and-simulation (SAS), approaches that validate consistency and diversity and approaches that focus on vulnerability and robust decision-making. Their analysis shows that diversity and vulnerability approaches help tackle uncertainty whereas multiple-objective and multiple-scale approaches help address complexity.

In tackling uncertainty, there are also scholars that look beyond the use of scenarios as they believe current policymakers, for example when dealing with the energy transition, deal with a type of deep uncertainty that cannot be addressed with scenario planning as they argue that scenarios have a natural tendency to stay close to evolutionary business-as-usual situations (Van Notten et al., 2005). This discipline that can be applied in situations where we 'only know that we do not know', is called decision-making under deep uncertainty (DMDU) as described by Marchau et al. (2018). Pruyt et al (2011) for instance consider a combination of system dynamics and exploratory modelling to explore and analyse uncertain dynamic issues and test deep policy robustness for the energy transition. Another example of a DMDU approach is that of dynamic adaptive policy pathways (DAPP) which considers decision making over time and provides ways to adapt strategies as conditions change (Haasnoot et al., 2019).

To sum up, there exist many ways to use scenarios and future thinking in order to deal with the complexity and uncertainty present in energy transitions, but they are typically applied on a large scale such as whole nations, Europe or even globally. In addition, the various approaches offer varying results and little is known about best practices. Therefore, the next paragraph aims at extracting lessons for the practical application of scenarios in the regional energy transition.

2.1.3 Lessons for the practical application of scenarios in the regional energy transition

As the strategy development in the regional energy transition in the Netherlands is part of a complex, multi-actor process, it is important to understand what are lessons for using scenarios in strategy development in this context. Because as Berkhout et al. (2002) also emphasize, the use of scenarios goes far beyond the application of a certain technique and concerns a process of social and organisational learning. O'brien and Meadows (2013) distinguish three phases in the process scenario planning; the preparatory phase, the development phase and the use phase, they conclude that the use phase of scenarios is far less well researched than the process of their development.

Berkhout et al. (2002) furthermore argue that scenario planning is not only a matter of expertise, making it crucial to engage the right stakeholders, especially the users of the scenario outputs, and to make sure the process is transparent and open to challenge for all participants. In line with this, Söderolm et al. (2011) highlight that scenario design should be more influenced by informed reasoning rather than modelling results. Höfer & Madlener (2020) propose and apply a participatory stakeholder process for evaluating quantitative energy transition scenarios using a

multi-criteria group decision model. As such they built on their earlier work (Höfer et al., 2019) in which they already propose a group decision model for evaluating qualitative alternatives. Their approach is unique in the sense that it incorporates stakeholders in every step of the process. They highlight that in the energy transition, trade-offs need to be made between many objectives (climate goals, economic welfare, ecological effects, etc) in a setting of stakeholders with diverging interests and opinions. Their application of the approach on the case of Germany identifies three groups of stakeholders with a similar opinion, the socio-ecological group, the socio-economic group and the economic-ecological group. Scenario planning thus concerns the process of gathering input, developing and customising the scenarios, presenting the scenarios and making decisions based on them, all with the involvement of relevant stakeholders.

McGookin et al. (2021) review participatory methods in energy system modelling and planning. They highlight a paradigm shift in energy policy, where public acceptance has become increasingly important and therefore it is crucial to have a meaningful integration of social acceptance in energy modelling and planning, where the integration is considered meaningful when actual stakeholder engagement occurs instead of incorporating sociotechnical theories or public attitude survey results. Their review shows that in most studies (~53%), stakeholder engagement was organised by means of scenario generation. According to them, this is not surprising as it ensures all significant uncertainties and different stakeholder perspectives are taken into account, helping participants in identifying common interests, while also promoting practical learning about energy systems and fostering innovative thinking about the future. They furthermore find three important benefits of taking a participative approach in energy modelling and planning; it improves legitimacy and robustness of the results, it promotes capacity building through mutual learning and it helps with consensus building and a shared ownership of the results. For subnational applications specifically, they state that stakeholder engagement is especially important, because it helps understand the areas characteristics, local perceptions and priorities and allows local people to express their concerns and understanding of particular technologies. Thus, it seems that participation is key when using scenario planning in the energy transition.

Carvajal et al. (2022) already discussed best practices for governments using national long term energy transition scenarios. Their results recognise three aspects that are of importance for best practices; robust scenario development, effective scenario use and institutional ownership of scenario capacity. They find that for a robust development of scenarios, a strong governance structure is required, whereas for effective use of the scenarios, it is important to clarify the purpose of scenario building and ensure transparent and effective communication and lastly institutional ownership of scenario capacity requires a correct balance between in-sourcing and out-sourcing of the scenario development capacity. In conclusion they state that in order for governments to make use of the complex insights from scenario planning processes, it demands robust energy governance, institutionalised energy planning processes and absorptive capacity in government.

Finally, Berkhout et al. (2002) highlight an important paradox where creating more and better scenarios gives more insight but also goes against the purpose of scenario analysis which is to simplify and clarify our ideas about the future. To add to this, Carvajal et al. (2022) also state that no matter how good the model, no model can generate accurate predictions for the future. This raises the question of the applicability of the approaches currently used in research (see 2.2.2) where different, extensive techniques make scenario approaches more accurately reflect the real world as well as the uncertainties and complexities in it but also make them more complicated

to apply. Moreover, Waisman et al. (2019) highlight that for long-term decarbonisation strategies to succeed, they "need to be well-understood and widely accepted by a majority of key stakeholders, including those involved in implementing the plans and those impacted by the changes. This broad group encompasses governments, indigenous organizations, industry groups, companies, energy providers, unions, experts, households, and non-governmental organizations." This practical applicability of scenario techniques is especially of importance in regional settings of the energy transition where the stakeholders involved are not scenarios experts, resources are often limited and ambitious climate goals need to be achieved in a relative short time frame.

2.3 TRANSITION MANAGEMENT AND SCENARIO PLANNING

The final topic of this literature review is the cross pollination of transition management theory and that of scenario planning. Little is known about the integration of these two disciplines as a limited amount of scholars have addressed the topic.

The combination of two more general disciplines of socio-technical transition theory and energy modelling is covered by Hirt et al. (2020). They reviewed the existing literature which links models and socio-technical transition theory for energy and climate solutions and find that studies link the two disciplines in order to find solutions for energy and climate challenges, to increase realism of models and to establish interdisciplinary learning. Based on their review, they conclude that the addition of a practical component is needed in this integrative research, because "in order to practically enact a transition, research should integrate the idea that the path that leads to a target must be thought out in such a way as to be practicable". They suggest this requires a move away from the popular focus on a national level towards more practical scales and innovative and practical methodologies in order to develop strategies that provide means to enact transitions.

Li et al. (2015) also discuss a similar integration of disciplines and review sociotechnical energy transition (STET) models to establish a taxonomy of this type of model. They recognise three requirements for STET models; the inclusion of techno-economic detail, explicit actor heterogeneity and transition pathway dynamics. Including techno-economic detail constitutes that a model is equipped to explore economic trade-offs while being bound by what is technically feasible, Li et al. (2015) state that in order to meet this requirement, a STET model must at least have a disaggregated portfolio of technology options with different price and performance characteristics as well as bounded systems with operational or resource constraints. Moreover, including actor heterogeneity in a model requires it to take multiple explicit actors into account and recognise their heterogeneous motives, rationale and agency to shape the transition. Lastly, the inclusion of transition pathway dynamics in STET models implies that the model assesses normative goals (e.g. to what extent is a low carbon energy system achieved) and considers a long time horizon to be able to account for potential new technologies or behavioural changes.

Some scholars do cover the presence of scenario planning within transition management. According to the TM framework (Loorbach, 2010), strategies are developed at a tactical level, as they operationalise the long-term visions and goals set at a strategic level. This illustrates an important difference between a vision, the desired future, and a strategy which is a way to reach this desired future. When using scenarios in this manner, a back-casting approach is most suitable.

Sondeijker et al. (2006) zoom in on the use of scenarios within transition management and state that there is a limited use currently and that most available scenario approaches do not fit the requirements for use in transition management. They suggest scenarios can be used at a strategic level and define criteria for both the process and the content of transition scenarios.

They state the process of scenario development must:

- Onset a social learning process for exploring future pathways,
- Generate a sense of urgency,
- Have a long-term orientation while being sensitive for weak signals,
- Stretch and focus future thinking at the same time

And the content must:

- Be as open as possible in exploring desirable pathways towards the future,
- Focus on societal transition challenge
- Deal with a whole system, not just a subsystem
- Be valuable for strategic, tactical and operational level
- Have a utopian character
- Have integral, consistent and coherent storylines

They finally suggest that in further research a focus on the process of scenario development is necessary. Raskin et al. (2002) in turn state that useful scenarios for TM stress integration, recognize uncertainty, appreciate irreducible normative aspects, and engage the public in discourse on sustainable development.

Wiek et al. (2006) consider different functions of scenarios in transitions, where they combine requirements for transition management with functions of scenarios. The resulting functional concept offers possible functions for both the resulting scenarios and the procedure of scenario construction. The concept is tested on a range of empirical scenario studies supporting transition processes on local, regional and national scales. According to Wiek et al. (2006) the functions of scenarios in transition processes range from prioritisation and strategy formation to goal setting, action motivation and communication. They conclude that their study is a start in the quest of both scenario construction research as well as transition management research to provide support in the choice regarding which type of scenario construction can fulfil which function in a contextual process and which method is appropriate for the various types and phases of a transition process.

Malekpour et al. (2020) propose a different bridging opportunity, namely that of transition management and decision-making under deep uncertainty (DMDU). They suggest that since both of these approaches focus on socio-technical systems and are used for strategic planning under uncertainty with a long-term focus, there is high potential for synergy. Both approaches also make use scenarios, but TM does it in a normative away and DMDU in an exploratory way. In general, TM is a highly interventionist approach and DMDU has an analytical character. The proposed, integrated approach uses the participatory co-creation process of transition management for orienting, codeveloping a future vision and agenda setting while utilising the transition model and a multitude of scenarios to stress test policy options. They argue the approach very applicable for use in the energy transition, but have their reservations about the practical effectiveness as both have problems in highly conventional policy making structures.

Finally, Frantzeskaki et al. (2019) use transition management theory as a starting point for their innovative scenario approach. They use exploratory, high-end climate and socio-economic change scenarios to construct transition pathways towards a shared sustainability vision at a European scale. As such, they combine a normative and exploratory approach as well as qualitative and quantitative approaches while also including stakeholders in the process. In this way, they show it is possible to apply an integrated scenario approach that is able to deal with high levels of complexity and uncertainty while also fulfilling the necessary functions of mapping, planning, learning, bridging and communicating (Rosenbloom, 2017).

To sum up, although the cross pollination of transition management and scenario planning is only considered in a limited way, combining the two disciplines shows potential to understand why and how the use of scenarios is useful in transition processes.

2.4 KEY TAKEAWAYS

The review of literature on the application of transition management (TM) for the regional energy transition shows TM as an interesting framework for steering the energy transition as it takes a multilevel perspective and actively addresses the complexity present in transition processes. Transition processes furthermore consist of four distinct phases of predevelopment, take-off, acceleration and stabilisation. Currently, the energy transition in Western Europe seems to be shifting from the take-off phase into the phase of acceleration. Recent research points out that this new phase presents new challenges related to whole systems change, interaction between multiple systems, decline and resistance of incumbent actors, consumer practices, social acceptance and governance. These challenges impose the risk of acceleration being traded for stagnation. Furthermore, the scale of steering a transition process is of importance as different scales present different challenges and drivers for the implementation of renewable energy. For the regional perspective, both formal and informal networks are important as well as the inclusion of the right actors in those networks and paying attention to process management. Challenges for regions include the dependence on higher tiers of government, a lack of political priority for energy transition as well as region-specific conditions related to the natural or socio-economic context. When defining strategies in the energy transition, it is thus important to consider the scope of the transition process, including the spatial scale, the phase of the transition process and relevant contextual factors.

From the literature on scenario planning it becomes evident that a scenario can be defined as a heuristic tool for foresight, enabling participants to envision possible futures in order to improve decision-making and strategy development. In addition, many different techniques for developing and using scenarios in the energy transition exist. Main differences between approaches include normative approaches (single-state future) versus exploratory approaches (multiple plausible futures) as well as the inclusion of qualitative versus quantitative input and output. Recent scholars have also focussed on the creation of integrated approaches where modelling results are coupled with narrative insights from stakeholder input for a better inclusion of socio-economic and politico-institutional factors. The current body of literature on energy transition scenarios however seems to concentrate on unprecedented national, continental or even global scales. Finally, in all applications of scenario planning, but especially subnational applications, the inclusion of the right stakeholders in the right way is crucial as scenario planning is not only a matter of expertise. This is also crucial for the implementation of the scenarios, as it is necessary that they are well-understood and widely accepted by a majority of key stakeholders. Thus, in the application of transition scenarios, there exist many different forms with different formation

processes, focus points and functions, but little is known about what approach suits what context.

Lastly, the review of the interplay between transition management and scenario planning highlights their combined potential to address energy transitions and socio-technical challenges. Scholars underline the importance of realism and addressing techno-economic and actor-driven complexities. Scholars finally highlight the different functions scenarios can fulfil in a transition process.

The findings of this literature review will be used to establish an analysis framework for the evaluation of the case data. This framework is presented in chapter 4. The next chapter will first explain the methodology.

3 METHODOLOGY

In this research, the practical application of transition scenarios is mapped against the existing literature on the use of scenarios in the energy transition, then compared to point out dysfunctionalities and opportunities on the use of transition scenarios within the regional energy transition. This is done by making use of a multiple case study method using interviews to collect data from real life experiences. This chapter explains the applied methodology (§2.1.1), the approach for selecting the cases (§2.1.2), the modes of data collection (§2.2) and the procedure for analysing the data (§2.3).

3.1 CASE STUDY

3.1.1 The case study method

The case study method allows for an in-depth analysis of complex issues within their real-life contexts (Crowe et al., 2011). This approach helps to elucidate the nuances of real situations (Zainal, 2007), as Flyvbjerg (2006) notes that knowledge in human affairs is inherently context-dependent. McGookin et al. (2021) add that “many of the barriers to the development of renewable energy are non-technical challenges that are dynamic and context dependent.” Crowe et al. (2011) highlight that the case study approach is well-regarded in the policy field. However, a limitation is that, with only a few cases considered, it is challenging to draw scientifically generalizable conclusions (Zainal, 2007). Nonetheless, as Flyvbjerg (2006) points out, this does not prevent the findings from contributing to the collective knowledge in a field. The case study method is well suited for answering the proposed research question of how transition scenarios can contribute to the implementation of regional energy strategies in the Netherlands, as context-dependent information on the current challenges in the implementation of the regional energy strategies is inherently needed to answer it. Moreover, in this research, the focus is on understanding different perspectives between strategy development on one side and strategy implementation on the other. This can only be achieved by gathering insights from real life experience from relevant actors who are or have been involved in the regional energy transition in the Netherlands themselves, specifically in the process of strategy development and in the current implementation. To add to this, Flyvbjerg (2006) quotes Beveridge (1951), stating that "more discoveries have arisen from intense observation than from statistics applied to large groups." However as Löhr & Mates (2022) also highlight, studying phenomena at the same time as they are taking place is complex and a challenge in itself.

3.1.2 Case selection

Two RES regions are selected as cases for this study; RES A and RES B. The actual names of the regions is intentionally kept out of this report to ensure anonymity of the interview participants as well as to avoid reader’s bias. The amount of cases considered is limited due to the preference to gain in-depth and detailed knowledge of each case and the limited time and resources available for this research project. By choosing two cases rather than just one case, the generalisability of the findings is improved as the results are not limited to a single context. In addition, by studying two cases, the findings will represent a diverse perspective, mitigating the development of a case specific bias. Finally, Stewart (2011) considers the multiple case study method in governance-related studies and suggests that by studying multiple cases, a researcher is able to investigate the relative effectiveness of a particular approach by extracting key factors that seem to have an influence on the outcome of interest. In this research, the practical application of transition

scenarios in two regions will be compared to extract key factors that influence the implementation of regional energy strategies.

The cases are chosen by means of information-oriented selection. As there are 30 unique energy regions in the Netherlands, there is a wide variety of regions, all with different, region-specific characteristics such as the urbanity of the area, location and landscape characteristics, economic activity and political preferences. In order for the study to best represent this variety, two relatively different regions are chosen. Different scholars already point out factors that distinguish energy regions from each other. Lutz, Lang, et al. (2017) point out that differences between regional energy systems are related to their natural and socio-economic context. Whereas Hoppe & Miedema (2020) furthermore state that the regional governance of energy transition in the Netherlands is characterised by structural characteristics of the regional network, regional network composition, actor characteristics, regional network governance and external factors. Differences in these factors thus also reflect differences between regions. Combining factors from these studies results in the following selection criteria for the two cases in this research:

- Characteristics of the regional network & governance structure
    - Size of the region
    - Presence of subnetworks
    - Presence of a regional network organisation
    - History of network interaction
- Socio-economic and natural context
    - Population density
    - Economic circumstances
    - Regional politics and policy priorities
    - Geographical location
    - Landscape characteristics

RES A is a large, densely populated, urbanised region in the western part of the Netherlands, whereas RES B is a smaller, more rural region at the border of the Netherlands. Even though both chosen cases struggle with the implementation of their regional energy strategy, RES A is somewhat seen as a frontrunner region as it is the first region in the Netherlands to publish their recalibration of the RES. In addition, APPM has been involved in both regions, ensuring the access to data. In RES A, APPM has been involved from the start of the RES program, albeit in different ways over the years. In RES B, APPM was recently asked to help in the implementation phase. In the case evaluation presented in chapter 5, more details on the chosen regions for the case study are provided.

3.2 DATA COLLECTION

In this research, qualitative data is collected through a desk study in combination with the conduction of semi-structured interviews.

3.2.1 Desk study

First, a literature review was employed to grasp a better understanding of the existing knowledge on managing the energy transition and the use of transition scenarios for this purpose. For this literature review, a semi-systematic approach was applied using the keywords “transition management”, “(regional) energy transition” and “(transition) scenarios” in combination with a snowballing method (forward and backwards). This approach ensures both breadth and depth in

the review as the researcher is exposed to a great variety of related research whilst having the flexibility to dive deeper into specifically relevant topics. The results of this review can be found in chapter 2 of this report.

Second, initial case study information was collected by analysing documents from the respective energy regions. These documents included publicly available reports on the regional energy strategy such as the strategy document itself, monitors and the implementation program. The findings from this initial analysis of the two cases are presented in the case evaluation in chapter 5 of this report. Together with the results from the literature review, this information is used to guide the structure of the interview questions. In addition, more detailed information on specific processes or events was obtained through documents provided by interview participants. An overview of the reviewed documents can be found in appendix B.

3.2.2 Semi-structured interviews

Empirical data is collected by means of semi-structured interviews with practitioners within the regional energy transition in the Netherlands. This method allows for access to past events and in-depth detailed information from personal experiences (Adler et al., 1995), which is important as the research is concerned with the process of the development of the regional energy strategies which took place in the period between 2019 and 2021. In addition, the research aims to collect direct and indirect effects of the use of transition scenarios within regional energy strategies, this is in-depth knowledge which requires deep conversations, as pre-prepared questionnaires could hinder the acquisition of detailed insights. Flyvbjerg (2006) emphasises that the value of insights gained from examples should not be underestimated, and such knowledge cannot be collected through quantitative methods like questionnaires.

Each interview has a length of approximately 60 minutes and is guided by means of an interview protocol. The findings in the desk study were used to set up the questions in the protocol. The protocol includes 5 topics; introduction, development of regional energy strategy, use of transition scenarios, strategy implementation and wrap up. In order to verify whether the practical problem of stagnation in the implementation of the regional energy strategy (as defined in §1.3) is present in the selected cases, interview participants were also asked how they perceive the general progress of the implementation of their regional energy strategy. This ensures that the findings indeed relate to the proposed problem definition. The protocol can be found in appendix A2. Important to note is that the protocol was merely used as a guideline and not as a script, each interview therefore had a unique set of questions.

Prior to the interview, participants received information on the goal of the research, the purpose of the interviews in the research as well as the topics that would be covered during the interview. This contributed to a more fruitful conversation, as participants were able to prepare and refresh their memory on past events prior to the conduction of the interview. Additionally, participants signed an informed consent form to confirm their voluntary participation and agreement with the recording and transcribing of the interview. Separate consent was asked for the use of quotes. The informed consent form can be found in appendix A3. Finally, as the collected data contains personally identifiable research data such as job descriptions and professional backgrounds, a data management plan is established in consultation with a data steward from the TU Delft. The data management plan describes how data is collected, managed and stored both during the research and afterwards to minimise the risk of data breaches.

3.2.3 Selecting & Recruiting interview participants

Split between the two cases, 19 interview participants have been selected. These are actors involved in the two chosen RES regions, specifically actors who have been involved with the development of the regional energy strategy (2019-2021) and actors who are more involved with the realisation of this strategy (2021-present) or both. For each case, the selection of participants includes at least interview participants from public, private and semi-private organisations to ensure the collection of diverse perspectives. Public parties from different scales of government have been approached, i.e. local (municipalities) and regional authorities (provinces). Private parties within the regional energy transition consist of developers of renewable energy projects and consultants asked to guide in the process. Semiprivate actors include distribution grid operators (DSO) and energy cooperatives. Participants are found and approached through the network of APPM Management Consultants and by making use of referrals from previously interviewed candidates. An anonymised list of interview participants is shown in appendix A1.

3.3 DATA ANALYSIS

The audio recorded interviews are first transcribed, after which the data is analysed by means of coding. After finalising the transcripts, interview participants received the transcript of their interview with highlighted important sections and were asked to check them for (factual) inaccuracies. Analysis of the data took place (with the exception of interviews 16-19[2]) after all the interviews were conducted, to minimise tunnel vision and keep an open mind during the interviews.

The interview topics and protocol are used as a guide for coding the data. This primarily concerned a thematic analysis, for which *ATLAS.ti* was used as a qualitative analysis tool and data management system. The coding of the interviews was an iterative process and included the following steps in varying orders.

1. Highlighting important sections in the interview
2. Assigning first order codes (what is the interview participant talking about?)
3. Thematic categorisation (development of RES , practical application of transition scenarios, implementation of RES)
4. Assigning second order themes (e.g. is this a challenge or a driving factor?)
5. Identifying subthemes (e.g. Is this related to process or result? Is this a complexity or uncertainty?)

By means of this iterative approach, the researcher was able to shift back and forth between different levels of abstraction, to ensure a thorough and comprehensive analysis. Revisiting the coding of themes and subthemes also stimulates the researcher to be reflexive about earlier conceptions (Morgan & Nica, 2020).

Substantively, the data analysis includes an evaluation of the general process of the development of regional energy strategies, an analysis of the practical application of transition scenarios and an analysis of the current challenges and driving factors in the implementation of regional energy strategies in both cases. The analysis of the use of transition scenarios will illustrate differences and similarities between the scenario approaches applied in the two cases. By linking the characteristics of the applied transition scenario approaches to the identified challenges and

[2] Interviews 16-19 were conducted on the 12th and 18th of September 2024, by then the data analysis had already started.

driving factors in the current implementation phase, the relation between transition scenario approaches and the implementation of regional energy strategies will become evident.

The results of the data analysis are presented in chapter 6. The next chapter will first introduce the framework of analysis that will define the theoretical lens through which the case data will be analysed.

4 FRAMEWORK OF ANALYSIS

By making use of the findings from the literature review as well as the general characteristics of the regional energy strategies, a framework for analysing the empirical data from the two cases is established. This framework is elaborated in this chapter.

From the literature review, it becomes evident that different approaches for developing and using transition scenarios exist and that different approaches can fulfil different functions in transition processes, but that little is known about when to use what approach and especially little is known about regional applications. This points to the aim of this research; finding out how transition scenarios can be used in the context of regional energy strategies, specifically focussing on the shift from strategy development to the implementation phase. The answer to the first research question determines the factors considered in the framework of analysis.

What are key factors to consider in the application of transition scenarios for regional energy strategies?

First, a better understanding of the context is needed as this will inform the requirements for the transition scenario approach. When considering the use of transition scenarios, this can be done by defining the *scope* and *goal* of the approach. These requirements will in term determine what *function* of transition scenarios is needed in this context. Wiek et al. (2006) already made a start in defining possible functions of scenarios and scenario construction in transition processes. They state that "the function of a method is neither completely determined by its components and procedural structure nor completely determined by one's intentions". For scenarios they therefore highlight the distinction between the function of scenarios themselves, calling them the *result functions* and the functions of scenario construction, i.e. the *procedure functions*. It is thus important to understand the function of the resulting scenarios as well as the function of the development process. Finally, a relation between the function and the *form* and *focus* of transition scenarios that best suits this function needs to be made.

The first section of this chapter will therefore operationalise the concept of scope for transition scenarios for regional energy strategies (§4.1). Followed by a section that operationalises the result functions (§4.2). The chapter finalises with an operationalisation of the procedure functions (§4.3).

4.1 SCOPE & GOAL

To operationalise the concept of scope for regional energy transition scenarios, the definition of a scenario is taken as starting point. According to Hertin et al. (1999), scenarios are defined as "coherent, internally consistent and plausible descriptions of possible future states". Scenarios thus concern a description of a future state. The question then remains of when that state is and what the state contains, in other words defining the temporal and spatial-functional scope.

Temporal scope

The when question depends on the timeline a scenario is constructed for. This relates to the time frame of the sustainability target a transition scenario is created for. For RES, the timeline question can be quite easily established as the program is rolled out to operationalise a target for 2030 (i.e. achieving 35 TWh of on-land renewable energy production by 2030). This timeline also relates to the type of transition management (Loorbach, 2007) the scenarios can complement. Scenarios for a long term (~30 years) can support the strategic level, whereas medium term

scenarios (5-15 years) can support transitions at a tactical level and short term scenarios (<5 years) can complement the operational sphere. In addition, the moment in time the transition scenarios are applied are important as well, as this determines the initial state (status quo). The status quo reveals information about the current stage of a transition process and current challenges in moving forward. This informs the required functions from the transition scenarios.

Spatial-functional scope

The what question can be answered by establishing the system boundaries of what is in the scenarios. This is determined by the location and system of interest. For RES, the transition scenarios will most likely be for a regional scale, and targeted at the transition of the energy system. Transition scholars describe this transition as the shift from one sociotechnical regime towards another through non-linear systemic change. Besides the scale and system of interest, location specific conditions such as the socio-economic conditions and natural context determined by the geographical location should also be considered in the scope of a transition scenario to make the results more realistic.

Thus, different scopes, require different functions of transition scenarios. As becomes evident from the literature review, different scopes, such as scales and phases of transitions also present different challenges. To better understand the scope of transition scenarios in this research, an analysis of the development and implementation process of regional energy strategies is made. This will be done by investigating the driving factors and challenges present in both regional cases, focussing on what was difficult during strategy development, as well as currently while trying to implement the strategy.

In this research, a driving factor is defined as an element that facilitates implementation when present but can act as a barrier when absent. Challenges describe in more general sense what is currently hindering the implementation of the regional energy strategies. When considering a regional scale, these can be challenges or driving factors that relate to the regional scale (similar for all regions), to the regional context (specific for each region). An example of a challenge that is typical for the regional scale and applies to all regions is the dependence on national policies and legislation. Region specific challenges relate to the specific conditions present in a region such as a limited amount of space due to a highly urbanised area.

The goal in turn relates to the intentions behind the application of transition scenarios.

4.2 RESULT FUNCTIONS

From the literature review (see §2.2.2) it became evident that many different types of transition scenarios exist, and that different types can also fulfil different functions. In basic terms, future scenarios have the function of broadening and narrowing our thoughts about possible future developments.

For transition scenarios, the result functions an approach can fulfil are defined by the form and focus of the transition scenarios, as well as the type of aspects that it includes.

When it comes to functions of transition scenarios, Guivarch et al. (2017) highlight that the "*raison d'etre"* of all scenario approaches is to help deal with the inherent presence of uncertainty and complexity. As such, all forms of transition scenarios have the function of tackling either uncertainty, complexity or both. For energy transition scenarios, this includes the complexity and uncertainty that is caused by the shift from one energy system to another energy system. Complexity in (construction) projects is defined by Baccarini (1996) and includes the

presence of differentiation and interdependency in aspects related to the project. In other words, the more dimensions a project entails, the more complex it is. Uncertainty, in a broad sense, can be defined as *limited knowledge* about future, past, or current eve. nts (Walker et al. 2013). Different forms of transition scenarios distinguish themselves from each other by either being normative or exploratory. Exploratory approaches concern a possibility space of different futures, highlighting the pluralistic nature of the future. As such, exploratory approaches can help to deal with uncertainty. Normative approaches consider a single state future and are also known as backcasting approaches, as they trace back steps that need to be taken to achieve the single state future. Here, 'the future' is envisioned as a single, definitive state, with a focus on the ability of social actors to influence change. As such, normative approaches are equipped to reveal pathways of change and show the different things needed to make that change happen, as well as dependencies between actions. Normative approaches therefore can help to deal with complexities.

Furthermore, a distinction between qualitative and quantitative elements can be made. Qualitative elements are characterised by their narrative structure and for instance include storylines, stakeholder perspectives and assumptions. Qualitative elements such as storylines are typically included to improve the analysis, integrate stakeholder views or facilitate communication (Weimer Jehle et al, 2020). Quantitative elements in contrast include numerical parameters and indicators, typically illustrating effects or impacts. Quantitative elements are key for comparing and making trade-offs. Qualitative elements are key for communicating and understanding of system interactions.

In this research, an additional distinction is made concerning the focus of a transition scenario approach. Here, a division is made between externally-driven and internally-driven approaches, concerning the focus on changes in external or independent factors (out of control) and the focus on different internal or dependent factors (within control) such as decision options. Externally driven approaches highlight uncertainties and dependencies, whereas decision-driven approaches highlight strategic directions and agency of change.

These three typologies for transition scenarios can be crosspollinated to create a possibility grid space of transition scenario approaches. Extrapolatory are not considered in this typology, as they have a predictive character and thus don’t concern an open future exploration, which is crucial in transition process according to Sondeijker et al (2006). Figure 4.1 shows a possibility space with four quadrants of result functions of transition scenarios. The possible result functions include: *Exploring contextual horizons, Exploring strategic directions, Envisioning strategic pathways* and *Mapping dependencies*. Within the four types, both qualitative elements and quantitative elements can occur.

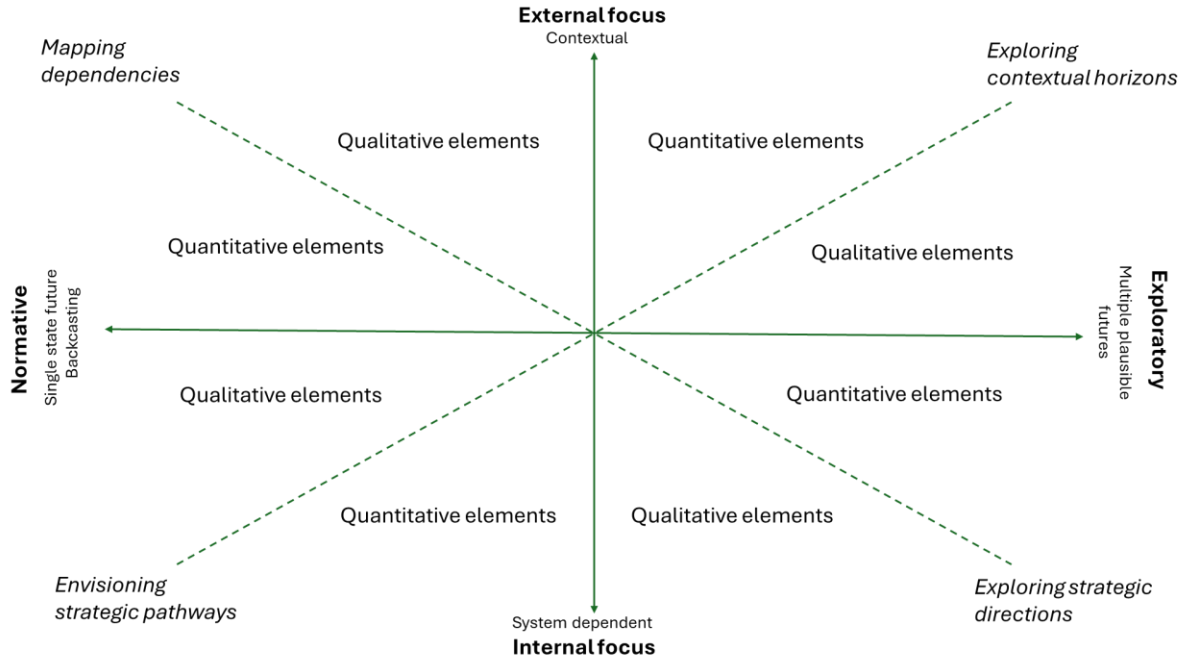

Figure 4.1: Possibility space of result functions of transition scenarios (Own illustration)

In the quadrant *Exploring contextual horizons,* changes in external factors are considered in an exploration of multiple different possible futures. Here, the focus is on exploring what the future could look like and discovering how changes in external factors impact the system of interest. Quantitative elements in this quadrant can include sensitivity analyses, for example to show the effect of changing electricity prices on the desirability of rooftop solar panels. Approaches in this quadrant help to answer questions such as: What can influence our strategy? How can these factors change in the future? What is the impact of these changes? As such, they help to tackle external uncertainty.

Transition scenarios in the quadrant *Exploring strategic directions* also include multiple different futures, however the content is more decision driven and thus concerns factors that can be influenced by the involved stakeholders. Quantitative elements in this quadrant can include impact analyses, showing the impact on CO2 emissions when deciding to cover all roofs of governmental buildings with solar panels. Approaches in this quadrant can help to answer questions such as: What are our strategic options? What are our goals and ambition? What do we want to do? They help give direction to choices and take away ambiguity about the desired future and as such tackle internal uncertainty.

Furthermore, the quadrant of *Envisioning strategic pathways* includes a single state future of what involved stakeholders would like the future to look like, similar to a vision. The scenarios that are created in turn consist of pathways of change towards this future. This includes tracing back the steps that can be taken by the involved stakeholders, showing their own agency of realising change. Quantitative elements can include calculations of required capacities or resources, whereas qualitative elements show relations and system dynamics. Approaches in this quadrant help to answer questions such as: What steps need to be taken to achieve this? How are we going to do that? What can we do? Who do we need for this? How are we going to engage them? By thinking about actions that can be taken by the involved actors, approaches in this quadrant help tackling internal complexity.

Finally, transition scenarios that fall into the quadrant of *Mapping dependencies* also consider a single state desired future. In this case scenarios also include pathways of change towards this future, but focussing on required changes in external factors or from external actors. Backcasting within this quadrant includes tracing back steps that need to be taken by uninvolved stakeholders, as such showing dependencies on others to realise the desired future. This gives the involved actors answers to questions such as: What do others need to do to achieve this? Who are they? How can we engage them? With these insights, they can decide how to deal with external complexities.

4.3 PROCEDURAL FUNCTIONS

Procedural functions of transition scenarios have to do with the activities involved in the application of transition scenarios such as gathering input, developing the scenarios and evaluation of the scenarios to make decisions based upon them. Wiek et al. (2006) highlight that for transition processes, the procedural functions of scenarios can include building competence by stimulating, imaginative, creative and controversial thinking, facilitating and organising team work by enabling interaction between experts and stakeholders and counselling decisionmakers by informing and inspiring policymakers. The procedural functions thus relate to benefits for stakeholders who have been involved in the process and the ability to benefit from the procedural functions depends on the way stakeholders are engaged in the process. The importance of stakeholder engagement also became evident from the literature review (see §2.2.3), as many scholars (i.e. Berkhout et al., 2002; Höfer & Madlener, 2020; Söderolm, 2011; Höfer et al., 2019; Mcgookin et al. 2021) highlight this in their publications, especially in subnational applications.

Therefore, the analysis of the procedure of the practical application of transition scenarios in this research will concentrate on how stakeholders are engaged. In order to do so, stakeholder engagement in scenario development for regional energy strategies is operationalised in this section. Stakeholder engagement is defined by considering the composition of the engaged stakeholders (participant composition), the way of engaging stakeholders (participant engagement strategy) and what input for the scenarios was collected from the stakeholder engagement (participant input).

Participant composition

When considering the participant composition in the procedures of transition scenarios, three aspects are taken into account: the number of participants, the diversity of the participants and the ratio between different types of participants. The larger the number of participants, the less likely it is that individual interests will prevail. This is important as regional energy strategies aim at organising the energy transition for the common interest. Diversity of participants depends on whether participants from varying perspectives were involved, for example local residents, governmental and nongovernmental organisations and local businesses. The higher the diversity, the more complete the stakeholder input is and the less likely that important perspectives are missed. Finally, a balanced ratio between different types of participants is important as this prevents the dominance of a certain perspective.

The question then remains what (types of) stakeholders are important to engage in the development of regional energy transition scenarios, when using them to create a strategy for achieving REP in the region. Waisman et al. (2019) highlight that for long-term decarbonisation strategies to succeed, they "need to be well-understood and widely accepted by a majority of key stakeholders, including those involved in implementing the plans and those impacted by the changes". In the context of regional energy strategies, there is also a large role for governmental

organisations as they are the ones establishing the strategy. The researcher proposes the following categorisation of stakeholders in the development of regional energy transition scenarios:

1. The authorities
    a. Municipalities, Waterboard, Provinces (officials, administrators, councils)
2. The affected
    a. Local residents, local businesses, interest groups
3. The actuators
    a. Developers, Energy Cooperatives, DSO
4. The advisors
    a. Advisors, Experts

By explicitly stating their roles, the relevance of their engagement becomes evident. Different stakeholders are furthermore engaged for different purposes and this should be taken into account when deciding on how to engage them. Authorities can for example be provided with decision support, whereas affected can understand possible future changes and understand the impact this might have on them. Actuators can inform the decisionmakers with guidelines of what is practically feasible and could be activated by their engagement. Advisors can provide necessary information.

The question of who should be engaged can also be informed by means of a stakeholder analysis, assessing for example the influence, interest and attitude of different stakeholders.

Engagement strategy

The engagement strategy considers how participants have been able to contribute to the scenario development process. This is operationalised as different modes of engagement, such as engaging stakeholders by means of a survey or by means of a workshop. Here, the meaningfulness of the participation is important. McGookin et al. (2021) for example state that the engagement is considered meaningful when actual stakeholder engagement occurs instead of incorporating sociotechnical theories or public attitude survey results. Arnstein (1969) already proposes a ladder of different degrees of citizen participation, where higher degrees of citizen participation offer more control to citizens. In this research, there are five categories for stakeholder participation in the process of forming and deciding on transition scenarios.

1. Non participation: stakeholder is not engaged or only symbolically without having any role.
2. Informing: stakeholder is only informed
3. Consulting: stakeholder is asked to give input
4. Participating: stakeholder can actively take part in the scenario processes and also give input where they see fit.
5. Co-deciding: stakeholder can actively take part and take part in decisions on how to move forward

Participant input

Finally, the input for the transition scenarios that is provided by stakeholders is considered. This answers the question: What were stakeholders asked to give as input? This could be an expert opinion, preference, feedback, etc. Or it could be that stakeholders weren't asked for input, but were only informed about the transition scenarios. The participant input can be categorised as:

1. Objective vs Subjective information

a. Is the stakeholder asked to give factual information or an opinion?

2. Own interest vs Common interest
    a. Is the stakeholder asked to speak on behalf of their own interest or on behalf of the common interest in the region?

4.4 RESULTING FRAMEWORK

The relation between the operationalised concepts for the scope, result functions and procedural functions of the practical application of transition scenarios are represented in the resulting conceptual framework which will be used for analysing the case data. Figure 4.2 presents the resulting framework.

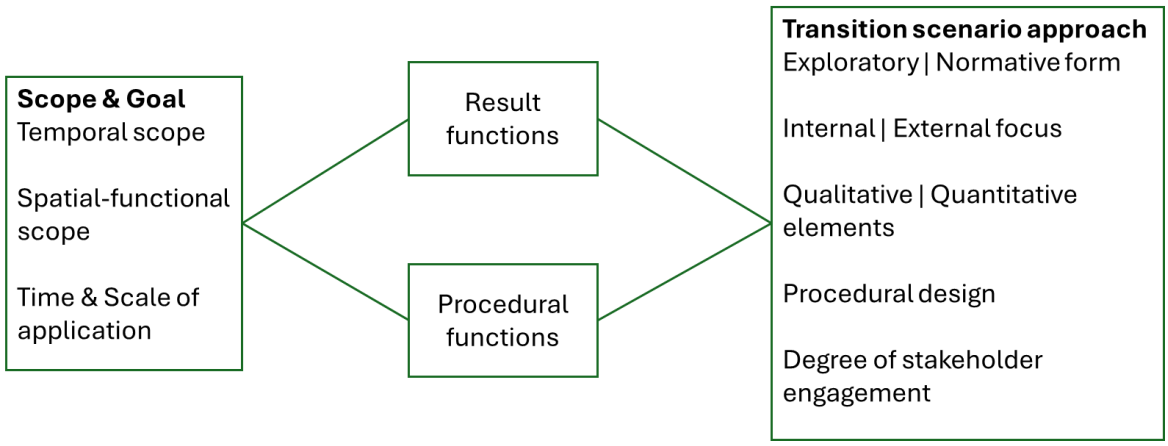

Figure 4.2: Framework of analysis

The framework will be used as a guideline to analyse the collected empirical data from about the practical application of transition scenarios in the two RES cases. The results of this analysis are presented in chapter 6. The next chapter will first introduce and evaluate the cases.

5 CASE EVALUATION

For this research, two different RES regions are selected for the case study; RES A and RES B. As Loorbach & Rotmans (2010) also highlighted, in transitions, process and substance are always intertwined, thus the procedural and contextual differences in the regions and how the energy transition unfolds are inherently linked. Therefore it is important to get a general idea of the differences in the characteristics of the regions (§5.1), organisation of the regional collaboration (§5.2), the established regional energy strategy (§5.3) and the current progress made in the implementation of the strategy (§5.4). This will contribute to understanding the scope of the transition scenarios and help to extract what effects can be linked to the different applications of transition scenarios. This case evaluation is based on the data gathered from official documents published by the regions as well as other publications from involved governmental organisations (i.e. municipalities, water boards and provinces).

5.1 REGIONAL CHARACTERISTICS[3]

This section describes the regions characteristics, focussing on differences in the structural characteristics of the network as well as the natural and socio-economic context.

5.1.1 RES A

RES A is a large region consisting of approximately 30 municipalities, varying between 10.000 and 800.000 inhabitants each. The region is home to approximately 2 million people and is located in the Randstad, a densely populated, highly urbanized area in the western part of the Netherlands. Outside of the urbanised areas, the landscape is characterised by farmlands, wetlands and coastal areas. Economic activity in the region is diverse with finance and wholesale and retail trade being the largest sectors in the region. The region is generally prosperous with a GDP per capita above the average (CBS, 2024). Politics in the region are historically more progressive (Voorn, 2021; De Voogd & Cuperus, 2021).

5.1.2 RES B

RES B is a smaller region consisting of approximately 15 municipalities, varying between 10.000 and 120.000 inhabitants each. The region is home to approximately 585.000 people and is located at the border of the Netherlands, which is known for its natural landscapes. The landscape can be characterised as mostly rural with one larger urban core. Current economic activity in the area is centred around small and medium sized enterprises with an emphasis on the industrial and tourism sectors. The region is less wealthy with a GDP per capita below average (CBS, 2024). Politics in the region are historically more conservative (Voorn, 2021; De Voogd & Cuperus, 2021.

5.2 ORGANISATION OF THE REGIONAL COLLABORATION

This section presents the organisation of the regional collaboration. This will also highlight the presence of subnetworks, the presence of a regional network organisation and the history of network interaction in both regions.

5.2.1 RES A

For the purpose of the RES, the region is divided into 6 subregions. Some of these subregions have compositions in which cooperation between municipalities has historically taken place, others

[3] The regional characteristics are purposefully kept quite general as to illustrate the differences between the two cases while ensuring anonymity of the cases and as such anonymity of the interview participants. For this same reason, employed regional sources are not referenced.

were new constellations. An important notion is that the RES program doesn't lead to changes in existing duties and powers of public authorities (Werkwijze - Regionale Energiestrategie, n.d.).

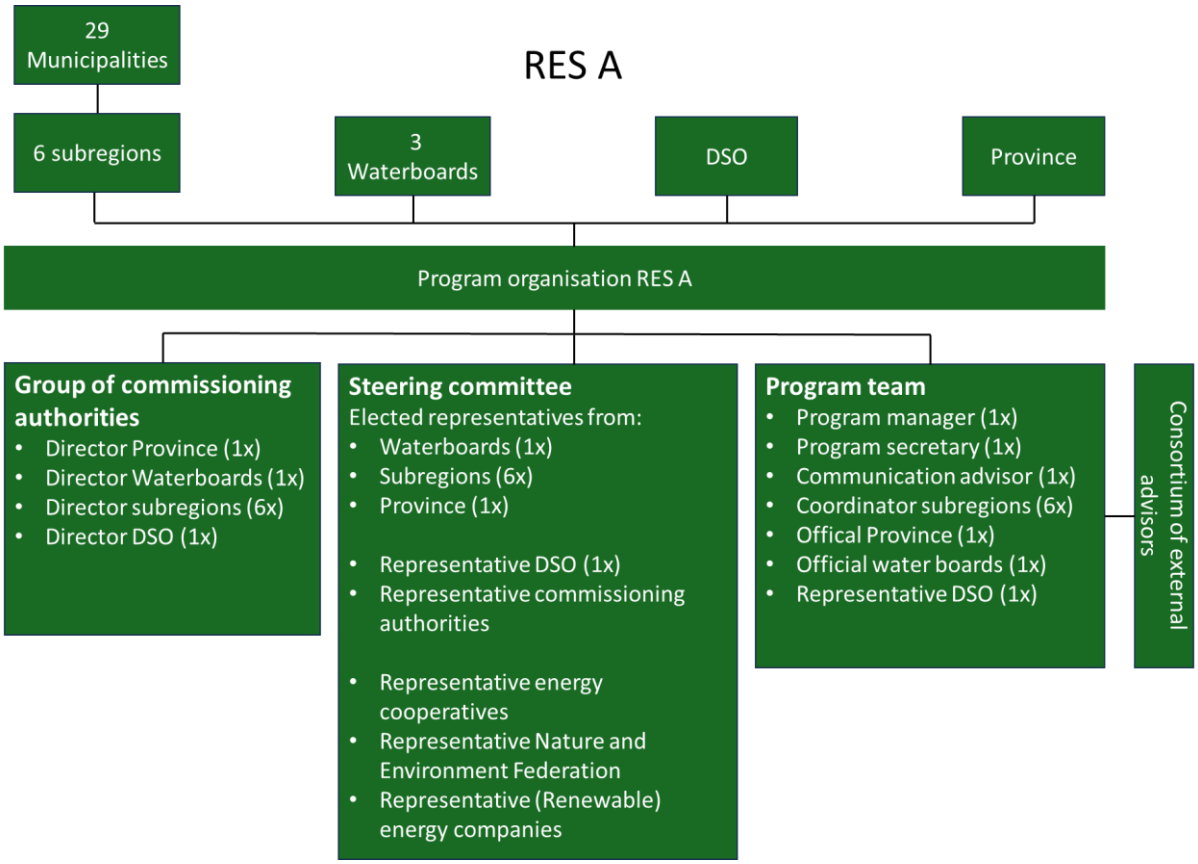

Figure 5.1: Schematic representation of organisation RES A

Figure 5.1 shows a visual representation of the organisation of the regional collaboration in RES A. The development and implementation of the Regional Energy Strategy in RES region A is facilitated by a program organisation. This organisation works on behalf of the governmental organisations in the region; municipalities, province and water boards (Document 5, see appendix B2) In RES A, the program organisation exists of a group of commissioning authorities, a program team and a steering committee. The program team is chaired by a program coordinator and is supported by a consortium of external advisors. The program organisation is responsible for coordinating the process and has no decision-making powers. The program team therefore reports to the steering committee who is responsible for ensuring democratic legitimacy and has decision-making powers. The steering committee consists of the elected representatives from the governmental organisations, a representative from the distribution grid operator and occasionally also other organisations such as energy cooperatives, nature and environment federations or (renewable) energy companies (Document 5, see appendix B2).

On a local level, each municipality has (at least) one official who is responsible for being involved with the RES region, typically this is an official of sustainability or energy transition. They communicate with the regional program organisation through the coordinator of the subregion, who is represented in the program team.

5.2.2 RES B

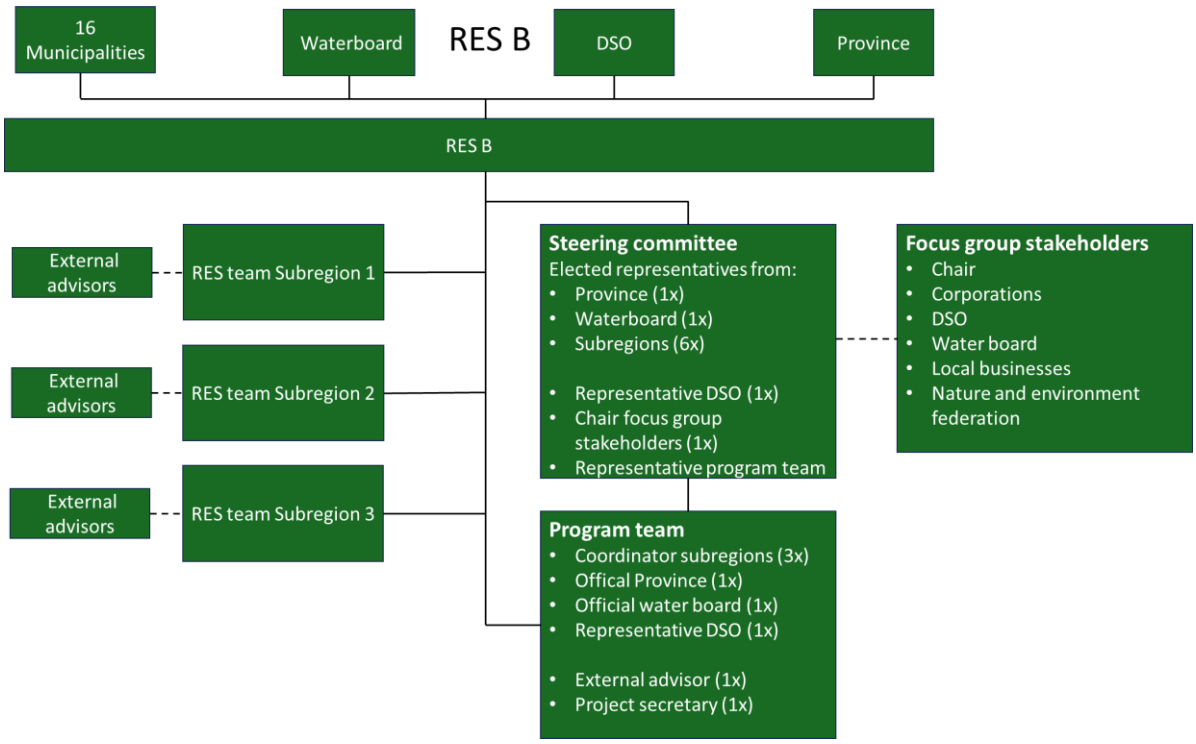

Figure 5.2: Schematic representation of organisation RES B (Own illustration, inspired on Document 15, see appendix B3)

Figure 5.2 shows the organisation of collaboration in RES B. RES region B is naturally divided into three subregions, as they have a history of collaboration in these constellations. One of the subregions even has a formal joint arrangement for the collaboration which is embodied in a subregional organisation. Because of this clear division, each of the subregions has their own RES team. The subregional RES teams consist of the municipal officials (one for each municipality) as well as a subregional coordinator. To represent regional stakeholders in the RES, RES B established a focus group of which the chairman is represented in the steering committee.

Throughout the RES process, the organisation of RES B has changed slightly. After establishing the RES, the program team was extended with a program manager and a program secretary as well as a communications advisor. The steering committee was also extended with the inclusion of a representative from Young RES, an organisation that represents the voice of young people in the region (Jongres, 2023). The organisation was also extended with different thematic taskforces to work on the implementation of the strategy , for example a taskforce solar PV on roof. The subregional structure still exists.

5.3 Regional Energy Strategy

5.3.1 RES A

In the established RES 1.0, RES A set an ambition in TWh for the production of renewable energy by 2030. At the moment of publication in 2021, 26% of this ambition was already realised with the existing REP in the region. In the RES 1.0, a total production potential was identified, distributed over 32 so-called 'search areas' in the region (Document 7, see appendix B3). A search area defines the geographical boundaries of potential locations for renewable energy projects. The search areas are also projected onto a map of the region, which was published in

the strategy document. The potential is divided into different types of renewable energy, this distribution is shown in figure 9.

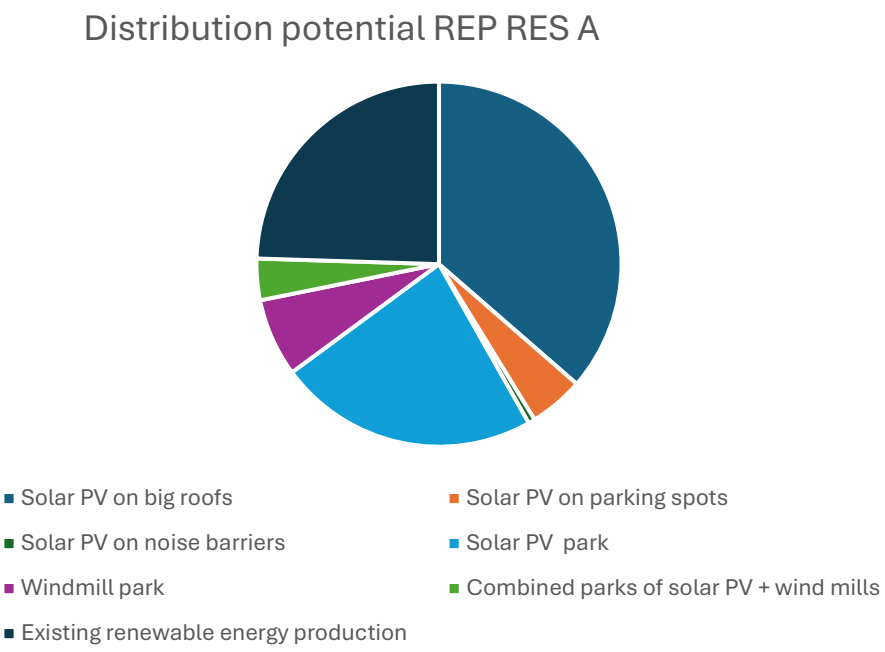

Figure 5.3: Distribution of renewable energy types in potential RES A (Own illustration, based on Document 7, see appendix B2)

From figure 5.3, it becomes evident that a big part of the ambition is allocated in solar PV, especially on big roofs. All of the solar PV potential accounts for approximately 65% of the total potential. Clearly, a choice was made to focus on solar PV projects in this region.

5.3.2 RES B

In the established RES 1.0, RES B also set an ambition in TWh for the production of renewable energy by 2030. At the moment of publication in 2021, 4% of this ambition was realised with the existing REP in the region. Pipeline projects were responsible for about 23% of the ambition. As only a small percentage of this ambition was locked away in existing projects, the strategy contains an ambitious target.

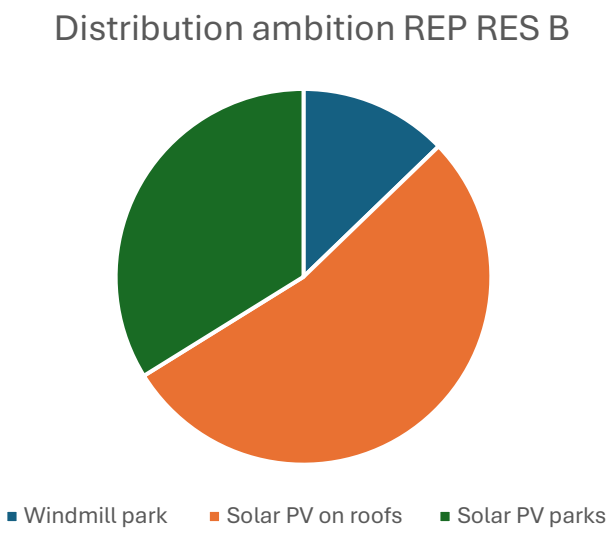

Figure 5.4: Distribution of renewable energy in ambition RES B (Own illustration, based on Document 17, see appendix B3)

Figure 5.4 shows the distribution of the ambition between the different types of renewable energy production. From this figure, it becomes evident that a big part of the ambition is allocated in solar PV, especially on roofs. All of the solar PV potential accounts for approximately 87% of the total potential. Clearly, a choice was made to focus on solar PV projects in this region.

The RES in case B also contains a map with potential locations for renewable energy production, although less emphasis is put on it compared to case A.

5.4 Progress in strategy implementation

5.4.2 RES A

In 2022, a first progress report was published. At the time of publication REP in the region was still the same as in 2021. The combination of pipeline and current projects did increase with 32% relative to 2021. This implies that some projects did indeed move from ambition to pipeline. (Document 10, see appendix B2)

5.4.3 RES B

In 2023, a first progress report of RES B was published. At the time of publication the REP in the region was equal to 9% of the ambition. This most likely was the result of the materialisation of pipeline projects. (Document 19, see appendix B3)

6. COMPARATIVE ANALYSIS

This chapter presents the findings of this study on the current development and implementation of regional energy strategies, highlighting the practical application of transition scenarios in this context. The findings from collecting and analysing the case study data are presented, utilising both the interview data as well as the reviewed documents.

The chapter starts with some general observations on the process of developing a regional energy strategy in both regions (§6.1). The remainder of the chapter is structured by answering the sub research questions for both regions. Starting with an analysis of the practical application of transition scenarios in both regions (§6.2). The final part of this chapter includes an analysis of how the strategies are implemented and the identified challenges and driving factors in the implementation phase (§6.3). Each section finalises with a comparative analysis, highlighting similarities and differences between the findings in the two cases.

In the conclusions (chapter 8), the findings from this comparative analysis will be used to answer the main research question and extract recommendations for the use of transition scenarios for regional energy strategies. The findings will be discussed in light of existing literature in chapter 7.

6.1 DEVELOPMENT OF REGIONAL ENERGY STRATEGIES

This first section is dedicated to a general analysis of the development process of the regional energy strategy in both regions. For the strategy development phase, the period between the start of the RES program and the establishment of the RES 1.0 is considered (2019-2021). The analysis includes a characterisation of the process of strategy development of both regions as well as the identification of some general strengths and difficulties in the process as experienced by the interview participants. The differences in the processes of the regions are characterised by the extent to which the process was defined, the organisation of the regional collaboration and the degree of openness of the process.

6.1.1 RES A

The process of the development of the regional energy strategy in case A can be characterised as well-defined, centrally coordinated and open.

The process guidance in RES A was tendered as a whole and executed by a consortium of external advisors consisting of process managers, experts in nature and landscape, economy, energy production and transition, in collaboration with the program manager. This made sure the process was centrally coordinated. RES A followed a structured process, conceived by the program organisation in collaboration with the consortium of external advisors. The overall process is shown in figure 6.1. In general, the process can be split into two phases, the establishment of a draft version of the RES (steps 1-4) and the adjustment from the draft RES towards the RES 1.0 (steps 5 and 6).

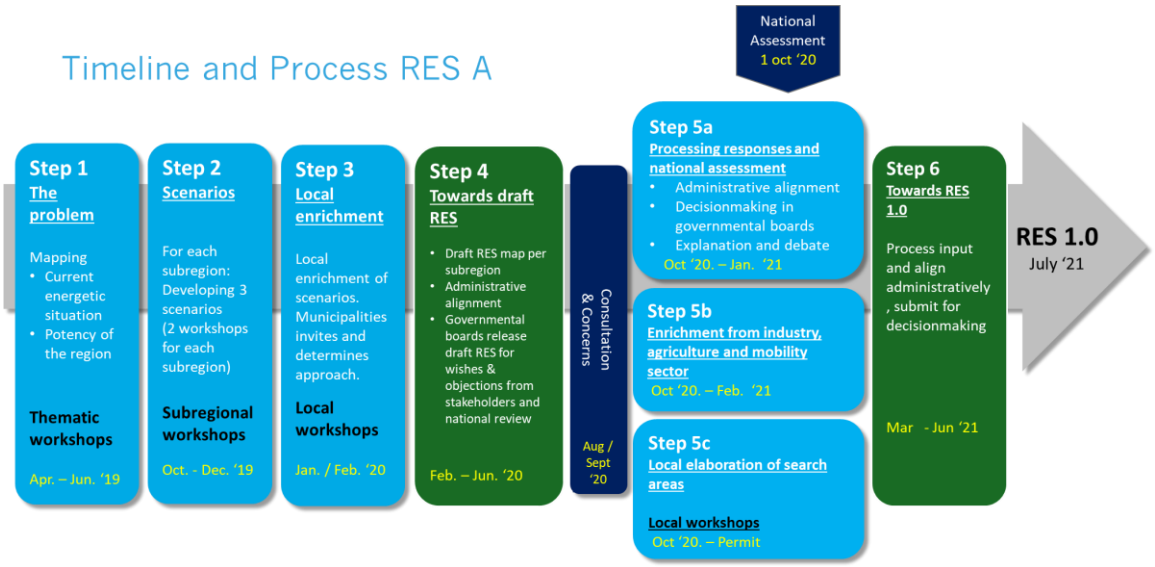

Figure 6.1: Overall process development RES A (Own illustration, adjusted from Document 5, see appendix B2)

Clearly visible in figure 6.1 is the explicit role of scenarios early in the process of coming to a regional energy strategy (step 2). It is also notable that explicit attention is given in this process to the inclusion of different stakeholder groups, for example in step 5b where industry, agriculture and mobility sector have the possibility to react on the draft RES.

The process approach was furthermore for the most part predetermined and thought out into great detail.

"So we really did that together with the consortium. From the RES program, we drafted a tender in which the main points were already included. Well, this is the kind of process we have in mind and the kind of results we want from the contract and the schedule that goes with it." ~ Interview 11

In the process of developing the RES, the program organisation was in the lead and made sure a similar methodology for coming to choices was used throughout the region.

"At the beginning, the program organisation really played a very important role. We were very much guided by the program manager who knew it all, who was also a very good program manager who told us very clearly what we had to do and how it was all going to work." ~ Interview 15

Finally, the RES program of RES region A aimed for a process as open as possible, which included specific attention to participation and transparent communication about the process steps, goals and intermediate outcomes. The whole RES process for example is also documented and published on the website of the RES region.

Difficulties and strengths

When asked to reflect on the strategy development process, interview participants in RES A were often positive, indicating that this structured approach with a strong central coordination and open setting was appreciated.

"Overall I'm ultimately quite positive also about the whole RES process, you know. It took an incredibly long time, but maybe that's also the time you need to take everyone on that trip. That also all residents go to all kinds of meetings and hear about everything and just get involved and also get used to the idea that wind turbines can also be built in our municipality." ~ Interview 15

Difficulty however was found in the fact that the topic of energy transition was new and therefore not everybody involved had the same level of knowledge on the topic.

"I think there might be some knowledge missing there too. Look you do mention things like a grid operator and how that works with connection, but also an operator or developer what they look at to make a business case or the market price of electricity, how do you sell power on the market? So how does that work? There are so many factors on that whole playing field, which the average colleague or RES employee or whoever has no clue about." ~ Interview 13

The RES was also a whole new approach which made it difficult to get started as ambiguity existed about what the goal was and what was expected from everyone involved.

"I do remember that in the beginning it was a lot of searching: what do they want from us? Large-scale generation, how? Where on earth do you start, right? So that was difficult." ~ Interview 15

"But it's also a way of working and it's also a whole new way. Back then, wasn't it? With this new intergovernmental cooperation, people also have to have a lot of trust, both in the process, in the program, and in each other. To dare to do that together. I think that goes very well." ~ Interview 19

What was also difficult is the strategic behaviour of municipalities within the region, where municipalities were often not willing to take on more of the task then needed.

"At the start, we also sort of determined our position. Yes, with the number of hectares under our belts, we decided that this is what we need for ourselves. We are not going to become an energy supplier for the region." ~ *Interview 14*

Finally, the transparency also led to media attention and resistance amongst local inhabitants.

"The moment the draft RES came out, there was also a lot of media attention. A lot of negative attention and there was resistance, and sometimes security had to be present at some of the workshops with residents, because the atmosphere was really not pleasant. I found that frightening, but looking back now, I wouldn't have done it any differently. I think it's very important to be transparent about that." ~ Interview 11

6.1.2 RES B

The process in RES can be characterised as decentralised, less structured and relatively closed.

The general timeline and process of the development of the Regional Energy Strategy in RES B is shown in figure 6.2. The process of RES B is less structured into activities and rather has a focus on the results that come out of each step. The actual activities to come to these results is organised within the subregional RES teams. The subregions therefore had the ability to organise the process as they saw fit. An important notion here is that there is no explicit role for scenarios in this process, although current and future energetic situations are a part of the factual base, indicating a future exploration of some sort.

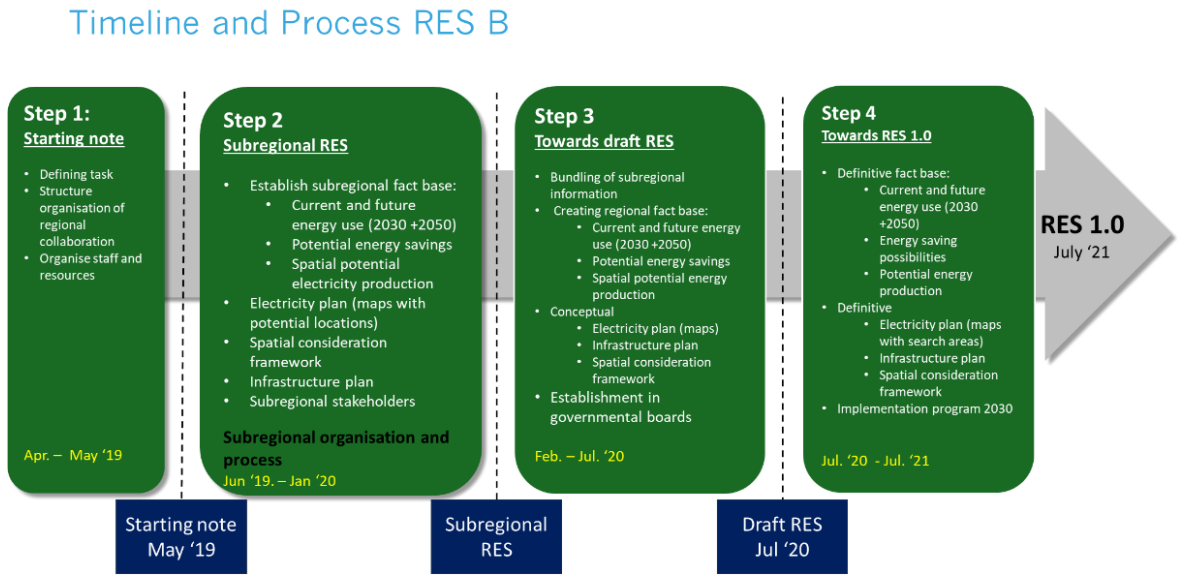

Figure 6.2: Timeline and process development of RES B (own illustration, based on Document 15, see appendix B3)

From the published document on the RES 1.0, it becomes evident that the process of coming to a draft RES had a rather technocratic nature, whereas the process of coming from the draft towards the RES 1.0 was considered as the social phase.

"From May 2019 to June 2020, representatives of the municipalities, the Water Board and the Province, together with external agencies, first worked on the technical phase and a draft RES, based on working workshops and administrative discussions. This draft RES was submitted in the middle of 2020. This phase was immediately followed by the social phase resulting in the present RES 1.0." ~ Document 17 (see appendix B3)

The region furthermore relies to a further extent on the knowledge and deployment of existing employees at regional and local governments. In addition, there is a strong divide between the subregions which resulted in a much more fragmented process.

RES B chose for a very decentralised approach where the primacy lied with the municipalities and the region was strongly divided by the subregional structure. By taking a very decentralised approach, RES B gave municipalities the opportunity to make local choices.

"But an important choice that was made is that it more remains in the three sub-regions here in the region, so that it is maintained less as a large region, but perhaps three smaller regions, and that everyone has made their own choices, slightly different. Whatever suits their sub-region best at that moment" ~ Interview 1

Different subregions also attracted different external advisors to help them.

"At the time, different subregions sometimes worked with different external advisors and where one went with engineering firm X, for example, another went with consultancy firm Y. But in the end, the same product more or less came out of these subprocesses, albeit in a different format." ~ Interview 2

The relatively unstructured character already becomes prevalent in the case evaluation (§5.3.4) where the process steps towards the RES are only generally defined. Finally, the process was relatively closed off to parties outside of the deciding governmental parties and their advisors.

"Actually, that draft RES. I always say, that was kind of a government affair, right?" ~ Interview 6

Difficulties and strengths
The decentralised approach in RES B also resulted in a fragmented process, where the different approaches in different subregions resulted in difficulties when trying to merge the findings into one regional energy strategy.

"When we integrated those 3 subareas, we ourselves also experienced that the principles that one subregion used, for example, were very different from those that another subregion used." ~ Interview 6

In RES B, the low knowledge level on energy transition was also experienced as difficult.

"We have had to deal with officials and nothing against those people, but they said: I have always been concerned with the environment. Energy I know nothing about, but I still have three years to go, so I'll sing it out." ~ Interview 8

"We sometimes had to laugh when a municipality wrote, we want to be climate neutral in 2030. Then we would say: climate neutral in 2030! Do you know what that means? Yes, but it sounds so nice. That was actually a period when everyone was repeating to each other: We are going climate neutral."

Furthermore, the political dimension of the process prevailed in the region as councillors struggled to determine their position. Councils tried to find a balance green ambitions that appealed to the electorate, NIMBY ("not in my backyard") sentiments and the challenge of understanding what are realistic and achievable goals.

"*But that makes, what I also pointed out to you earlier, the difficulty for councillors. It's a complex dossier, energy transition, and decisions are often made on gut feeling; I want to be re-elected*" ~ Interview 1

"Nimby, you know this term of course, not in my backyard. You don't want to know how many times I have experienced that. We all think this is fine but not in our municipality" ~ Interview 8

6.1.3 Comparative analysis
When analysing the development of regional energy strategies and the unfolding of the regional energy transition in both regions, it soon became clear that in general the two regions proceed very differently. These differences are reflected in this section.

From the characterisation of the strategy development process in both regions it becomes evident that the two regions have a very different process approach. RES A takes a centralised, structured and open approach to the process whereas RES B had a decentralised, less structured and more closed off process. The following interview quotes from the account manager of both RES A and RES B on behalf of the national program also underlines this.

"Well, there is almost no greater difference between these two regions, I think" ~ Interview 16

"In RES A, things are also done in a very process structured and business-like manner. And in RES B, it goes much different. So in the subregions and in smaller clubs some more. There, the meetings take a bit longer because there it is not, chop chop chop. There first has to be talked about how it is with your family and so forth. It's just a different culture." ~ Interview 16

In the interviews, participants also reflected on the process of coming to a regional energy strategy and highlighted some of the difficulties they experienced as well as things they appreciated.

In both regions, the low level of knowledge about energy and the energy transition, especially amongst municipal officials and elected representatives such as councilmen, was a difficulty. Both for involved stakeholders with knowledge as well as for the councilmen themselves as they didn't have the right sufficient knowledge to base their decisions on. Energy also never used to be a subject of concern for decentral governments, the officials involved in RES therefore were the first officials and aldermen of energy in most municipalities.

Another difficulty that both regions experienced was the ambiguity around what a regional energy strategy is and how to develop such a strategy. In RES A, the strong coordination and structured process guidance from the program team helped to tackle this.

Finally, both regions experienced challenges in navigating the political dimension of the process. While municipal councils sought to showcase ambitious sustainability goals to appeal to their electorates, they also grappled with concerns about contributing more than necessary and achieving a fair distribution of responsibilities in the region to meet these ambitions.

RES B furthermore struggled due to their fragmented organisation and process, resulting in integration problems, inefficiencies and inability to come to an agreement on regional scale due to the large differences between the subregions.

RES A in contrast benefitted from their coordinated and participatory approach, which turned out to really start up a regional collaboration as well as a broadly supported regional energy strategy.

6.2 PRACTICAL APPLICATION OF TRANSITION SCENARIOS

In their Regional Energy Strategy, regions had to set an ambition target of how much (TWh) renewable energy from on land solar and wind they aim to produce by 2030. In order to determine this target, regions explored the possibilities for REP in their region. This research aims at finding out how transition scenarios have been used in this process.

By means of a desk study and the interviews, data is gathered on this practical application of transition scenarios in the two selected cases. The data is bundled and analysed using the established framework in chapter 4 as a guideline. This will contribute to answering the sub question:

How have transition scenarios been used in the development of regional energy strategies?

Following the framework of analysis, this will be investigated by looking the scope and goal as well as the procedural and result functions of the applied transition scenario approach. As defined in the analysis framework (see §4), the most important procedural functions in the context of regional energy strategies are related to the engagement of stakeholders in the formation and evaluation of transition scenarios. The analysis of stakeholder engagement in the process of using transition scenarios is split into three aspects; participant composition, participant engagement strategy and participant input. The result functions are determined by the focus and form of the resulting transition scenarios.

In addition, the interview participants were also asked to reflect on the use of scenarios, as this research takes place in retrospect to the application of transition scenarios in the RES regions. This will contribute to answering the sub question:

What is the perceived effect of using transition scenarios in regional energy strategies?

This includes the interview participants perspectives, what did they consider as helpful about the transition scenarios, what was difficult and what were the most important effects?

The analysis is presented case by case, starting with RES A (§6.2.1) followed by RES B (§6.2.2). The differences and similarities between the applied approaches are discussed in the final section (§6.2.3).

6.2.1 RES A

This section presents a brief overview of the findings from the analysis of the practical application of transition scenarios in RES A. More details can be found in appendix C, including a descriptive summary of the scenario approach used in RES A (C.1), as well as the table with the data analysis of the resulting scenario (C.2).

Scope & Goal

As became evident from the analysis of the development of the regional energy strategy, scenarios were a fundamental step in the process of coming to a regional energy strategy in RES A. The aim of this is highlighted in the following statement:

"*The aim of step 2 is to jointly draw up three scenarios for the sub-region, in which we explore the possibilities for renewable energy production. The scenarios form the foundation for step 3 of the local consultation. Based on the scenarios, during the local consultation we test which components and which types of locations appeal, where there are additional opportunities and where there are possibilities under certain conditions*." ~ Document 12 (see appendix B2)

From this statement, it is clear that the scenarios have a spatial scope bounded by the geographical borders of the subregions and the scope is further demarcated by considering only the renewable energy production side of the energy system. The temporal scope is defined as:

"RES has a horizon of 2030 with a look ahead to 2050" ~ Document 12 (see appendix B2)

It also becomes evident that the goal of the scenario development in RES A was to come up with options for REP in the region in a participative matter as well as testing social and political support for different configurations of renewable energy production. This is also endorsed by this interview quote:

"*So the goal as far as I was concerned, if I remember correctly from those scenario studies, was to extract conditions for renewable energy production where people could sort of find consensus on.*" ~ Interview 19

Result functions

The coding and analysis of the result functions of the scenarios in RES A can be found in appendix C.2.

The form of transition scenarios in RES A can best be characterised as exploratory as multiple different future scenarios are developed for each subregion.

"*Then we developed scenarios. We did this on the basis of. What is important per sub-region, we had those sessions, for example. Landscape is very important. Or economic development is very important to us. Things like that and that led to 3 scenarios per subregion.*" ~ Interview 11

This exploratory character is also emphasised in the following quote:

"So for the final energy strategy, the question is not to choose one of the three scenarios, but to engage in a dialogue on possible search directions for the incorporation of renewable energy based on the insights." ~ Document 13 (see appendix B2)

The focus of the transition scenarios used in case A can best be characterised as internally driven as the emphasis was on identifying strategic directions for the region as well as pointing out the preferred and less preferred options. The transition scenarios thus acted as underpinning for the decisions made in the regional energy strategy.

"*And then and with that you actually also made the choice; suppose, we want the parts from the energy landscape we think are very good. Then we also choose to generate a lot in our region." ~ Interview 11*

The region also didn't consider any contextual scenarios.

"But we didn't so much indeed come up with scenarios for the context." ~ Interview 14

As such transition scenarios of RES A thus had the most commonalities with the quadrant of *exploring strategic directions*.

The content of the scenarios showed the future impact and effects of possible strategic directions. The scenarios were quite elaborate and contained both qualitative and quantitative elements. Each scenario consisted of a narrative description of the future, as well as the potential future renewable energy production (for both 2030 and 2050) in that scenario and an impact assessment which scored the scenarios in relation to each other. The assessment included future CO2 emissions, ecological impacts, economic impacts as well as spatial impact. The spatial impact is also shown on maps to visualise the impact (Document 14, see appendix B2).

"Ecologists, landscape architects and economists then estimated the effects of the scenarios on space, landscape and nature and investment, among other things. The information gathered in the preparation phase was used for this." ~ Document 8 (see appendix B2)

As such, the resulting scenarios also contributed to the understanding of the effects of different strategic choices.

Procedural functions

Table 1 shows the analysis of stakeholder engagement in the formation of transition scenarios in RES A. It becomes evident that the formation of transition scenarios in RES A was a participative process with a great variety of different stakeholders engaged, often in a meaningful way with interactive workshops. Interesting to note is also the fact that different inputs were asked from different participants, whereas so-called business stakeholders such as the DSO and local companies were asked to give factual inputs about the options for renewable energy production, local inhabitants were asked to give their opinion about the different transition scenarios.

Table 6.1: Stakeholder engagement in the development of transition scenarios in RES A

Quote & Concept	Coding
Large group of participants *"Yes, we spoke to more than 2,000 people, so it really was a very participative process."* ~ Interview 11 *"There were 50 to 70 participants per workshop."* ~ Document 8 (see appendix B2)	**Participant composition**
Diverse group of participants "And then you sat with someone from energy cooperative, someone from the province, municipality, a farmer, a local resident, etc." ~ Interview 18	
Lack of diversity in involved local inhabitants *"So there is already a pre-selection in the construct of such a meeting with which you exclude people, so I have always observed that. Well that the voice of the silent middle is not heard, because it's always people who think something about it. And the people who like it, who think, it will be fine, they don't go there. Again, it is often the people who already think something is very bad, who then make their voices heard"* ~ Interview 19	
Thematic workshops with business stakeholders *"We actually started with thematic workshops with all business stakeholders and partners with the municipality, civil servants with the grid operators and the like."*~ Interview 11	**Engagement strategy**
Interactive workshops on subregional scale *"In step 2, three scenarios were developed for each sub-region. For this purpose, two regional meetings were organised per subregion with partners from the municipalities involved, regional stakeholders and civil society organisations."* ~ Document 8 (see appendix B2)	
Observation *"And councillors, they often simply acted as observers throughout the RES process. And who of course also had to judge eventually; did this go well?"* ~ Interview 14	
Local workshops – Serious games *"Those scenarios were then tested in local ateliers with residents, society, etc."* ~ Interview 11 *"I remember back then we also did those, what we called serious games. We played those with residents. We played it with entrepreneurs. And with council members. "* ~ Interview 14 *"at the workshops that anyone could go to, the live version then, so what I just sensed is that there are only a few people. Of course, it's at night in a town hall"* ~ Interview 19	
Factual information on current REP, spatial constraints for REP, energy demand *"There we made a kind of picture of what is the state of affairs of the spatial regimes in terms of renewable energy generation and so actually made a kind of factual information base together"* ~ Interview 11	**Stakeholder input**
Important values and principles for the region *"We did this on the basis of what is important per sub-region, we discussed those in input session. For example, landscape is very important. Or economic*	

development is very important to us. Things like that and that led to 3 scenarios per subregion." ~ Interview 11	
Feedback on the scenarios *"Those scenarios were then tested in local workshops with residents, society, etc. They were asked: what parts of the scenario appeal to you and what don't? People could then rate or sticker the scenario aspects or.... I think we did that with green and red stickers, saying, well, I like this idea and not that one. But it was mainly about which parts of the scenarios people liked and disliked, so to speak."* ~ Interview 11	

Effects

When asked to reflect on the application of transition scenarios, interview participants often mention the stakeholder input sessions for the scenarios and how they contributed to engaging stakeholders in an accessible way. As such, the scenario development process acted as a participation tool within the process of developing a regional energy strategy in RES A.

"Yes. Well, I think what I already mentioned, those serious games, that really helped a lot. So a bit of scenario thinking with those stakeholders, but in a very accessible way. That did really help in the commitment as well. It was a nice way to back up our own ideas as well. Do stakeholders a little bit come up with the same as what we have come up with. So is there some logic in whatever we come up with and is that logic also seen by others?" ~ Interview 14

The scenarios and the workshops were also seen as good thought exercises that helped in stimulating the conversation about renewable energy production.

"I myself thought that the extreme scenarios were very visual and also very stimulating, because of course they were extremes. It was maximum generation, it was maximum preservation of landscape or..., well there were all these beautiful and clever names to stimulate people. We probably don't want this exactly the way it is, but what elements do you like? Well, pictures and maps and visualisation always work stimulating, especially if it's something people don't want. People know that very well, they can tell very well what they don't want. And then you do get the conversation going, so in that respect I think that worked well." ~ Interview 19

The scenarios and the input sessions contributed to putting the topic literally and figuratively on the map.

"Well, that's really a, if you ask me now what with all the experience I have now, I don't really think those scenario workshops have really brought much in terms of content. They did make sure the topic was literally and figuratively put on the map." ~ Interview 15

Although the content of the scenarios was not always praised, the impact assessment was considered as beneficial.

"Yes, I think it was useful, also because we did a kind of impact assessment in it. Of what does it mean if you make this choice for the landscape, for nature, for the power grids and so on? But in retrospect, when you look at the results of those scenario workshops. Everything on business sites, along the infrastructure, as little wind as possible, you know the obvious locations. So for the content, you might have done it differently, but to get everyone involved and also to land ownership with the municipality for example, it has been a very good process, so especially the by-catch of the scenarios. That's an important one though." ~ Interview 11

In RES A, the procedural functions of the transition scenarios were clearly seen as more important than the result functions. Interview participants did recognise difficulties with the engagement of different types of stakeholders.

"*What was difficult anyway was the participation story, so the stakeholders like the grid operator and so on who could really think along at that higher abstraction level of the RES. But you just really noticed that residents found that really difficult*." ~ Interview 14

The openness of the exploration was also not always appreciated, as it also let to the consideration of unfeasible options.

"*That's exactly what in retrospect I actually found quite amateurish, you know? That's obviously not how a professional wind developer would ever proceed. They would just do a proper analysis first. Where can it be done in the first place? If you look carefully and use a bit of the general criteria, then you just stay away from valuable natural areas. Of course, that has caused a lot of unrest. Because, of course, you also burden your citizens for years. For years, you drive everyone crazy with those wind turbines, while for the most part still talking about areas, where nothing is possible anyway*. " ~ Interview 15

Finally, the scenarios with their provocative maps and figures also stirred up the conversation in the media.

"And you could see that the moment there were maps with scenarios. Then all, fuss arose in the newspapers, you know? Now look what they came up with, while it was one of the scenarios and then you had to explain, it's a scenario, this is not going to be the plan

6.2.2 RES B

This section presents a brief overview of the findings from the analysis of the practical application of transition scenarios in RES B. More details can be found in appendix C, including a descriptive summary of the scenario approach used in RES B (C.3), as well as the table with the data analysis of the resulting scenario (C.4).

Scope and Goal

As became evident from the analysis of the development of the regional energy strategy (see §6.1.2), scenarios weren't used explicitly in the creation of the regional energy strategy in RES B. The following interview quote actually makes it seem as if though no future scenarios were considered, but only options in the current conditions. This indicates a limited temporal scope.

"*We have not used future scenarios, so we have emphatically not done that. The only thing we did do is, where does the RES ambition come out if we put out certain options? So if, for example, we exclude solar on agricultural land altogether. With that analysis, a bandwidth for the potential renewable energy production in the region has been determined. Certain choices led to our ambition for renewable energy generation. But that scenario was really based on current possibilities in current constraints and not looking at any future visions and plans that were there within individual municipalities or regions. " ~ Interview 2*

Another interview participant does indicate that a time frame until 2030 was used.

"Look, if you're talking about a time frame of 10 years, scenario thinking is slightly different from longer-term thinking. So over that period of 10 years mainly thought about of, well, what can indeed? We have compared 3 substantive scenarios and what does that deliver? Point. And then what does that mean for the ambition? I can remember that discussion on 2050, when I was

involved, the idea was, we'll think about that later, we'll see that then, that will come afterwards." ~ Interview 6

The ambition set in the draft RES did include a bandwidth of the potential ambition which was based on three scenarios: A conservative and optimistic scenario as well as an option in between. These three scenarios have also been used to show the minimum and maximum of the technical potential for producing renewable energy in the region. They were also used as input for the grid impact analysis by the DSO.

Furthermore, as the three subregions each had their own approach of coming to a draft RES, scenarios were also developed and applied separately in the different subregions. The spatial scope of the transition scenarios is thus less clear, as scenarios for the subregions were created as well as for the region as a whole. Different regions also used different parts of the energy system, where some only considered renewable energy production, others also included energy savings.

"A*t the time we had a number of studies carried out into the potential of renewable generation by landscape agencies, among others. What is spatially possible? Where is wind energy possible, where is solar energy possible, what are the exclusion areas? Because we also have enough of those in the region. But another agency also mapped the potential for energy saving, also with the idea of the Trias Energetica."* ~ Interview 2

The different subregions in RES B thus had different scopes of transition scenarios and different goals for using them.

Result functions

The transition scenarios used in RES B, can be characterised as a small exploration with a great focus on exploring the desirability of the options.

It was a small exploration, as only a limited amount of scenarios was considered. Most interview candidates actually don't even consider it as scenario thinking.

"They did look at a technical scenario and a realistic scenario. But I don't think that's really scenario thinking" ~ Interview 4

One interview candidate even refers to the fact that the bandwith was only later added and the ambition was actually already determined before considering the possible options for REP in the region. This indicates a resemblance with a normative approach of transition scenarios.

"*The national government had already published the target of what should be generated in total. So the region already knew, so to speak, what the approximate task was and they just calculated accordingly. There was really also reasoning, if we should generate this number, are we going to make that or not? And well, so that bandwidth is logical that that was added later on. But anyway, a generic idea of what the ambition should be, was clear at the beginning."* ~ Interview 6

In RES B there was no consideration of changes in external factors.

"And the second thing I haven't experienced, because I think scenario thinking or future thinking also involves kind of thinking about a realisation strategy huh? How do we think we can do that and how do we deal with uncertainties and so on huh? And well, I haven't experienced that line of thinking, not at all" ~ Interview 6

As such, the approach was more internally driven. The following quote also emphasises the consideration of different strategic directions.

"And from there, we have worked through different alternatives. So for example, if we want to deploy maximum on solar, maximum on wind or a combination and then also area-based." ~ Interview 6

In terms of content, the scenarios also contained few elements. The main output of the scenarios was the potential for renewable energy generation.

"The only thing we did do is, where does the RES ambition come out if we put out certain options" ~ Interview 2

The scenarios were also used as input for a grid impact analysis.

"The DSO has made a calculation to provide insight into the potential impact of the possible scenarios on energy infrastructure. They specifically looked at the impact on Sub (High Voltage/Middle Voltage) stations" ~ Document 16 (see appendix B3)

Qualitative elements concerned the options of renewable energy that were included. Maps were also made of potential locations, although these were not specific for a scenario rather than mapping all the possibilities for different types of renewable energy production.

"But really options for solar and wind and what we initially did is make an analysis, which was really a desk analysis. An analysis of where can something be done and where can something definitely not be done, so that we have mapped." ~ Interview 6

The maps also strongly emphasised locations where no renewable energy production was allowed or possible, focusing on exclusion areas.

"I also reacted strongly against this when those of those maps were created. I said, you are entering the thought process negatively, where can it all not be done? No the focus should be: where can it be done?" ~ Interview 17

Thus, the transition scenarios in RES B also share the most similarities with *exploring strategic options,* although much less elaborate.

Procedural functions

This section analyses stakeholder engagement in the formation of the different options (or transition scenarios) for the regional energy strategy in RES B. About participation and stakeholder engagement the RES region writes the following in their strategy document:

"Participation in the RES process: We included public representatives and residents in the preparation process, by means of (digital) meetings, surveys and information letters. We also used a focus group consisting of parties representing different interest groups." ~ Document 17 (see appendix B3)

The analysis is presented in table 2. A key takeway from the analysis is the fact that little stakeholders were involved in the creation of the transition scenarios, outside the officials from governmental organisations and the external advisors. Although an attempt was made to include actuators via the focus group, which even had a representative in the deciding steering group, they were barely asked for input and also excluded in all the preparatory work. As such, they were

not able to influence the options they could help decide on. Impacted stakeholders were mostly informed and consulted by means of information meetings and the public attitude survey.

Table 6.2: Stakeholder engagement in the development of transition scenarios in RES B

Quote & Concept	Coding
Lack of actuators *"Of course, that was also one of the complaints huh? That companies and interest groups said; but we are not involved at all in that whole RES. While we have to do it in a big way. That is why I called it a government affair. I think when it comes to scenario thinking and making a realisation strategy. Do you need other parties thinking along? And who can influence the results of all those studies, and I think that happened very little."* ~ Interview 6	**Participant composition**
Excess of authorities *"so as far as that is concerned, the risk this creates is that it becomes very much an administrative affair. And that it will naturally be less supported or deliver less to those parties who are actually very keen to be involved."*~ Interview 2 *"And the input for that came from the municipal organisations, so it wasn't just me. It was also my colleagues here and from other municipalities" ~ Interview 10*	
One representative of the focus group *"But I can't, on my own anyway, represent all the interests of those parties in the focus group. From large industry, medium-sized industry, 120,000 SMEs, but also healthcare institutions, educational institutions, things like nature and environment groups and the regional fire brigade are in it." ~ Interview 8*	
Survey *"And then the second phase was that social phase. Then we conducted a survey, again with the subregion. A letter was sent to all residents to fill it in. There was a huge response" ~ Interview 10*	**Engagement strategy**
Focus group *"We also set up a focus group for the RES region at the time, which represents other societal parties such as educational institutions, SMEs, young RES, etc."* ~ Interview 2	
Digital information evenings *"And in subregion 3, information evenings were organised, those had to be online as it was in covid times. At those sessions people could ask questions, companies could ask questions and so on, we also explained what the RES was and what people thought about it. And that actually all came together in that RES 1.0 well."* ~ Interview 10 *"So that was mainly a lot of communication and a little less participation" ~ Interview 2*	
Brainstorm sessions *"In addition, an administrative inspiration session for the RES took place in October 2019 to include municipal directors and officials in this process." ~ Document 16 (See appendix B3)*	

"Yes, we actually just had to set some sort of course together and well, I organised and chaired a number of brainstorming sessions in that whole process. And that was mainly in the subregion with the municipalities, by the way, in that process towards eventually just those first contours of what it should become" ~ Interview 6	
Advice *"We as focus group were asked for advice less than 5 times in that time" ~ Interview 8*	**Participant input**
Communication strategies *"And what then is usually their task? The RES has a focus group of people who are active on the periphery of the energy transition, and in these focus groups they mainly discuss how to communicate with citizens. That is actually the main theme in that. So you have no policy influence, you have no executive tasks so to speak, just a sounding board function." ~ Interview 17*	

Effects

In RES B, more difficulties than benefits were mentioned about the transition scenarios. The fragmented use of transition scenarios and the different approaches in the subregions is seen as difficult.

"And actually we agreed too little with each other as a starting point. So we have spent a lot of time and effort to bring that back together again." ~ Interview 6

Furthermore, the lack of input from actuating stakeholders such as businesses and developers, resulted in the scenarios being based mostly on government data which turned out to be outdated.

"So when you have to make an estimate, you naturally get some wishful thinking, don't you? Then, as a civil servant, you've picked up that somewhere, there might be 3,000 solar panels. Yes, if you haven't done any on-site research? And what kind of solar panels then? And where do you then go with that electricity? Has that been considered as well, or are we going to put ugly batteries there? So you see, it is just really difficult to give an informed projection if you only base yourself on government data, which you have to realise that that data is often outdated" ~ Interview 8

The transition scenarios therefore were not informed with a practical perspective. Interview participants also thought that the exploration lacked consideration to what is realistic and feasible in the timeline.

"But strategy development for me is also really also about thinking, not just about what all the options are and what is possible, but especially just what is realistic and feasible. What do you do if one scenario doesn't work and another one does? And what is your realisation strategy? That's part of it. And, I haven't experienced that at all in time that I was involved." ~ Interview 6

Interview participants are also critical on the decisions for the ambition that were made partially on the basis of the scenarios.

"Yes, I think an unrealistic choice was made there to say, well, we are going to focus mainly on rooftop solar, because we don't really want anything in our landscape." ~ Interview 4

"So those how that ambition in TWh came about. I don't know. But it's a simple addition of what people think they know from existing projects and upcoming projects. And well, here it comes, if I am very critical, it has just been quicksand." ~ Interview 8

"I have no idea what people came up with at the time to think that rooftop solar would take off so much." ~ Interview 3

Especially the province was critical on the resulting ambition.

"We as province did indicate, strange that the other RES region in the province is making a lower bid. With an area twice the size of RES B, which has less national landscape and less urban agglomeration. So we always questioned it." ~ Interview 5

"But yes, I think in the end, setting the ambition also became a kind of political story. As it is in most regions." ~ Interview 4

"In RES B, we could scrape together some things with pain and effort. And yes, I think we did look a bit more into the question of how far we can get as far as possible. But it was less well substantiated than in other regions."

6.2.3 Comparative analysis

The analysis of the practical application of transition scenarios shows that the two regions have used transition scenarios to different extents. Whereas RES A has used scenario development as an explicit step in the process of coming to their regional energy strategy, RES B has considered different options for REP in the subregions and afterwards translated these options into three regional scenarios to inform decision-makers at the regional level.

Even though the regions are very different, the general scope of the transition scenarios is similar, as both applications are used for the creation of a RES. This predetermines a time horizon of 2030, in line with the nationally set target. A similar spatial scale was also used as both regions created subregional scenarios to inform decisions at the regional level. Moreover, both regions used the transition scenarios in the beginning of the development of their RES, and used the results to underpin their draft RES.

The procedure of developing and evaluating transition scenarios, on the other hand, differs significantly. A first big difference is that in RES A, the approach was streamlined by the consortium of external advisors, making sure the scenarios were developed in a similar way and with similar underlying assumptions. In RES B the different subregions took their own approach, often also with the help of different external advisors. This has resulted in difficulties later on when trying to integrate the subregional scenarios.

Furthermore, the way different regional stakeholders participated in the process was also approached differently in the two cases. RES A actively engages stakeholders in the process of creating and evaluating transition scenarios. The region has organised interactive workshops where not only input for the scenarios was collected, but stakeholders were also given the opportunity to co-decide on the directions of the future exploration. Also notable is the input that was asked from stakeholders in RES A as they were not only asked for factual information and preferences but also asked to discuss what could be important values for the region in this energy transition. This helped to stay away from political sensitivity around the subject, preventing stakeholders in pushing forward their own interests and as such staying away from sentiments such as "nimby" (not in my backyard). As such the procedure of developing transition scenarios was used to generate and integrate knowledge about the energy system in the region, as well as

its possible future developments. This allowed the integration of knowledge about conditions and preferences for the future regional energy system. The resulting scenarios served as a vehicle to structure these collective thoughts. In addition, it becomes evident that the procedure has enabled interactions between different types of stakeholders, stimulating discussion on different viewpoints and values as well as building competence by exchanging knowledge and stimulating creative and controversial thinking. The scenario workshops as such also facilitated regional network building.

The procedural functions of the transition scenarios in RES B by contrast are limited as the stakeholders actively engaged in the process were also limited. Especially, the composition of participants lacked diversity and mostly consisted of RES officials and advisors. The information used for the transition scenarios was therefore rather unilateral and little "real life" knowledge from actuating stakeholders was integrated. This made it difficult to create realistic scenario options. The stakeholder engagement that did take place, was limited to consulting or informing and didn't facilitate interactions between different types of stakeholders. As such, potential procedural functions of transition scenarios such as competence building and facilitating and organising team working did not effectuate in RES B, except perhaps within the subregions. This hindered building regional cooperation in an already fragmented region.

The analysis of the form and focus of the resulting transition scenarios shows that both approaches share the most similarity with the quadrant of exploring strategic directions. The exploration in RES A however was much more open as more plausible future states were considered, really highlighting the pluralistic nature of the future. RES B contrastingly only considered a limited exploration, distinguishing between extreme future states such as a maximum, minimum and a more realistic middle scenario. Due to the little nuance in the scenarios, the discussion was also little nuanced, causing friction between stakeholders.

Considering the elements of the resulting scenarios, both cases logically included a quantitative potential for REP in the transition scenarios, as this could inform the decision of what quantitative ambition to choose for 2030. In addition RES A included an impact analysis to be able to compare the consequences of the different strategic directions. The different transition scenarios were systematically scored in relation to each other on different aspects to highlight consequences of choosing certain directions. One of the main elements here was also spatial impact, which was also illustrated in maps to visualise the impact of each scenario. These outputs were used to test local preferences in workshops with citizens. Decisionmakers could observe these sessions providing them with arguments for later political decision-making. RES B only used the scenarios as input for a grid impact assessment and to inform the ambition for renewable energy production in the region. Discussions on preferences were often of political nature and focussed on the impact renewable energy production would have on the preservation of the landscape, an important value in the region. RES B furthermore didn't include any narrative elements in the scenarios, hindering communication of the results. A final big difference in the use of the transition scenarios is that RES A highlighted their explorative nature and emphasised that the scenarios were extremes and the idea was not to pick one of the scenarios, but to explore options and inspire those involved. RES B contrastingly viewed the scenarios more as options, for example whether to include solar PV on agricultural land or not.

By using the transition scenarios to explore strategic directions and inform strategic decisions with the results, the transition scenarios took away some internal uncertainty about the desired course for the regions. However, the other quadrants of transition scenarios and thus also the other result functions were not utilised in both regions. Although both cases used the transition

scenarios to inform their strategic ambitions, no backcasting to discover realisation strategies took place. Both applications therefore lacked consideration of the practical feasibility of the strategic directions. In addition, contextual changes and implications for the regional energy strategies were barely considered by both cases.

6.3 IMPLEMENTATION OF REGIONAL ENERGY STRATEGIES

Besides understanding how transition scenarios have been used in regional energy strategies, this research aims at finding out how they can contribute to the implementation of these strategies. Therefore it is necessary to understand how this implementation unfolds, as well as identifying challenges and driving factors in this process. In 2021, the RES 1.0 is established in all regions, this moment is therefore defined as the start of the implementation phase. An analysis of different stakeholders roles and responsibilities in the implementation is also made to grasp a better understanding of interview participants' perspectives. This analysis is used as background information and can be found in appendix D.1.

To understand why regions are struggling to implement their strategies, interviews participants were asked what they view as the most important challenges and driving factors in this implementation phase of the regional energy strategies. This data is used to answer the last research question:

What challenges and driving factors influence the implementation of regional energy strategies?

The findings are presented in a case by case analysis, starting with RES A (6.3.1), followed by RES B (§6.3.2). Some findings are case neutral and can be found in appendix D4. The analysis of each case starts with a verification step to check whether the problem as established in chapter 1 is indeed present in the selected cases. Afterwards, the findings in the cases are aggregated to highlight patterns in the found challenges and driving factors (§6.3.3). The section finalises with a comparative analysis which highlights similarities and differences between the challenges and driving factors found in the two cases, including an analysis of which types of challenges prevail in what region (§6.3.4).

6.3.1 RES A

Problem verification

The difficulty in the implementation in RES A is underlined by the program manager in the following quote:

"*The intentions are very well established on paper. In my region too, I think there is quite a strong sense of unity in that, but the implementation is just recalcitrant. The game changes, the rules change along the way, but circumstances also change along the way." ~ Interview 19*

In addition, a representative of the DSO also notices that the RES is currently mostly a paper document:

"I do think that so far the RES is still mostly a paper document and little implementation is taking place if you ask me. And if you look at our developments, the developments that are happening at our place, these are all developments that are actually happening outside the RES. So the current projects that are being developed, those are often not included in the RES." ~ Interview 13

Process of implementation

In RES A, there was a strong shift in the role and task distribution after the RES 1.0 was established. Whereas the program organisation firmly steered the regional process from the start until the establishment of RES 1.0 (2019-2021), the implementation phase is less coordinated and responsibilities lie more with organisations themselves than with the region. This is also reflected in this interview quote from a municipal officer:

"Actually until that moment, the municipality was actually a bit the party that just cooperated in the process of the RES region. But at one point, the RES region said, okay, we have now supervised it and your council has now determined those search areas. And now it's your turn." ~ Interview 15

Challenges and driving factors

From the problem verification it becomes clear that RES A is struggling to realise their strategy ambitions. A challenge that is often referred to by interview participants is the interdependencies between different actions and actors. For example the interdependency between the development of policy frameworks by municipalities and the development of project plans by project initiators. Developers need municipalities to supply them with policy frameworks and requirements for their projects so they can apply for a permit.

"If there is no policy, then we cannot just develop a project either, so there must be something." ~ Interview 18

Members from the RES program team in turn refer to the fact that they feel responsible for the implementation, but they are not the ones who are going to actually build those renewable energy projects:

"Saying "We're going to make it happen", is of course always a tricky one. Because at the end of the day, you only have certain options as RES team. You're not the implementation club. You have to draw up a plan for places where you think where is potential for things to be developed. But ultimately there have to be developers who are going to do things and the market has to cooperate." ~ Interview 13

A municipal officer gives a similar notion:

"So we all just had to look a bit as well; how does this work out? How interesting is it still for developers to develop a solar park? Well, it turns out it is still quite interesting. But you just don't have much control over that as a municipality." ~ Interview 14

And more interdependencies exist, such as the dependency on the cooperation of a land owner, a DSO who needs to align their plans with the TSO and the dependency on higher tiers of government whose policies or decisions often overrule local ones. This last dependency is illustrated in this quote:

"So the next step is for these other municipalities to decide what they want to do with their search areas in this nature reserve. And then together with the province we just have to make a plan. You see, it is not the case that as a municipality you can decide on four wind turbines by yourself. Province is competent authority when it comes to wind farms over 5 megawatts. If we wanted to put just one wind turbine down in the municipality then, we could do it ourselves, but now we need to involve the province" ~ Interview 15

Interview participants furthermore often mentioned the difficulty with changing external factors. These included for example the changing political climate (both national and subnational). This is illustrated by this interview quote, which in addition also underlines the challenge of the non-binding nature of the RES.

"The province said, we're not going to do that, even though it is in the RES. That also had to do with new coalitions and the negotiations that took place. And this was an issue they didn't come out of." ~ Interview 11

New coalitions also have the ability to establish new policies, changing the financial conditions for renewable energy projects. The following quote shows the difficulty of shifting financial conditions.

"So quite a big part of our ambition, is in solar on roof. We all had the idea; that is a kind of self-fulfilling prophecy, everyone wants that. Also there the circumstances are shifting. From energy crisis, which made it booming. Well, then, what is going to happen with feed-in tariffs and what is your payback time on solar panels currently? And can it all still be done? So there are a lot of parts that are out of our control that do matter." ~ Interview 19

Finally, the region struggles due to spatial characteristics that make the implementation of renewable energy projects complex. The urban density of the region in fact makes that there is little space in general, but contrastingly to places where there is space, there is a robust grid, making grid congestion less of a problem.

"I think that in the beginning we were not very clear with each other about what exactly the effects would be. A lot of built-up areas, a lot of companies, so there is often a robust grid there but there is little room for generation because it is built-up." ~ Interview 13

The density also makes that many different spatial regimes must be integrated:

"RES A is a complex region because many policies and restrictions from laws and regulations come together here because it is a fully built-up part of the province." ~ Interview 19

This in turn imposes stricter regulations in general for new developments due to a high vicinity to populated areas:

"But of course there is also the story of a business case, because the area we chose is in an area with a height restriction, so those big wind turbines, the ones where you can also really just make a good business case for, 250 m high, you can just never put those here. We're talking about 145 m maximum here, they're relatively small wind turbines. Pretty difficult to make a business case for that at all." ~ Interview 15

Interview participants however also referred to factors that help them in the implementation, despite all of the difficulties. They for example highlight the well-functioning cooperation in the region. This interview quote from the program manager for example underlines the cooperation between the involved governmental organisations:

"And I think the biggest gain of the RES is not even necessarily in meeting the hard targets, but the realisation that we as governments can really work together on the task and seek each other out and hold each other up when it gets tough." ~ Interview 19

"So the only chance we see to realise this project, because we still believe in the goals of the RES, we still want it, is that we just have a really good cooperation with the 3 municipalities, and with

the province, with the landowners, with Rijkswaterstaat, with Staatsbosbeheer and all others who have to deal with it." ~ Interview 15

The following two quotes illustrate also the commitment in the region:

"No, Everyone is really trying incredibly hard. But it is not moving fast enough for several reasons; public support, grid congestion. Birds, you name it, all sorts of things." ~ Interview 11

"But I do find it that there is just real energy and quality on the team and also from the municipality now. Well, the officials on it are all in there with good energy. We hopefully are too." ~ Interview 13

But also in this region, it seems that even though the intention is often there, implementation is challenging.

"I believe, that as a municipality, if you're really committed to it, your basic attitude should be to roll out the red carpet project initiatives. What can you do to contribute to it being as easy as possible and as fast as possible if there is a good plan? And I also think everyone has that intention, but whether it works equally well everywhere, perhaps not. And that may be due to a lack of capacity. That could be a political colour of a college, that could be protection regimes, just hard barriers, whatever." ~ Interview 19

An overview of all identified challenges mentioned by interview candidates from RES A can be found in appendix D2.

6.3.2 RES B

Problem verification
In RES B, a representative of the subregion highlights that only a small percentage of their stated ambition has operationalised four years into the program:

"*Well, very simple, bad. If we look also at the national figure, such as the picture from the NPRES which is published annually. We just dangle at the bottom with I think something like 14% of the RES ambition realised. Yes so if we purely just relate it to numbers which is what it is all about in the end, very nice that we have a fine cooperation with each other, but the goal is not yet in sight*." ~ Interview 2

A representative from the program team also underlines the difficulty in implementation and notes that people are trying, but things are just progressing slowly.

"*Not so good. I also think that if you look at the numbers that we are progressing very slowly. And that's certainly not down to effort. I think everybody does work really hard to try to make progress, but I think it's just difficult and complex to make big metres in this."* ~ Interview 9

Finally, a representative from the province in RES B similarly to RES A recognises that the plans remain mostly on paper.

"*Plans have been committed to paper. But extremely little has been realised*."~ Interview 5

Challenge and Driving factors
In RES B, the difficulty in the implementation phase is also evident from the problem verification. Interview participants often refer to the difficulty with the changing political climate, especially in their own municipalities and province but also of the national government.

“Back then, there were a lot of ambitious aldermen from fairly green houses, so they set the bar high. Surely, municipal elections have caused quite a change. That also makes the realisation of a RES quite difficult because a municipality naturally changes political colour, every four years.” ~ Interview 5

This has also caused the introduction of new policies and regulations, making earlier appointed search areas unfeasible. This of course also has to do with the fact that the RES is a non-binding agreement.

“There are too many restrictions to actually make it happen. Solar on land has become more difficult. Wind energy is almost impossible, so the only thing left is actually rooftop solar.” ~ Interview 2

Different interview participants also refer that the fact that especially the current coalition at the province has little ambition for the region to become sustainable, and as such is a blocking stakeholder in the implementation of REP.

“And don't forget, of course, that we live in a political climate this moment, especially also in the in the provincial house. Where politics is swayed by people who are not exactly supportive of the energy transition.” ~ Interview 17

Multiple interview participants furthermore highlight the difficulty for governments to choose between different political priorities, resulting in making no choices, which delays the creation of policies that are needed to implement the RES.

“We are also a Novex area and therefore there are just multiple spatial challenges in this territory and you can't achieve everything. I can also imagine that is difficult. I often speak to people from sustainability, we all want renewable energy and an energy transition. But I can imagine those also sitting in a council or a college with people who would like to build more houses. If you then both look at the same piece of land. Yes, they all need space too. So where do you choose? How do you deal with that?” ~ Interview 9

When choices are made, renewable energy production is often not prioritised. Many candidates for example refer to a project of national interest potentially coming to the region that has thrown off plans for wind turbines at that location.

“As province we are trying to bring a special project of national interest to the area. That has meant that 4 to 8 wind turbines in a subregion cannot go ahead because of possible vibrations created by the wind turbines that would harm the project, so people want to do everything possible to get this project to come to the region. So hence the windmills are on hold there for now.” ~ Interview 3

But also other objectives, such as the preservation of the natural landscape are preferred over the energy transition ambitions.

“The risk that arises is that our region becomes an Open Air Museum where everything should stay as it is and that, above all, we shouldn't damage the vulnerable landscape and that, as a result, landscape interests outweigh energy transition interests. And of course there is something to be said for that. On the other hand, we also know that we simply have an energy challenge in the region and there is also great socio-economic deprivation in all the urban areas in the region.” ~ Interview 2

Some interview participants also relate the difficulty of RES with the more conservative character of the region.

"The region is by nature very often already reluctant to innovate. So on the one hand, the RES was very ambitious, we are going to achieve that. But then they didn't know how to realise that." ~ Interview 1

Although the region in general can be seen as more conservative, there exist differences in politics in the region which also leads to friction. Both between the subregions, as well as between villages in some subregions.

"That's all church village politics isn't it? So every municipality is different, you know? And there it's a huge task to make a bit of chocolate out of that, isn't it?" ~ Interview 6

This in combination with the strong organisational divide has resulted in a very fragmented region.

"I think the biggest stumbling block are those 3 sub-regions with their own way of working together, which is also very different, so one subregion has it based on a formally designated partnership. In the other two subregions, it is a bit more informal, a bit more voluntary." ~ Interview 4

As a result, regional cooperation on the energy transition never really took off. The region also struggles with capacity issues at governmental organisations, both in terms of effective hours that can be spent to work on RES as well as the knowledge and skills of those officials. This also has to do with the fact that energy is a new policy field at the regional level. Knowledge is also often lost again, as many turnovers have taken place in the members involved with RES.

"Municipalities have limited capacity at all. So even with the extra resources made available from the government to attract capacity. It is a difficult labour market, so there is just scarcity so even with extra resources the municipality does not always manage to attract the right persons." ~ Interview 3

Finally, grid congestion is often referred to, as being both a difficulty as it makes projects more complex, but also a blessing in disguise at can also stimulate to act now rather than waiting till no capacity is left.

"Grid congestion is also a constraint that is growing. It was barely talked about in 2021, but there are opportunities there too, if we combine it with storage and things like that, for example, does make the business case a bit more difficult. But that's really not the only and, maybe not the biggest constraint. We certainly shouldn't hide behind that." ~ Interview 2

"We are now dealing with that grid congestion, which is a blessing in disguise though." ~ Interview 8

The geographical characteristics and location of the region do also make things more difficult sometimes.

"Look a statement I heard recently from one of a director: we don't do anything at all on our own renewable generation. We will wait until the power comes from the North Sea. Yes not noticing network congestion. And that if we want power from the North Sea we have to go through multiple other regions first. Well, then the power will run out long before you get to this region." ~ Interview 17

Specifically difficult in RES B, is the fact that driving factors do not seem to be present, and as such act as barriers in the implementation phase. Interview candidates do highlight things that would help if it would be present. This often relates to increasing the sense of urgency for renewable energy, as these will increase commitment of stakeholders, create political priority and spur action.

"That urgency, it has to come to light somehow. And this is not only among citizens, but certainly also among administrators. How urgent is it? And in that respect, it may not even be so wrong that this network congestion exists at the moment. But it is still just not busy enough, more pressure is needed. To make sure that is actually translated into actions. We are now all looking at the grid operators to strengthen the pipelines? Yes but it might be much better to think about doing the generation in your neighbourhood, because then you don't have to lay down that pipeline, you don't have to wait for that? And also that the realisation comes, that it's not all that easy anymore is it? So that you really have to come up with something together." ~ Interview 17

Also the lack of cooperation is seen as a barrier.

"In RES B, the energy transition never got off the ground. That has everything to do, I think, with administrative cooperation not getting off the ground"

6.3.3 Categorisation of challenges and driving factors

The challenges experienced by the regions are categorised into different types of challenges, to understand what types of challenges are dominant in both regions and how this relates to the use of transition scenarios.

First, a differentiation can be made into challenges that relate to complexity and challenges that relate to uncertainty. Complexity in (construction) projects is defined by Baccarini (1996) and includes the presence of differentiation and interdependency in aspects related to the project. In other words, the more dimensions a project entails, the more complex it is. Uncertainty, in a broad sense, can be defined as *limited knowledge* about future, past, or current events (Walker et al. 2013).

A distinction can also be made between challenges that relate to external factors and challenges that relate to internal factors. External factors concern instances that often happen outside of the region and are such not directly influenced by regional actors. Internal factors concern things that happen within the region, and are as such a result of actions from regional actors.

When interview participants were asked about driving factors in the implementation or what would be needed to give the implementation a boost, they often refer to stakeholder related aspects such as good cooperation between stakeholders and commitment or support from stakeholders. Therefore, the related driving factors are categorised into cooperation and commitment.

This section will explain the different types of challenges and driving factors.

Uncertainty related challenges

Uncertainty related challenges are often related to external factors, most dominantly consisting of political or financial aspects. This category for example includes the changing political climate, at the national, provincial and local scale. After the establishment of the RES 1.0, different elections took place, such as municipal council elections in 2022 and the national elections in

2023. Especially when relative ‘green’ political congregations were replaced by more conservative parties, challenges arose.

As a result, new policies were also established by these new congregations such as stricter regulations for solar PV projects on agricultural land. In addition, renewable projects need to be approved through a permit procedure, in which a municipal or provincial council also has the ability to object or approve specific projects.

Furthermore, many financial factors that influence the business case and thus the financial feasibility of renewable energy projects changed over time. Amongst them is the changing price of electricity. Furthermore, the feasibility of projects still strongly depends on existing structures that boost renewable energy projects such as subsidy schemes of which the conditions are also changing throughout the years.

Uncertainty challenges related to internal factors however also occur. This includes for example the uncertainty about changes in members of the RES team, or the uncertainty that still exists about the developments that will effectuate in the search areas appointed in the RES.

“And what I just said within the RES, it is still very diffuse and a lot of uncertainty about the developments of a search area that they have coloured in. And two, well, outside the RES different things are happening than are included in the RES. So that's a complex one for us to run your investment programmes on that” ~ Interview 13

Complexity related challenges

Complexity challenges often relate to the complexity of implementing renewable energy projects. In the context of RES, the implementation of renewable energy projects is complex due to characteristics of a location, contradictory interests, increasing differentiation of projects and interdependencies between stakeholders. Complexity can for example increase due to inability to get grid connection, which requires extra elements and often more stakeholders to be involved in a project. This is illustrated in the following quote:

“*So the moment you want to connect smart, you often need, for example, a battery. So then the RES or the customer, looks at the grid operator to fix that, because “you guys don't have the grid in order”. But we can't do that, because we are not allowed to invest in batteries. So a customer will have to do that himself, or the project developer. So with that comes an extra complexity in the process, because it is not just solar panels anymore.”* ~ Interview 13

An example of internal complexity is the interdependencies between different involved stakeholders in the region, such as the interdependency between a developer and the municipality . Internal complexity challenges also include the need to integrate different spatial regimes, adding aspects to consider as well as a need to include even more different stakeholders. An external complexity in contrast is the dependence on higher tiers of government.

Driving factors

Interview participants refer to cooperation and state it helps because it is easier to share information, make agreements and find solutions for issues together. In this category interview participants for example refer to the cooperation between similar organisations (intermunicipal cooperation, collective organisations for energy cooperatives, etc.) as well as the cooperation between different organisations (collaboration between a municipality and a developer). The driving factor of cooperation is illustrated by these two interview quotes:

"And that cooperation is crucial. In seeking solutions of both the administrative, procedural problems, but it's also a bit interpersonal, the moment we work together then you get the effect that you actually want to move forward." ~ Interview 17

In addition, the category of commitment relates to the support and priority of different stakeholders for the implementation of renewable energy projects. Under this category for example falls political priority and the support for projects by local inhabitants. To ensure commitment, stakeholders have to believe in the goals of the RES, as such they must be aware of it as well as feel that it is important. Commitment is therefore strongly related to the sense of urgency for the regional energy transition as well as their understanding of the benefits of it. When stakeholders are committed to the RES it can help the implementation because it spurs action. Commitment also ensures stakeholders are willing to overcome obstacles and allocate the required resources to do so. The driving factor commitment is illustrated by the following three interview quotes:

"You have administrative and political urgency. If that's not there, you're really not going to accelerate." ~ Interview 11

"We also have good contact with a regional energy cooperative. They are always looking for rooftops that they can move forward with. And yes, even now with grid congestion, they are still looking for roofs where they can do something anyway." ~ Interview 10

"Everything starts with awareness first. It started the climate agreement too. We all have to realise that steps have to be taken because we are messing up the world." Interview 16

6.3.4 Comparative analysis

From the analysis of the implementation phase of the regional energy strategies in both regions, it is clear that both regions have difficulty to realise their established ambitions. This verifies that the problem statement (see §1.3) is indeed present in both cases.

When comparing the challenges that are mentioned by interview participants in both cases, it becomes evident that there are challenges that apply to both regions as well as challenges that are case specific. Figure 12 and 13 show the distribution of the identified challenge categories in both cases.

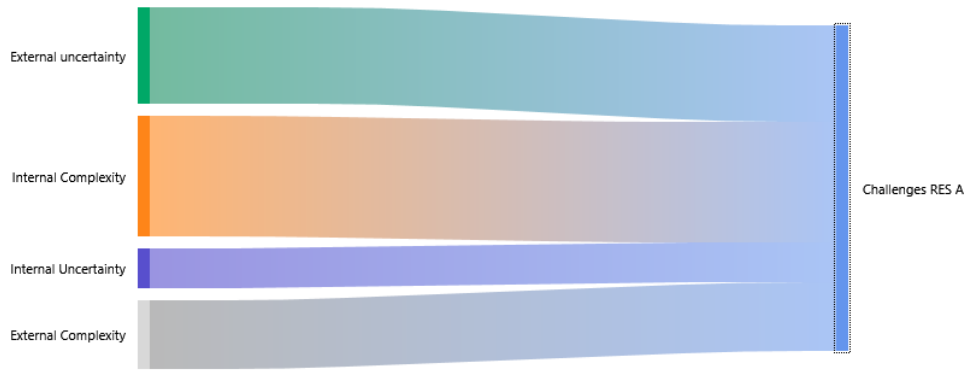

Figure 6.3: Distribution challenges RES A

In RES A, challenges related to complexities are most often mentioned, such as the increased complexity of projects due to grid congestion as well as the difficulty with the integration of

different spatial regimes in the densely populated area. The changing external conditions such as the changing electricity prices and the uncertainty about when and what new regulations will go into effect are part of the main challenges in RES A. In RES A, the good regional collaboration nevertheless helps in the implementation as stakeholders are committed to the energy transition ambitions and able to bundle their strengths to overcome challenges.

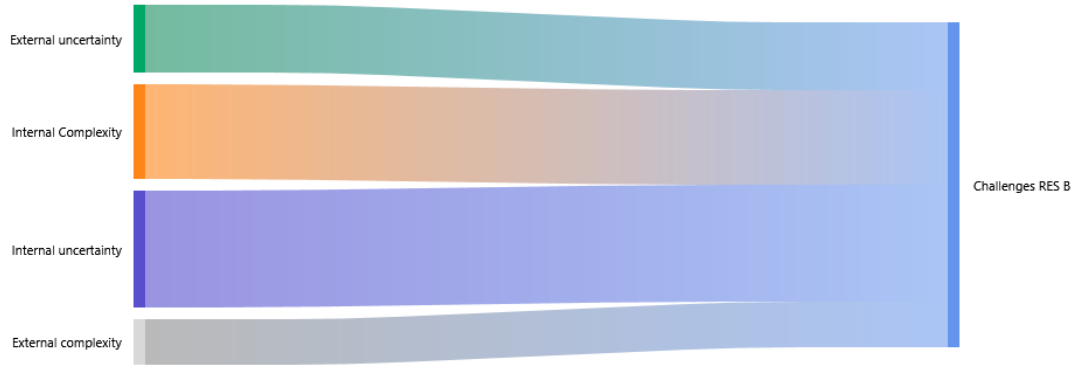

Figure 6.4: Distribution challenges RES B

In RES B, interview participants most often referred to challenges related to internal factors, such as the cooperation between different governments as well as the difficulty with capacity management. Contrastingly to RES A, internal uncertainty makes up a big part of the challenges mention in RES A. This is related to the high number of turnovers creating a loss of knowledge as well as the fragmentation and inconsistency in political priorities and ambitions, making it unclear what the desired future looks like. For RES B, the lack of commitment and cooperation in the region furthermore creates an additional challenge as forces are not combined to tackle difficulties.

As becomes evident from figure 12 and 13, both regions struggle with the changing conditions, especially in the political climate. Changes in the national government impact both regions and creates uncertainty about existing policies for renewable energy production such as subsidy schemes and spatial requirements. The recent introduction of tighter regulations for solar PV projects on agricultural land is for example mentioned by many interview participants as a development they did not see coming which impacts their ability to implement the previously made plans. This also illustrates the difficulty of regional energy planning as dependencies on higher tiers of government exist. Both regions thus struggle with the external uncertainties and the external complexities.

Although the regional contexts are very different, for both regions the implementation of renewable energy projects is highly complex due to spatial characteristics of the region that inflict a number of restrictive spatial regimes for developments, where RES A struggles with its urbanised areas, RES B deals with valuable natural landscapes. Both regions thus also struggle with internal complexity.

Interestingly, grid congestion is mentioned as both a challenge as well as a driving factor. On the one hand, it creates an urgency to act now as capacity in the future is uncertain. At the same time, the presence of grid congestion gives the idea that nothing more is possible.

The implementation of regional energy strategies is thus challenging in both cases due to internal and external uncertainties and complexities. Different actions also need to be taken by different stakeholders in order to move forward, making commitment and cooperation crucial driving factors to overcome the challenging conditions in this implementation phase.

The next chapter will discuss the findings in light of the existing literature.

7 DISCUSSION

In this chapter, the presented results are discussed in light of the research objective and existing literature. First, the results are interpreted in order to relate the findings to the existing literature on (regional) energy transition management and the use of scenarios for steering the energy transition (§7.1). In addition, the theoretical and practical implications of the study results are discussed (§7.2), followed by a discussion of the limitations of the research approach and results (§7.3). The chapter finalises with recommendations for further research (§7.4).

7.1 INTERPRETATION OF RESULTS

The aim of this study was to gain a better understanding of how transition scenarios have been used in regional energy strategies and how this contributes to the implementation of these strategies. The findings about the practical application of transition scenarios in the context of regional energy strategies will be discussed in light of the existing literature in this section.

In response to the lack of attention to the regional scale in the existing body of literature, both in transition literature as well as in scenario studies, this research has made a start in grasping the most important aspects for regional applications of transition scenarios. This research has made a start in operationalising important concepts that will enable regional practitioners to utilise the added values from this heuristic tool for foresight. These concepts include the scope of the approach (time and scale) which informs required procedural and result functions of the scenarios and in turn informs the required form and focus. In that sense, this research also adheres to Hirt et al. (2020), who state that a practical component is lacking in the existing body of knowledge on transition scenarios.

In response to Guivarch et al. (2017), who make a start in defining which scenario techniques are aimed at dealing with complexities and which ones are better equipped to deal with uncertainties, this research proposes a broad categorisation for all types of approaches. The categorisation proposes that exploratory approaches, which highlight the pluralistic nature of the future, are meant for dealing with uncertainty whereas normative approaches, which highlight actors potential to shape the future, are meant for dealing with complexities.

When comparing the findings about the practical application of transition scenarios from the case study, with those applied in recent publications of transition scenario approaches (i.e. Pregger et al., 2020; Kopfmüller et al., 2021; Marchau et al., 2018; Li et al., 2015), it becomes evident that the approaches applied in practice are less elaborate than the approaches considered by scholars. This discrepancy can be explained by the fact that the applications studied in this research consider a regional scale, in contrast to the popular national or global scales considered by scholars. At a regional scale, involved actors such as regional policy officials, councilmen and inhabitants are often not scenario experts and their knowledge on transition processes (especially at the start of a regional transition process) is often limited, imposing difficulties for the application of transition scenarios. This underlines the previous findings of Waisman et al. (2019) who highlight that in order for long-term decarbonisation strategies to succeed, they “need to be well-understood and widely accepted by a majority of key stakeholders, including those involved in implementing the plans and those impacted by the changes.” In addition, the resources and capacity available for the RES project are limited, making very elaborate approaches inappropriate at the regional scale. Both cases therefore make use of external advisors to guide them, although this imposes the risk of knowledge loss after contracts end, endorsing findings by Carvajal (2022) who state a right balance of insourcing and outsourcing scenario development capacity is needed to ensure institutional ownership of the

results. The difficulty in RES B with different scenario approaches in different subregions resulting in different results also underline Naegler et al. (2021)'s demand for transparency in scenario procedures.

For regional approaches, the basic functions of broadening and narrowing our thoughts about future developments are thus essential. The importance of the openness of the future exploration in transition management as highlighted Sondeijker et al. (2006) becomes evident from the differences in the extent of the exploration between the cases. Where RES A highlighted the pluralistic nature of the future and as such stimulated creative and controversial thinking amongst involved stakeholders, leading to fruitful discussions, RES B wasn't able to benefit as much due to the limited future states involved. The analysis also aligns with the ideas of Berkhout et al. (2002) and Wiek et al. (2006), emphasizing the added value of transition scenarios in their function as vehicles for generating and integrating knowledge, serving as vehicles for collective thoughts about the future. Söderolm (2011) stressed the need for scenarios to inform current decisionmakers, which also becomes evident in this research as they can help to substantiate trade-offs in the political arena. However for the implementation of transition strategies, transition scenarios should not only inform current decisionmakers but also activate those who are responsible for the implementation of those decisions. As such, the findings are also in line with Berkhout et al., 2002; Höfer & Madlener, 2020; Söderolm, 2020; Höfer et al., 2019; Mcgookin et al. 2021, who emphasise stakeholder engagement as an important factor when using transition scenarios. This research adds to this by operationalising the concept of stakeholder engagement in the process of developing and evaluating regional energy transition scenarios; highlighting the relevance of participant composition, participant engagement strategies and participant input. To sum up, the procedural functions of transition scenarios are thus of great importance in the regional context, in RES A, they were even valued higher by practitioners than the result functions.

Besides the scale of application, it is also relevant to consider the time of application. From the literature review, it became evident that recent publications on transition management focus on the approaching acceleration phase and the new challenges it presents. At the start of the RES trajectory, energy policy was a whole new policy field at the regional scale in the Netherlands, signalling that the governance of the energy transition at the regional scale was still in its early stages. This can be explained by the historically nationally oriented organisation of the Dutch energy system and the technical nature of the electricity grid which was constructed for large-scale production at locations far away from populated areas. This energy system is the result of a previous energy transition that took place from the early till the late 1900's as outlined by Loorbach et al. (2008) where the development of a large-scale oriented energy system was driven by the introduction of coal and natural gas which favoured economies of scale. The introduction of regional renewable energy production in the Netherlands thus requires a dual transition process, from fossil resources to renewable resources as well as from a central towards a decentral energy system. Other publications, that consider regional cases in other countries such as Lutz, Lang et al. (2017) in Germany, might therefore also encounter different challenges and drivers since the German energy system historically developed in decentralised nodes and is often structured locally and regionally.

Currently however, the challenges identified in the implementation phase of regional energy strategies in the two cases share similarities with the acceleration phase challenges as identified by Markard (2018). Interview participants in both cases highlighted the increased complexity due to the interaction between different scales as national policies do not always align with the ambitions of regional energy strategies. Furthermore the interaction with other sectors was

mostly noticed in RES B where renewable energy projects battle for space and governmental capacity with objectives from other sectors. In the implementation of renewable energy in the regions, social acceptance by consumers also appears to be of great importance, as resistance from local inhabitants often blocks the realisation of renewable energy projects. The found difficulty with the changing political climate in both cases and the difficulty to make well informed political choices in RES B is also in line with the findings of Meadowcroft (2009), who highlights the difficulty of steering transition processes due to the required enumeration of political choices in the same direction in a political arena of competing interests and ideologies, power plays and persuasion. The challenges identified in the implementation of regional energy strategies, are also in line with the RET challenges found by Hoppe & Miedema (2020), especially the lack of political priority for energy transition at the regional scale as found in RES B, and the dependence on actions and sport from higher tiers of government is prevalent.

Contradictory to Markard (2018), no challenges were identified regarding the decline of existing (non-renewable) industries due to the competition with renewables. This most likely can be linked to the fact that REP on a regional scale is still unable to compete with fossil alternatives due to economies of scale, the integration with the current system (grid stability) and existing legal and financial frameworks that favour large scale energy production. Developers of regional renewable energy projects for example highlight the necessity of subsidy schemes to ensure financing for the project. These challenges highlight the difficulty of moving from the take-off towards the acceleration phase and the presence of discrepancies between stages of transition at different scales and locations. When onsetting a transition process by means of regional energy strategies, it is thus important to consider the initial conditions and adept the application of transition scenarios in order to develop strategies accordingly.

7.2 IMPLICATIONS OF THE RESEARCH

Theoretical implications of this research include the need for careful consideration of the scope of application when considering the use of transition scenarios as national approaches do not fit the requirements for regional applications. This research has made a start in defining conditions that determine the required procedural and result functions of transition scenarios, but more detailed conditions can be established. Furthermore, this research implies an increased focus on the practical application of transition scenarios, where scholars should spent their attention less on making better techniques for foresight and more on considering how practitioners can make the best use of foresight studies. And finally, this research highlights the importance of the basic functions of scenarios to focus and stretch our thinking about the future. This value of scenarios is even greater when scenarios visualise the possible future and its impacts. A shift away from extensive data-driven scenario techniques is therefore suggested. Scholarly attention should in turn be given to the integration of visual elements in general, and spatial elements such as maps in particular, into transition scenarios.

Practical implications for the use of transition scenarios for onsetting regional energy transitions include careful consideration of how to include different stakeholders in the formation and evaluation of the transition scenarios. When including local population in transition scenario development it is important to think about people with diverging perspectives as well as different backgrounds in general. This can be done by considering the engagement strategy, including the setup of the input session (time and location) or by deliberately selecting and inviting groups with different perspectives, making sure that both proponents and opponents are included. Here, the work of Höfer and Madlener (2020) who identify different opinion groups of stakeholders could be used to identify stakeholder groups with similar interests. It is important though to consider what input is asked from different stakeholders, as not all stakeholders are able to discuss the future

at the same abstraction level. Finally, when applying transition scenarios, the evaluation of scenario options should have an increased focus on practical feasibility in order to create realistic strategies. This could be achieved by giving a more explicit role in the process of developing and deciding on transition scenarios to actuating stakeholders as they are often more aware of practical constraints.

7.3 LIMITATIONS OF THE RESEARCH

The limitations of this research will be discussed by considering the applied research design, data collection and analysis and the generalisability of the results.

First, the research design is considered. As the research relies on the comparison of approaches in two regions that are very different from each other, it is difficult to verify whether the found instants are actually related to the application of transitions scenarios or could also be explained by differences in factors that were not considered in this research. This research has attempted to mitigate this by including an integral analysis of the process of the development of regional energy strategies. Furthermore, this research focuses on the added value of transition scenarios in the gap between strategy development and implementation in regional energy strategies, however this automatically excludes other concepts that could potentially also fill this gap. The research findings for example show the importance of stakeholder cooperation and commitment in the implementation of regional energy strategies, other ways to stimulate this could be explored to improve the implementation of strategies. This could for example be done by looking into the governance structure of RES, stakeholder management strategies or potentially even cooperation agreements such as public-private partnerships to smooth out the interdependencies between developers and governments in the realisation of regional renewable energy projects.

Furthermore, the mode of data collection should be considered. The main data source of this research consists of insights from the 19 interviewed participants. When looking critically at the selected participants, it reveals that the majority of them are policy officials and members of the RES program team, who are mostly involved at strategic or tactical levels and have a slighter role in the current implementation phase. This makes it difficult to draw clear conclusions on how transition scenarios can be used in the implementation phase as not many “implementers” were interviewed. Furthermore, due to the limited time available for the project, the documents and the conduction of interviews took please simultaneously. The data collection could have been more focused if document analysis had taken place prior to setting up the interviews, as this would have allowed the researcher to ask more targeted questions. In addition, data collection on previous events was difficult in RES B as many actors that were involved in the strategy development are no longer involved with RES. Finally, by including the difficulty in the implementation of regional energy strategies in the problem definition and sharing this with the interview participants, the focus when asking how the implementation is going was automatically more on the challenges rather than the driving factors. Careful consideration of the information shared with interview participants prior to the conduction of the interview .

For the generalisability of the findings, it is important to consider the fact that both cases are in the Netherlands. As stated in the first section of this chapter, requirements for transition scenarios are different for different scales, locations and times. Different regions thus also present different regional conditions such as natural and socio-economic contexts. A region in China for example operates very differently than in the Netherlands. The size of a region for example could limit the ability to physically involve stakeholders in the process.

Finally, this research uses a categorisation of uncertainty versus complexity to inform the choice for an exploratory or normative transition scenario approach. This categorisation, although practically helpful, is rather limited. The degree and type of uncertainty for example is not accounted for, whereas Marchau et al. (2018) already recognise five levels of uncertainty in decision-making ranging from determinism to total ignorance depending on the available knowledge about the context, the system of interest, the system outcomes and the valuation of the future outcomes by stakeholders. In scenario planning, the length of the term considered could for example be an indicator of the level of uncertainty, the longer the term of planning, the higher the degree of uncertainty. By adding a categorisation of the level of uncertainty, one can inform the choice of choosing to focus on either uncertainty or complexity based approaches. Or alternatively the degree of uncertainty can inform how elaborate the approach must be in order to deal with the present uncertainty. A similar notion can be made about the axis of complexity, where similarly the type and degree of complexity are relevant to consider. Baccarini (1987) stresses the need for specifying the origin of the complexity and proposes a categorisation into technical and organisational complexity. The categorisation of the type of complexity can in turn inform the ratio between social and technical in sociotechnical transition scenarios. Additionally, the degree of complexity can be discovered by looking at the scope of the transition scenarios. Regional conditions such as high urban density indicate higher complexities for integrating renewable energy. Scholars are also not in agreement about what determines complexity, as Williams (1991) for example also states that project complexity is partly determined by the present uncertainty.

7.4 Recommendations for Future Research

First, this research has made a start in operationalising and linking relevant concepts in the practical application of transition scenarios for the regional context. The scope of application however is also found to be of great importance. Considering different scopes such as local levels or even organisations could therefore be an interesting topic for future research.

In addition, by building on the framework of stakeholder engagement in transition scenario development established in this research, further research should consider specific engagement requirements for the different stakeholder types, giving specific attention to the level of knowledge and the level of abstraction (strategic/tactical/operational) of different actors. This will provide practical lessons on when to involve what stakeholders and what to ask of these stakeholders when developing transition scenarios.

Furthermore, this research has shown that the implementation of regional energy strategies is challenging as stakeholders come up with the strategies in a collaborative process, but the implementation processes happen within organisations themselves and by using each stakeholders own instruments. Implementation of regional energy strategies could therefore benefit from the design for a collaborative process for the implementation of renewable energy projects. This process design should provide a step by step approach for the planning of renewable energy projects on a regional scale, starting with a potential location and finishing with a concrete project plan. An initial examination of the relative agency of involved actors in the realisation of renewable energy projects is included in this research by showing the different actions that need to be taken by different actors. A more detailed analysis on the interests, agency and interdependencies of different actors could provide insights for the process requirements.

Furthermore, more knowledge about the development and implementation of strategies in governmental steering of transitions could be useful as this new and innovative way of working

strongly differs from traditional process of policy making. The analysis of regional energy strategies shows that the process of creating and implementing a regional energy strategy is difficult in combination with existing policy frameworks and political cycles in governmental organisations. Specific attention should thus be given to the political dimension during strategy development, the impact of the short-term political cycle (re-elections) on the implementation of long-term energy strategies and the integration with other (transitioning) sectors such as the built environment and mobility. Lessons could also be derived by looking at 'traditional' strategic management approaches prevalent in business settings.

Finally, this research shows that when considering options for renewable energy projects at a regional scale, the spatial implications are of great importance. Future(s) research should thus consider how spatial elements such as maps can best be integrated with existing scenario techniques.

8 CONCLUSIONS & RECOMMENDATIONS

In the Netherlands, the government rolled out the national program regional energy strategies to operationalise the national energy transition goals as part of the climate agreement. In 2021, the program got off to a promising start as each of the 30 energy regions established their strategies. However, as the program is shifting from strategic direction towards the implementation, regions are struggling with the implementation of their strategies.

In literature, the of use scenarios to formulate strategies aimed at initiating energy transitions is well regarded. However, little attention is given to the relation between the use of scenarios for strategy development and the implementation of those strategies. In addition, most scholars consider transition scenarios for unprecedented scales, neglecting the regional perspective even though this scale is very relevant for the implementation of energy transition ambitions. Finally, many different transition scenario approaches exist but little is known about best practices for different contexts.

Therefore, the objective of this research is to formulate recommendations for the use of transition scenarios in regional energy strategies in such a way that they contribute to the implementation of those strategies. This objective is reflected in the main research question:

How can transition scenarios contribute to the implementation of regional energy strategies in the Netherlands?

This question is answered by applying a multiple case study approach, considering two Regional Energy Strategy (RES) regions in the Netherlands; RES A and RES B. In both cases, the practical application of transition scenarios in the development of their regional energy strategy is evaluated and current challenges and success factors in the implementation of the regional energy strategies are identified. The practical application of transition scenarios is mapped against the existing literature on the use of scenarios in the energy transition, then compared to point out dysfunctionalities and opportunities on the use of transition scenarios within the regional energy transition. In addition, the identified challenges and driving factors in the implementation phase present important topics to consider when using transition scenarios. As such, the research combines both inductive and deductive elements.

In order to analyse the practical application of transition scenarios in both cases, a framework of analysis is established from the findings in the literature review. This framework operationalises the most important concepts related to the application of transition scenarios; the scope & goal of the approach, the result functions and the procedural functions of the approach. To understand the different result functions for different types of transition scenarios, a possibility space is developed. This visualisation distinguishes between exploratory and normative approaches as well as approaches with an internal or external focus. Figure X shows the possibility space, for an elaboration of the different transition scenario types and their characteristics, please refer to chapter 4.

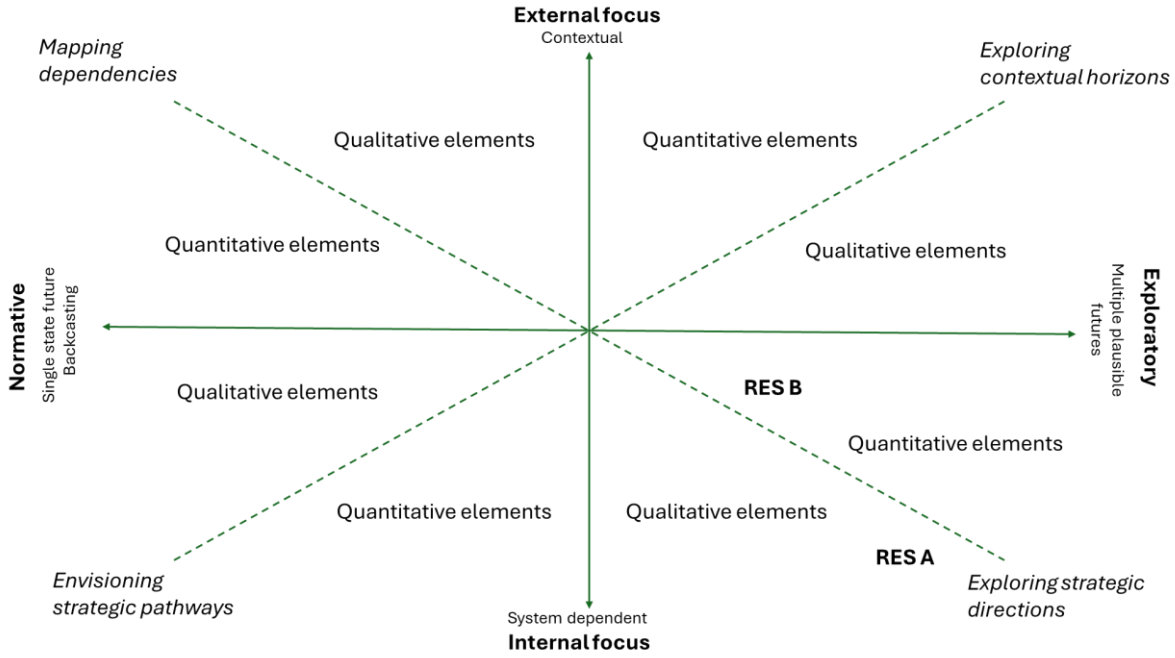

Figure 8.1: Possibility space of result functions of transition scenarios with positioning of RES A and RES B (Own illustration)

The analysis of the practical application of transition scenarios in both cases shows that currently used applications of transition scenarios for regional energy strategies have the most commonalities with the quadrant of exploring strategic directions. The application in RES A had a more explorative nature as multiple different strategic directions based on leading principles were explored, highlighting the pluralistic nature of the future. The application in RES B in contrast was limited to only a couple of transition scenarios, only illustrating the minimum and maximum of the possibilities for renewable energy production in the region. Procedural functions of transition scenarios are determined by the stakeholders that are engaged in the process, this is operationalised in the consideration of participant composition, participant engagement strategy and participation input.

To discuss the contribution of transition scenarios in the implementation of regional energy strategies, the two guiding questions as proposed in the research approach (§1.6) will be used.

*How **have** transition scenarios contributed to the implementation of regional energy strategies in the Netherlands?*

From the analysis of the two RES cases, it becomes evident that in RES A, transition scenarios have contributed to the implementation of regional energy strategies mostly through the procedural functions. By applying a participative approach, awareness on the subject of energy transition is raised amongst the involved stakeholders. This has increased the commitment of the involved stakeholders, as well as their knowledge level on energy transition and potentially their sense of urgency of the topic. The transition scenarios furthermore served as a vehicle to integrate the knowledge and perceptions about the energy system in the region. And by using an engagement strategy where different stakeholders are able to interact with each other, scenario development enables mutual learning and networking. As such, applying a participative approach in the development of transition scenarios has contributed to the cooperation and commitment in the region, both of which are identified as driving factors for implementing regional energy strategies.

The resulting scenarios in turn helped in the communication with elements such as the narrative descriptions of the future and the maps showing the spatial impact. The result functions of the used transition scenarios therefore mostly include the ability of transition scenarios to stimulate conversation about the different options and providing insight into the impact of different choices by including impact assessments on important regional aspects such as the potential renewable energy production and the impacts on important values for the region such as economy, preservation of the landscape or independence. This has aided in decision making and especially supported the justification of certain decisions. This is beneficial as the implementation of regional energy strategies requires different actors to decide to go through with a renewable energy project over a long period of time. In political arenas of competing interests, this can be especially valuable.

In RES B, less benefits of the application of transition scenarios were experienced as the exploration was limited. Therefore, creative and controversial thinking was not stimulated amongst involved stakeholders. The region had a relatively closed of approach where mostly authorities and advisors were involved, limiting the input of knowledge from practitioners in the region, resulting in little consideration of the practical feasibility of options. In addition, the stakeholder involvement didn't facilitate interaction between different stakeholder groups, missing opportunities for the creation of regional connections and cooperation. Furthermore, the development was approached differently in different subregions, resulting in fragmented results and difficulty with the integration at a regional level.

Thus, in order to get the most benefits out of the results of scenarios, the organisation of the process is of great importance. In case the process is not structured, difficulties similar to those in RES B can arise, where the fragmented approach resulted in integration problems, which in turn lead to discussion and the results not being embraced by a majority of the stakeholders. Important aspects in the process are following a clear procedure, specifying the goal of different parts of the analysis, jointly determining assumptions and thinking about the integration of results in advance.

Finally, remarkable in the practical application of transition scenarios in both cases is the spatial implementation of scenarios using maps to illustrate spatial impacts of different scenarios in the region. The colouring of locations for REP on maps also stimulates integral decision-making as it allows for making spatial trade-offs. For the implementation of renewable energy on a regional scale in the Netherlands, geographical considerations are very important as the space available as well as the characteristics of the landscape strongly determine the possibilities for renewable energy production. In the Netherlands specifically, space has always been important, as the country is densely populated and developments require the integration of many different spatial regimes.

It thus becomes evident that the procedural functions of transition scenarios are very valuable and can be a very valuable tool for managing stakeholders in transition processes, as the process of scenario development can stimulate commitment and cooperation in the region. The result functions can furthermore contribute to making trade-offs and aligning the ideas about the desired future directions (tackling internal uncertainty). Finally, transition scenarios should provide insight in relation to other goals in order to improve their benefit in political decision-making, this can for example be done by making integral spatial scenarios.

*How **can** transition scenarios contribute to the implementation of regional energy strategies in the Netherlands?*

In the current application of transition scenarios the regions did not use the full spectrum of the different types of transition scenarios of the possibility space established in this research. As such possible benefits of normative approaches using backcasting to discover realisation strategies and externally driven approaches to identify sensitivities to changes in external contexts are unexploited in current applications.

From the analysis of the implementation of the regional energy strategies it however becomes evident that the challenges experienced in the regions are related to uncertainties and complexities, both internal and external.

In order to deal with the internal and external complexities, strategy development would benefit by applying a normative approach to transition scenarios, as this will provide more insight into the steps that need to be taken to realise a strategy. This is also in line with Hirt et al. (2020) who state that "in order to practically enact a transition, research should integrate the idea that the path that leads to a target must be thought out in such a way as to be practicable". By putting more emphasis on the actions that need to be taken to realise a transition target, the actors involved with the creation of regional energy strategies will also become more aware of their own agency to implement the strategy. As such the scenario exploration helps to identify possible stakeholder dependencies in the implementation phase. By identifying dependencies early on, strategic options that are less dependent on other actors can be chosen or ways to engage the crucial stakeholders can be explored. This in turn will help to deal with the complexity present in the regional energy transition, which is one of the main challenges in the implementation of regional energy strategies. The path that leads to a target must be thought out in such a way that viable, action-oriented strategies result from it.

In addition, the current applications of transition scenarios had an internal focus, even though the analysis of the implementation shows that the changes in external factors are challenging the implementation of regional energy strategies. Although some of these challenges are inherent to the context and cannot be influenced by those involved in RES, their explicit consideration can help to come up with strategies to deal with them. By including an exploration of contextual factors in the transition scenarios and linking the impact of these changes to the feasibility of strategic options, sensitivities of the strategy options are made explicit. This can help in choosing strategy options that are less sensitive to changes in external factors or come up with strategies to deal with the different contexts. This will increase the robustness of regional energy strategies. Regional energy strategies could for example also make use of the work of Haasnoot et al. (2019) to come up with adaptive pathways that anticipate change and adjust the strategy accordingly.

However, different contexts require different functions of transition scenarios. In future applications of transition scenarios it is thus important to consider the scope of application as this can inform the result and procedural functions required, which in turn can help to decide what form and focus of transition scenarios should be used and how to organise the procedures. The scope is defined by the time and place of the application and the time and place considered in the transition scenarios. The time and place of application can inform the procedural functions such as who needs to be involved and why. At the start of a regional transition process for example, instances such as awareness creation, long-term goal setting, knowledge generation and integration and stimulating interaction to allow network building are of great importance to kickstart the transition. This requires stakeholders who can think at a high abstraction level and

have a long-term focus. At a later stage nevertheless, more practical knowledge is required to be able to make trade-offs between different ambitions of different sectors and ensure system level integration. This requires the engagement of stakeholders who have more “workfloor” knowledge and give insights about the practical feasibility of options as this will ensure the developed strategies are in line with the operational reality. This will also inform strategic agents about challenges in the implementation of previous strategies. In addition, the scope of application can provide valuable information about the

For the required result functions, the scope of the transition scenarios themselves is of importance as this will inform the relative importance of uncertainties or complexities and the need for an internal or external focus. When considering a long term perspective, higher degrees of uncertainties often prevail, making explorative approaches more appropriate. For shorter terms, identifying pathways and extracting actionable strategies to tackle complexities makes normative approaches more effective.

The focus on internal or external factors depends on the conditions in a region and the ability to operate dependently or not. In case of high dependencies on other regions or (inter)national changes such as is the case for the regions in the Netherlands, including an external focus can provide valuable insights. Regions with more autonomy on the design of their energy system by contrast, can benefit more from internal focuses.

In a general sense, a recommendation to first explore to determine desired future states and then be normative to extract actionable pathways can be made. However, the availability of time and resources for the application of transition scenarios should always be considered.

In conclusion, transition scenarios have contributed to the implementation of regional energy strategies mostly through their procedural functions, allowing engaged stakeholders to broaden as well as focus their thoughts about the future. Participative approaches furthermore allow processes of mutual learning and network building. When using transition scenarios in the regional context it is thus important to include a meaningful engagement of diverse stakeholders to stimulate regional awareness, commitment and cooperation. The practical application furthermore shows an interesting direction for scenario research in the form of spatial transition scenarios. Finally, in future applications of transition scenarios, it is important to consider the spatial and temporal scope as this will inform the requirements and design of the approach.

BIBLIOGRAPHY

1. Adler, P. A., Adler, P., & Weiss, R. S. (1995). Learning from Strangers: The Art and Method of Qualitative Interview Studies. Contemporary Sociology, 24(3), 420. https://doi.org/10.2307/2076552
2. Arnstein, S. R. (1969). A ladder of citizen participation. Journal of the American Institute of Planners, 35(4), 216–224. https://doi.org/10.1080/01944366908977225
3. Baccarini, D. (1996). The concept of project complexity—a review. International Journal of Project Management, 14(4), 201–204. https://doi.org/10.1016/0263-7863(95)00093-3
4. Berkhout, F., & Hertin, J. (2002). Foresight futures scenarios: developing and applying a participative strategic planning tool *. Greener Management International, 37–53. https://go.gale.com/ps/i.do?id=GALE%7CA99430030&v=2.1&it=r&linkaccess=abs&issn=09669671&p=AONE&sw=w
5. Berkhout, F., Hertin, J., & Jordan, A. (2002). Socio-economic futures in climate change impact assessment: using scenarios as 'learning machines.' *Global Environmental Change*, *12*(2), 83–95. https://doi.org/10.1016/s0959-3780(02)00006-7
6. Burt, G., & Van Der Heijden, K. (2008). Towards a framework to understand purpose in Futures Studies: The role of Vickers' Appreciative System. Technological Forecasting & Social Change/Technological Forecasting and Social Change, 75(8), 1109–1127. https://doi.org/10.1016/j.techfore.2008.03.003
7. Carvajal, P. E., Miketa, A., Goussous, N., & Fulcheri, P. (2022). Best practice in government use and development of Long-Term energy transition scenarios. Energies, 15(6), 2180. https://doi.org/10.3390/en15062180
8. CBS. (2024, April 29). Regionale kerncijfers; nationale rekeningen. Centraal Bureau Voor De Statistiek. https://www.cbs.nl/nl-nl/cijfers/detail/84432NED

9. Crowe, S., Cresswell, K., Robertson, A., Huby, G., Avery, A., & Sheikh, A. (2011). The case study approach. BMC Medical Research Methodology, 11(1). https://doi.org/10.1186/1471-2288-11-100
10. De Voogd, J., & Cuperus, R. (2021, December). Atlas van Afgehaakt Nederland. Rapport | Kennisbank Openbaar Bestuur. https://www.kennisopenbaarbestuur.nl/documenten/rapporten/2021/12/17/atlas-van-afgehaakt-nederland
11. de Vries, R., Vringer, K., Visser, H., & Wentink, C. (2019). Gemeentelijke bestuurskracht in de en-ergietransitie (tech. rep.). PBL. Den Haag. https://www.pbl.nl/publicaties/gemeentelijke-bestuurskracht-en-de-energietransitie
12. Dialoog over versnelling van de energietransitie in Utrecht. (2022, June 21). publicspace.nl. https://publicspace.nl/calendar/dialoog-over-versnelling-van-de-energietransitie-in-utrecht/
13. DPG Media Privacy Gate. (n.d.). https://www.nu.nl/politiek/6285846/stroomnet-zo-goed-als-vol-netbeheerders-trekken-miljarden-uit-voor-uitbreiding.html?referrer=https%3A%2F%2Fwww.google.com%2F
14. EBN. (2023, July 13). Infographic 2022 - EBN. https://www.ebn.nl/feiten-en-cijfers/kennisbank/infographic-2022/
15. Europees Milieuagentschap (EEA). (2023, March 28). Uitstoot van broeikasgassen per land en per sector (infografiek) | Onderwerpen | Europees Parlement. Europarl.nl. Retrieved April 26, 2024, from https://www.europarl.europa.eu/topics/nl/article/20180301STO98928/uitstoot-van-broeikasgassen-per-land-en-per-sector-infografiek
16. EZK. (2018, March 18). Het Akkoord. Klimaatakkoord. https://www.klimaatakkoord.nl/klimaatakkoord

17. Flyvbjerg, B. (2006). Five misunderstandings about Case-Study research. Qualitative Inquiry, 12(2), 219–245. https://doi.org/10.1177/1077800405284363
18. Flyvbjerg, B. (2001). Making social science matter. https://doi.org/10.1017/cbo9780511810503
19. Frantzeskaki, N., Hölscher, K., Holman, I. P., Pedde, S., Jaeger, J., Kok, K., & Harrison, P. A. (2019). Transition pathways to sustainability in greater than 2 °C climate futures of Europe. Regional Environmental Change, 19(3), 777–789. https://doi.org/10.1007/s10113-019-01475-x
20. Frantzeskaki, N., Hölscher, K., Wittmayer, J. M., Avelino, F., & Bach, M. (2018). Transition Management in and for Cities: Introducing a new governance approach to address urban challenges. In Future city (pp. 1–40). https://doi.org/10.1007/978-3-319-69273-9_1
21. Frantzeskaki, N., Loorbach, D., & Meadowcroft, J. (2012). Governing societal transitions to sustainability. International Journal of Sustainable Development, 15(1/2), 19. https://doi.org/10.1504/ijsd.2012.044032
22. Geels, F. W. (2002). Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. Research Policy, 31(8–9), 1257–1274. https://doi.org/10.1016/s0048-7333(02)00062-8
23. Geels, F., & Kemp, R. (2000). Transities vanuit sociotechnisch perspectief. Ministerie VROM. https://research.utwente.nl/en/publications/transities-vanuit-sociotechnisch-perspectief
24. Gemeente Zuidplas. (2024, May 2). RES Midden-Holland: vaststelling Programma Zon op Veld vertraagd. *Gemeente Zuidplas*. https://www.zuidplas.nl/res-midden-holland-vaststelling-programma-zon-op-veld-vertraagd
25. Godet, M. (1987). Scenarios and strategic management. Long Range Planning, 21(4), 143. https://doi.org/10.1016/0024-6301(88)90021-0

26. Grin, J., Rotmans, J., & Schot, J. (2010). Transitions to Sustainable Development: New directions in the study of Long term Transformative Change. http://ci.nii.ac.jp/ncid/BB02987227
27. Groenleven. (2020, May 28). Drijvend zonnepark. facebook.com. https://www.facebook.com/photo/?fbid=3948773751831777&set=a.472495609459626
28. Guivarch, C., Lempert, R., & Trutnevyte, E. (2017). Scenario techniques for energy and environmental research: An overview of recent developments to broaden the capacity to deal with complexity and uncertainty. Environmental Modelling & Software, 97, 201–210. https://doi.org/10.1016/j.envsoft.2017.07.017
29. Haasnoot, M., Warren, A., & Kwakkel, J. H. (2019). Dynamic Adaptive Policy Pathways (DAPP). In Springer eBooks (pp. 71–92). https://doi.org/10.1007/978-3-030-05252-2_4
30. Haukkala, T. (2019). *The wicked problem of a low carbon energy transition - Structure, agency and framing in the multi-actor process of solar PV deployment in Finland*. https://aaltodoc.aalto.fi/items/d1c04ea2-1a92-4486-91f6-ace82f576b89
31. Hertin, J., Lorenzoni, I., Skea, J., Berkhout, F., 1999. Review of Relevant Climate Impact and Futures Literature. SPRU, Brighton.
32. Höfer, T., & Madlener, R. (2020). A participatory stakeholder process for evaluating sustainable energy transition scenarios. Energy Policy, 139, 111277. https://doi.org/10.1016/j.enpol.2020.111277
33. Höfer, T., Ruediger, V. N., & Madlener, R. (2019). Using Value-Focused thinking and Multi-Criteria group Decision-Making to evaluate energy transition alternatives. Social Science Research Network. https://doi.org/10.2139/ssrn.3501616
34. Hoppe, T., & Miedema, M. (2020). A Governance Approach to Regional Energy Transition: Meaning, Conceptualization and practice. Sustainability, 12(3), 915. https://doi.org/10.3390/su12030915

35. Jakimowicz, A. (2022). The energy transition as a super wicked problem: The energy sector in the era of prosumer Capitalism. *Energies*, *15*(23), 9109. https://doi.org/10.3390/en15239109

36. Jongres. (2023, October 28). Ons verhaal - JOnGRES. Pageking. https://jongres.nl/over-jongres/

37. Kaygusuz, K. (2007). Energy for sustainable Development: key issues and challenges. Energy Sources. Part B, Economics, Planning, and Policy/Energy Sources. Part B, Economics, Planning and Policy, 2(1), 73–83. https://doi.org/10.1080/15567240500402560

38. Kern, F., & Howlett, M. (2009). Implementing transition management as policy reforms: a case study of the Dutch energy sector. Policy Sciences, 42(4), 391–408. https://doi.org/10.1007/s11077-009-9099-x

39. Kopfmüller, J., Weimer-Jehle, W., Naegler, T., Buchgeister, J., Bräutigam, K., & Stelzer, V. (2021). Integrative scenario assessment as a tool to support decisions in energy transition. *Energies*, *14*(6), 1580. https://doi.org/10.3390/en14061580

40. Löhr, M., & Mattes, J. (2022). Facing transition phase two: Analysing actor strategies in a stagnating acceleration phase. Technological Forecasting & Social Change/Technological Forecasting and Social Change, 174, 121221. https://doi.org/10.1016/j.techfore.2021.121221

41. Loorbach, D. (2007). Transition Management for Sustainable Development: A Prescriptive, Complexity-Based Governance Framework. Governance, 23(1), 161–183. https://doi.org/10.1111/j.1468-0491.2009.01471.x

42. Loorbach, D., & Rotmans, J. (2006). Managing transitions for sustainable development. In Kluwer Academic Publishers eBooks (pp. 187–206). https://doi.org/10.1007/1-4020-4418-6_10

43. Loorbach, D., & Rotmans, J. (2010). The practice of transition management: Examples and lessons from four distinct cases. Futures, 42(3), 237–246. https://doi.org/10.1016/j.futures.2009.11.009

44. Loorbach, D., Frantzeskaki, N., & Avelino, F. (2017). Sustainability Transitions Research: Transforming Science and Practice for Societal Change. Annual Review of Environment and Resources, 42(1), 599–626. https://doi.org/10.1146/annurev-environ-102014-021340

45. Loorbach, D., Van Der Brugge, R., & Taanman, M. (2008). Governance in the energy transition: Practice of transition management in the Netherlands. International Journal of Environmental Technology and Management, 9(2/3), 294. https://doi.org/10.1504/ijetm.2008.019039

46. Loorbach, D., Wittmayer, J. M., Shiroyama, H., Fujino, J., & Mizuguchi, S. (2016). Governance of urban sustainability transitions. In Theory and practice of urban sustainability transitions. https://doi.org/10.1007/978-4-431-55426-4

47. Lutz, L. M., Fischer, L., Newig, J., & Lang, D. J. (2017). Driving factors for the regional implementation of renewable energy - A multiple case study on the German energy transition. Energy Policy, 105, 136–147. https://doi.org/10.1016/j.enpol.2017.02.019

48. Lutz, L. M., Lang, D., & Von Wehrden, H. (2017). Facilitating Regional Energy Transition Strategies: Toward a typology of Regions. Sustainability, 9(9), 1560. https://doi.org/10.3390/su9091560

49. Malekpour, S., Walker, W. E., De Haan, F. J., Frantzeskaki, N., & Marchau, V. A. (2020). Bridging Decision Making under Deep Uncertainty (DMDU) and Transition Management (TM) to improve strategic planning for sustainable development. Environmental Science & Policy, 107, 158–167. https://doi.org/10.1016/j.envsci.2020.03.002

50. Marchau, V. a. W. J., Walker, W. E., Bloemen, P. J. T. M., & Popper, S. W. (2019). Decision Making under Deep Uncertainty. In Springer eBooks. https://doi.org/10.1007/978-3-030-05252-2

51. Markard, J., Geels, F. W., & Raven, R. (2020). Challenges in the acceleration of sustainability transitions. Environmental Research Letters, 15(8), 081001. https://doi.org/10.1088/1748-9326/ab9468

52. Markard, J. (2018). The next phase of the energy transition and its implications for research and policy. Nature Energy, 3(8), 628–633. https://doi.org/10.1038/s41560-018-0171-7

53. Matthijsen, J., Chranioti, A., Heshusius, S., Scholte, S., Van Der Kooij, P., Kool, M., & RHDHV (2023). *Monitor RES 2023. Een voortgangsanalyse van de Regionale Energie Strategieën*. PBL Planbureau voor de Leefomgeving. https://www.pbl.nl/uploads/default/downloads/pbl/2023/monitor-res-2023-een-voortgangsanalyse-van-de-regionale-energie-strategieen.pdf

54. Matthijsen, J., Chranioti, A., Sorel, N., Eerens, H., Van Der Veen, R., Nabielek, P., Evers, D., & PBL Planbureau voor de Leefomgeving. (2022). *Monitor RES 2022. Een voortgangsanalyse van de Regionale Energie Strategieën*. PBL Planbureau voor de Leefomgeving. https://www.pbl.nl/uploads/default/downloads/pbl-2022-monitor-res-2022-een-voortgangsanalyse-van-de-regionale-energie-strategieen_4985.pdf

55. Matthijsen, J., Chranioti, A., Uyterlinde, M., Tavares, J. L., Schie, M. V., Sorel, N., Eerens, H., Hoorn, A. V., & PBL Planbureau voor de Leefomgeving. (2021). *Monitor RES 1.0. Een analyse van de Regionale Energie Strategieën 1.0*. PBL Planbureau voor de Leefomgeving. https://www.pbl.nl/uploads/default/downloads/pbl-2021-monitor-res-1.0-4509.pdf

56. McGookin, C., Gallachóir, B. Ó., & Byrne, E. (2022). Systematically reviewing the use of participatory methods in energy system modelling and planning literature. MethodsX, 9, 101862. https://doi.org/10.1016/j.mex.2022.101862

57. Meadowcroft, J. (2009). What about the politics? Sustainable development, transition management, and long term energy transitions. Policy Sciences, 42(4), 323–340. https://doi.org/10.1007/s11077-009-9097-z

58. Meyerhoff, J., René Kemp, & Derk Loorbach. (2005). Dutch policies to manage the transition to sustainable energy. In Jahrbuch Okologische Okonomik (Vols. 4–4, pp. 123–151). https://repub.eur.nl/pub/7629/DRIFT-2006-002.pdf

59. Mintzberg, H. (1987). The Strategy Concept I: Five PS for Strategy. California Management Review, 30(1), 11–24. https://doi.org/10.2307/41165263

60. Morgan, D. L., & Nica, A. (2020). Iterative Thematic Inquiry: A new method for analyzing qualitative data. International Journal of Qualitative Methods, 19, 160940692095511. https://doi.org/10.1177/1609406920955118

61. Naegler, T., Sutardhio, C., Weidlich, A., & Pregger, T. (2021). Exploring long-term strategies for the german energy transition - A review of multi-Sector energy scenarios. Renewable and Sustainable Energy Transition, 1, 100010. https://doi.org/10.1016/j.rset.2021.100010

62. Netbeheer Nederland. (2023, June 6). “Geef elektriciteitsnet stikstofvrijstelling, anders valt transitie stil.” Unc Inc / Unc Inc Amsterdam - uncinc.nl. https://www.netbeheernederland.nl/artikelen/nieuws/geef-elektriciteitsnet-stikstofvrijstelling-anders-valt-transitie-stil

63. NPRES. (n.d.). *Nationaal Programma Regionale energiestrategie - Regionale energiestrategie*. Regionale Energiestrategie. Retrieved April 26, 2024, from https://regionale-energiestrategie.nl/home/default.aspx

64. Nuon. (2017, July 28). Slimme kostenbesparing van Nuon: zonnepanelen bij windmolens. RTL Nieuws & Entertainment. https://www.rtl.nl/nieuws/nederland/artikel/127636/slimme-kostenbesparing-van-nuon-zonnepanelen-bij-windmolens
65. O'Brien, F. A., & Meadows, M. (2013). Scenario orientation and use to support strategy development. *Technological Forecasting & Social Change/Technological Forecasting and Social Change*, *80*(4), 643–656. https://doi.org/10.1016/j.techfore.2012.06.006
66. PARIS AGREEMENT. (2015). In UNITED NATIONS. https://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf
67. PBL. (2023, December 7). *35 TWh-doel zon en wind op land in 2030 goed haalbaar, maar groei op langere termijn stagneert*. Planbureau Voor De Leefomgeving. Retrieved May 3, 2024, from https://www.pbl.nl/actueel/nieuws/35-twh-doel-zon-en-wind-op-land-in-2030-goed-haalbaar-maar-groei-op-langere-termijn-stagneert#:~:text=Toenemende%20vertraging%20bij%20realisatie%20zonneparken,waar%20dit%20voorheen%20nauwelijks%20gebeurde.
68. Pregger, T., Naegler, T., Weimer-Jehle, W., Prehofer, S., & Hauser, W. (2019). Moving towards socio-technical scenarios of the German energy transition—lessons learned from integrated energy scenario building. *Climatic Change*, *162*(4), 1743–1762. https://doi.org/10.1007/s10584-019-02598-0
69. Pruyt, E., Kwakkel, J., Yucel, G., & Hamarat, C. (2011). Energy Transitions towards Sustainability I: A Staged Exploration of Complexity and Deep Uncertainty. Repository TU Delft. https://repository.tudelft.nl/islandora/object/uuid%3A3091bbe8-67f7-4fa8-bef3-a826c90ba5fc
70. Raskin, P. (2002). great transition: the promise and lure of the times ahead. Policy Commons. https://cdn.sei.org/wp-content/uploads/2019/04/great-transition-2002.pdf

71. Rip A, Kemp R. (1998). Technological change. In Human Choice and Climate Change, Vol. 2, ed. S Rayner, EL Malone, pp. 327–99. Columbus, Ohio: Battelle Press
72. Rosenbloom, D. (2017). Pathways: An emerging concept for the theory and governance of low-carbon transitions. Global Environmental Change, 43, 37–50. https://doi.org/10.1016/j.gloenvcha.2016.12.011
73. Rotmans, J., Loorbach, D., Kemp, R., Dutch Research Institute for Transitions, Drift, & Erasmus University Rotterdam. (2007). Transition Management: its origin, evolution and critique. https://repub.eur.nl/pub/37240/Metis_125563.pdf
74. Rotmans, J., Kemp, R., & Van Asselt, M. (2001). More evolution than revolution: transition management in public policy. Foresight, 3(1), 15–31. https://doi.org/10.1108/14636680110803003
75. Schwab, J. L., & Diaz, N. (2023). The discursive blinkers of climate change: Energy transition as a wicked problem. *the Extractive Industries and Society/the Extractive Industries and Society*, *15*, 101319. https://doi.org/10.1016/j.exis.2023.101319
76. Smith, A., Voß, J., & Grin, J. (2010). Innovation studies and sustainability transitions: The allure of the multi-level perspective and its challenges. Research Policy, 39(4), 435–448. https://doi.org/10.1016/j.respol.2010.01.023
77. Sondeijker, S., Geurts, J. W., Rotmans, J., & Tukker, A. (2006). Imagining sustainability: the added value of transition scenarios in transition management. *Foresight*, *8*(5), 15–30. https://doi.org/10.1108/14636680610703063
78. Söderholm, P., Hildingsson, R., Johansson, B., Khan, J., & Wilhelmsson, F. (2011). Governing the transition to low-carbon futures: A critical survey of energy scenarios for 2050. Futures, 43(10), 1105–1116. https://doi.org/10.1016/j.futures.2011.07.009
79. Stewart, J. (2011). Multiple-case study methods in governance-related research. Public Management Review, 14(1), 67–82. https://doi.org/10.1080/14719037.2011.589618

80. Van Der Brugge, R., Rotmans, J., & Loorbach, D. (2005). The transition in Dutch water management. Regional Environmental Change, 5(4), 164–176. https://doi.org/10.1007/s10113-004-0086-7

81. Van Notten, P., Sleegers, A., & Van Asselt, M. (2005). The future shocks: On discontinuity and scenario development. Technological Forecasting & Social Change/Technological Forecasting and Social Change, 72(2), 175–194. https://doi.org/10.1016/j.techfore.2003.12.003

82. Voorn, B. (2021). De politieke oriëntatie van Nederlandse gemeenten, 2021. Retrieved December 5, 2024, from https://www.researchgate.net/publication/350641167_De_politieke_orientatie_van_Nederlandse_gemeenten_2021

83. Walker,W. E., Lempert, R. J., & Kwakkel, J. H. (2013). Deep uncertainty, entry. In S. I. Gass &M.C. Fu (eds.), Encyclopedia of operations research and management science (pp. 395–402, 3rd ed.). New York: Springer.

84. Weimer-Jehle, W., Vögele, S., Hauser, W., Kosow, H., Poganietz, W., & Prehofer, S. (2020). Socio-technical energy scenarios: state-of-the-art and CIB-based approaches. Climatic Change, 162(4), 1723–1741. https://doi.org/10.1007/s10584-020-02680-y

85. Werkwijze - regionale energiestrategie. (n.d.). Regionale Energiestrategie. https://www.regionale-energiestrategie.nl/werkwijze/default.aspx

86. Wiek, A., Binder, C. R., & Scholz, R. (2006). Functions of scenarios in transition processes. *Futures*, *38*(7), 740–766. https://doi.org/10.1016/j.futures.2005.12.003

87. Zainal, Z. (2007). Case study as a research method. ResearchGate. https://www.researchgate.net/publication/41822817_Case_study_as_a_research_method

APPENDICES

A. INTERVIEW MATERIALS AND PARTICIPANT LIST

This appendix contains all the materials used for the interviews. Appendix A1 contains an anonymised list of interview participants, appendix A2 contains the interview protocol and appendix A3 contains the consent form.

A.1 List of interview participants

This appendix contains an anonymised list of the interview participants. Table A.1 shows the list of participants, specifying the region they were involved in, the organisation they represent, their function in the organisation, the timeframe of their involvement in the RES region and a description of their involvement in RES.

Table A.1: Anonymised list of interview participants

Nr.	**Case**	***Organisation***	***Function***	***Timeframe involvement***	***Description involvement RES***
1	B	DSO	Associate energy transition	2021-present	Part of program team on behalf of DSO.
2	B	Intermunicipal cooperative	Subregional program manager energy transition	2019-present	Representative subregion and as such part of program team. Former project secretary and co-writer RES.
3	B	Province	Project manager RES	2023-present	Part of program team on behalf of province.
4	B	Energy Transition consultancy	Consultant	2019-2023	Different roles as external advisor; exploration future energy demand; cowriter RES, technical advisor, progress report.
5	B	Province	Policy advisor and strategist	2019-2023	Part of program team on behalf of province.
6	B	Engineering and Consultancy firm	Consultant	2019-2020	Different roles as external advisor; spatial analysis of potential REP locations, brainstorm sessions vision development subregion.
7	A	Process and project management consultancy	Consultant	2019-2020	Process manager draft RES, cocreator process approach draft RES & RES 1.0.
8	B	Regional foundation for sustainable entrepreneurship	Cofounder	2020-present	Chairman focus group and as such representative of regional business and organisations in the steering committee.
9	B	Program organisation RES	Program coordinator	2022-2024	Coordinating and facilitating role; organising regional meetings, knowledge sharing, focal point for municipalities.
10	B	Municipality	Policy officer sustainability	2020-present	Responsible for policy creation on energy transition and involved with subregional RES on behalf of municipality.

11	A*[4]	Program organisation RES	Program coordinator	2019-present	Coordinating and facilitating role; chair of program team, cocreator process approach draft RES & RES 1.0.
12	B	Independent advisor	Consultant	2023-present	External advisor offering expertise on strategy, participation and process management.
13	A*	DSO	Area manager	2019-present	Part of program team on behalf of DSO.
14	A	Municipality X	Policy officer energy transition	2019-present	Responsible for policy creation on energy transition, part of subregional RES on behalf of municipality.
15	A	Municipality Y	Policy officer energy transition	2019-present	Responsible for policy creation on energy transition, part of subregional RES on behalf of municipality.
16	A/B	NPRES	Account manager RES A & B	2022-present	Liaison between national program and RES regions.
17	B	Regional umbrella organisation for energy cooperatives	Chairman	2021-present	No official role in RES, coordination between energy cooperatives in the region.
18	A/B	Developer solar parks	Project developer	2019-present	No official role in RES. Developer solar parks throughout the Netherlands. Personally involved in a REP project in RES A.
19	A	Program organisation RES	Program coordinator	2019-present	Coordinating and facilitating role; chair of program team, organising information sessions, knowledge sharing, etc.

A.2 Interview protocol

The interview protocol can be found in this appendix. It contains a listing of areas to be covered in the interview along with, for each area, a listing of topics or questions that together will suggest lines of inquiry. Prior to the interview, respondents received a consent form which stated a brief explanation of the research and the topics that would be covered interview as well as how the collected data was processed. By signing the consent form, respondents gave permission to record an transcribe the interview. The processing of the interviews is anonymous, separate permission was requested for the use of traceable quotes.

The interview protocol is written in Dutch, as all respondents are fluent in the language. The bold statements represent the different subjects covered. Numbered questions are asked by the interviewer, whereas the topics listed below are used as guideline for the interviewer to ask for more details. Within the subject “Use of scenarios in the RES”, the interviewer first asked whether the interview participant is aware of the use of scenarios within the context of the RES. If the

[4]A* indicates the interview participant is active in the neighbouring RES region with whom RES A has intensely collaborated since the start of the RES program.

answer is yes, the interviewer will ask the specific questions about scenarios, whereas if the answer is no, the interviewer will ask further to see if perhaps an approach similar to scenarios was used, for example by asking whether different options were considered.

Interview Protocol

Algemeen

Betreft RES regio:

Respondent (Naam, organisatie, functie):

Datum interview:

Gesprekstijd (Aantal minuten):

Doel:

Uit recente monitoren van de NPRES blijkt dat veel regio's moeite hebben met het tot uitvoer brengen van de eerder gemaakte afspraken in de Regionale Energie Strategie. Dit blijkt uit een beperkte doorstroming van "ambitieprojecten" naar "pijplijnprojecten".

Mijn onderzoek gaat over wisselwerking tussen strategievorming en uitvoer binnen de RES, specifiek het gebruik van scenario's hierin. In de literatuur wordt een strategie verstaan als een plan, methode of reeks manoeuvres om een specifiek doel of resultaat te bereiken. Het uitvoeren van de strategie (het actieplan) zou dan moeten leiden tot het behalen van het gestelde doel. Scenario's worden gezien als een waardevolle tool om te komen tot een goede strategie die rekening houdt met de complexiteit en onzekerheid die aanwezig is in de energietransitie.

Transities (zoals de energietransitie) worden gevormd op verschillende niveaus, denk hierbij aan plannen/afspraken die worden gemaakt op verschillende overheidsniveaus (Europees, landelijk, regionaal, lokaal. Maar ook binnen organisaties, zoals (strategisch) management, middle management en uitvoerend personeel. Elk niveau heeft een andere focus en bijbehorende obstakels. In de transitieliteratuur worden 3 niveaus onderscheden: het strategisch, tactisch en operationeel niveau. In de context van de RES onderzoek ik eventuele contradicties tussen het strategische en operationele niveau.

Door middel van interviews met verschillende betrokken partijen bij de RES, wil ik inzicht krijgen in het proces van strategieontwikkeling, scenariogebruik binnen de RES en de vertaling van de opgestelde strategie naar uitvoer om zo inzicht te krijgen in eventuele contradicties in de strategische keuzes die gemaakt zijn en de operationele realiteit hiervan.

Opzet van het interview: De onderzoeker interviewt verschillende partijen die op hun manier betrokken zijn bij het opstellen en/of het uitvoeren van de regionale energiestrategie in de regio. Het interview zal ongeveer 60 minuten duren en bestaat uit 5 onderdelen: introductie, totstandkoming RES, scenariogebruik, vertaling naar uitvoer en afronding.

(Verstreken tijd: 5 minuten)

Introductie

Interviewer: Het interview duurt ongeveer 60 minuten. Laten we beginnen.

1. Kunt u zichzelf kort voorstellen: Naam + korte uitleg van uw huidige functie en uw professionele achtergrond mbt (regionale) energietransitie.
2. Wat is volgens u het doel van de Regionale Energie Strategie in uw regio?

(Verstreken tijd: 15 minuten)

Totstandkoming van de RES

Interviewer: De RES 1.0 is vastgesteld in 2021, ik zou graag inzicht krijgen in hoe deze strategie tot stand is gekomen.

1. Wat was de betrokkenheid van uzelf en uw organisatie in de totstandkoming van de Regionale Energie Strategie in uw regio?
    a. Concept RES (2019-2020)
    b. RES 1.0 (2020-2021)
2. Wat kunt u vertellen over het proces van de totstandkoming van de concept RES en de RES 1.0?
    a. Wie waren daarbij betrokken?
    b. Hoe kwamen keuzes tot stand?
    c. Wat ging er goed en wat ging minder? Waar lag dit aan?
3. Wat ziet u als de belangrijkste (strategische) keuzes die gemaakt zijn in de RES?
    a. Het bod
    b. Focuspunten
4. Waren er ook kansen voor de regio waar bewust niet voor gekozen is? En waarom?

(Verstreken tijd: 25 minuten)

Scenario gebruik binnen de RES

Interviewer: In de literatuur worden transitiescenario's aangewezen als waardevolle tools voor het omgaan met de onzekerheden en complexiteiten in de energietransitie. Ik ben benieuwd in hoeverre deze zijn toegepast binnen de context van de RES en hoe. Scenario's zijn een vorm van toekomstdenken en omvatten plausibele, samenhangende, intern consistente en beschrijvingen van mogelijke toekomstige toestanden.

5. In de totstandkoming van de keuzes die in de RES zijn gemaakt, is er gebruik gemaakt van scenario's?

Als respondent zegt "JA"

    a. Wat was de reden voor het doen van een scenariostudie?
        1. Welke functie/doel had het?
    b. Wanneer is de scenariostudie uitgevoerd en door wie?
        1. Opdrachtgever of initiatiefnemer
        2. Uitvoerende partij
        3. Betrokken partijen
    c. Wat voor scenario's waren dit?
        1. Exploratief: Context scenario's
        2. Normatief: Ontwikkelpaden naar 1 gewenst toekomstbeeld

d. Hoe zijn ze ontwikkelt?
    1. Kwalitatief: Stakeholder input (“narratives”)
    2. Kwantitatief: Modelstudie resultaten

e. Wat is er gedaan met de resultaten van de scenariostudie?
    1. Hoe heeft dit de keuzes die gemaakt zijn beïnvloedt?

f. Wat vond u van deze scenariostudie?
    1. Was dit nuttig ja/nee, waarom?

Als respondent zegt “NEE”

6. Zijn er verschillende varianten of opties overwogen in de totstandkoming van keuzes in de RES?
- **a.** Zo ja, welke varianten waren dit?
- **b.** Hoe zijn deze tot stand gekomen?

7. Is er in de beginperiode nagedacht over hoe de regio de energietransitie voor zich zag? Was er een bepaalde visie of gewenst toekomstbeeld?
- **a.** Is er vervolgens ook nagedacht over hoe dit bereikt zou kunnen worden?
    - **i.** Wat er precies nodig was om dit beeld te realiseren?

8. De RES is een traject waarbij er op landelijk niveau doelstellingen zijn bepaald voor 2030 en 2050, het gaat dus om een proces op de lange termijn waarbij van tevoren nog niet duidelijk is hoe alles zal gaan lopen. Hoe is in de totstandkoming van de RES omgegaan met deze onzekerheden?
- **a.** Is er bijvoorbeeld nagedacht over mogelijke contextuele veranderingen?
- **b.** Zijn hierbij verschillende toekomstwerelden verkend?
- **c.** Risico’s voor de haalbaarheid van de strategie?

9. Is er nagedacht over eventuele mogelijkheden om de strategie of keuzes aan te passen na verloop van tijd?
- **a.** Als dat zo is, waren er bepaalde voorwaarden waaraan voldaan moest worden om dit aan te passen?

(Verstreken tijd: 30-40 minuten)

Implementatie van de strategie

Interviewer: Het document RES 1.0 ligt er nu sinds 3 jaar, ik ben benieuwd hoe het nu gaat.

10. Welke rol speelt uw organisatie en uzelf in de uitvoering van de Regionale Energie Strategie in uw regio?
- **a.** Wat gaat hierin goed en wat minder, waar ligt dat aan?

11. Hoe zijn de gemaakte keuzes in de RES vertaald naar acties binnen uw eigen organisatie?
- **a.** Zijn er grote veranderingen geweest in de aanpak van de RES door de tijd heen?

12. Hoe vindt u in algemene zin dat het gaat met de uitvoer van de RES?

13. Zijn er specifieke projecten waar u over kunt vertellen die typeren hoe het gaat met de RES?

14. Waar liggen volgens u de grootste kansen en knelpunten voor de implementatie van de RES?
- **a.** Specifiek: welke van deze knelpunten zijn pas na de vaststelling van de RES aan het licht gekomen?

(Verstreken tijd: 45-50 minuten)

Afronding

Interviewer: Dan zijn we nu bij de laatste twee vragen van het interview aangekomen.

15. Kunt u samenvatten waar het gesprek over ging?
16. Is er nog iets wat u terug wilt koppelen?
   a. Iets wat niet besproken is tijdens dit interview, aanvulling.
   b. Tips voor volgende interviews.

Interviewer: Bedankt voor het interview.

A.3 Consent form

This appendix contains the informed consent form that was signed by all interview participants.

Delft University of Technology
Informed consent form

Part 1: General Information
You are being invited to participate in a research study titled *Regional Energy Transition in the Netherlands: from strategy to execution*. This study is being done by Milou de Vries supervised by Paul Chan, Martijn Leijten and Hazal Kaya from the TU Delft in collaboration with APPM Management Consultants. The researcher Milou de Vries is doing an internship at APPM Management Consultants as part of the Master Thesis project.

The purpose of this research study is to gain insight in the role of scenario planning in the gap between strategy development and operations in the Regional Energy Transition in the Netherlands. To this end, the research gathers different perspectives from people involved in the regional energy transition . These are gathered by means of an audio-recorded interview which will take approximately **60** minutes to complete. The data will be used for understanding the process of how the Regional Energy Strategy was established and the role of scenario planning in this process as well as identifying current challenges in getting from this strategy document towards execution. This data is used in a master thesis that will be publicly defended and published afterwards. I will be asking you to answer different questions on your involvement in the regional energy transition, your experience with the development of the RES, your perception of current challenges and the underlying reasons for these.

As with any online activity the risk of a breach is always possible. To the best of our ability your answers in this study will remain confidential. We will minimize any risks by rephrasing any job descriptions (for personal identification) and to store the data on a TU Delft data storage which is only accessible by the researcher and its supervisors. The personal data collected (names, email addresses and job descriptions) will not be shared with any other party and any documentation on the interview (including a transcript and conclusions) will be anonymised. After analysing the interviews, you as participant, will receive a summary and draft of what will be documented. You can check the draft, give feedback, and opt-out if this is desired. This summary will be included in the publicly available MSc thesis.

Your participation in this study is entirely voluntary and you can withdraw at any time. You are free to omit any questions. The personal data collected during this interview is stored for the duration of the research and will be deleted at the latest one month after completion of the research (approximately November 2024).

For any questions or remarks, you can contact Milou de Vries by sending an email to m.y.devries@student.tudelft.nl.

Part 2: Explicit Consent points

PLEASE TICK THE APPROPRIATE BOXES	Yes	No
A: GENERAL AGREEMENT – RESEARCH GOALS, PARTICPANT TASKS AND VOLUNTARY PARTICIPATION		
1. I have read and understood the study information dated [*DD/MM/YYYY*], or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.	☐	☐
2. I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	☐	☐
3. I understand that taking part in the study involves an audio-recorded interview. *These audio-recordings will be transcribed as text and anonymised. After the study is finished, the recordings will be destroyed.*	☐	☐
4. I understand that the study will approximately end in November 2024.	☐	☐
B: POTENTIAL RISKS OF PARTICIPATING (INCLUDING DATA PROTECTION)		
5. I understand that taking part in the study also involves collecting specific personally identifiable information (PII) name and job description and associated personally identifiable research data (PIRD), involvement in RES , with the potential risk of my identity being revealed.	☐	☐
6. I understand that the following steps will be taken to minimise the threat of a data breach, and protect my identity in the event of such a breach: • Rephrasing of job descriptions • The personal data collected (names, email addresses and job descriptions) will not be shared with any other party and any documentation on the interview (including a transcript and conclusions) will be anonymised • Data is stored on TU Delft data storage which is only accessible by the researcher and its supervisors.	☐	☐
7. I understand that personal information collected about me that can identify me, such as my name and job description, will not be shared beyond the study team.	☐	☐
8. I understand that the (identifiable) personal data I provide will be destroyed after the study is finished, approximately November 2024.	☐	☐
C: RESEARCH PUBLICATION, DISSEMINATION AND APPLICATION		
9. I understand that after the research study the de-identified information I provide will be used for a master thesis report which will be published on the TU Delft repository.	☐	☐
10. I agree that my responses, views or other input can be **quoted** anonymously in research outputs	☐	☐
D: (LONGTERM) DATA STORAGE, ACCESS AND REUSE		
16. I give permission for the de-identified interview transcripts that I provide to be archived as appendix to the Master Thesis report which will be published on the TU Delft repository so it can be used for future research and learning.	☐	☐
17. I understand that access to this repository is open access.	☐	☐

Signatures

I have read and understood and I consent to participate.

Name of participant	Signature	Date

I, as researcher, have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

Researcher name	Signature	Date

Study contact details for further information: Milou de Vries, m.y.devries@student.tudelft.nl

B. LIST OF REVIEWED DOCUMENTS

This appendix includes an overview of the reviewed documents for this research. Some of these documents were provided by interview participants and are therefore unpublished. Starting with general documents on RES in B1, followed by case specific documents in B2 (RES A) and B3 (RES B).

B.1 General documents

Table B.1 shows the general reviewed documents about RES in the Netherlands.

Table B.1 General documents

Nr.	Document name	Authors &	Publication	Description of content
1.	Monitor Concept RES	Mathijssen et al.	PBL, 2021 (link)	Analysis of the published draft RES documents of all regions in light of the 2030 national energy transition goals.
2.	Monitor RES 1.0	Mathijssen et al.	PBL, 2021 (link)	Analysis of the published RES 1.0 strategy documents of all regions in light of the 2030 national energy transition goals.
3.	Monitor RES 2022	Mathijssen et al.	PBL, 2022 (link)	Evaluation of the progress of the National Program RES. Monitoring the achievability of the 2030 national energy transition goals on renewable energy production.
4.	Monitor RES 2023	Mathijssen et al.	PBL, 2023 (link)	Evaluation of the progress of the National Program RES by grouping insights from the regional monitors. Monitoring the achievability of the 2030 national energy transition goals on renewable energy production.

B.2 RES A

Table B.2 shows the case specific documents that were reviewed from RES A.

Table B.2 Documents RES A

Nr	Document name	Authors	Publication	Description of content
5.	Startnotitie Regionale Energie Strategie	Stuurgroep Regionale Energie Strategie	n.d. (link)	Interpretation of RES for region, organisation of regional collaboration, scope determination RES A, guiding principles for RES process.
6.	Concept RES	Stuurgroep Regionale Energie Strategie	2020 (link)	Draft version of regional energy strategy. Including results of initial exploratory phase, details on the use and content of transition scenarios and the identified potential for REP in the region.
7.	RES 1.0	Stuurgroep Regionale Energie Strategie	2021 (link)	First version of regional energy strategy. Including established ambitions, directions and plans for REP in the region.
8.	Making of RES 1.0	Unknown	n.d. (link)	Description of process to come to a regional energy strategy, including scenario approach, workshops, etc.

9.	Uitvoeringsprogramma	Noord Holland Zuid	2022 (link)	Plan for the implementation of RES including changes in the organisation, timeline with operational goals, activities and monitoring protocol. RES A has summarised this in five tracks.
10.	Eerste RES-Monitor	Noord Holland Zuid	2022 (link)	Monitoring agreements from implementation program. Including monitoring of electricity goals, electricity infrastructure and process.
11.	Eerste voortgangsrapportage RES A	Noord Holland Zuid	2023 (link)	Progress report, published every two years to keep track of progress in light of the set ambitions in RES. It also evaluates the achievability of the goals.
12.	Aanpak en verkennende scenario's per deelregio	Unknown	Unpublished, received from interview participant 7	Explanation of the different organised subregional workshops as part of the development of the regional energy transition scenarios. Including the reasons for doing the workshops as well as the content and format of the workshops.
13.	Verkennende scenario's per deelregio	Unknown	Unpublished, received from interview participant 7	Detailed description of the characteristics and content of the created regional energy transition scenarios.
14.	Scenario poster	Unknown	Unpublished, received from interview participant 7	Example of the resulting posters with scenarios that were used in workshops with stakeholders to discuss and evaluate them.

B.3 RES B

Table B.3 shows the case specific documents that were reviewed from RES B.

Table B.3 Documents RES B

Nr	Document name	Authors	Publication	Description of content
15.	Startnotitie RES B	Delheij et al.	n.d. (link)	Interpretation of RES for the region, organisation of regional collaboration, scope determination RES B, generic steps of process RES development.
16.	Concept RES	Schmitz et al.	2020 (link)	Draft version of regional energy strategy. Including results of initial exploratory phase, details on the use and content of transition scenarios and the identified potential for REP in the region.
17.	RES 1.0	Krabbendam et al.	2021 (link)	First version of regional energy strategy. Including established ambitions, directions and plans for REP in the region.
18.	Uitvoeringsagenda RES B	Stuurgroep RES	2022 (link)	Plan for the implementation of RES including governance structure, and

				monitoring protocol. In addition, RES B highlights 4 themes of implementation: support/participation, energy savings, renewable generation, renewable heat.
19.	Voortgangsrapportage RES B	Unknown	2023 (link)	Progress report, published to keep track of progress in light of the set ambitions in RES. It contains a summary of the taken steps towards implementation and the results of these steps.

C. PRACTICAL APPLICATION OF TRANSITION SCENARIOS

In these appendices, more detailed information on the scenario approach used in RES A is given. B1 contains a written out summary of the approach, B2 contains a document on the approach received from interview participant 7.

C.1 RES A: Summary of transition scenario approach

This appendix contains a summary of the scenario approach used in RES A, starting with the scenario preparation, followed by the scenario development and finally the scenario evaluation.

The understanding of how this took place is established by combining insights from the interviews with the content of public documents as well as documents provided by interview candidate 7. See appendix B for an overview of the reviewed documents.

Scenario preparation

RES A started with an 'inventory phase' in which a fact base as starting point for the scenarios was determined. This fact base consisted of the current and expected energy demand, the current REP in the region and the existing spatial constrictions for REP on land. This also included a spatial analysis of current functions of land in the region. This factual base was prepared by a consortium of experts which the region has engaged to guide them through the process of creating a regional energy strategy. (Document 8, see appendix B2)

"We actually started with thematic workshops with all business stakeholders and partners with the municipality, civil servants with the grid operators and the like. That was actually a kind of, there we made a kind of picture of what is the state of affairs in terms of spatial regimes in terms of production and so actually made a kind of factual information base together?" ~ Interview 11

In addition to this expert analysis, RES A took a participatory approach in collecting input for the factual base. In thematic workshops in each subregion, business stakeholders such as civil servants, grid operator, developers and other relevant stakeholders from the region had the opportunity to shed their light on the fact base and sharpen or complete the information where necessary.

"*But with each other, looking at the region, what do we see happening there? Where do we see potential? What potential do we see?"* ~ Interview 13

These sessions already had a spatial focus, where the first contours of potential locations for renewable energy production emerged.

"Then actually putting maps on the table and ticking things off with each other. Well, hopefully also drawing things in of here would be potential and actually we have that whole process for the RES from zero to well the first maps" ~ Interview 13

Scenario development

After establishing the factual base, three exploratory regional energy transition scenarios per subregion were developed.

The scenarios are for the most part developed by the consortium using input from two different workshops in the subregions; one to establish the **leading principles** on which the scenarios would be based and the second one to discuss the scenarios and finetune them where

necessary. In the workshops relevant stakeholders in the subregion were invited, both public and private, ranging from government officials on the field of spatial planning to local businesses or housing corporations. The officials involved in RES from the governments in the subregion were tasked to invite them. The workshops were prepared and led by advisors from the consortium.

"We have had several workshops, also with councillors, but also with residents. Then you often got an introduction from the program, or from someone from the RES program, and then you went into groups together, we had 4 or 5 groups with those cards where you were asked different things." ~ Interview 15

In both workshops an interactive approach was applied. The first workshop was centred around stimulating a discussion on what could be leading principles to base the regional energy strategy on, as well as determining spatial interpretation of REP that would fit those principles **("the building blocks").** A building block consists of a form of energy production, a type of location and any additional conditions. (Document 8, see appendix B2)

An example of a leading principle could be "preserving the landscape" and a building block that would fit that principle is an emphasis on solar PV on big roofs as it doesn't take space in the landscape. Figure 15 gives more examples of building blocks.

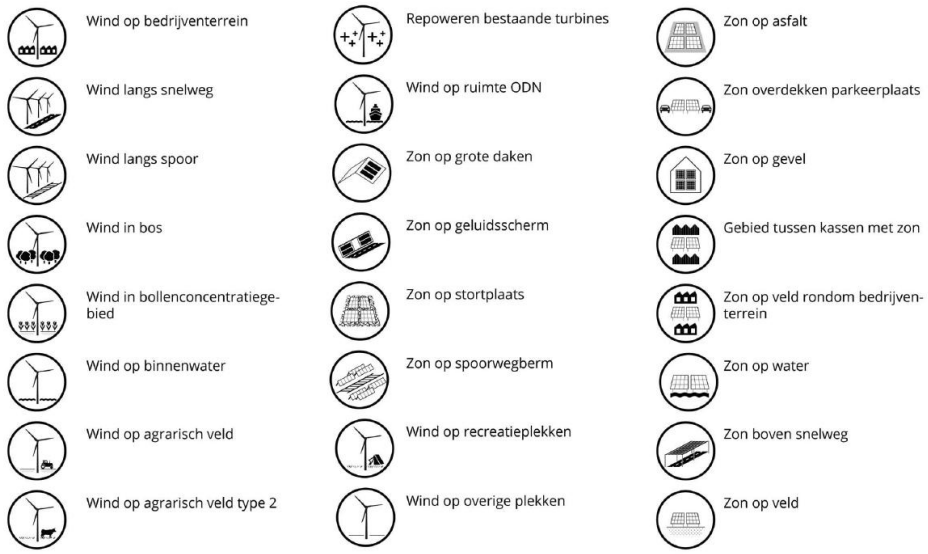

Figure C.1: Building blocks transition scenarios RES A (from document 8, see appendix B2)

Participants were divided in small groups and tasked to brainstorm about what they considered important values and principles for the subregion. At the end of the workshop, a decision would be made what three leading principles would be used to create the scenarios, as well as which building blocks would fit those principles.

"*Then we developed scenarios. We did this on the basis of. What is important per sub-region, we had those sessions, for example. Landscape is very important. Or economic development is very important to us. Things like that and that led to 3 scenarios per subregion.*" ~ Interview 11

The chosen leading principles were elaborated into future scenarios by the consortium. The scenarios were extremes using the leading principles to show the corners of the playing field of possible directions for the regional energy strategy, this is illustrated in figure 16.

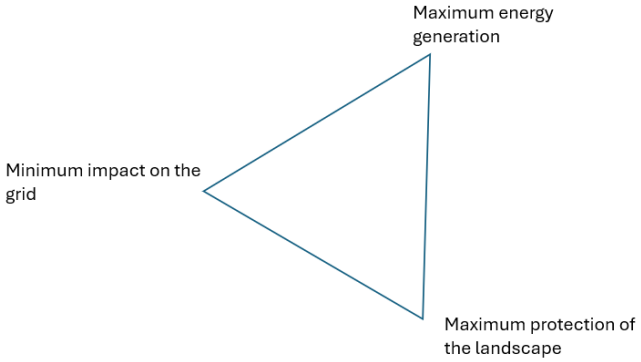

Figure C.2: Example of leading principles for transition scenarios RES A (own illustration, inspired from document 13, see appendix B2)

"An exploratory scenario is an outline of a possible energy strategy, based on one or more leading principles" ~ Document 13 (see appendix B2)

In addition, in the document on the development of the regional energy strategy the following purpose of the scenarios was stated:

"*These scenarios are a tool to explore extremes and to determine together which interpretation of sustainable energy production fits within the (sub)region and municipalities"*. ~ Document 8 (see appendix B2)

In the second workshop, the developed scenarios are presented to the participants with the goal of discussing them and determining where adjustments are needed. The presented scenarios contained a narrative description of what the energetic future would look like, as well as a quantitative component of the potential REP that could be achieved in the region combined with the spatial implementation of this production illustrated on a map. The quantitative potential of REP included two time frames: 2030 as well as 2050. Finally, the presented scenarios also included a scoring (1-5) of their secondary effects such as the influence on nature and biodiversity or the contribution to reducing CO2 emissions. Scores were given in relation to the other scenarios. The secondary effects were a mix of quantitative and qualitative inputs from experts.

"Ecologists, landscape architects and economists then estimated the effects of the scenarios on space, landscape and nature and investment, among other things. The information gathered in the preparation phase was used for this." ~ Document 8 (see appendix B2)

In document 8, it is also emphasised that this workshop served the purpose of finetuning the scenarios and that a discussion on the pros and cons of them would follow in a later step of the process. After gathering input on the scenarios, they were finalised by the consortium. The final scenarios were elaborated on posters including a large map of the subregion, a table of building blocks, the possible production per building block and a summary of the scenario's characteristics.

"*The aim of the second workshop is to discuss and, where necessary, sharpen the scenarios with associated building blocks and effects.*" ~ Document 12 (see appendix B2)

Scenario evaluation

Once the scenarios were developed and adjusted using the input from the workshops in the subregions, they were presented in local workshops. These were organised by municipalities who were also responsible for the invitation of participants. In most cases, these included local inhabitants, local interested parties and often also councillors and statesmen. In these workshops, the fact that the scenarios served an exploratory purpose was emphasized.

"So for the final energy strategy, the question is not to choose one of the three scenarios, but to engage in a dialogue on possible search directions for the incorporation of renewable energy based on the insights." ~ Document 13 (see appendix B2)

The goal of the local workshops was to test the support for different options for renewable energy production. During these local meetings, the building blocks of the scenarios were tested for support and the conditions under which REP would be appropriate in the respective municipality were discussed.

With the gathered input from the local workshops, the consortium made new maps for each subregion with potential locations for REP as well as the corresponding quantitative potential of renewable energy production. These maps were once more discussed in subregional workshops with the relevant officials from all municipalities. This resulted in the first maps on RES region scale which contained "search areas" for REP in the region. These were then discussed within the steering committee and municipal and state councils. This resulted in the draft regional energy strategy in case A, including a quantitative ambition of REP by 2030.

C.2 RES A: Analysis of resulting scenarios

Table C.1 shows the analysis of the resulting scenarios in RES A.

Table C.1: Analysis of resulting scenarios RES A

Quotes & Concepts	Coding
Multiple (3) future scenarios per subregion *"For each subregion, based on values and characteristics, three specific scenarios were created*." ~ Document 13 (see appendix B2)	**Exploratory aspects**
Possibility space of extremes *"An exploratory scenario is an outline of a possible energy strategy, based on one or more leading principles"* ~ Document 13 (see appendix B2) *"3 extreme scenarios that determine the corners of the playing field of possible directions for the regional energy strategy*" ~ Document 13 (see appendix B2)	
Not applicable in this case	**Normative aspects**
No contextual exploration *But we didn't so much indeed come up with scenarios for the context.* ~ Interview 14	**Externally-driven**
Trying to find consensus on the most desired aspects of the transition scenarios *"but it was mainly about which parts of the scenarios people liked and disliked" ~ Interview 11*	**Internally-driven**

Decision support "*And then and with that you actually also made the choice; suppose, we want the parts from the energy landscape we think are very good. Then we also choose to generate a lot in our region. ~ Interview 11*	
Narrative description of future based on leading principle, such as "Maximum energy generation"	**Qualitative elements**
Different configurations of REP *"A building block of the scenarios consists of a form of energy generation, a type of location and possibly additional conditions" ~* Document 8, see appendix B2	
Maps with potential locations *"we have given all those places where we thought something could be done a boundary or a mark on the map" ~* Interview 19	
Potential energy production & demand in 2030 and 2050 (TWh) "*The primary effects for each scenario at a glance: Installed capacity of wind turbines and solar panels, with indications of possible locations on map and associated potentials. Energy demand per energy carrier in 2017, 2030 and 2050. Energy generation or potential in 2030 and 2050*." ~ Document 13, see appendix B2	**Quantitative elements**
Impact assessment *"Scoring on secondary effects* - *CO2* - *Nature and landscape* - *Spatial impact (m2)* - *Direct economic effects (labour market & education)* - *Indirect economic effects (tourism, agriculture, datacentres)* - *Costs and benefits" ~ Document 13, see appendix B2* *"Using key figures and models, the effects for each building block are determined and added up." ~ Document 13, see appendix B2* *"That's an effects analysis, of what does this scenario do to the landscape, to the energy system? With the, well you name it, does that score good or bad? And so we could compare the scenarios a bit relative to each other." ~ Interview 11*	

C.3 RES B: Summary of transition scenario approach

This appendix contains a summary of the scenario approach used in RES B.

The understanding of how this took place is established by combining insights from the interviews with the content of public documents. See appendix B for an overview of the reviewed documents.

Scenarios weren't used explicitly in the creation of the regional energy strategy in RES B. The ambition set in the draft RES did include a bandwidth of the potential ambition which was based on three scenarios: A conservative and optimistic scenario as well as an option in between. These three scenarios have been used to show the minimum and maximum of the technical potential for producing renewable energy in the region. They were also used as input for the grid impact analysis by the DSO.

"*We have not used future scenarios, so we have emphatically not done that. The only thing we did do is, where does the RES ambition come out if we put out certain options? So if, for example, we*

exclude solar on agricultural land altogether. With that analysis, a bandwith for the potential renewable energy production in the region has been determined. Certain choices led to our ambition for renewable energy generation. But that scenario was really based on current possibilities in current constraints and not looking at any future visions and plans that were there within individual municipalities or regions. " ~ Interview 2

The draft RES document indeed does refer to the consideration of three scenarios that determine the bandwidth of potential ambition for REP in the region. The scenarios included a production potential in TWh as well as a specification of which types of REP are included in that scenario. (Document 16, see appendix B3). A type of REP is defined by the source of renewable energy and a specific location type, for example solar PV on roofs. These three scenarios were:

1. A conservative scenario which is based on the existing spatial policies for renewable energy production.
2. A scenario where some policy restrictions are eased and the limits of existing (legal) restrictions and opportunities for wind energy and solar on agricultural land are explored.
3. An optimistic scenario or maximum-technical potential scenario which assumes that all existing policy restrictions for REP are taken away.

"For the maximum scenario, we really looked at, okay, what is spatially technically possible maximum if we just "turn" everything on. " ~ Interview 2

The types of REP considered in the scenarios were: solar PV on rooftops, solar PV on residual lands, solar PV on parking lots, solar PV alongside infrastructure, solar PV on agricultural land and wind energy projects. Effectively, these scenarios considered whether or not to include the potential for solar PV on agricultural land and whether or not to include wind energy projects, as these were considered the most politically sensitive.

The development of these scenarios included an analysis of 'hard' constraints as well as 'soft' constraints. The 'hard' constraints included spatial, technical, or legal constraints such as legal distance norms for wind mills. 'Soft constraints' on the other hand considered the desirability of certain spatial considerations for renewable energy production, such as solar PV on sloped surfaces.

"Initially we really looked at the hard constraints, so what simply cannot be done. And yes, of course that is not going to change in a few years' time. But then soft constraints were also looked at. For instance, it is a political choice whether or not to allow solar PV on certain slopes. Spatially technically it is possible." ~ Interview 2

To arrive at a policy ambition, various studies were used to calculate what is technically possible in terms of large-scale generation if only legal restrictions are taken into account. Spatial assessment frameworks were then used to determine what is considered feasible in spatial terms. The above resulted in global search areas for large-scale wind and solar PV generation and three possible scenarios, depending on the degree of applicable (legal) restrictions (Document 16, see appendix B3).

Furthermore, as the three subregions each had their own approach of coming to a draft RES, scenarios were also used in different ways in the different subregions.

[About vision development on the energy transition] *So not in the framework of the RES region. Those sessions mainly took place within individual municipalities or within subregions to*

determine positions on those kinds of scenarios, but not within the RES region framework. ~ Interview 2

Subregion 1
Subregion 1 used two scenarios to establish the ambition for renewable energy production, a maximum technical scenario and an integral realistic scenario. The maximum technical scenario was based on 'hard' constraints such as the size of a potential location and the generation potential of a wind turbine or solar panel. This technical scenario was supplemented with 'softer' constraints such as social and political desirability and existing spatial plans to create the integral realistic scenario.
Well within my own subregion, we really looked at what is spatially technically possible within those set frameworks ~ Interview 2

"For wind energy and solar PV a map is made showing locations where there is technical potential for REP and how much energy could be generated. On the basis of this technical scenario, a realistic scenario is created which also takes into account the desirability and impossibilities of locations. This also includes technical, spatial planning, -egal and softer constraints. By adding up the potentials of the sources, the total potential for generating renewable energy is determined." ~ Document 16 (see appendix B3)

Subregion 2
Subregion 2 used different scenarios to illustrate different strategies for the heat transition in the built environment (i.e. heat grid, heat pumps, green gas, etc.), which included the effects of different scenarios on the future electricity demand. These scenarios however haven't been used explicitly to develop the strategy for REP in the region.
"Based on national strategies (alternative solutions for heating homes and buildings), we explored, roughly per district in subregion 2, which strategy in the period up to 2030 from the perspective of energy system efficiency is considered most feasible and/or desirable." ~ Document 16 (see appendix B3)

Subregion 3
Subregion 3 similarly to subregion 1 used two scenarios for the potential for renewable energy production. The first scenario only considers REP with dual use of space (i.e. solar on roofs, parking lots, etc.) within urbanised areas. The second scenario is a combination of the first scenario with the addition of opportunities for REP outside of urbanised areas.

"For the potential renewable energy production in the subregion, two scenarios are proposed. Scenario 1 concerns the potential opportunities, largely within the built-up area (rooftops, vacant lots and car parks). Scenario 2 concerns all potential opportunities within the region and thus includes both the potential sites of scenario 1 and also the potential location outside the built-up area (including agricultural land and agricultural yards, as well as potential sites for wind energy." ~ Document 16 (see appendix B3)

As became evident in the case evaluation, every subregion had to establish the expected future energy demand in 2030 and 2050, which was often done using future scenarios for the electricity demand of different sectors. These scenarios included aspects such as the increase in electricity use for heating, increased electricity use due to electric vehicle charging and decreased electricity use due to efficiency measures for electrical appliances (Document 16, see appendix B3). These scenarios were used as basis for strategies to promote energy savings and are thus out of the scope of this research.

C.4 RES B: Analysis of resulting scenarios

The analysis of the resulting scenarios in RES B is shown in table C.2.

Table C.2: Analysis of resulting scenarios RES A

Quotes & Concepts	Coding
Limited options *"They did look at a technical scenario and a realistic scenario. But I don't think that's really scenario thinking" ~ Interview 4* *"We have not used future scenarios, so we have emphatically not done that. The only thing we did do is, where does the RES ambition come out if we put out certain options? So if, for example, we exclude solar on agricultural land altogether, a range between 1.1 and 1.9 TWh has been determined."* ~ Interview 2	**Exploratory aspects**
No realisation strategy *"So if we in RES B said, we have to fully commit to rooftop solar, right? Which was one of the calculations wasn't it? Then the question didn't come up of yes, but how do we think we can achieve that and what are we going to do if that doesn't work out or something? Or what obstacles do we encounter? That we as municipalities and provinces can solve ourselves or others perhaps or so?"* ~ Interview 6 **Preset target** "*The national government had already published the target of what should be generated in total. So the region already knew, so to speak, what the approximate task was and they just calculated accordingly. There was really also reasoning, if we should generate this number, are we going to make that or not? And well, so that bandwidth is logical that that was logically added in later. But anyway, a generic idea of what the ambition should be, was clear at the beginning."* ~ Interview 6	**Normative aspects**
No contextual exploration *"So that's one and the second thing I haven't experienced, because I think scenario thinking or future thinking also involves kind of thinking about a realisation strategy huh? How do we think we can do that and how do we deal with uncertainties and so on huh? And well, I haven't experienced that line of thinking, not at all" ~ Interview 6*	**Externally-driven**
Choosing the best options *"These were all landscape considerations. Back then, for instance, there was no grid congestion to consider. That was really about. What are the best locations for solar on land?"* ~ Interview 10 *"Certain choices led to a scenario of 1.3 TWh"* ~ Interview 2	**Internally-driven**
Inclusion of different types of renewable energy option (i.e. wind, solar PV on roof, solar PV on agricultural land) *"And from there, there are sort of, we have worked through different alternatives. What we say, yes, we want to deploy maximum on solar, maximum on wind or a combination or and then also area-based."* ~ Interview 6	**Qualitative elements**
Locations based on spatial limitations	

"Well within my own subregion, we really looked at what is spatially technically possible within those set frameworks." ~ Interview 2 *"But really solar and wind and what we did is initially we did an analysis, which was really a desk analysis. An analysis of where can something be done and where can something definitely not be done, so that we have mapped."* ~ Interview 6	
Desirability considerations *"At one point we thought of, well, if you have solar energy, solar parks, right? If you would want those, should you want them on a slope, over a very steep slope or not? And then what about visibility huh? So you drive somewhere and what do you see huh? So that perception side of things also received important attention along the way."* ~ Interview 6	
Potential energy production in 2030 (TWh) *"We have compared 3 substantive scenarios and what does that deliver? That's it. And then what does that mean for the ambition?"* ~ Interview 6 *"The only thing we did do is, where does the RES ambition come out if we put out certain options"* ~ Interview 2	**Quantitative elements**
Future energy demand in 2030 and 2050 (TWh) *"What does it mean for electricity demand? And can we generate everything that remains in terms of electricity demand in RES B in the end, can we generate that regionally? But yes, we also quickly came to the conclusion that that was not feasible in RES B, but we did use that as background for the story. To ensure that large-scale generation was taken seriously."* ~ Interview 4	
Impact analysis grid capacity *"The DSO has made a calculation to provide insight into the potential impact of the possible scenarios on energy infrastructure. They specifically looked at the impact on Sub (High Voltage/Middle Voltage) stations"* ~ Document 16 (see appendix B3)	

D. IMPLEMENTATION OF REGIONAL ENERGY STRATEGIES

This appendix contains all materials for the analysis of the implementation phase of regional energy strategies. Appendix D1 contains the actor analysis that was done, showing the perspectives of different actors in this implementation phase. Appendices D2 and D3 show the analysis of the implementation in both cases, including the tables with the coding of quotes from interview participants about challenges and driving factors in the implementation of RES. Finally, appendices D4 and D5 show the aggregation and categorisation of the identified challenges and driving factors in the regions.

D.1 Process of implementation – Actor analysis

To implement the regional energy strategy, a translation needs to be made from the search areas appointed in the RES into concrete renewable energy projects. A translation thus has to take place from a potential spot on the map towards an actual project plan, with a specific location, number of wind mills or solar panels, grid connection, functioning business case and a permit.

In order to do so, different actions need to be taken by different actors.

Developer needs to want it

In order for a renewable energy project to be realised, someone needs to want to develop it. Typically, this entails a developer who sees a potential business case for a plot on a certain location. Developers are often private parties specialised in the realisation of renewable energy projects. For larger scale projects (typically at a national scale), this also includes experienced regime actors that have been predominant in energy production from fossil resources. At a regional scale, many new niche actors arise such as smaller developers and energy cooperatives consisting of local inhabitants.

Whether a location is desirable for a potential developer, depends on many different factors such as the size of the plot, specific technical or ecological considerations, spatial restrictions and the willingness of a land owner. These factors together determine the risk profile of the project, based on which a developer will make the trade-off whether to initiate the project or not. For example, the presence of protected animals in the area makes a location less desirable as additional research into the location will most likely be necessary which increases the costs. This is also illustrated by this quote from a solar park developer:

"*But if I am THE developer then a triple A site is a plot that is a straightforward, where you can just build a neat square solar farm where there are no gas pipes in the ground, for example. What else can hinder it all? For instance, there are certain landscapes you'd rather not be in, if you know there's some special bird walking around, I don't want that. Close to grid connection is often nice, because often the longer the distance, the higher your grid connection costs and then the project often becomes unprofitable, so those are the triple A locations*." ~ Interview 17

In some cases, the developer will not stay owner of the renewable energy project after it is developed, but sell it to an operator. This requires another actor to be involved and find the project desirable. The interviewed developer in this research however takes an integrated approach as they both develop and operate their renewable energy projects:

"*So we do everything, we not only develop them, we also finance those projects. We build them and we manage them so of all the projects we have built so far, we still own. As opposed to angry foreign investor stories and the Chinese run off with the profits of the project. We are not Chinese and we still own our projects*." ~ Interview 17

DSO needs to connect it

In order for a renewable energy project to actually operate and be able to deliver the produced renewable energy to consumers, a connection to the grid is needed. At the regional scale, this is the task of the DSO. This interview quote illustrates the role of the DSO within RES:

"*We are the connecting party. We are very important, because a solar panel without a connection does nothing and wind turbines without a connection also does nothing, so we are very important, but if you look at the organisation within the RES? Those are the water board and the municipalities and the grid operator is included but not as a party that also takes decisions in it*." ~ Interview 13

Due to the initiation of the energy transition, a rapid growth in decentral energy production and consumption has taken place over the past few years. This has significantly increased the amount of work for DSO's as requests for grid connections are stacking up and the existing grid is reaching its capacity requiring expansion works. This has caused long wait times for connection applications from renewable energy projects. It also requires DSO's to plan far ahead as their working capacity is limited.

"*At the moment, no more can be done on the grid. So then we have to expand. I mean, if you apply for something with us, we are already planning Q1 2026 now. So it's going very fast*" ~ Interview 13

In addition, DSO's are regulated by the energy act, which means they have the objective to operate the grid as efficiently as possible, as all investments are made with public money. This means they are not allowed to invest in the grid based on potential plans, but they need some sort of certainty that a project will be realised.

"*And what I just said within the RES, it is still very diffuse and a lot of uncertainty about the developments of a search area that they have coloured in. So we cannot invest on this, we are not going to do that, because that is just not socially responsible, we are not allowed to do that, so we don't do that."* ~ Interview 13

Finally , the distribution grid also connects to the high voltage transmission system, which is operated by the TSO. Thus, a DSO also has to align their plans with that of the TSO in order to ensure grid stability.

"*But you still have a dependency because ultimately it also has to be able to be connected to the TSO's grid*" ~ Interview 13

Governments need to allow it

Governmental organisations such as the municipalities and provinces need to allow projects to be developed by providing requirements in policy frameworks, adding locations in their environmental plans and giving permission through permitting procedures.

And that is, of course, a very important step that you guarantee the spatial contours of your RES in your environmental plans, so that eventually an environmental permit can be granted there. ~ Interview 11

In some cases (often larger projects), governments are also required to do an environmental impact assessment (in Dutch: MER) or start up a tender procedure.

Difficulty here is the fact that energy planning was never a task of municipalities and provinces and setting up all of these procedures is something completely new.

"There was actually no proper laws and regulations for officials to adhere to, which made it very difficult to work quickly" ~ Interview 17

And as energy is a new field, it is often occupied by relatively new government officials who have to stand their ground against established disciplines such as spatial planning. Finally, governmental organisations are fighting internal battles between priorities as their tasks include many more things than the energy transition.

"Well then you get there with a young discipline that actually really has to fight its way into the space, because it wasn't there. It was just far away on the Maasvlakte and well not here and now we have to make space for it. And it's a young field. It's just quite difficult for such a new official to do that. So it is sometimes quite complicated internally." ~ Interview 12

Local inhabitants need to accept it:

In the case of renewable energy projects on land, local inhabitants are often also impacted. Therefore, social acceptance of a project is required. Important considerations for inhabitants are for example the adjustment of views on the landscape and noise pollution of wind mills as these could personally hinder them but also impact the value of their property.

"*And if you say, this is a search area, it can also very quickly reduce the value of any houses that are nearby."* ~ Interview 9

RES program can offer support

Finally, the RES program organisation can offer support in the implementation phase, but has no power or concrete actions to take. Activities in the implementation phase therefore include organising information sessions, putting things on the agenda, and hiring expertise to solve problems with specific projects.

"*What is difficult about this role is that you have influence, but no power so you can put things on the table with such a program. You can put things on the agenda, you can push, you can facilitate, you can make things open for discussion, but ultimately you are not in charge and it is the administrators who naturally retain their instruments at local level and really take the decisions there."* ~ Interview 19

D.2 RES A: Challenges and Driving factors

The table in this appendix shows all the identified challenges in the implementation phase mentioned in RES A.

Table D.1: Identified challenges in RES A

Quote	Challenge
"Especially in these times, where we now also have a government that I don't think is keen on wind on land anymore either. So we just have to come up with a damn good story to put windmills here in the middle of this busy area near a big city." ~ Interview 15	**Changing political climate:** New national government (2021, 2023); New provincial councils (2023), New municipal councils (2022) & blocking power of municipal councils, Non-binding nature of RES, Changing political preferences and priorities. Ambiguity about the desired future in the political debate
"The province said, we're not going to do that, even though it is in the RES. That also had to do with, well, new coalitions and the negotiations that took place. And this was an issue they didn't come out of." ~ Interview 11	
"I do notice that it is relatively easy for municipalities to say, oh but this search area won't work for a while, so let's not do that. And,	

that is difficult, so I think realisation is really lagging behind what could be done. But that really has a very heavy political component. You notice that the councillors sitting there now, those are not the councillors who enacted the RES 1.0." ~ Interview 14	
"The other side of course is also the political climate huh? Well, with current national politics, there are different stories. What do we actually want in the Netherlands? So it is also not an unambiguous picture where we are working towards. Yes, there is a target of 35 TWh, but along the way there are all kinds of different scenarios of how we should want to do that. Or scenarios that we shouldn't want to do it at all, so that doesn't help, so to speak. There is not one story, not one point we are working towards in the social debate." ~ Interview 13	
"So quite a big part of our ambition, is in solar on roof. We all had the idea; that is a kind of self-fulfilling prophecy, everyone wants that. Also there the circumstances are shifting. From energy crisis, which made it booming. Well, then, what is going to happen with feed-in tariffs and what is your payback time on solar panels currently? And can it all still be done? So there are a lot of parts that are out of our control that do matter." ~ Interview 19 *"The fact that we now have negative prices in the market is another such development, which I think has come here, say, in the last two years. Again, that doesn't help operators to think; I'm going to invest in solar or wind, so you have a lot of external factors that you have no control over as an RES."* ~ Interview 13	**Changing financial conditions:** Changing electricity prices, Changing schemes for electricity pricing, inflation
"Yes, but there are also assumptions made in the RES ambition. And now it turns out, that low-hanging fruit is perhaps less likely to be cashed in than we expected. Wind energy encounters resistance, there is something about grid congestion that plays in my region slightly less than in many other regions. But nevertheless, in people's minds it is very much there." ~ Interview 19	**Changing circumstances** Social resistance, grid congestion
"The appointed areas in the RES were called search areas, so for example within this area we can develop solar PV parks. But as DSO it is extremely difficult for us to reflect on that. Because yes, if you draw in 40 hectares of search area, will there be 40 hectares of solar or will there be one hectare of solar? That's either 40 megawatts or one megawatt, so that is one substation or just a small connection, so that's really huge." ~ Interview 13	**Uncertainty about the plans** RES is not concrete enough, developments are not definitive, DSO is unable to invest on plans RES
"[about adding RES search areas to DSO's investment agenda] Actually the latter, so we said, we cannot invest on this, we are not going to do that, because that is just not socially responsible, we are not allowed to do that, so we don't do that." ~ Interview 13	

"And what I just said within the RES, it is still very diffuse and a lot of uncertainty about the developments of a search area that they have coloured in. And two, well, outside the RES different things are happening than are included in the RES. So that's a complex one for us to run your investment programmes on that" ~ Interview 13	
"You need implementation power in municipalities, because everyone is busy and does something else on top of it." ~ Interview 11	**Capacity management in organisations** Lack of time to work on RES, Engaging different governmental officials
"You said it's about moving from planning to implementation. And then you need very different types of people. Planning are really policy officials. And implementation is more like someone who takes the lead within a municipal organisation to get a project approved, who goes through by all the desks and so on, so that requires a completely different role. So we are in the phase now where you might say, other people are needed. Other departments, spatial planning, municipal licensing, instead of the RES official we have been working with for five years." ~ Interview 11	
"I think that in the beginning we were not very clear with each other about what exactly the effects would be. A lot of built-up areas, a lot of companies, so there is often a robust grid there but there is little room for generation because it is built-up." ~ Interview 13	**Spatial characteristics and regimes** Dense urban regions have robust grid but no space, Remoter locations have more space but no grid, Many different policy restrictions, financial or practical feasibility doesn't match with spatial desirability .
"Nearby on car parks well, lots of potential along the coast. That's already nice. Only then you get that we have to pull cables through natura 2000 areas and the dunes, for example. So those kind of things we have indicated there. Of course, if we want that together, we have to organise that. Only, keep in mind that that also has to happen, so then you also have to create conditions there and that is also included in this document" ~ Interview 13	
"But of course there is also the story of a business case, because the area we chose is in an area with a height restriction, so those big wind turbines, the ones where you can also really just make a good business case for, 250 m high, you can just never put those here. We're talking about 145 m maximum here, they're relatively small wind turbines. Pretty difficult to make a business case for that at all." ~ Interview 15 *"RES A is a complex region because many policies and restrictions from laws and regulations come together here. And it is a fully built-up part of the province."* ~ Interview 19	

"We applied for the permit in December 2020. So the whole permit process until you submit it, until you actually have the stamp, takes about two years. Yes, and before that you have another six months of participation, figuring things out." ~ Interview 18 *"But the process for permitting a solar field is quite complex and comprehensive. And we also asked for quite a few things in our policy, so we also had to outline that process at the same time. Which steps does an initiator have to go through and at which moments do they also have to pay the municipality, for example, to carry out certain studies?"* ~ Interview 14	**Long procedures:** Permit procedures, Changing regulations, takes a long time and you depend on others to do it, Recalibration of RES takes a lot of time
"Because a decision has to be made for it, or legislation has to be amended for it. Well that that just takes time, so to speak, sometimes you may have thought of something together two years ago, but then it just takes a long time before you can actually say you can implement it" ~ Interview 13	
"And, so we're now looking at can we do such a recalibration once a year, which just makes us a bit more flexible to incorporate new insights. And in a way that it's only about municipalities that have changes and that the municipalities that don't have changes can just get on with implementation and we don't bother them with that." ~ Interview 11	
""We're going to make it happen", is of course always a tricky one. Yes, you start thinking about everything too. But yes, at the end of the day, you only have certain options. You're not, you're not the implementation club. You have to draw up a plan on which you think where there is potential where things can be developed. But ultimately there have to be developers who are going to do things and the market has to cooperate." ~ Interview 13	**Dependency on developers and the market**
"So the moment you want to connect smart, you often need, for example, a battery. So then the RES or the customer, looks at the grid operator to fix that, because "you guys don't have the grid in order". But we can't do that, because we are not allowed to invest in batteries. So a customer will have to do that himself, or the project developer. So with that comes an extra complexity in the process, because it is not just solar panels anymore." ~ Interview 13 *"But you still have a dependency ultimately it also has to be able to be connected to Tennet's grid"* ~ Interview 13	**Grid congestion increases complexity** DSO cannot invest in batteries because of energy act, extra dimension in project

"Last year actually the government has come up with a tightened solar ladder that basically says, we don't do any more renewable energy projects on farmland, unless you're so far in that pipeline." ~ Interview 14 *"And that too is actually very complex, because it's actually a bit the same as in our case with wind energy, namely that, first of all, you have to get together with a lot of governments and get their act together."* ~ Interview 15	**Dependency on higher tiers of government** Changing regulations for REP, new national policies, new provincial policies, Province is competent authority for many REP projects
"And the rules of the game change along the way don't they? For wind energy, there was a distance standard, extra from the province, which has been abandoned. There has been another consultation. New norms, environmental standardisation for wind, that has not yet been set either. For solar, there has come the second solar letter from the minister, making that more difficult." ~ Interview 19	
"A municipality wants to build wind turbines there, together with at least the energy cooperative that operates there. This required a statement of no objections from the province." ~ Interview 11 *"So the next step is for these municipalities to decide what they want to do with their areas in this natural reserve. And then together with the province we just have to make a plan. You see, it is not the case that as a municipality you can decide on four wind turbines by yourself. Province is competent authority when it comes to wind farms over 5 megawatts. If we wanted to put just one wind turbine down in the municipality then, we could go our way."* ~ Interview 15	

Driving factors

Table D.2 shows the identified quotes about driving factors in RES A.

Table D.2: Driving factors RES A

Quote	Driving factor
"No, Everyone is really trying incredibly hard. But it is not moving fast enough for several reasons. Public support, grid congestion. Birds, you name it, all sorts of things." ~ Interview 11 *"And now you actually see now that we are a couple of years on, if you go to a municipal council now. Yes, Everybody knows what the RES is and why it has to be, what their role is, so it did help a lot in getting the task to all municipalities and so on. So I wouldn't do it any differently than we did then."* ~ Interview 11	**Commitment:** effort, task ownership and understanding, good energy in the team, raising awareness

"But I do find it that there is just real energy and quality on the team and also from the municipality now. Well, the official on it are all in there with good energy. We hopefully are too." ~ Interview 13 *"I think people are pennywise pound foolish now. If you do nothing now, then our children and our grandchildren if you still get them and want them. They have to foot the bill, they are stuck and with the mess and with not enough resources to manage it properly anymore."* ~ Interview 19	
"I really find that cooperation both officially and administratively, very special and valuable. People really exchange knowledge, all the administrative meetings are always well attended, even though we always have an impossible agenda with so many items." ~ Interview 11 *"And I think the biggest gain of the RES is not even necessarily in meeting the hard targets, but the realisation that we as governments can really work together on the task and seek each other out and hold each other up when the going gets tough and when the going gets tough."* ~ Interview 19 *"We just have to come up with a damn good story to put windmills here in the middle of this busy area near a big city and so the only chance we see to realise this, because we still believe in the goals of the RES, we still want it, is that we just have a really good cooperation with the 3 municipalities, and with the province, with the landowners, with Rijkswaterstaat, with Staatsbosbeheer who all have to deal with it."* ~ Interview 15	**Cooperation:** governmental cooperation

D.3 RES B: Challenges and driving factors

The table in this appendix shows all the identified challenges in the implementation phase mentioned in RES B.

Table D.3 Challenges in RES B

Quote	Challenge
"And one notices that nationally a BBB is also emerging." ~ Interview 3	**Changing political climate:** Changes in national politics, Changing in local politics, Changing provincial politics, Short term focus in politics
"Back then, there were a lot of ambitious aldermen from fairly green houses, so they set the bar high. Surely, municipal elections have caused quite a change. That also makes the realisation of an RES quite difficult because a municipality naturally changes colour, political colour, every four years." ~ Interview 5 *"Yes this has also I think definitely changed over the years, the RES document was drafted with actually all the others with all the other directors. The directors who are sitting now I don't think there is anyone who was present at the project, at the RES 1.0."* ~ Interview 9 *"No, in any case, it was still in the minds of the officials that at some point we will have to start working with solar on land, because otherwise you will not have enough surface area to generate the energy you need. Only at that time, there was not the political feeling to go there."* ~ Interview 10	
"I also do think that the province just has no ambition. That also has to do with this coalition and the previous one. I think they just don't want wind turbines." ~ Interview 12	
"Municipal politicians don't have a 2050 focus; they have a focus of a maximum of four years." ~ Interview 1	
"It also has to do with rules of play changing during the game. Solar on land or agricultural land is actually prohibited for some time now." ~ Interview 5 *"There are too many restrictions to actually make it happen. Solar on land has become more difficult. Wind energy is almost impossible, so the only thing left is actually rooftop solar."* ~ Interview 2 *"Yes that net-metering scheme is being abolished. Yes, well, for large-scale it does not matter that much, but there is still a kind of intermediate category where it does matter."* ~ Interview 3	**Changing regulations**
"And don't forget, of course, that we live in a political climate this moment, especially also in the in the governorate as they call it here, the provincial house. Where politics is swayed by people who are not exactly supportive of the energy transition." ~ Interview 17 *"There is a lot of opposition, but also no real help from the province who says: stop for a moment. But we do have a mission*	**Blocking stakeholder:** Province has little sustainable ambitions

to fulfil and that mission is: we stand for that 1.33 TWh. Dear municipality if you are not going to meet it, I am going to take over the direction and so that is not happening." ~ Interview 1 *"I think, there are a number of things. One, politically there is little ambition among a number of municipalities and certainly the province to become a sustainable region or to go for an integral concept that is energy future-proof for this region."* ~ Interview 12 *"The province is not always proving to be very decisive."* ~ Interview 1 *"The moment it was postponed at that location, it was mainly because the province did not like the idea of solar on land, in general, and it eventually led to a tightening of provincial policy to allow even less possibilities for solar on land. And that was already the province's idea at the time, so at the time when it was raised in the RES region, yes, they did put the brakes on, didn't they? Hold on, we're going to wait and see. And let the project developer to finally decide when they had to pay for their grid connection to the DSO: okay, let's wait and see, we won't keep that connection."* ~ Interview 10	
"And that tourism sector, it knows how to lobby so well that nothing gets off the ground." ~ Interview 17	**Political trade-offs between goals/values/projects** Lobby of tourism sector, Preservation of nature and landscape, Difficulty with prioritising between goals, Agricultural lobby, Project of national interest
"You also see a lot of resistance to local sustainable generation via wind and solar in the region. On the one hand, windmills, difficult because we have a five-star landscape. Province doesn't want to, I'm saying it very oversimplified, but in any case, they find it complicated. Some municipalities too, but especially province, because they want to protect the landscape. That, of course, is also a value." ~ Interview 12 *"And space and preserving natural areas, is very high on the agenda here* ~ Interview 1	

"We are also a novex area where therefore there are just multiple spatial challenges in this territory and you can't achieve everything. I can also imagine that is difficult. I often speak to people from sustainability, we all want renewable energy and an energy transition. But I can imagine those also sitting in a council or a college with people who would like to build more houses. If you then both look at the same piece of land. Yes, they all need space too. So where do you choose? How do you deal with that?" ~ Interview 9 *"For the RES, there is a commitment to effort right? We have committed to those RES 1.0 goals, but we have also committed to housing development and we have committed to nature development and we have committed to. Well, you name it."* ~ Interview 5 *"I think the biggest problem is actually that it's a political trade-off. That is it is a political choice? I think that, technically there are all obstacles as well, but often something more can be done there. Or of course with additional funding or whatever so. If you really want it, it can be done. But how badly do you want it and what time and obstacles are you willing to put in place for that"* ~ Interview 9 *"The limited space available, that people generally prefer to see filled in with housing or other developments at the very least rather than putting a wind turbine or a solar park there."* ~ Interview 3 "*That was not negotiable. So then you just notice that the administrative climate to get the energy transition going is very small. Also the support that energy cooperatives get from the government, especially from municipalities, that is minimal to negative, even in these region"*	
"And then also the yes the agricultural lobby I call it, the agricultural lobby is also very strong at the moment, which also effectively creates barriers." ~ Interview 3	
"We could put 5 big wind turbines in the region with a height of 225 m. Twice the size of the Euromast, do you realise that? Then you know what we get here. Have you ever heard of this special project with national interest?" ~ Interview 8 *"As province we are trying to bring a special project of national interest to the area. That has meant that 4 to 8 wind turbines in a subregion cannot go ahead because of possible vibrations created by the wind turbines would harm the project, so people want to do everything possible to get this project to come to the region. So hence the windmills are on hold there for now."* ~ Interview 3	
"So it often seems as if it is the aldermen and councilmembers who cause the conflict, while the shop floor gets along very well." ~ Interview 1	**Fragmentation and friction:** Friction between elected representatives, strong separation between 3

"But the fact that we have 3 sub-regions that all have their own, official and administrative coordination moments, yes, That is not the case in all RES regions. That sometimes slows things down." *"I think the biggest stumbling block are those 3 sub-regions with their own way of working together, which is also very different, so on subregion has it based on a formally designated partnership. In the other two subregions, it is a bit more informal, a bit more voluntary."* ~ Interview 4 *"And there is no region in that sense. The RES region is not a region, there is no cooperation between those 3 subregions, it is just not a unity. So there is also a kind of friction in that" ~ Interview 12* *"So I think that is one of the drawbacks of all these sub-regions. It's divided and it stays divided."* ~ Interview 1 *"That's all church village politics isn't it? So every municipality is different, you know? And there it's a huge task to make a bit of chocolate out of that, isn't it?"* ~ Interview 6	subregions, big differences between villages and subregions, ambition split out between municipalities
"In RES B, each municipality has X of the total ambition on its plate. But you have to achieve the ambition together, and here you don't have to work together. Look, one municipality just says if I've done my part, I'm done, I've kept the agreements?" ~ Interview 12	
"One, a bottleneck just remains time. We just have to deal with that. Ideally, we could all spend a lot more time on this. But municipal officials also just have to spread their attention over many files. I think, if we could just devote more time and attention to this, it would automatically at least run a bit smoother, not easier, but then we could pick up the pace? That's where I think one of the biggest stumbling blocks is at the moment." ~ Interview 2 *"Municipalities have limited capacity at all. So even with the extra resources made available from the government to attract capacity. It is a difficult labour market, so there is just scarcity so even with extra resources the municipality does not always manage to attract the right persons."* ~ Interview 3	**Capacity management:** Lack of capacity at municipalities, Energy is a new policy field thus there is a lack of knowledge and skill, High turnover in involved people at RES

"There was actually no proper laws and regulations for officials to adhere to, which made it very difficult to work quickly. And I k know that often causes annoyance at the energy cooperative. Because why does it all take so long? And yes, but there was just too little knowledge and expertise in the civil service to apply good regulations there." Interview 17 *Occasionally at the administrative level. I do think that people did not always realise what they had signed. Yes, in administrative terms, I am referring in particular to the aldermen and yes, maybe the deputies, but I must say that the level of knowledge is certainly also limited in the councils and the states.* ~ Interview 3 *"Of course, the level of knowledge has to be in order to have that conversation at all. You cannot expect every councillor to be an expert on energy transition"* ~ Interview 12	
"You do notice in the RES region that there is very high turnover" ~ Interview 3 *"At the same time, a lot of new people have arrived, some fresh out of school, so that makes it very difficult. They often start again with a knowledge gap. Yes, and I understand that both the programme manager and the programme secretary resigned recently. Both of them, yes, I don't know if that or that is reason that they feel it is pulling a dead horse."* ~ Interview 4 *"Programme manager has left. Programme secretary is also leaving now. Come again new people with hopefully new momentum. Whereas I have to say those are very, very competent people. Then you start all over again, don't you?"* ~ Interview 8 "*And then we also have, and this is also very unhealthy, too many changes in the members of the RES. I won't tire you with the names, but there have been at least 5 switches in the program team alone over the past years."*	
"Look a statement I heard recently from one of a director: we don't do anything at all on our own renewable generation. We will wait until the power comes from the North Sea. Yes not noticing network congestion. And that if we want power from the North Sea we have to go through multiple other regions first. Well, then the power will run out long before you get to this region." ~ Interview 17 *"Ofcourse in this one subregion they have to deal with NATO because of the military airport across the border. Yes, and that just means no windmills."* ~ Interview 8 *"And the crazy thing then occurs that if you cross the border here, there are more wind turbines there than in the whole region put together. So there, they are laughing their heads off, they just don't get it, and we get annoyed because we don't get it either."* ~ Interview 8 *"If you look across the border, you see wind turbines, but in the Netherlands, it's not allowed there is it? There is opposition there, people don't want wind turbines there."* ~ Interview 17	**Difficulty due to geographical location and spatial characteristics** Geographical location, airport across the border, border region, hills in landscape.

"There is also, physically it is very different I would say RES B has hills. Where water flows down and where there is no wind to catch in the valleys either, because that's on the peaks." ~ Interview 16	
"People in the region are a bit more reserved, they're more careful. People like to wait and see." ~ Interview 1 *"The region is by nature very often already very reluctant to innovate. So on the one hand, the RES was very ambitious, we are going to achieve that. But then they didn't know how to realise that."* ~ Interview 1 *"The risk that arises is that our region becomes an Open Air Museum where everything should stay as it is and that, above all, we shouldn't damage the vulnerable landscape and that, as a result, landscape interests outweigh energy transition interests. And of course there is something to be said for that. On the other hand, we also know that we simply have an energy challenge in the region, there is also great socio-economic deprivation in all the urban areas in the region."* ~ Interview 2 *"I think people don't realise that there is no solution other than renewable generation. And yes, that there is no, how do you say, there is not going to be a EUREKA project, which will solve all the problems at once. I have the impression that there is still the hope that people nationwide will come up with something that will make all the large-scale generation projects in the regions unnecessary*." ~ Interview 3 *"But when it comes to the big picture, they very often look at their neighbours. I warn them very much against thinking now: Oh, we will get the energy from the sea anyway, so yes, the sustainable generation will come anyway."* ~ Interview 1	**Culture and attitude:** Wait and see, Reluctant to innovate, Conservative
"That's right yes, the RES is even established by the municipal councils, the highest body. But if the Council changes and the board changes, yes they can of course reverse that. Yes, that's how it works in Dutch politics." ~ Interview 5 *"There was a group of municipalities that said, well, we do want to work with solar on land, even though it is complicated in this landscape. But we still want to see if it can be done and that group then came forward, but our councils don't want to. Motions have been passed, it has simply been put rock solid in coalition agreements, no solar on land. Well, what do we do then? Because they also still say, we are going to achieve the RES ambition."* ~ Interview 12 *"Whereas ultimately you run into the fact that the RES has no powers and so each party falls back on its own powers and so just can't make things possible either."* ~ Interview 3	**Non-binding nature of RES**

"But I can't remember the RES as being an important document for your area development, that is that something that we really just have to take into account, that doesn't happen." ~ Interview 6	
"So in those early days, you had a business case with one hectare of solar field. That was already a business case, then came the period 2 hectares. And for two years back I spoke to a developer and they already said to me then. Yes, if it's not a cooperative and we have to do it, we already need at least 10 hectares to get a decent business case out of it at all" ~ Interview 1	**Grid congestion** Grid congestion has a negative effect on business case, Grid congestion
"Much more so, if we are already talking about net congestion. Then there are often solutions to be found, but they are very negative for the business case." ~ Interview 17 *"Grid congestion is also a constraint that is growing. It was barely talked about in 2021, but there are opportunities there too, if we combine it with storage and things like that, for example, does make the business case a bit more difficult. But that's really not the only and, maybe not the biggest constraint. We certainly shouldn't hide behind that."* ~ Interview 2 *"At a certain point grid congestion of course became an additional challenge."* ~ Interview 10	
"We are now dealing with that grid congestion, which is a blessing in disguise though." ~ Interview 8	
"[About solar PV on roofs] And yes, there you just have to deal with a lot of different owners with all kinds of different motives, all of whom you will have to approach individually. That just makes it difficult." ~ Interview 2	**Stakeholder interdependencies:** Dependencies on owners of land, Dependencies across the border, Dependencies of higher tiers of government.
"Because you need others for that. Yes, you always have that, actually, but in this case you need the companies in particular, because they own those roofs" ~ Interview 4 *"But they are yes things where you effectively as governments yes, do not have all the powers and cannot force people to put solar on their roofs. Especially companies in this case. So yes, that is difficult to see direct results from that. And that will certainly never add up to the RES bid that has been submitted."*	
"And as long as there is no policy, no yes projects can also be tested if they are submitted or requested by developers."	
"And yes, then here you also have specific ..., there is a NATO base just over the borders and that radar should not be disturbed. And that is a constant discussion with the Ministry of Defence to what extent wind turbines may or may not be erected there, and in fact no agreement is reached. So yes and then nothing comes to fruition, so yes." ~ Interview 3 *"Because ultimately the municipalities, aren't going to do that energy transition, are they? So those who facilitate maybe or remove some barriers or those who subsidise maybe here and*	

there or so? And they make sure that there is some policy space or not, but ultimately they are not parties who are going to decide about it." ~ Interview 6 *"And basically in some cases there are just not enough policies at municipalities to actually make choices on that. You notice that also municipalities are asked by developers. Only there was again the problem, because the policy is not there. So that it is often a barrier, because there is not enough, good enough policy to make choices about whether or not something is possible. Because municipalities themselves don't yet know what they want to do with it."* ~ Interview 9 *And yes, the province finally has the authority when it comes to the national landscape. So if you want something, yes, they also have something to say about it. Then you do need them, if you if you want something* . ~ Interview 10	

Driving factors

Table D.4 shows the mentioned driving factors by interview participants in RES B, although they are often not present in the region.

Table D.4: Driving factors in RES B

Quote	Non present driving factors
"I'll give you an example, there is a regional energy cooperative, at umbrella level. It developed the masterclass for councillors, a few years ago in RES B when there were still 513 councillors, who were offered this two-hour masterclass, right? Just a quick catch-up and so on and so forth, you know. Do you know what the number of applications was? 13 councillors, who, let's say, wanted to make the effort to go and learn about all the challenges of energy policy that are going to be involved in the coming years" ~ Interview 8 *"And those councils are now just the big problem here. Those are made up of people who are often not interested, often not informed, not committed, not steerable, not consultable."* ~ Interview 8	**No commitment**
"I think the sense of urgency is fairly lacking" ~ Interview 3	**No sense of urgency**
"And that cooperation is crucial. In so seeking solutions of both the administrative, procedural items, but it's also a bit interpersonal the moment we work together then you get the effect that you actually want to move forward." ~ Interview 17 *"Well, I have a kind of rule: If you don't cooperate yourself, it's very difficult to cooperate with "the outside world", I'll call it. So in recent years we have invested a lot in cooperation between the municipalities and province, the DSO and you do see that we are now increasingly working together with our stakeholders in projects as well."* ~ Interview 12	**No cooperation**

"*I think that RES 1.0 was written with a certain ambition, also with the aim and purpose and actually also with a real ambition to go for it and to work towards a good sustainable energy and energy transition. And that a lot of things fell out of the sky that were not foreseen or, as I said, perhaps in the preparation time, working towards the RES 1.0, that there is not enough time to work everything out in detail, to see what is realistic*" ~ Interview 9	**Realistic strategy & Understanding what needs to be done to realise it**
"I'm not pretending they were a bunch of nitwits, not at all, but they did realise that a lot had to be done if we wanted to be able to actually realise that ambition. On the other hand, if you don't set that bar high, nothing ever happens" ~ Interview 8	

D.4 Case neutral findings

Table D.5 : Case neutral challenges

Quote	Challenge
"And the bank finances mainly because that SDE subsidy is there. That's for 15 years, so that's a guarantee that there will always be income on the project, so that's why it's needed because they can't compete with fossil fuels yet, so yes, it's actually a kind of floor price they set with that SDE and that's why the bank finances your solar farm." ~ Interview 18	Subsidies are still needed to finance REP, Subsidy schemes are changing
"And they have chosen a plot of land that belongs to the province, well if you want something on provincial land then it's 10 years down the line, a tender is issued for it, a call for tenders has to be issued for it, etc". ~ Interview 18	Long procedures with for REP on governmental land
"And we say, we have a nice project. Yes, and for some reason you don't get any further, because a municipality finds it all very frightening. And we then think: but you have established these plans in the RES, right? That's what I thought was going to be the effect of the RES of, they commit to something, so we're going to do it. So you notice that we think: you have committed, so we have a project here, let's go! And then some municipalities say: well yes, but actually no..." ~ Interview 18	Non-binding nature of RES,
What are you running into? Anyway, the whole Energy file, is a new shoot on the tree in government land. *Energy was just always there, there was no need to make decisions and policies about that. So that has become a whole new branch of sport. And that means that there are now energy aldermen all at once. There are Energy Deputies, there is a Ministry of Climate and Green Growth. That wasn't there before.* ~ Interview 16	Energy is new policy field in decentral governments
"The last energy law dates from 20, 30 years ago. When gas was produced just so in a few places in the Netherlands and from that gas electricity was made again." ~ Interview 16	Long procedures to create laws.

"And then that's not there yesterday, because new laws and regulations just take a few years. In that, too, you have an awareness process to go through." ~ Interview 16	
"I am also going to add that governments are generally not very good at execution. They know that about themselves too. The market is just much better at that." ~ Interview 16	Dependency on the market

D.5 Driving factors

Table D.6 shows the driving factors in

Table D.6: Driving factors in the implementation of regional energy strategies

Quote	Driving factor
"And so the only chance we see to realise this, because we still believe in the goals of the RES, we still want it, is that we just have a really good cooperation with the 3 municipalities, and with the province, with the landowners, and with all the other stakeholders" ~ Interview 15 *"And that cooperation is crucial. In seeking solutions of both the administrative, procedural items, but it's also a bit interpersonal the moment we work together then you get the effect that you actually want to move forward."* ~ Interview 17	**Cooperation between stakeholders**
"*There is actually a formula for success in energy transition: supported from the bottom up, politically good choices made*" ~ Interview 1 *"And own members of energy cooperatives have to bring it together and that's how it works, because then you get a sudden support in the population to start those projects as well. If 1000 people here are members of the energy cooperative, I have 1000 People in the municipality who would like to see a wind turbine?" ~ Interview 17*	**Commitment of stakeholders;** Bottom-up, local support, Sense of urgency, political commitment
"That urgency, it has to come to light somehow. And this is not only among citizens, but certainly also among administrators. How urgent is it? And in that respect, it may not even be so wrong that this network congestion exists at the moment. But it is still just not busy enough, more pressure is needed. To make sure that is actually translated into actions. We are now all looking at the grid operators to strengthen the pipelines? Yes but it might be much better to think about doing the generation in your neighbourhood, because then you don't have to lay down that pipeline, you don't have to wait for that? And also that the realisation comes, that it's not all that easy anymore is	

it? So that you really have to come up with something together.” ~ Interview 17 *“I think people don't realise that there is no solution other than renewable generation. And yes, that there is no, how do you say, there is not going to be a EUREKA project, which will solve all the problems at once. I have the impression that there is still the hope that people nationwide will come up with something that will make all the large-scale generation projects in the regions unnecessary.”* ~ Interview 3	
“Yes and then: how strong are you as a city councillor huh? Do you dare to take a decision that might not be fully supported by your constituency? Because they might just say at the next election, we don't need you anymore. That's how it works in politics” ~ Interview 12 “*You just need administrative boldness*” ~ Interview 1	