Harvesting wind

An analysis of wind energy generation in forests in the Netherlands and Germany

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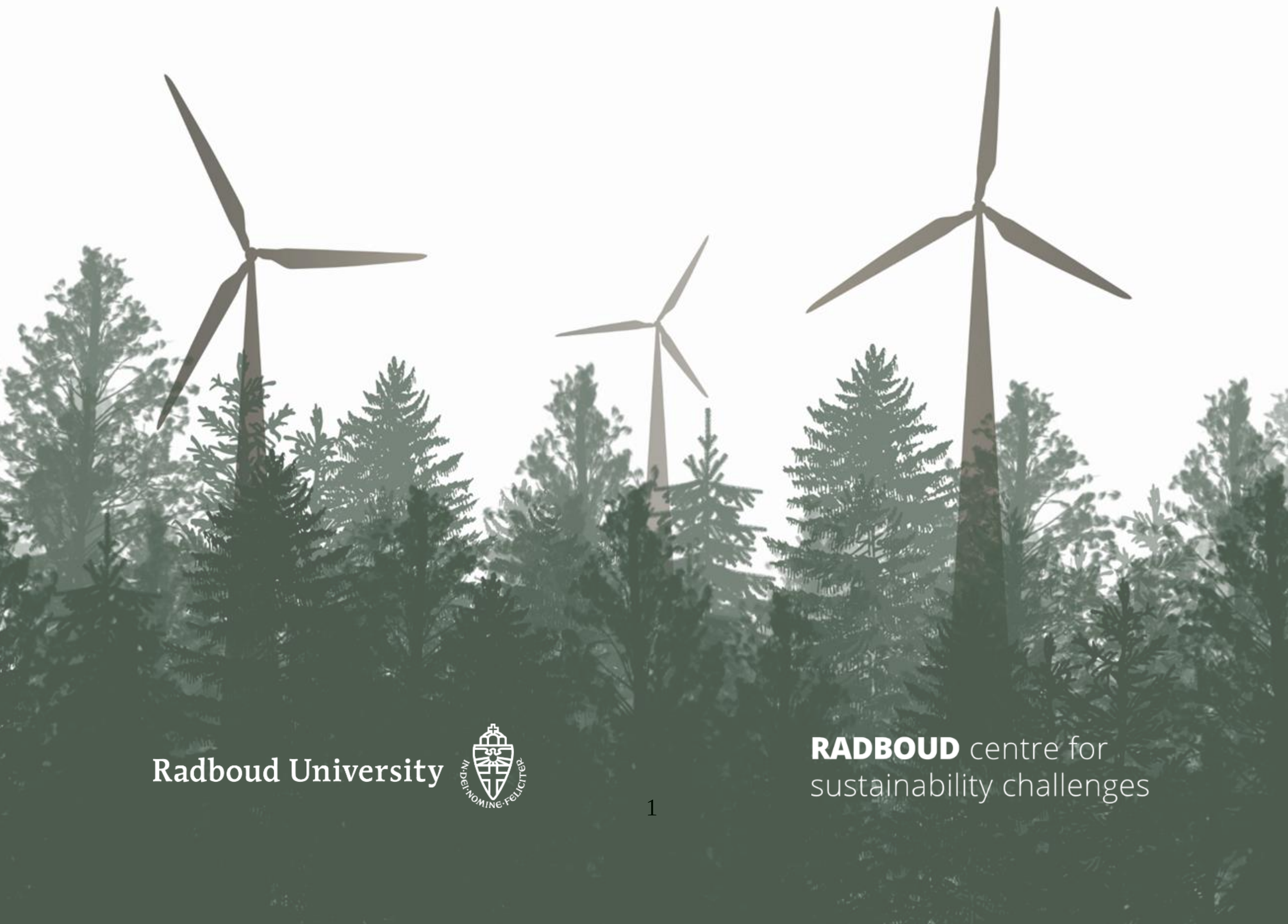

Preface

The idea for this research started when I read an article about the first wind turbines in forests in the Netherlands, in the Robbenoordbos. My curiosity was triggered immediately; wind turbines are vital in our effort to mitigate climate change, but forests, nature and biodiversity also urgently need protection. So, I was determined to find out more about the impacts of constructing wind turbines in forests and learning about the motivations behind this decision.

In the process of writing this thesis, I read a large number of documents. I also spoke to 19 stakeholders from the two countries, who took the time to share their knowledge and views with me. I can say with certainty that I learned a lot from each of these conversations. With the help of my supervisor Prof. Dr. Ingrid Visseren-Hamakers, to whom I owe many thanks, I managed to transform all these insights into the research that lies before you.

In addition to Ingrid, I would hereby like to thank Dr. Carlijn Hendriks for her support. Our frequent meetings helped me organise my thoughts and kept me talking about my research project. I would also like to thank my friends and family for their continuous support and help.

I hope you will enjoy the reading.

Roos van der Reijden
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Summary

In order to reach the goals agreed in the Paris Agreement, and thus to mitigate climate crisis, many countries are phasing out fossil fuels and accelerating expansion of renewable energy. Many countries, among which the Netherlands and Germany, have devised plans to expand renewable energy production. An often used renewable energy source is wind energy. As the production of wind energy is expanding, so are the sites at which wind turbines are constructed. Although often found in open landscapes, turbines are also placed in forests. Reasons for this might be of geographical nature and lack of space, but also societal arguments. Due to the size and consequent visibility of wind turbines, wind energy project are often met with opposition. Although wind energy generation in forests increases the share of renewable energy in these countries, it can have negative effects on forest quality, nature and biodiversity.

This thesis therefore explores the policy arrangements regarding this topic in four cases across two countries. Is aims to answer the research question: *What are the similarities and differences in the evolution of the policy arrangements of the nexus in the Veluwe, Wieringermeer, Thüringen, and Baden-Württemberg, and how can these similarities and differences be explained?* The thesis thereby introduces a new conceptual framework, a combination of the policy arrangement approach with the nexus approach. Furthermore, it adds a fifth dimension to the policy arrangement approach, the societal context. The nexus is defined as wind energy in forests, and climate change, forest, and biodiversity and nature where relevant for wind energy in forests.

One of the main insights derived from this research is that large differences among the policy arrangements exist. Additionally, the emphasis put on each of the nexus dimensions differs per case. Nevertheless, important similarities between the cases have also been identified. For example, attention for the nature and biodiversity policy domain is recognised in all cases. The differences and similarities can, among others, be attributed to different and similar laws, emphases on the policy dimensions, and societal circumstances.

Keywords: wind energy, biodiversity, nature, climate change, forest, Policy Arrangement approach, nexus approach.

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1. Introduction

The increased generation and consumption of renewable energy is important for mitigating climate change (IPCC, 2011). Of the available renewable energy sources, wind energy is a widely adopted one, accounting for more than 18% of total renewable energy (wind energy, as well as hydropower, marine energy, solar energy, bioenergy, and geothermal energy) generated worldwide in 2017 (IRENA, 2019d). In the following year, wind energy even provided 6% of the total global energy generation mix (IRENA, 2019a). Over the past decades, the production of wind energy has greatly increased, both onshore and offshore. Moreover, due to technological advances that have enabled building higher turbines, forests are now suitable sites for wind energy generation (Enevoldsen, 2017). However, the construction of wind turbines in forests requires felling of trees (Enevoldsen, 2018). Trees are important, among others, for their capacity to capture carbon dioxide (CO_2). Additionally, deforestation poses a threat to biodiversity (Giam, 2017; IPBES, 2019a). Wind energy generation in forests thus entails an important trade-off, as both wind energy generation and forests have an important role to play in sustainable development (Hof, Dymond & Mladenoff, 2017; Longobardi et al., 2016; Dai et al., 2016). Stakeholders involved in or affected by the decision to generate wind energy in forests have taken a different stance in the debate.

In this thesis, the evolution of the policy arrangements regarding the nexus – of wind energy in forests and aspects of climate change, forest, and biodiversity and nature where relevant for wind energy in forests – in two locations in the Netherlands (Wieringermeer and Veluwe) and two states in Germany (Baden-Württemberg and Thüringen) are analysed and compared. These four areas are chosen for comparison, because they employ different strategies regarding wind energy generation in forests. In Germany, the number of wind turbines in forests has been rapidly increasing since 2010, with 2,086 turbines in operation in forests at the end of 2020 (FA Wind, 2021b). The country's strategy towards wind energy generation in this particular setting has been subject to research (Bunzel et al., 2019). In the Netherlands, on the other hand, the first four turbines in a forested area, namely in the Robbenoordbos in the Wieringermeer (in the municipality Hollands Kroon, Noord-Holland), became operational in September 2020 (van de Bilt et al., 2014; Windpark Wieringermeer, n.d.). As a consequence, wind energy generation in forests in this country has not been the subject of research yet. These two countries are also selected for comparative research as they are both member states of the European Union (EU) and thereby subject to European legislation (Voermans, 2019).

The strategies employed in the four abovementioned areas are researched by looking at their policy arrangements regarding this issue. A policy arrangement is understood as the organisation of an issue in a policy domain (Arts, Leroy & van Tatenhove, 2006). A policy domain is defined as "a component of the political system that is organized around substantive issue" (Burstein, 1991, p.328). The policy arrangements regarding wind energy generation in forests in the Veluwe, Wieringermeer, Thüringen, and Baden-Württemberg are researched by means of a combination of the nexus approach and the Policy Arrangement Approach (PAA). The PAA is a conceptual tool to "analyse and understand change and stability within policy arrangements" (Liefferink, 2006, p.45). This is done by analysing the PAA's four dimensions – namely actors, resources and power, discourses, and rules of the game – in light of the policy arrangement under consideration (Liefferink, 2006). In this thesis, the PAA (further explained in section 3.1.4) is used to explain and compare the evolution of four policy arrangements, two in the Netherlands and two in Germany. However, when considering the issue of wind energy generation in forests, not one, but four policy domains stand out as relevant. These policy domains are wind energy in forests, climate change, forest, and biodiversity and nature (Bunzel et al., 2019; Enevoldsen, 2018; Gasparatos et al., 2017). In order to analyse these four policy domains together, the nexus approach is used. The nexus approach is a tool to identify "cross-sectoral, multi-scale policy interdependencies that reduce mismatches in policy making" (Benson, Gain & Rouillard, 2015, p.756). It recognizes that objectives in one policy domain influence those in others. It therefore aims to establish an integrative way of thinking of goal setting in policy domains (Benson, Gain & Rouillard, 2015; Rasul & Sharma, 2016; more elaborately explained in section 3.1.6).

In this thesis, the PAA and nexus approach are combined in one conceptual framework, to allow a comprehensive analysis of the evolution of the policy arrangements regarding wind energy generation in forests in the Wieringermeer, the Veluwe, Baden-Württemberg, and Thüringen. The focus is on the nexus between the wind energy in forests domain and the other three domains. This nexus is analysed by means of the PAA. Data is gathered by a combination of desk research and interviews with relevant stakeholders (see chapter 4).

1.1 Problem statement

The production of electricity from wind is continuously increasing. Germany and the Netherlands are not the only two countries with wind turbines installed in forests. Although there is not a great abundance of research focused on wind energy generation in forests in various countries, there is research on the topic conducted in Denmark, Norway, Sweden, and the United Kingdom (Enevoldsen, 2017). The expansion of wind energy generation is desirable for its potential to reduce energy related greenhouse gas (GHG) emissions and is therefore a means to meeting the agreed climate goals (see below). Nevertheless, wind energy generation in forests has significant negative impacts on forest cover, forest quality, and biodiversity (Gasparatos et al., 2017). Its GHG emissions, although lower than those associated with fossil fuels, should not entirely be neglected (Nugent & Sovacool, 2014). In the following, the four policy domains and their importance for wind energy generation in forests are introduced and explained.

Climate change

The end of 2015 marked the introduction of the Paris Agreement, adopted by the 196 UNFCCC (United Nations Framework Convention on Climate Change) countries that are Party to the Convention worldwide (UNFCCC, 2021). By adopting the agreement, the Parties committed to limiting GHG emissions and keeping global temperature rise well below 2°C (UNFCCC, 2015). The agreement thereby aims to mitigate climate change. If global temperatures were to rise more than 1.5-2°C, this global warming would result in extreme climate events, among other impacts. In Europe alone, such a temperature increase would likely lead to increased droughts, more frequent temperature extremes, increased floods, storms and wildfires. This in turn has severe implications for society, nature, and animals (King & Karoly, 2017; Alfieri et al., 2015; Forzieri et al., 2016). If global warming is limited to 1.5-2°C, the aforementioned climate events might still appear, but are expected to be less severe (King & Karoly, 2017). In the Paris Agreement, each country formulates their nationally determined contributions (NDCs), in which they outline their GHG emission reduction goal. These NDCs are, however, not legally binding. Signatory states are expected to pursue their goals by creating and implementing measures and policies on a national level (Bodansky, 2016).

In order to meet their NDCs, the Netherlands and Germany have proposed and implemented various climate policies (Szulecki et al., 2016; van Vuuren et al., 2017). In achieving the goals set in the Paris Agreement, research by IRENA (2019c) finds that, among other measures, "a combination of renewable energy, energy efficiency and electrification represent a safe, reliable, affordable and already deployable pathway capable of achieving over 90 percent of the energy-related CO_2 emission reductions needed to meet pledged climate goals" (p.10). Other solutions for combatting climate change include, among others, lowering energy consumption, insulating houses, and shifting towards plant-based diets (Sohn, Kalbar & Birkved, 2017; Huebner & Shipworth, 2017; Abrahamse & Shwom, 2018; Macdiarmid & Whybrow, 2019). Although policies aimed at these climate change mitigation measures are not at the core of the present research, they are worth noting.

Energy policy

In order to meet its renewable energy targets, the EU and its Member States need to continue expanding the generation of renewable energy (European Commission, n.d. a). To that end, the amount of energy generated by wind turbines is expected to continuously increase in the next decades (Pacesila, Burcea & Colesca, 2016). Large differences can be observed between countries' efforts to generate and consume energy from renewable sources. Germany's share of energy from renewable sources – as a percentage of gross final energy consumption – amounted to 17.4% in 2019, closing in on the 2020 target set at 18% (European Commission, n.d. b). In the Netherlands, in comparison, 8.8% of gross final energy consumption consisted of renewable energy, instead of the 14% needed to meet the 2020 target (European Commission, n.d. c). Aside from replacing energy derived from fossil fuels with renewable energy, reducing energy consumption is an important measure for diminishing GHG emissions (Huebner & Shipworth, 2017; Abrahamse & Shwom, 2018).

Biodiversity and nature

As defined by the Convention on Biological Diversity, biological diversity is “the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems” (United Nations, 1992, p.3). The concept of nature has proven to be more difficult to define. In this context, it is understood to mean “[t]he whole of material reality, considered as independent of human activity and history” (Ducarme & Couvet, 2020, p.4). Biodiversity is thus an aspect of nature. Couvet (2017) distinguishes five types of values provided by biodiversity. Firstly, biodiversity is intrinsically valuable, meaning that it should be preserved for its own sake (Couvet, 2017). An argument for this value is that “each species is important, and that species have a right to exist even if they do not benefit humans” (Berry et al., 2016, p.1747). Secondly, the provisioning value of biodiversity lies in the products it provides for humans. These products include food and natural resources for the generation of energy. The third value is cultural; biodiversity is to be valued because it is connected to religious, recreational and educational practices. Fourthly, biodiversity should be valued for the conditions it creates for humanity, the functional value (Couvet, 2017). As a part of this value, biodiversity is important in light of climate change. Isbell et al. (2015) have found that “biodiversity increased ecosystem resistance for a broad range of climate events, including wet or dry, moderate or extreme, and brief or prolonged events” (p.574). The current loss of biodiversity is thus expected to negatively impact the functioning of ecosystems (Lohbeck et al., 2016; Hautier et al., 2015; Whitehorn et al., 2019). Fifthly and finally, biodiversity’s option value describes the value it may prove to have in the future by protecting us against diseases and from ecosystems that do not yet exist (Couvet, 2017). Biodiversity thus serves multiple essential purposes.

Forest

Like renewable energy generation, forests have an important potential to mitigate climate change. Trees and other plants take up CO_2 from the atmosphere, thus functioning as carbon sinks (Naudts et al., 2016). However, due to severe deforestation between 1750 and 1850, and consequent changes in forest management, European forests are currently characterised by a carbon debt (Naudts et al., 2016). Moreover, deforestation and forest degradation pose a threat to biodiversity (Augustynczik et al., 2019). Forest conservation and sustainable forest management is thus needed, as it serves the goal of reversing the loss of forest cover and preserving biodiversity and nature. Thereby, it has the potential to contribute to forest health, reduce the loss of biodiversity, and mitigate the impact of water, air, and soil pollution (Economic and Social Council, 2017). However, unsustainable forest management and deforestation threaten forests’ capacity to mitigate climate change (Naudts et al., 2016; Longobardi et al., 2016). In this thesis, the role of forests is described in the context of wind energy generation in forests. Forests also play an important role in bioenergy generation, a type of energy generation that uses organic material such as wood chips (Gasparatos et al., 2017). The effects of bioenergy, and other energy sources – renewable and non-renewable – on biodiversity and nature, forests, and climate change are discussed in Appendix A.

1.2 Research aim and research question

The aim of this thesis is threefold. Firstly, this research aims to provide an explanation for the evolution of the current policy arrangements regarding wind energy generation in forests in the Veluwe, Wieringermeer, Thüringen, and Baden-Württemberg. Additionally, it aims to explain the similarities and/or differences between the policy arrangements in these areas. Thirdly, an approach for using the PAA framework and the nexus approach in combination is developed in this thesis. Following this research aim, this thesis addresses the research question:

What are the similarities and differences in the evolution of the policy arrangements of the nexus in the Veluwe, Wieringermeer, Thüringen, and Baden-Württemberg, and how can these similarities and differences be explained?

This research question implies four sub-questions, namely

(1) *How did the policy arrangements of the four cases evolve?;*

(2) *How can these evolutions be explained?;*

(3) *How are these evolutions similar and how are they different?;*

(4) *How can the similarities and differences be explained?*.

1.3 Scientific and societal relevance

Scientific relevance

The topic of wind energy generation in forests is relatively new in the scientific literature (Enevoldsen, 2017; Enevoldsen, 2016; Bunzel et al., 2019). As the first wind turbines in forests in the Netherlands have gone into operation in 2020, at the time of writing, little scientific literature on wind energy generation in forests in the Netherlands was found (Londo & Kramer, 2019; Kistenkas, 2009; 2012). Additionally, although the nexus approach has been applied to various policy domains (Benson, Gain & Rouillard, 2015; Rasul & Sharma, 2016; Soto Golcher & Visseren-Hamakers, 2018), the analysis of the nexus of wind energy in forests, and aspects of climate change, forest, and biodiversity and nature where relevant for wind energy in forests is novel. Finally, the combination between the nexus approach and the PAA that this thesis aims to establish is not found in scientific literature either. The current thesis thus contributes to the existing literature both theoretically and empirically.

Societal relevance

In order to fight climate change, replacing fossil fuels with renewable energy sources is of great importance. However, wind energy projects may be met with resistance. Resistance may stem from worries about changes in valued landscape as a result of the construction of wind turbines, concerns about health effects of the turbines – such as sound annoyance and disturbed sleep – and the effects they may have on certain species (van Kamp & van den Berg, 2018; Carley et al. 2020; Petrova, 2016). Resistance against wind turbines is often referred to NIMBY-ism: not in my backyard (Carley et al., 2020). As the available space for renewable energy becomes scarcer and resistance against wind turbines in visible locations persists, forests and other natural areas are being considered for wind energy generation. In order to avoid damage to forests, biodiversity, and nature, important considerations need to be made. The results of this thesis contribute to the discussion about wind energy generation in forests by providing insights in the various factors that play a role in the decisions and trade-offs that need to be made. The comparison of the cases, and the considerations that were made, may be a good starting point for future debates around this topic. Finally, this research sheds light on positive and negative correlations (known as synergies and trade-offs) between the sustainable development goals (SDGs). The seventeen SDGs describe goals that are to be achieved by 2030. Progress in one SDG may either help or hinder progress in another (Pradhan et al., 2017). SDG 7 (affordable and clean energy), SDG 13 (climate action), and SDG 15 (life on land) are relevant for the current research (United Nations, n.d.). Depending on how wind energy projects are designed, progress in SDG 7 may either pose synergies or trade-offs with the other two SDGs.

1.4 Reading guide

The structure of this research is as follows: chapter 2 provides a literature review in which wind energy and its impact on climate change, forest, and biodiversity and nature are explained. The theoretical and conceptual framework can be found in chapter 3. Chapter 4 outlines the methodology and chapter 5 provides the research findings. The conclusion and discussion can be found in chapter 6.

2. Literature review

2.1 Wind energy and its impact on climate change, forest, and biodiversity and nature

A distinction can be made between offshore wind energy generation and two types of onshore wind energy generation (Enevoldsen & Valentine, 2016). In the case of the first, wind turbines are installed on seabeds, approximately 10 kilometres from the coast (Bilgili, Yasar & Simsek, 2011). This type of wind energy generation is generally associated with the highest energy generation. The two types of onshore wind energy generation distinguished here are wind energy generation in rural areas, and wind energy generation in forests (Enevoldsen & Valentine, 2016). The focus of this research is on the latter.

Wind energy and biodiversity and nature

The effects of wind energy generation on biodiversity and nature are twofold. Firstly, wind turbines impact the lives of birds and bats. There is significant bird and bat mortality as a result of collisions with wind turbines (Firestone, 2019). Wind turbines may also cause an alteration in migratory patterns, as birds avoid the wind turbines and transmission lines (Kumar et al., 2016; Ledec, Rapp & Aiello, 2011). Wind turbines have the potential to disrupt birds' feeding and roosting patterns (Gasparatos et al., 2017). Bats too, experience fatal accidents surrounding wind turbines. These generally occur more frequently than bird collisions, as bats are attracted by the turbines (Ledec et al., 2011). Bat fatality can be caused by collision with the turbines. A second cause of bat fatality is barotrauma – which occurs when bats encounter air pressure reductions near turbines – which, among others, results in severe internal bleedings (Voigt et al., 2015).

It should be noted, however, that wind turbine collision is only one of the anthropogenic causes of bird fatality. The most common cause is domestic cat predation, associated with billions of bird fatalities annually in the United States of America alone. In comparison, collision with wind turbines accounts for hundreds of thousands of cases of bird fatality annually. Other anthropogenic causes of bird fatality include accidents and collision with building windows, cars, power lines, and communication towers (Loss, Will & Marra, 2015). The incidence of bird and bat mortality can be reduced by decreasing turbine speeds and suspending wind energy generation during migration periods (Arnett et al., 2011; Gasparatos et al., 2017).

The second effect of wind energy generation on biodiversity and nature is found in the effect of turbines and necessary infrastructure on habitats, potentially leading to habitat transformation, degradation, and loss (Firestone, 2019). As Ledec, Rapp and Aiello (2011) outline, transmission lines connect wind turbines to power demand centres. According to the regulations, "tall trees are not allowed to prevent physical interference with the lines and possible electrical shorts. When a transmission line (…) crosses forested areas, the result can be significant deforestation that incrementally adds to the project's carbon footprint" (Ledec et al., 2011, p.27). In some places, habitat transformation and deforestation result in a significant impact on unique, local species (Ledec et al., 2011).

Wind energy and forests

In forests, wind turbines need to be high enough to generate energy above treetops. For a long time, technology did not allow for tall enough turbines, but advances in technology in recent years have led to increased height, making forests suitable sites for wind energy generation (Enevoldsen, 2016). Wind energy generation in forests, however, is associated with deforestation (Ledec, Rapp & Aiello, 2011; Enevoldsen, 2016). Enevoldsen (2018) researched the impact of deforestation for the construction of wind turbines. He finds that, when the area of deforestation is limited to 1 hectare (ha), the construction of wind turbines in forests has a positive effect on wind energy's net carbon emissions. This is explained by the fact that the use of wind turbines to generate energy saves more carbon, as an alternative to fossil fuels, than the trees in that area could capture. A wind farm requiring 1 ha of space produces 9550 MWh per year. Enevoldsen (2018), assuming a set wind turbine capacity in his calculations, finds that that an increase in the felling area is not beneficial. He calculates the CO_2 savings in four scenarios, namely for 1 ha, 4.84 ha, 12.92 ha, and 23.04 ha of felling. His findings show that both after 1 and 20 years of operation the 1 ha scenario results in the largest CO_2 savings. Nevertheless, although the other three scenarios result in net CO_2 emissions after one year, they do all achieve CO_2 savings after 20 years of operation (Enevoldsen, 2018).

Wind energy and climate change

Amponsah et al. (2014) reviewed research on the life cycles of various electricity and heat generation technologies. In such life cycle analysis (LCA) research, all phases of a product's life are analysed, from the acquisition of materials to disposal of the product after its use. The authors report the minimum and maximum values of GHG emissions (Amponsah et al., 2014), expressed in CO_2 equivalents per kWh (CO_2-eq/kWh). The CO_2 equivalent is "a measure for quantifying the climate-forcing strength of greenhouse gases by normalizing for the amount equivalent to CO_2" (Hernandez et al., 2014, p.773). Their research finds that onshore wind energy generation is associated with mean emissions of 34.2g CO_2-eq/kWh (Amponsah et al., 2014, see figure 1).

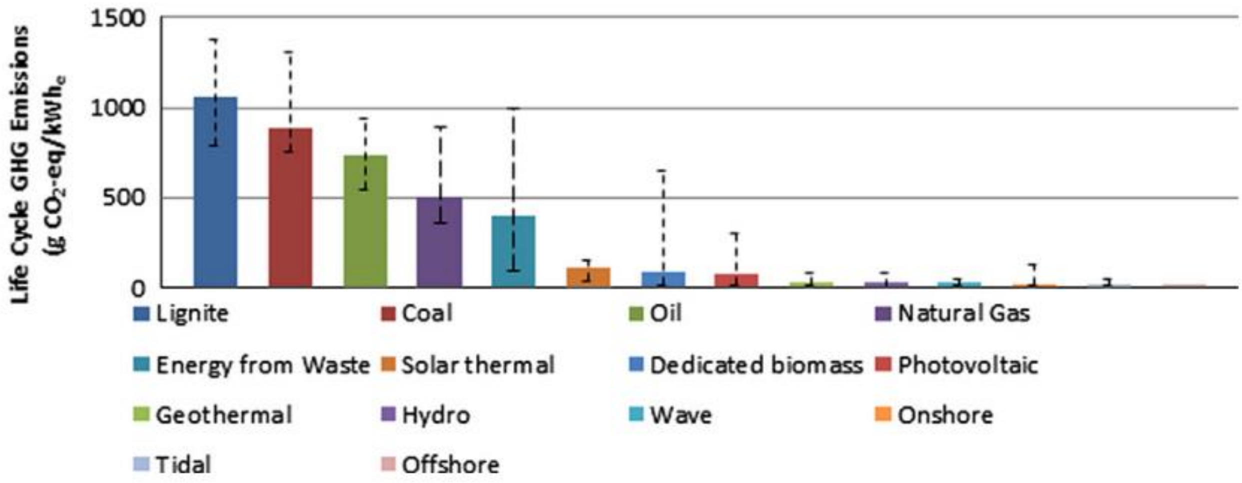

Figure 1: Life cycle GHG emissions of fourteen energy sources (Amponsah et al., 2014, p.471)

2.2 Other energy sources and their impact

Appendix A provides an overview of various sources of energy generation and the impacts these have on forests, climate change, and biodiversity and nature. The information in the appendix serves to provide a comparison between the effects of wind energy generation as well other renewable and non-renewable energy sources on these three policy domains. Together with the previous paragraph, the appendix highlights what factors policy makers may take into consideration when making decisions about energy generation sources, their location, and the consequent impacts (Chaudhary et al. 2015). From the information summarized in the appendix it can be concluded that – although renewable energy generation has some negative impacts on climate change, forest, and biodiversity and nature – these negative effects are limited compared to those caused by fossil fuels. Renewable energy generation thus remains a promising strategy for climate change mitigation.

2.3 Research approaches to wind energy in forests

The subject of wind energy generation in forests has been researched in various disciplines. The current research employs a political science lens. At the time of writing, not much research on this topic has been conducted taking the lens of this discipline. Disciplines that are represented in research on this topic include natural science, and legal approaches. The following is a summary of the research conducted in these disciplines. Although these disciplines do not play a central role in the current research, the quoted studies have informed the introduction to this thesis.

Enevoldsen (2016; 2017; 2018) employs a technical approach when studying wind turbines in forests. In his dissertation, the focus is on wind turbines in forests in Northern Europe. Enevoldsen defines the characteristics of wind energy generation in forests, outlines the risks related to the construction, operation and decommissioning of these turbines, and provides suggestions for handling these risks. Furthermore, his work includes research on the magnitude of deforestation required for turbine construction and its effects on GHG emission savings (Enevoldsen, 2018). Some of the findings of this research can be found in section 2.1.

A different disciplinary approach to the study of wind energy generation in forests is a legal approach. Akerboom et al. (2018) conducted research in five North-western EU countries to evaluate to what extent renewable energy projects adhere to EU regulation on the protection of species. The majority of the research considers wind energy, although there is no specific focus on wind energy generation in forests. A different legal approach was taken by Bunzel et al. (2019), who conducted research on the legal arrangements regarding wind energy generation in forests in Germany. The authors find that there are no national regulations regarding wind turbines in forests, as these are formulated by federal states.

A third perspective applied in research on renewable energy more generally is the ecological perspective. In most of this research, the specific issue of wind energy generation in forests is not the main interest. The focus is on renewable energy and its impacts on biodiversity and nature more generally. Still, the studied effects of wind energy on biodiversity remain relevant for the present research. Gasparatos et al. (2017) and Santangeli et al. (2015) conducted research on the effects of renewable energy on biodiversity. Gasparatos et al. (2017) find that all renewable energies discussed – solar energy, wind power, hydropower, bioenergy, ocean energy, and geothermal energy – are directly or indirectly associated with "ecosystem change and biodiversity loss" (p.174). Santangeli et al. (2015) compare the impact of bioenergy, wind energy, and solar energy on biodiversity, and find that the first "has potential to severely harm biodiversity" (p.947), whereas the impact of the latter two is much smaller.

3. Theoretical and conceptual framework

The conceptual framework adopted in this thesis is a combination of the PAA and the nexus approach, briefly introduced here and further explained in section 3.2. The PAA is a framework used to analyse stabilisation or change of policy arrangements. The framework consists of four dimensions, namely actors, discourses, resources and power, and rules of the game. In this research, a fifth dimension is added; the societal context. The nexus approach encourages integrated thinking by highlighting the influences of changes made in one policy domain on other policy domains. In the current research, the PAA and the nexus approach are combined to better understand the complex topic of wind energy generation in forests. The study object of this thesis is the policy arrangement encompassing the nexus of wind energy in forests, and aspects of climate change, forest, and biodiversity and nature where relevant for wind energy in forests. As outlined in the previous chapters, wind energy generation in forests impacts biodiversity and nature, forest, and climate change. The nexus approach allows for an integration of these interactions in the PAA analysis. Before further elaborating on the PAA and the nexus approach, relevant theories and bodies of literature are introduced in the next section.

3.1 Theoretical framework

In this section, theories and bodies of literature that are closely connected to the PAA, and the nexus approach are introduced. This is done to enhance the understanding of the PAA and the nexus approach and to illustrate their embeddedness in theory. First, they are described, and consequently, their relevance for this thesis is explained. Although not part of this research and therefore not described in this section, it should be noted that there is also a large body of literature about comparative European politics (for example Bondarouk, Liefferink & Mastenbroek, 2020).

3.1.1 Structuration theory

In his structuration theory, Giddens' (1984) makes a distinction between the individual and society, which he terms 'agency' and 'structure'. His theory developed as a critique to theories which merely focus on one of the two (Arts & van Tatenhove, 2006). These theories considered agency and structure as a dualism, meaning they are seen as independent. Giddens, however, considers them interdependent, a duality (Busco, 2009). He describes the structure as the context that is the "material and ideational conditions which define the range of actions available to actors" (Arts & van Tatenhove, 2006, p.23). Giddens also recognises agency, understood as the ability of an actor or a group of actors to influence their environment (Giddens, 1984; Arts & van Tatenhove, 2006). He describes these two not as opposites, but as a duality. Human activities are heavily influenced by their structure, which is "both constraining and enabling", thus influencing the behaviour of actors (Giddens, 1984, p.25). In a similar fashion, structure is produced by actors' behaviour (Arts & van Tatenhove, 2006).

Importance in this thesis

Actors or actor groups aim to influence the policy arrangement according to their discourses, using the resources available to them. The societal context and rules dimensions are influential for the structure in which this agency is performed. These determine the range of agents' possible actions and are in turn shaped by their actions, as it "guides[s] individuals' behaviour in contexts of co-presence" (Busco, 2009, p.254). Arts and van Tatenhove (2006) apply Giddens' structuration theory to policy arrangements and show how the theory is important for the PAA. They note that agency and structure do not influence each other in an equal manner. While structure greatly influences and constrain individuals' behaviour, the interactions between agents does not immediately lead to changes in structure (Arts and van Tatenhove, 2006).

3.1.2 Discourse theory

Discourse is a widely researched concept, authors include Foucault (1971), Hajer (2002), Habermas (1993), and Fairclough (2001). A brief description of the work by the first two authors is provided here. Foucault, one of the most prominent discourse theorists, understands discourse as "all meaningful statements or texts that have effects on the world" (Waitt, 2005, p.164). Discourse impacts how people view the world and thus how they act. A certain phenomenon is understood by observing the social construction of that topic through "utterances, representations, and written publications" (Waitt, 2005, p.170; Foucault, 1971). Discourse is thus a combination of statements, which includes (written or spoken) text, but also images or even architecture (Feindt & Oels, 2006). Foucault's understanding of discourse is focused on knowledge rather than on mere communications. Discourse shapes people's understanding of reality (Feindt & Oels, 2006). As a consequence, discourse limits how people can think of certain phenomena and constrains their actions. Discursive structures change over time (Waitt, 2005).

The following paragraph provides a brief overview of Hajer's understanding of discourse theory. The concept is widely debated, and various different interpretations exist. In this research, the interpretation of Hajer is adopted. According to Hajer, discourse should be understood as "an ensemble of ideas, concepts, and categories through which meaning is given to social and physical phenomena" (Hajer & Versteeg, 2005, p.175). Hajer stresses that discourse does not mean the same as discussion. Discourse is what can be observed as a pattern in discussions. The discussion is the object of evaluation in which the discourse can be recognised in the concepts used in the discussion (Hajer, 2002, p.64). Hajer consequently defines discourse analysis as "the examination of argumentative structure in documents and other written or spoken statements as well as the practices through which these utterances are made" (Hajer, 2006, p.66). Hajer emphasises that discourse analysis aims to uncover knowledge rather than truth. This reflects a constructivist research philosophy (see section 4.1). Constructivism does not assume that an objective truth exists. Instead, truth is relative, formed by perception and understanding. The aim of discourse analysis is not to uncover an objective truth, but rather to understand the "multiple, socially constructed realities" (Hajer & Versteeg, 2005, p.176).

Importance in this thesis

Discourse is important in the PAA is two regards. Firstly, discourse is one of the five dimensions of the PAA. Discourse in this research is understood as the meaning actors or actor groups attribute to certain notions. For instance, the ideas they have about wind energy (in forests), nature, economic development, renewable energy, impact the meaning they attribute to the topic and thus the standpoint they adopt in discussions about it. Secondly, discourse is a part of the societal context. The societal context is shaped by the way a society values, among others, economic growth, and the lives of animals that may be at risk or otherwise affected by human activity.

3.1.3 Discursive institutionalism

Discursive institutionalism is a strand of new institutionalism, which developed as a critique on (old) institutionalism. Institutions are understood as formal and informal rules and shared norms that shape the interaction between actors (Gilad, 2007). Institutionalism then, as defined by March and Olsen (2006) is "a general approach to the study of political institutions, a set of theoretical ideas and hypotheses concerning the relations between institutional characteristics and political agency, performance and change" (p.4). It focuses on institutions' structures and analyses how institutions influence individual behaviour and social processes (March & Olsen, 2006; Ochieng, 2019). New institutionalism does not isolate institutions in its research, but instead analyses the interactions between institutions and society. New institutionalism thus focuses on the two-way interplay between institutions and society, whereas (old) institutionalism merely analyses how institutions influence conduct in society (Ochieng, 2019).

New institutionalism consists of four strands, rational choice institutionalism, historical institutionalism, sociological institutionalism, and discursive institutionalism (Schmidt, 2008). The former three consider institutions static, they attribute institutional changes primarily to factors external to the institution under consideration. Discursive institutionalism instead takes note of the influence of discourse. Discourse, in this context, is defined as "formulation of idea and the communication of that idea" (Zurnić, 2014, p.217). Discursive institutionalism distinguishes itself, because it views change in institutions as dynamic, caused by "ideas and discursive interaction" (Schmidt, 2010, p.5). It thus stresses the importance of discourse, ideas and communication in changing institutions (Schmidt, 2008). Discursive institutionalism assumes that "ideas and the discourses through which they are generated and exchanged during policymaking and public deliberation, may undermine or reinforce institutions, and thereby cause change or stagnation" (Ochieng, 2017, p.9).

Importance in this thesis

Discursive institutionalism assumes that discourse is at the root of institutional change. Institutional change then is an endogenous process, influenced by the ideas and communication about them by actors involved in the institution. Institutions are "both given and contingent" (p.166), meaning that they are continuously shaped, but also pose constraints (Wahlström & Sundberg, 2018). Here, one finds overlap between discursive institutionalism and Giddens' structuration theory, as discursive institutionalism assumes that "institutions are structures, which constrain the action of actors working inside them, and which are, at the same time, created and changed by actors" (Zurnić, 2014, p.227). Therefore, institutions are both internal and external to agents, as they shape agents' ideas and are shaped by actors' communication of those ideas (Wahlström & Sundberg, 2018). In short, discursive institutionalism is a theory used to explain the role of discourse in institutional change. A way to measure discursive institutionalism is the PAA.

3.1.4 Policy arrangements approach

The PAA is used to analyse policy arrangements, which are defined as "the temporary stabilisation of the content and organisation of a policy domain" (Arts, Leroy & van Tatenhove, 2006, p.96; Liefferink, 2006). The content and organisation of a policy domain changes as actors within the domain generate and communicate ideas. The policy domain stabilises when patterns in these interactions are formed, for instance when rules are developed and a structure is formed (Liefferink, 2006). The current research focuses on the development of four policy arrangements, namely two in the Netherlands and two in Germany. The cases are introduced in section 4.6.

The PAA consist of four dimensions, namely actors, resources and power, rules of the game, and discourses. These dimensions are interconnected, meaning that a change in one also causes changes in the other dimensions (Ochieng, 2019). This interconnectedness also implies that the analysis of a policy arrangement can start from each of the four dimensions. After having determined a starting dimension, the other dimensions are analysed in light of the first dimension. In addition to the four most commonly used dimensions, the 'societal context' has been added as a fifth dimension as policy arrangements should be viewed in a societal context (Liefferink, 2006; see figure 2). Policy arrangements may be influenced by "changes in the broader social, cultural, political or economic context or in fact the physical environment" (Liefferink, 2006, p.49). In the following, the dimensions of the PAA are explained.

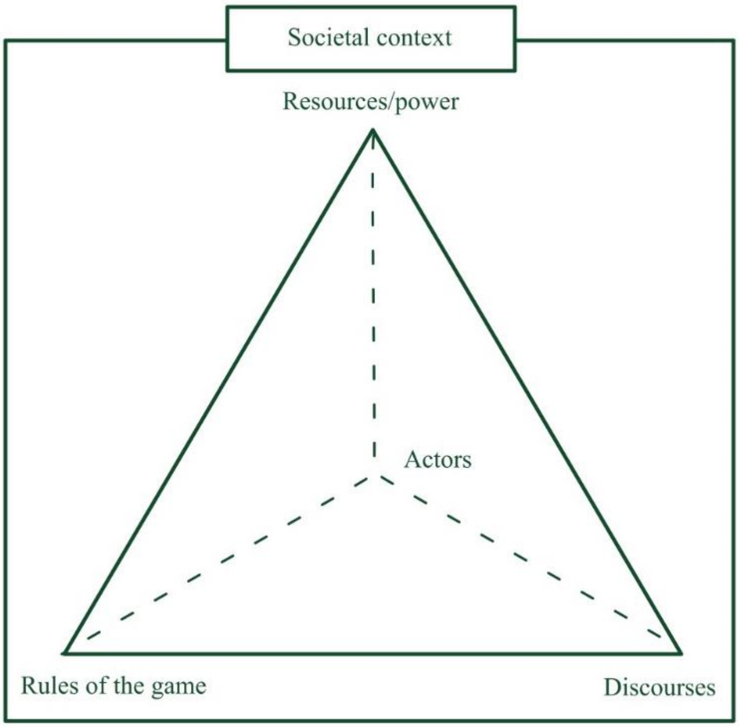

Figure 2: The Policy Arrangement Approach
(adapted from Liefferink, 2006).

The PAA dimensions

Societal context

Although the societal context is not one of the dimensions in the original outline of the PAA, it is an important factor to take into consideration when analysing change or stability in policy arrangements (Liefferink, 2006). As defined by Liefferink (2006), this context includes social, cultural, political, physical and economic factors. A change in one of those factors affects the other dimensions and therefore affects the policy arrangement. In turn, the policy arrangement affects the societal context. An example of this dimension in the context of wind energy generation in forests could be a change in the public opinion as a result of a shock, such as a natural disaster.

Actors

The actor dimension consists of "actors and their coalitions involved in the policy domain" (Liefferink, 2006, p.47). In the context of the current research, actors are the stakeholders who have been involved in the dialogue on wind energy generation in forests, have been involved in projects, and/or affected by projects. The interactions between actors are vital to the success of a policy arrangement. When analysing this dimension, the focus is therefore on interactions, coalitions and opposition in the light of achieving (shared) goals (Ochieng, 2019). Whether actors are in (dis)agreement largely depends on the discourses they represent.

Discourses

The discourse dimension describes the views, norms, and values actors hold (Liefferink, 2006). Discourses determine the view of reality an actor has and, as such, determine the way realities are debated by various actors. When discourses gain a certain coherence, they can "become institutionalised into rules" (Ochieng, 2019, p.27) and they can then "undermine or reinforce exiting institutions, and thereby cause institutional change or stagnation" (Ochieng, 2017, p.9). The actors may hold different world views or aspire different policy outcomes. The stances that stakeholders take ultimately affect the policy arrangement.

Resources and power

The dimension of resources and power refers to the "division of resources between these actors, leading to differences in power and influence, where power refers to the mobilisation and deployment of the available resources, and influence who determines policy outcomes and how" (Liefferink, 2006, p.47). Resources thus provide actors with varying degrees of power. Examples of resources include technology, money, knowledge, authority and property (Ochieng, 2019). For instance, land is a property possessed by landowners that allow them the power to influence the location of wind turbines.

Rules of the game

The rules of the game dimension entails both "formal procedures of decision making and implementation as well as informal rules and 'routines' of interaction" (Liefferink, 2006, p.47). The formal procedures entail legislation and agreements that are enforced by authorities. The informal rules consist of norms and culture. This dimension thus determines the formulation of issues, policies and decisions (Ochieng, 2019). Institutions – previously defined as formal and informal rules and shared norms – are thus also a part of this dimension. Among others, legislation about wind energy planning and nature protection, as well as approval procedures are relevant aspects of this dimension in this research.

3.1.5 Governance literature

Historically, governing was primarily done by governmental actors, thus referred to as government. Over time, a shift from government to governance can be observed. Governance literature describes the involvement of a multitude of actors on policymaking and implementation. The actors involved in governance still include actors from governments, but also include actors from businesses, civil society, or a combination of these three societal spheres (Steurer, 2013; Rhodes, 2012). The concept *governance* thus recognises the increased influence of non-state actors on society, highlighting the changing role of governments in the process of governing society. As such, it is used to analyse how and by whom societal challenges are addressed. The concept is also useful in analysing which rules guide the interactions between the involved actors (Ochieng, 2019; Stoker, 1998). The shift from government to governance can be attributed to multiple processes, among others the decentralisation of policies, stakeholder participation in policy making, and the inclusion of non-state parties in the supply of social services (Sellers, 2011; Maciel & Bock, 2013).

Importance in this thesis

Governance is closely tied to the PAA framework as a whole, as the PAA aims to explain how policy arrangements are established. In doing so, it analyses which actors influence policy outcomes, how these actors interact with one another, which rules guide these interactions and influence the policy outcomes, and which policy outcomes the actors wish to establish. In the analysis of policy arrangements, the PAA thus offers an insight in the mechanisms and actors involved in governance.

3.1.6 Integrative Governance and the nexus approach

More specifically, this thesis contributes to the literature on integrative governance. Visseren-Hamakers (2018) defines this as “the theories and practices that focus on the relationships between governance instruments and/or governance systems” (p.1392). Governance instruments are understood as policies and rules, which may be created by governments, but also by other societal actors. Governance systems, then, are the “total of instruments on a certain issue at a specific level of governance” (Visseren-Hamakers, 2018, p.1343). Integrative governance thus does not focus merely on one governance instrument, but concentrates on the relationship between instruments (Visseren-Hamakers, 2018).

Recognising the interactions between policies and rules is also at the core of the nexus approach, an emerging body of literature in the integrative governance literature (Weitz et al., 2017; Visseren-Hamakers, 2015). The nexus approach is an alternative to the focus on challenges and goals in separate policy domains (Rasul & Sharma, 2016). The approach encourages a more cohesive way of thinking about policy domains, highlighting interconnectedness (Soto Golcher & Visseren-Hamakers, 2018; World Economic Forum, 2011; Benson, Gain & Rouillard, 2015). “The nexus approach is conceived as a way to balance conflicting sectoral objectives (…), enhance resource efficiency and promote policy coherence and integration” (Soto Golcher & Visseren-Hamakers, 2018, p.1416). The goal of the nexus approach is to reduce the chance of efforts made in one policy domain negatively affecting another domain (Weitz et al., 2017). As argued by Hoff (2011), “given the interconnectedness across sectors (…), space and time, a reduction of negative economic, social and environmental externalities can increase overall resource use efficiency and sustainability” (in Benson, Gain & Rouillard, 2015, p.759-760). So far, the nexus approach has primarily been used as a theoretical or analytical concept in the governance literature, but effective translation of the concept into policy making has proven difficult (Weitz et al., 2017).

Importance in this thesis

The integrative governance and nexus literature are relevant in this research because they both highlight the interrelationships between policies. As can be concluded from section 2.1, installing wind turbines in forests has major impacts on other policy domains. The nexus is therefore defined as wind energy in forests and aspects of climate change, forest, and biodiversity and nature where relevant for wind energy in forests (as can be seen in figure 3, where the nexus is illustrated by the blue area). This nexus was chosen, because some changes in the latter three policy domains impact the wind energy in forests domain and vice versa. However, not all aspects of these domains are relevant for wind energy in forests. For example, a decision about conservation targets of a certain fish species, made in the biodiversity and nature policy domain, does not directly impact the wind energy in forests domain.

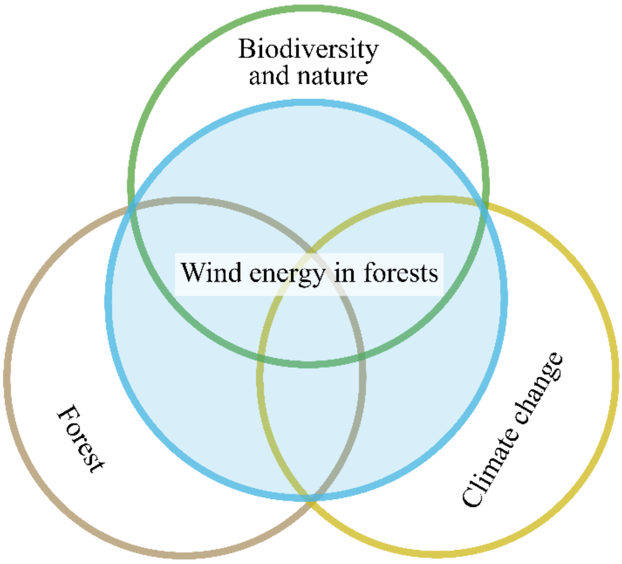

Figure 3: The nexus

The nexus is wind energy in forests and aspects of climate change, forest, and biodiversity and nature where relevant for wind energy in forests (the blue area).

3.2 Conceptual framework

The conceptual framework adopted in this thesis is a combination of the PAA and the nexus approach (see figure 4). These two approaches are combined in order to provide a complete and integrated overview of the wind energy generation in forests topic in the four cases in the Netherlands and Germany. As highlighted in the previous section and in section 2.1, the synergies and trade-offs between these policy domains are significant. So, in order to take these into account in the research, a combination of the PAA and nexus was chosen (see figure 4).

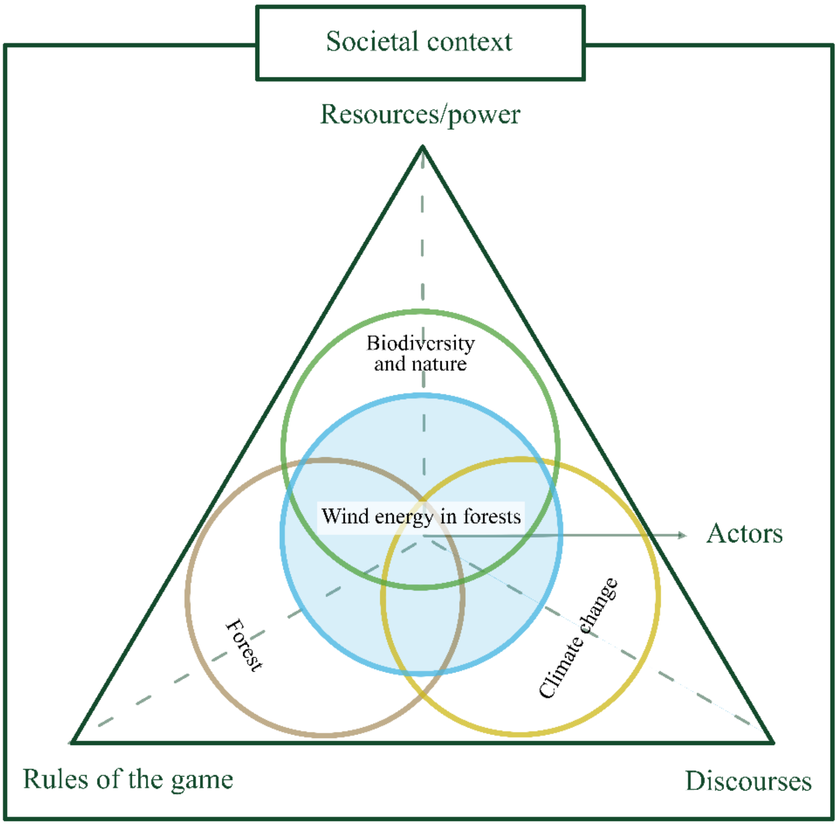

Figure 4: Integration of the nexus of wind energy in forests with climate change, forest, and biodiversity and nature in the Policy Arrangement approach.

In combining these approaches, the nexus is the subject of analysis of the PAA. Using the PAA, the evolution of the policy arrangement governing this nexus is studied. Four policy arrangements are studied in this research – namely those of Veluwe, Wieringermeer, Thüringen, and Baden-Württemberg cases. This means that for each of the four cases the evolution of the policy arrangement governing the nexus is researched. This will thus result in the analysis of four policy arrangements, one for each case.

To operationalise the five dimensions of the PAA, the indicators created by Wiering and Arts (2006) are adopted in this thesis. The authors have termed these indicators 'change indicators', measuring change (or lack thereof) in the dimensions in the PAA. In the current research the societal context has been added as the fifth dimension of the PAA. Therefore, a set of indicators for the societal context was created (see table 1). Information about some indicators (such as legislation) may be readily found by consulting documents, whereas information about other indicators (such as paradigms) can best be acquired by interviewing actors. Again other dimensions (such as power relations) are researched by a combination of these methods (more information about the research methods can be found in section 4.3).

Dimension	Change indicators:
Societal context	• **Shocks**: disturbances on a societal level (ex.: a natural disaster). • **Political developments**: changes in the administrative realm (ex.: change of (local) government after elections, or impactful political decisions). • **International developments**: developments in other countries that influence conduct on a national or local scale (ex.: wind energy generation in other countries inspired projects in the Netherlands). • **Technological developments**: innovation in technology related to wind energy in forests (ex.: developments in wind turbine design allow for wind energy generation in forests). • **Societal discourses**: dominant ways of thinking about certain topics (ex.: human-nature relationship, the energy transition, and the focus on economic growth).
Resources/power	• **Resource constellation**: "assets which policy actors have or can mobilise on the basis of which they can exercise power" (Wiering & Arts, 2006, p.330). • **Power relations**: the differences in power between actors, actors with more resources at their availability may be better able to achieve their desired outcomes.
Actors	• **Actor constellation**: the set of actors that influence policymaking, either directly or indirectly. • **Interaction patterns**: describes the way actors interact (ex.: increased or decreased interactions, and cooperative or conflictual interactions (Ochieng, 2017)).
Rules of the game	• **Legislation**: laws and policies relevant for wind energy generation (in forests), including subsidies on wind energy. • **Procedures**: mode of conducting business (ex.: once finished, zoning plans need to be made available for review by interested stakeholders). • **Political culture**: describes the way in which political procedures are handled (ex.: the Dutch polder model versus the German formal-legalistic model (Wiering & Arts, 2006)).
Discourses	• **Paradigms**: views held by individual actors. • **Utopias**: actors' ideal policy outcome. • **Policy programmes**: strategies employed by actors to achieve their ideal policy outcome.

Table 1: Overview of the PAA dimensions and their indicators (adapted from Wiering and Arts, 2006).

4. Methodology

4.1 Research philosophy

The research philosophy, or research paradigm, reveals the beliefs of the researcher about the nature of knowledge and how it can be acquired (Guba & Lincoln, 1994). Two research philosophies are adopted in this thesis, namely postpositivism and constructivism. The first, postpositivism, is a response to positivism. Positivism is a philosophy mostly adopted by natural scientists. It assumes that scientific research is to be conducted by the use of senses, mostly through experiments. The knowledge generated through this method of inquiry is consequently seen as objective; the findings are deemed true (Moon & Blackman, 2014; Guba & Lincoln, 1994). Postpositivism also adopts the view that research is objectivist, meaning that "reality exists independent, or outside, of the individual mind", but does not assume that reality can be perfectly understood (Moon & Blackman, 2014, p.1171). Whereas positivist research aims to verify hypotheses, postpositivist research strives to falsify claims (Moon & Blackman, 2014). In doing so, multiple research methods are used. The findings are then deemed to be likely true, unless proven otherwise (Guba & Lincoln, 1994). Institutional research, as conducted in this thesis, is often postpositivist research (Dryzek & Torgerson, 1993; Durning, 1999).

Additionally, a constructivist research paradigm is adopted in this thesis. Constructivism considers truth to be relative. As such, an individual's truth can change over time, as individuals gain more knowledge through their interactions with one another. This implies that individuals and groups have their own interpretation of reality and may perceive the same object in a different way than another individual does. In research, knowledge is created by the interaction between the researcher and the subject (Guba & Lincoln, 1994; Moses & Knutsen, 2012). The discourse analysis embedded in the PAA framework implies a constructivist research strategy, as this emphasizes the claim that individuals have their own understanding of reality (Lindekilde, 2014).

Although these two research paradigms hold competing claims, they are both at the core of this research. The constructivist paradigm is adopted to gain an understanding of individuals' or groups' perceptions of the issue of wind energy generation in forests. It is acknowledged that individuals or groups of individuals perceive this issue in different ways, endorsing different discourses. The postpositivist paradigm is adopted to gain an understanding of the (evolution of the) policy arrangements regarding this issue in the four cases. Thus, both paradigms are adopted throughout the research. Thereby, this research aims to formulate an objective understanding of the policy arrangements, while acknowledging that this understanding is not perfect and that the stakeholders involved in the issue create their own perception of the issue.

4.2 Research strategy

The research strategy is defined as "the overall design or logical procedure that will be followed" (van Thiel, 2014d, p.57). Van Thiel (2014d) distinguishes between four research strategies, namely experiment, survey, case study and desk research. The research strategy used in this thesis is the case study. The cases under investigation in case study research vary widely and may include people, events, policies, and projects. These cases are studied in their real-life context (van Thiel, 2014f). In this thesis, the cases under investigation are the Veluwe, Wieringermeer, Thüringen, and Baden-Württemberg. More specifically, the research strategy employed here is the comparative case study. The comparative method in case study research "explores similarities revealed in different situations or cases sharing some common element(s) while differing in others" (Knight, 2001, p.7040).

4.3 Research methods

4.3.1 Data collection

The data collection methods employed in this thesis are desk research and interviews. Thus, more than one method is used, which is referred to as triangulation (van Thiel, 2014c). Desk research is a research method in which existing data is used (van Thiel, 2014b). As a part of this thesis, readily available information in the form of policy documents, news articles, academic publications, previous studies, and project-related information will be used. Secondly, interviews with stakeholders will be conducted. These stakeholders may be nature conservation organisation representatives, residents affected by wind power plans, policymakers, researchers, and other actors. Such a wide range of actors is chosen because, as Liefferink (2006) argues, individual actors or coalitions from state, market and civil society spheres may influence the outcome of policy arrangements. The selection of the interviewees happens as a result of the desk research, meaning a purposive sample is created. The interviewees are selected on the basis of their involvement in the research subject (van Thiel, 2014c). The number of interviews is determined by the point of saturation, meaning that no more interviews are scheduled once it becomes clear that interviews no longer generate new information. The interviews for the Dutch cases, as well as one interview for the Baden-Württemberg case, were conducted in Dutch. The interviews for the German cases were conducted in a mix between English and German. The transcriptions of the interviews that were (partly) conducted in German are translated to English. Many of the analysed documents are also written in Dutch or German. Some quotes in chapter 5 are translations from either of these languages to English. The quotes are translated by the author. Interviewees are referred to by their position and the organisation they work for. They are cited by referring to the number they are assigned in the overview in appendix D. A total of 19 interviews were conducted, and four stakeholders answered the interview questions in written form via email.

4.3.2 Data analysis

In this thesis, data analysis is organized by recording the interviews, transcribing them and saving them in a separate folder. Then, van Thiel (2014a) suggests data reduction, in which the researcher "does a so-called quick scan per data unit (which can be an interview transcript, a text or an image), and selects the data or parts thereof that will be included in the analysis" (p.143). The research aim, research question, and conceptual framework guide this process of data reduction. To this end, the data is coded using the codes in the code book (appendix E). The analysed documents – such as websites, policy documents, and publications – are organised in separate files. Five such files are created, namely one for each case, and one for information pertaining to both German cases. A separate file for Germany is created, as important recent developments have taken place on a national. The information in each of these documents is arranged according to the dimensions of the PAA and the nexus. Similar data reduction is conducted for the interviews. The most important statements of each interview are copied into one of the summary documents described above. This process creates an overview per case of the information gathered from both the interviews and desk research.

4.4 Validity and reliability

The validity of research consists of internal and external validity. The former refers to the question of whether the correct effects were measured to answer the research question. External validity is concerned with the question of "the extent to which a study can be generalized" (van Thiel, 2014c, p.49). External validity thus asks if the conclusions of the research also hold for similar cases. Validity of research is ensured by choosing appropriate instruments and selecting the right sample (van Thiel, 2014a). Reliability of research is determined by the accuracy and consistency of measurement. The reliability thus depends on the precise execution of the research. The accuracy component of reliability is fulfilled when appropriate instruments are used, and the correct variables are measured. The second component, consistency, is achieved when a research can be duplicated (van Thiel, 2014a). This entails that "under similar circumstances the same measurement will lead to similar results" (van Thiel, 2014c, p.48). In this thesis, the validity and reliability are ensured by carefully documenting the steps that were taken during the research, by choosing measurement instruments that are suitable for answering the research question, and by consulting with professionals and peers. These steps ensure that the resulting research is valid and reliable and can thus be duplicated.

4.5 Ethics

Rules for research ethics dictate that interviewees' responses are handled respectfully, in a manner agreed upon between the researcher and the interviewee (van Thiel, 2014e). In this thesis, the anonymity of interviewees can only partially be ensured. When analysing the policy arrangements, it is sometimes necessary to provide information about the occupation or role of the participant, in order to analyse the views of different actors. Interviewees are therefore referred to by the organisation they represent and the position they hold within the organisation (see appendix D). Additionally, prior informed consent is important requirement to assure adherence to ethical rules (van Thiel, 2014e). In this thesis, informed consent is assured by sending interviewees an information sheet prior to the interview which, among others, informs them that the interview is recorded (see appendix B). Upon positive response, a date for the interview is agreed. All interviews are conducted and recorded using web conferencing software Webex. Before the start of the recording, the interviewee is once again asked for their consent for recording the interview. The interviewee is also informed that the recording is only used for transcription and is not shared with others. After the interview, the next steps are discussed with the interviewee. They are explained that the transcription of the interview will be shared with them. So, participants are able to read and comment on the transcription of the interview. They are also informed if a direct quote from the interview is included in the research.

4.6 Introduction to the cases

As stated above, the research strategy employed in this thesis is the comparative case study. There are four cases under consideration. Two cases are located in the Netherlands: the Wieringermeer in the province of Noord-Holland, and the Veluwe in the province of Gelderland. The other two cases are states (*Bundesländer*) in Germany: Baden-Württemberg and Thüringen. Figure 5 shows the four cases on the maps of the two countries.

Figure 5: Overview of the four cases in the two countries (map not to scale)

<u>The Netherlands</u>

In the Netherlands, four wind turbines are operational in the Robbenoordbos (Wieringermeer) at the time of writing. This case was chosen, as these four turbines, which are part of the Prinses Ariane Windpark, are the first wind turbines in forests in the Netherlands (Vattenfall, 2020). The second Dutch case in the Netherlands is the Veluwe. The potential for wind energy generation in the surroundings of this nature area were first researched in 2016 (Wing et al., 2016).

Germany

In Germany, the regulations on wind energy generation in forests are not formulated at the national, but at the state level (FA Wind, 2021b). Therefore, two cases were chosen in Germany, one state in which wind energy generation in forests is permitted and one in which it is not. Figure 6 provides an overview of which states allow wind energy generation in forests. Thüringen was selected as a case, because of recent developments surrounding legislation for wind energy generation in forests. Since December 2020, wind energy generation in forests is no longer allowed in the state (Haak, 2020). The second case in Germany, the state of Baden-Württemberg, does allow wind energy generation in forests. This state was chosen, because, on contrast to the legislation in Thüringen, wind energy generation in forests has continuously been allowed. Furthermore, the author has connections in this state, and turbines can be observed in forests when visiting the state. In this state, 334 of 779 turbines are located in forests (FA Wind, 2021b; BWE, 2020).

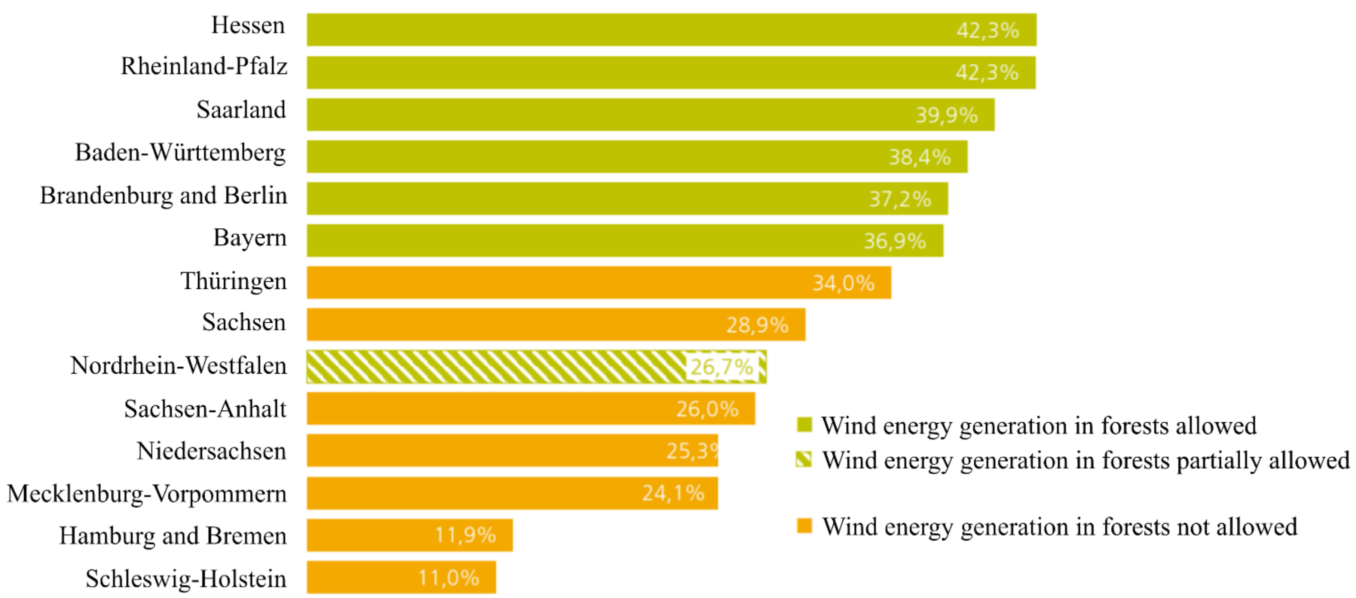

Figure 6: Forest cover (as % of state area) and the legal status of wind energy generation in forests per state (adapted from FA Wind, 2021b).

5. Results

5.1 Dutch cases

Although the policy arrangements in the Veluwe and the Wieringermeer cases are characterised by a different development process, the PAA dimensions of these cases have some important similarities. This chapter therefore starts by analysing the similarities within the PAA dimensions of both cases. Consequently, the development of the policy arrangement of each case is explained.

5.1.1 Societal context

According to interviewees, limited visibility of turbines and land scarcity are two important reasons for considering wind turbine installation in forests. Suitable sites for wind energy generation – especially considering various other spatial uses, like agriculture, housing, and transportation – in the Netherlands are scarce (interviewee 2, 4, 7 & 8). Furthermore, forests are seen as potentially suitable sites, because the plants are not as visible as in open landscapes (interviewee 1, 4 & 7). Two interviewees (7 & 9) quote experimentation, and the accumulation of information about environmental effects as important reasons for considering wind turbines in forests. Additionally, the development of wind energy generation in other European countries have contributed to the wish to also start a project in the Netherlands (interviewee 9). About the Veluwe case, an interviewee involved in the preparatory research remarked: “we advised to […] install one or two turbines on the Veluwe, and monitor the effects. […] If you start now and monitor it for 10 years, by 2030 you will know if we should focus on wind energy generation in forests or not, because you have conducted research for 10 years” (interviewee 7).

5.1.2 Rules of the game

A number of national agreements have been important in the development of the policy arrangements of the two Dutch cases. Table 2 summarises the agreements that have been most influential in the Wieringermeer and Veluwe cases, providing information about involved actors, the year of publication, and the agreement’s targets. The subsequent paragraph briefly expands on the agreements and highlights their importance for the cases.

Agreements	Involved actors	Year of publication	Target(s)
Energy Agreement for sustainable growth (*Energieakkoord voor duurzame groei*)	47 parties, including national and provincial governments, nature organisations, energy associations and companies, municipalities, transport companies, and grid operators.	2013	6000 MW wind energy on land by 2020, divided into provincial targets: • Noord-Holland: 685.5 MW. • Gelderland: 230.5 MW (SER, 2013; RVO, 2019a; Rijksoverheid, 2014).
Paris Agreement	198 UNFCCC parties.	2015	Limit "global warming to well below 2, preferably to 1.5 degrees Celsius, compared to pre-industrial levels" (UNFCCC, 2021, para.2). This goal has been translated into NDCs.
National Climate Agreement (*Klimaatakkoord*)	National and provincial governments, municipalities, NGOs, nature organisations, energy associations and companies, municipalities, transport companies, and grid operators (Voortgangsoverleg Klimaatakkoord, 2020).	2019	Translation of the Paris Agreement for national implementation; 49% reduction of GHG emissions by 2030 (compared to 1990) and climate neutrality by 2050. These goals are adopted and increased by the provinces: • Noord-Holland: 49% reduction of GHG emissions and climate neutrality by 2030 (Provincie Noord-Holland, 2020). • Gelderland: 55% reduction of GHG emissions by 2030 and climate neutrality by 2050 (Provincie Gelderland, 2020).
Regional Energy Strategy, RES (*Regionale Energie Strategie*), draft.	30 RES regions, consisting of one or more municipalities working together with the provincial government, nature organisations, water authorities (*waterschappen*), research agencies and consultancy firms, and energy associations and companies.	2020	The RES regions started preparations in 2018, with the goal to achieve 35 TWh renewable energy on land by 2030 (a goal outlined in the climate agreement).
RES 1.0	Same as for the draft RES.	2021	Final plans of each RES region to implement renewable energy projects on their territory.

Table 2: Relevant agreements in the Netherlands.

The Energy Agreement has been important for the Wieringermeer case, as the Prinses Ariane Windpark contributes to the provincial goal specified in the agreement (SER, 2013; Rijksoverheid, 2015). On an international level, the Paris agreement played a vital role for all four cases in this research, as it led to the formulation of national emission reduction and renewable energy generation goals (see section 1.1; Bodansky, 2016). The national climate agreement specifies and elaborates on these goals in a national context (Rijksoverheid, 2019a). In order to realise the renewable energy goal outlined in the climate agreement, 30 energy regions have been created. In 2020, each of these regions published the draft version of their RES. The RES have been especially influential in the development of the policy arrangement in the Veluwe case. The RES regions (see figure 7) consist of one – in the case of RES regions Goeree-

Overflakkee, and Hoeksche Waard – or more (up to 29) municipalities (Nationaal Programma RES, n.d. b). In contrast to the wind energy target in the Energy Agreement, the renewable energy target in the Climate Agreement is not divided into sub-targets for the RES regions. Instead, the regions are expected to evaluate the feasibility in their area, and define feasible energy generation targets. Evaluation by PBL (2021) of the draft strategies concluded that the national target was surpassed by 17.5 TWh. The RES 1.0, published in July 2021, outlines the formal decisions made about renewable energy generation in each of the RES regions. The proposed renewable energy generation of all the RES 1.0 add up to approximately 55TWh, significantly more than the envisioned 35TWh (Nationaal Programma RES, 2021). From here on, the RES will be updated every two years (PBL, 2021).

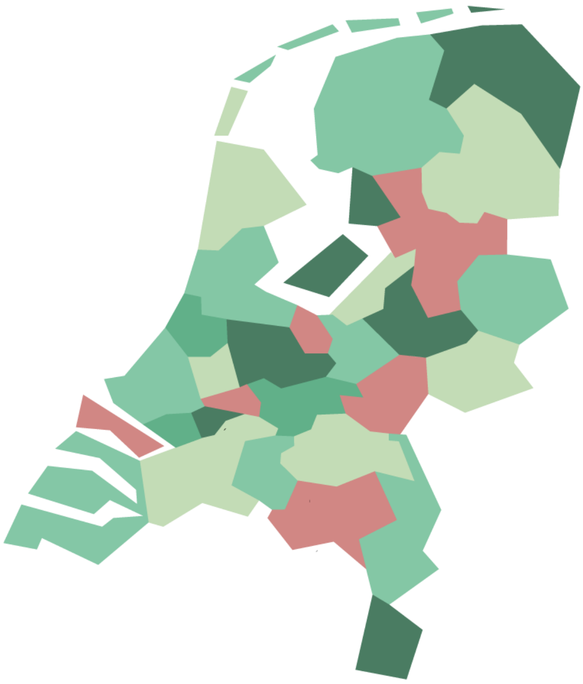

Figure 7: Overview of the 30 RES regions.
(NVDE, 2020).

A number of laws and strategy documents have been influential in the two policy arrangements of the Dutch cases. An overview of these documents is provided in table 3. Like table 2, this table does not provide a complete overview of all laws and strategies that influence wind energy in forests in the Netherlands, but instead highlights laws and documents that have been found – through the data collection methods – to be especially relevant in the two Dutch cases presented here.

Laws and strategies	Year of publication	Contents
Birds Directive and Habitats Directive, together forming the Natura 2000 network.	1992	"Natura 2000 sites have been designated specifically to protect core areas for a sub-set of species or habitat types listed in the Habitats and Birds Directives" (European Commission, n.d. d, para. 1).
Nature Protection Act (*wet natuurbescherming*)	2017	Protection of animals and plant species (Rijksoverheid, n.d. c), includes: • NNN (*Natuurnetwerk Nederland*) • Natura 2000 (RVO, 2021).
Environmental Management Act (*Wet milieubeheer*)	1979	The act determines how the environment is to be protected. It includes legislation about silent areas (*stiltegebieden*), which are assigned and managed by the provincial government (Atlas Leefomgeving, n.d.).
Climate Law (*klimaatwet*)	2020	Enshrines the national Climate Agreement (see table 2) in law (Rijksoverheid, 2019b).
Nature-inclusive Energy Transition for Wind and High Voltage on Land	2020	The document provides guidelines for combining wind energy and transmission line expansion with nature and species protection (Nationaal Programma RES, n.d. a).
Forests' Strategy (*bossenstrategie*)	2020	Strategy document outlining ambitions for 2030, for the sake of strengthening both nature conservation and climate goals (Rijksoverheid, 2020).
Surroundings Act (*omgevingswet*)	2022	Simplifies processes for spatial projects by combining 26 laws and multiple regulations (Rijksoverheid, n.d. b).

Table 3: Relevant laws and strategies in the Netherlands.

Natura 2000 sites are selected by EU member states, based on criteria for species protection and habitat maintenance or restoration as part of the two directives. For each Natura 2000 site, member states are to formulate conservation objectives for each species or habitat type (European Commission, n.d. d; European Commission, 2012). This legislation is especially important in the Veluwe case. The Veluwe is a Natura 2000 site and the conservation objective for the honey buzzard – protected under the Birds Directive – prevents large scale wind energy generation on and around the Veluwe (Altenburg & Wymenga, & Sovon, 2020). European Natura 2000 goals are transposed in national legislation in the Nature Protection Act. The province is executive authority for this law, meaning that it bears responsibility for the conservation objectives for Natura 2000 areas in their jurisdiction (interviewee 5; Rijksoverheid, n.d. a). This act also includes the NNN, a national network of protected nature areas in the Netherlands (Provincie Noord-Holland, n.d. a; RVO, 2021). The Environmental Management Act is relevant for the Wieringermeer case, as wind turbine construction here affects a silent area in the forest (Rijksoverheid, 2015). The climate law has been important in the Veluwe case, as the RES are one of the efforts to meet its objectives. The law gives the goals outlined in the climate agreement a legal foundation (Rijksoverheid, 2019b). An agreement based on the 'Nature-inclusive Energy Transition for Wind and High Voltage on Land' document is expected in 2021. This will likely have implications for future projects for wind energy generation in forests and other nature areas (Nationaal Programma RES, n.d. a). Ambitions in the Forests' Strategy include increasing forest cover by 10% compared to 2017, and improving forest quality. The document also briefly introduces the idea of planting new forest in combination with constructing wind turbines (Rijksoverheid, 2020). This is considered a linking opportunity (*meekoppelkans*). Such opportunities aim to create win-win situations by using available space for multiple purposes (interviewee 2 & 5; Nationaal Programma RES, n.d. a). Finally, the Surroundings Act is a law that aims to simplify application and approval procedures for spatial projects, such as building houses, or constructing energy generation plants. The law also aims to shorten approval procedures, and enhance participation by involving citizens at an earlier stage (interviewee 3; Rijksoverheid, n.d. b).

5.1.3 Actors

Actor group	**Wieringermeer**	**Veluwe**
Governments	• European Union • National government • Province of Noord-Holland • Municipality of Hollands Kroon (formerly municipality of Wieringermeer)	• European Union • National government • Province of Gelderland • Municipalities in Gelderland involved in RES regions
RES regions	N.a.[1]	• Noord-Veluwe • Food Valley • Cleantech • Arnhem-Nijmegen
NGOs	• Natuurmonumenten • Natuur en Milieufederatie Noord-Holland	• Natuurmonumenten • Natuur en Milieu Gelderland
Grid operators	Liander	Liander
Landowners	Staatsbosbeheer	N.a.[2]
Energy companies	Vattenfall	N.a.[2]
Wind turbine owners	• ECN (*Energieonderzoek Centrum Nederland*) • Vattenfall • Windcollective Wieringermeer	N.a.[2]
Consultancy and research firms	• Pondera Consult • Bureau Waardenburg	• Sovon • Wing • Altenburg & Wymenga
Energy related interest groups	• Energie Samen • NLVOW (*Nederlandse Vereniging Omwonenden Windturbines*)	• Energie Samen • NLVOW (*Nederlandse Vereniging Omwonenden Windturbines*)
Citizens	Local residents, and others who are interested in or concerned about wind energy generation in forests.	Local residents, and others who are interested in or concerned about wind energy generation in forests.

Table 4: Overview of important actors involved in wind energy projects in forests in the Netherlands.

[1] The RES were developed during the construction of the windfarm in the Wieringermeer and thus did not play a role in the development of the policy arrangement of this case.
[2] As of yet, no concrete plans for wind turbine installation have been made in the Veluwe case. As a consequence, no energy companies, landowners, or wind turbine owners are involved in this case.

5.1.4 Resources and power

Table 4 provides an overview of the actor groups involved in the policy arrangements of the two Dutch cases. Here, their role, and the resources and power of those actors are described. There is no clear consensus among the interviewees about power relationships. Some interviewees argue that there are important power differences (interviewee 3, 4 & 8), whereas others did not explicitly make such claims.

Governments play a vital role in the policy arrangements of both cases, as they have a leading role in drafting and enforcing legislation, and coordinating agreements such as the energy agreement and the national climate agreement. For instance, municipalities and provinces coordinate the RES together. They try to involve a large range of other actors in the process, such as consultancy and research firms, NGOs, and citizens (interviewee 5). Furthermore, as they are authorised to grant permits, municipalities (for projects smaller than 5MW), provincial governments (5-100 MW), and the national government (> 100 MW) have a decisive influence on the approval of wind energy projects (RVO, 2019b). Furthermore, the land that is considered for wind energy generation in the two cases is primarily owned by governments or semi-governmental organisations. In the Veluwe case (see section 5.2), wind energy generation was considered on state-owned grounds along highways (interviewee 6). In the Wieringermeer case, turbines have been built on grounds owned by Staatsbosbeheer. Although the organisation is no longer part of the government, it does manage public property and thus aims to facilitate the societal objective of generating renewable energy (interviewee 1).

NGOs are often consulted in plans affecting nature areas (interviewees 2, 3 & 8). Nevertheless, interviewee 8 argues that the organisations' knowledge about forests, biodiversity, and nature could be put to better use when planning wind energy projects in forests or other nature areas, by involving them more extensively in the discussion. Aside from advising governments or energy companies, NGOs like the Natuur en Milieufederaties and Natuurmonumenten also have a lot of consultations and meetings with each other (interviewee 3 & 8).

Liander operates the grid in Gelderland, Noord-Holland, and three other provinces (Liander, 2021). They are responsible for connecting new renewable energy projects to the grid. An interviewee emphasized the influential role of grid operator Liander. Renewable energy projects call for a reinforcement of the power grid. However, Liander is careful with establishing such reinforcement, because under the current electricity law, grid operators risk a fine if the grid is reinforced, but the renewable energy project is not accomplished. Simultaneously however, projects rely on grid reinforcement (interviewee 8; ACM, 2021).

Landowners are also ascribed an influential role (interviewee 2, 3, 8 & 9). They are contacted when opportunities for wind energy generation on their land are explored. They thus play a decisive role in the location selection; if they do not want a turbine on the land, the project cannot be realised on that location (interviewee 9). For instance, Natuurmonumenten has made the decision to not allow wind turbines on their land (interviewee 2).

Energy companies, such as Vattenfall, search for suitable wind energy sites themselves, or are approached to make an offer for a new windfarm (interviewee 1). Energy cooperatives are collectives of citizens who run a renewable energy project together. Interest groups represent certain actor groups. Two important interest groups in the two Dutch cases are Energie Samen and the NLVOW (*Nederlandse Vereniging Omwonenden Windturbines*). Energie Samen is a national interest group representing local energy cooperatives, advocating for widespread opportunities for citizens to participate in and benefit from renewable energy projects (Energie Samen, n.d.). NLVOW represents the interests of citizens living in close proximity to wind turbines (interviewee 4). Consultancy and research firms are hired to conduct research on the envisioned windfarm, with regards to financial feasibility, and impact on local nature and biodiversity (interviewee 6 & 7).

There is no clear consensus about the power of citizens among the interviewees. Many interviewees stress that citizen involvement is important for acceptance of a wind energy project (interviewee 2, 3, 4, 5, 7, 8 & 9). According to some, the influence of citizens on wind energy projects should be greater (interviewee 3 & 4). They suggest that citizens should be involved in projects at an earlier stage, as now their participation is limited to either agree with, or object to projects – by means of large scale protesting, or by object to zoning plans at the Council of State (*Raad van State*) – in late stages of project development. Some citizens feel that they are involved only after the most important decisions have already been made and their input mostly consists of, as an interviewee phrases it, “signing at the bottom of the page” (interviewee 6). On the other hand, this interviewee also ascribed citizens an influential position, arguing that it is hard to realise a project if citizens are strongly against it (interviewee 6).

5.1.5 Discourse

Through interviews, two types of discourses have been identified, namely discourses on wind energy in forests, and discourses on decision making. The first type consists of three discourses, namely (1) the discourse of opportunity, (2) the discourse of careful evaluation, and (3) the discourse of exclusion. The discourses on decision making consist of (1) local approach, and the (2) supra-regional approach. Furthermore, whereas most organisations ascribe to one discourse, there is division among individuals within others. For example, within Staatsbosbeheer some employees identify with the opportunity discourse, whereas others are more prone to the careful evaluation, or even the exclusion discourse (interviewee 1).

Discourses on wind energy in forests

Opportunity

Some actors focus on the need to realise wind energy on a large scale. They see wind energy generation in forests as an opportunity (interviewee 1, 5, 6 & 9). Wind turbines generate a large revenue stream for landowners. Landowner Staatsbosbeheer, for instance, sees wind energy generation on their land as an opportunity for restoring and enhancing forest quality and biodiversity by using the revenues of the wind turbines to this end (interviewee 1 & 9). The organisation calls this linking opportunity 'nature wind' (*natuurwind*) (interviewee 1). Another example of such an opportunity is creating new forests in combination with wind turbines, as outlined in the Forests' Strategy. This discourse is thus characterised by a dominant focus on generating renewable energy, which may come with benefits in other policy domains.

Careful evaluation

The discourse of careful consideration is represented by a set of actors who prefer to place wind turbines elsewhere, but acknowledge that spatial scarcity in the Netherlands may result in wind power projects in forests (interviewee 3, 4, 5 & 8). These actors are willing to contribute their knowledge and resources to these projects, but stress the importance of research, monitoring, and compensation for biodiversity. The Natuur en Milieu federations in Noord-Holland and Gelderland represent this discourse. They are not fundamentally against wind turbines in forests, as they recognise that the "problem is so acute, that we cannot exclude certain locations upfront" (interviewee 3). The organisations do argue against wind energy generation in valuable nature areas, like forests that are part of Natura 2000 or the Gelders Natuurnetwerk. This discourse is thus characterised by discussion and favours case by case evaluation over generic rules.

Exclusion

The discourse of exclusion is primarily characterised by Natuurmonumenten (interviewee 2). Interviewees from Natuurmonumenten and the Natuur Milieu federations also indicate that some smaller, local nature conservation organisations and individuals they collaborate with represent this discourse (interviewees 2, 3 & 8). Advocates of this discourse argue for clustering of wind turbines in industrial locations, for replacing older wind turbines with newer, more cost-effective models, and for installation of solar panels on empty rooftops. As the interviewee from Natuurmonumenten said: "there is no need to solve the climate crisis by aggravating the biodiversity crisis, there are smarter and better alternatives" (interviewee 2). This discourse considers forests and other nature areas unsuitable sites for wind energy generation.

Discourses on decision making

Local approach

The local approach discourse is represented by those who believe that renewable energy plans can best be made on a local level. The approach can currently most prominently be observed in the RES regions. The regions, formed in 2018, take a local approach to the national renewable energy target. The National Programme supports the RES regions, connects them to one another and to the national government. Even though the approach is local, interactions and collaboration between the regions is encouraged (Nationaal Programma RES, n.d. c). This discourse is characterised by a focus on a local approach to opportunities and motivation for renewable energy projects in the region.

Supra-regional approach

The supra-regional approach discourse is primarily represented by actors who have concerns about the effects that wind energy projects have on biodiversity, like nature conservation NGOs (interviewee 8). They emphasize that the cumulative effects of wind energy projects on nature should be well considered in decision making processes (interviewee 2). Therefore, some actors advocate for a supra-regional approach – for instance on a province level rather than a RES level – when selecting suitable wind farm locations (interviewee 8). This discourse is characterised by an emphasis on a large-scale approach to renewable energy projects, by considering suitable sites and sources on a supra-regional level.

5.2 Veluwe

The Veluwe is a nature area in the Netherlands, consisting of approximately 1,000km^2 forests, heath, and sandy landscapes. The area is located in Gelderland, a province in the eastern part of the Netherlands (see figure 5; ANWB, n.d). The site is a Natura 2000 area with conservation objectives as part of the Habitats Directive (19 habitat types and 7 habitat species) and the Birds Directive (10 bird species) (Ministerie van Landbouw, Natuur en Voedselkwaliteit, n.d.). In the policy arrangement of this case, the conservation objective for the honey buzzard (see figure 8) is especially important. This bird of prey breeds in forests, and can be found in multiple European countries. The honey buzzard resides and breeds in the Netherlands from April till September (outside the Veluwe also in Drenthe and Noord-Brabant), and spends winters in sub-Saharan Africa. The bird is active in an area of approximately 30km^2 (Ministerie van Landbouw, Natuur en Voedselkwaliteit, n.d.; Nijssen et al., 2019).

Figure 8: The honey buzzard (pernis apivorus)
(Eaglewatch, 2021)

Societal context

The province of Gelderland aims to be climate neutral by 2050, as expressed in the province's Climate Agreement (Provincie Gelderland, 2020). To this end, various projects for wind energy generation were proposed in the province. Three studies – performed in preparation for these projects – flagged interference with Natura 2000 objectives. Two other studies analysed the feasibility of wind energy generation along the highways A28 and A50, primarily on land owned by Rijkswaterstaat (Altenburg & Wymenga, 2020; Altenburg & Wymenga, & Feddes/Olthof, 2019; interviewee 6). Additionally, an explorative study published in 2016 analysed the legal-ecological feasibility of wind energy generation on the Veluwe (Wing et al., 2016). All three studies highlight the risk of interference of wind turbines with the Natura 2000 conservation objective for the honey buzzard on the Veluwe. The Veluwe spans across four RES regions, namely Noord-Veluwe, Food Valley, Cleantech, and Arnhem-

Nijmegen (see figure 9). Therefore, in preparation for the RES 1.0, the four RES regions and the provincial government discussed options for wind energy generation in the province, and requested Altenburg & Wymenga and Sovon (2020) to investigate the possibilities for wind energy on and around the Veluwe.

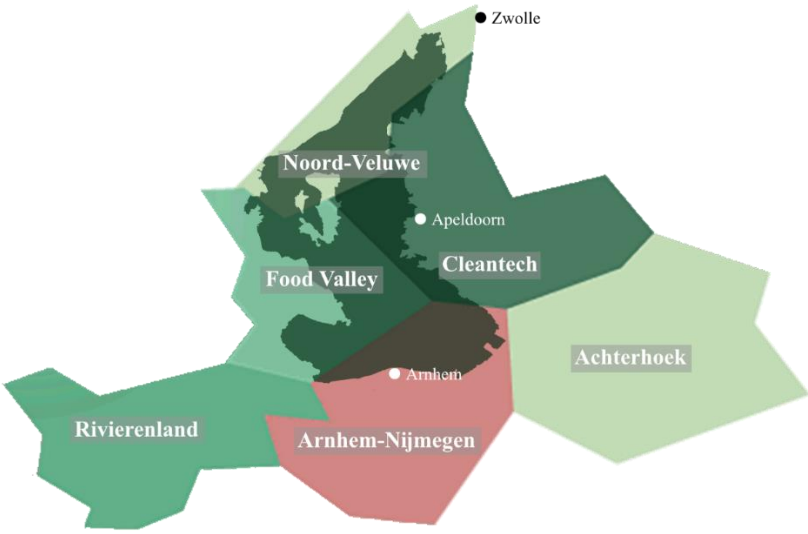

Figure 9: RES regions in the province of Gelderland with the Veluwe in dark green (adapted from RES in beeld, 2021; Partij voor de Dieren Gelderland, 2018).

<u>Rules of the game</u>

Natura 2000 targets for the honey buzzard call for a conservation objective of 100 breeding pairs on the Veluwe (average over multiple years) (Ministerie van Landbouw, Natuur en Voedselkwaliteit, n.d.). The investigation by Altenburg & Wymenga and Sovon (2020) confirmed the influence of wind energy plans on the conservation objective of the honey buzzard. Currently, an estimated 94 pairs are present on and around the Veluwe, meaning that the conservation objective is not being met. Research concludes that on and up to one kilometre around the Veluwe, wind energy generation would have such a large negative impact on the honey buzzard, that it would essentially eliminate any possibility for wind energy generation in the larger area around the Veluwe. Up to 8 kilometres around the Veluwe, on the other hand, some wind energy projects may be possible. As the honey buzzard forages in a larger area, the research focused on the potential for wind energy generation up to 8 kilometres around the Veluwe (see figure 10). When accounting for existing and planned projects that have already been granted a permit – the conservation objective for the honey buzzard limits the number of turbines in the 8 kilometre zone to 4-11 turbines (up to 9-22 turbines if turbine operation is paused in August, when honey buzzards forage outside of the Veluwe). These numbers are in stark contrast with the 70-80 wind turbines the RES regions collectively envisioned in this area (Altenburg & Wymenga, & Sovon, 2020).

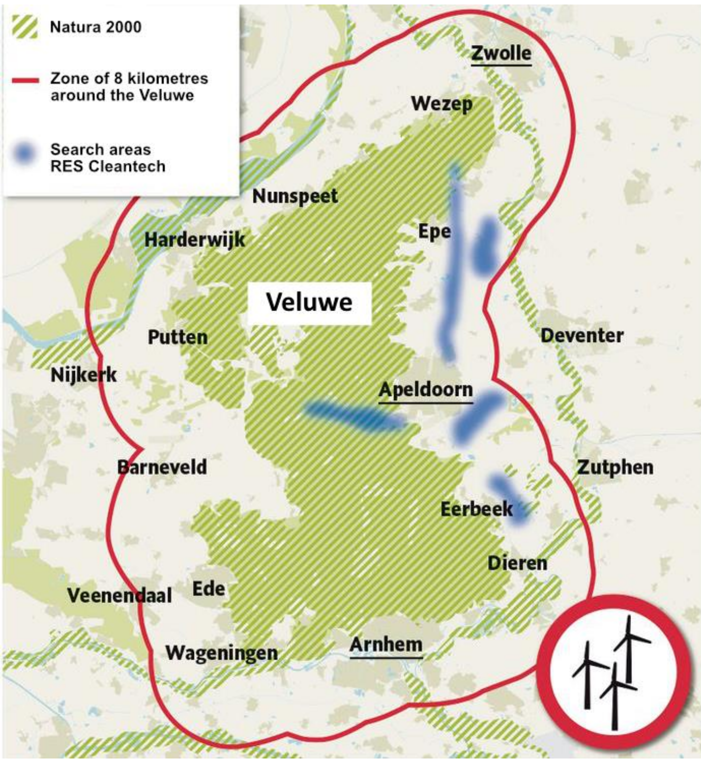

Figure 10: Zone of influence of the honey buzzard: up to 8 kilometres outside of the Veluwe. The search area of the Noord-Veluwe, Food Valley and Arnhem-Nijmegen RES regions are not shown in this image (adapted from Megens, 2021).

Actors

The research was requested by the four RES regions, as the provincial government and involved municipalities bear responsibility for designing the RES. In the process, the parties discussed and consulted with a wide variety of stakeholders, such as energy cooperatives, energy companies, and research institutes (interviewees 5 & 6). Nature conservation NGOs were also consulted during the investigation, and will play a role in the continuation of the process (interviewee 6).

Resources and power

Interviewees (2, 5, 6 & 8) highlight that the province and RES regions play an important role in the development of the policy arrangement. As a member of the energy transition team of the province of Gelderland explains: “in the RES, the province is on equal footing with other stakeholders in the discussion, but when talking about installing wind turbines on such a scale, we are the competent authority” (interviewee 5). So, even though the municipalities and other stakeholders – such as nature conservation NGOs – have gained a formal seat at the table through the RES process, the province remains responsible for executing the nature protection act, and grants permits for large wind farms (interviewee 5; RVO, 2019b). The provincial government is thus responsible for upholding the Natura 2000 conservation objective for the honey buzzard. The European Union is also mentioned as a powerful actor in the matter (interviewee 6). A stakeholder from the province explains: “we carry out European legislation, for example Natura 2000 […] we carry out the legislation, but we cannot change it. Then you would have to go to Europe” (interviewee 5). A smaller influence is ascribed to NGOs concerned with nature conservation (interviewee 8). In this preparatory stage – there are no concrete projects in the area at the time of writing – citizens are not yet actively involved (interviewee 6).

More research will be conducted before decisions about wind energy generation on and around the Veluwe will be made (interviewees 5 & 6). So, one could argue that all options are explored in an effort to start generating wind energy in the area. Two research projects are envisioned; one study should determine the honey buzzard’s ability to avoid collision with wind turbines, and a second study will establish if there are locations in the 8 kilometre zone where the species does not forage at all (interviewee 6). If the species is not sighted is some places, this could allow for construction of turbines in specific locations. These two studies will further specify the number of wind turbines that can be placed in the 8 kilometre zone around the Veluwe. Research on the impact of wind energy generation in the area on other species protected under Natura 2000 has thus far not been necessary. The project leader of the research explains that the honey buzzard “is posing major restrictions on the possibilities to place wind turbines in the Veluwe region. These restrictions are for the main part broader than restrictions posed by other species. You could say they are more or less being protected by the honey buzzard” (interviewee 6).

Discourses

The dominant discourses observed in this case are opportunity and the supra-regional approach discourses. As the Veluwe is subject to European Natura 2000 legislation, research for species protection was required (Altenburg & Wymenga and Sovon, 2020). Furthermore, the current provincial government has recently published a strategy for biodiversity conservation with an emphasis on the nature-inclusive energy transition (Provincie Gelderland, 2021). The case is characterised by a large focus on the honey buzzard. One could thus argue that the dominant discourse is the careful evaluation discourse. However, all possibilities to generate wind energy in the area are being explored in an effort to find suitable locations for wind turbines. A large focus on achieving goals in the climate change policy domain can be observed. Furthermore, the supra-regional discourse is apparent in this case. The collaboration between the four RES regions in discussing and researching potential for wind energy on and around the Veluwe shows that the issue subject is explored beyond the local realm of each separate RES region.

How did the policy arrangement evolve?

In conclusion, the policy arrangement of the Veluwe case can be seen as stable; currently, there are no turbines situated in the area, and there are no concrete plans for construction. In this case, a conflict can be observed between the biodiversity and nature, and the renewable energy policy domains. The case is characterised by an emphasis on the climate change policy domain. Powerful actors – governments involved in the RES – aim to reach the goals in this domain. However, existing Natura 2000 legislation hinders reaching the goals set out in the climate change policy domain. The biodiversity and nature policy domain is narrow. As the conservation objective for this species poses limitations to wind energy generation on the Veluwe, no other species are researched. One could thus argue that in this case, policy objective of the biodiversity and nature policy domain equals the conservation objective for the honey buzzard. The goals in the biodiversity and nature policy domain greatly hinder achievement of the renewable energy targets in the climate change domain, which is the main goal of powerful actors. Even though the possibilities are carefully evaluated, the opportunity discourse is dominant in this case. The second dominant discourse is the supra-regional approach. As the Veluwe spans across multiple RES regions, the governments decided to analyse the possibilities in an integrated manner, beyond their own region. Finally, no attention to the forestry policy domain was noted. This could be attributed to the fact that no plans for wind energy generation in the Veluwe area have developed into concrete plans (interviewee 5). As these plans materialise, a larger focus on the forestry domain can be expected, considering the provincial government requires reforestation of felled areas (Provincie Gelderland, n.d.).

5.3 Wieringermeer

The Wieringermeer is a polder in the north of Noord-Holland, in the municipality Hollands Kroon (see figure 5). On September 30th, 2020, Vattenfall officially opened the windfarm in the polder, named the Prinses Ariane Windpark (Vattenfall, 2020). The windfarm has a capacity of 350 MW, an addition of 250 MW to the existing turbines at the start of the project planning (Rijksoverheid, 2015). Four of the turbines are located in the Robbenoordbos (approximately 550 ha). The turbines in the Robbenoordbos are the first case of wind energy generation in a forest in the Netherlands (see figure 11; Windpark Wieringermeer, n.d,; Vattenfall, 2018).

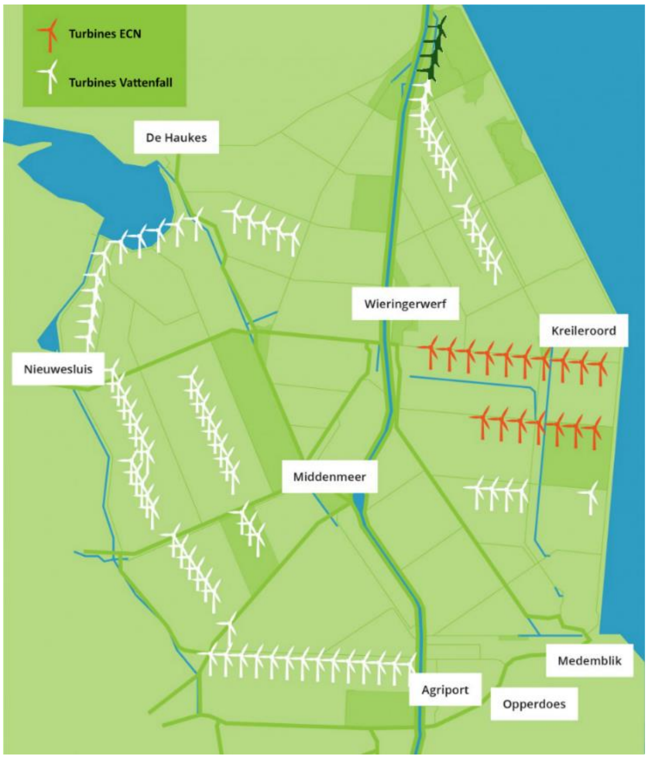

Figure 11: The Prinses Ariane Windpark in the Wieringermeer

Turbines owned by Vattenfall in white, turbines owned by ECN in red, and the four turbines located in the Robbenoordbos in green (adapted from Windenergie Nieuws, 2019).

<u>Societal context</u>

The policy arrangement of this case starts with the wish to expand existing wind energy capacity and meet the goals set in the Energy Agreement (Rijksoverheid, 2015). The municipality of Wieringermeer and province of Noord-Holland were presented with a multitude of plans for single, or small clusters of wind turbines in the Wieringermeer (see figure 5). The approval of projects on an individual basis, however, resulted in a "chaotic image" of the landscape (interviewee 9). The municipality of Wieringermeer thus formulated a vision for a more integral approach to wind energy generation in the area. After research, publication of various preparatory documents, and the organisation of two 'windweekends' – in which citizens and other stakeholders were informed and consulted about the plans – the municipality of Wieringermeer formulated a structural vision (structuurvisie) for the Windplan Wieringermeer in November 2011 (interviewee 9; Rijksoverheid, 2015). This document gave the plans a formal status for the municipality Hollands Kroon[3]. The plans involved replacing smaller, old turbines with newer models (a process called repowering), adding new turbines, and arranging all turbines in neat lines, emphasizing the original structure of the Wieringermeer (see figure 11).

The installation of wind turbines in this forest was seen as an important pilot project. The municipal project leader (interviewee 9) of the Prinses Ariane Windpark explains that the placement of wind turbines in the Robbenoordbos was seen as a pilot project, meant to discover if this type of location is suitable for wind energy generation, and to investigate what the effects on nature and biodiversity are (interviewee 9). Landowner Staatsbosbeheer also viewed this project as an important opportunity (interviewee 1). Interviewee 1 further adds that technological developments in the wind power industry have enabled wind energy generation in the forest.

Actors

The initiative for the project was taken by the municipality of Hollands Kroon. Other important actors are turbine owners ECN, Vattenfall, and windcollective Wieringermeer – the latter being a group of 32 individual wind turbine owners who, throughout the years, organised themselves – the owners of the wind turbines in the Wieringermeer. The three actors convened as Windkracht Wieringermeer, which officially announced its support for and intention to contribute to the municipality's efforts to expand the existing wind power capacity and restructure existing and new turbines. Vattenfall was chosen to implement the project, considering they already owned a number of turbines in the Wieringermeer. Eventually, Vattenfall bought the turbines from the wind collective Wieringermeer (Rijksoverheid, 2015; Provincie Noord-Holland, n.d. b). The financial consequences of this endeavour resulted in, according to the project manager, a "why not in my backyard?!" response from citizens, considering the money that can be earned from leasing one's land for wind turbine construction (interviewee 9). However, there has also been opposition against the windfarm (Gemeente Wieringermeer, 2011).

As the landowner in the forest, Staatsbosbeheer's position towards wind energy generation on their land was also important to the project. Staatsbosbeheer's position changed in 2012. Until then, two-thirds of Staatsbosbeheer's income consisted of governmental subsidies. When these subsidies were reduced, the organisation lost a third of its income and increasingly focused on generating their own funds.

[3] On January 1st 2012, the municipality Wieringermeer merged into the municipality Hollands Kroon, together with the municipalities Anna Paulowna, Niedorp, and Wieringen.

An aspect of this effort involved changing the organisation's stance towards renewable energy from 'no, unless…' to 'yes, provided it can be achieved in a responsible manner'. A representative of Staatsbosbeheer explains that a wind turbine generates an annual revenue of 30,000 - 40,000 euros for the organisation, adding that "if they are not installed on our grounds, they are often placed just outside of our property" (interviewee 1). The hindrance to nature and biodiversity is comparable, but "the revenue goes to the neighbour" (interviewee 1). Instead, by allowing wind turbines on their land, the revenue Staatsbosbeheer receives is used to enhance nature conservation.

Rules of the game

There are several reasons for the decision to install four turbines of the windfarm in the Robbenoordbos. Firstly, the placement of turbines in the Robbenoordbos was chosen to "provide as much space as possible for new locations for wind turbines" (Rijksoverheid, 2015, p.41). Research established that there are no other locations in the province suitable for the windfarm, and the turbines in the forest were required for financial feasibility of the windfarm (interviewee 9; Rijksoverheid, 2015). The current alignment was chosen, because – like the other turbines of the windfarm – it complements the structure of the polder, as the turbines are lined parallel to the highway (interviewee 9). Also, compared to the two alternative alignments, it had the least effects on local ecology. This alignment includes the least amount of tree felling. In the original plan, significantly more forest needed to be felled, among others to create a road needed for the construction of the turbines (Rijksoverheid, 2015). Secondly, the Robbenoordbos was chosen as a location because it is partly surrounded by Natura 2000 areas – namely the IJsselmeer and the Waddenzee – but is not part of the nature conservation scheme itself (RVO, n.d.). Research established that no harm of species protected under Natura 2000 legislation is expected (Rijksoverheid, 2015). The turbines are equipped with the possibility to pause operation during nights with little wind and high animal activity. The effectiveness of this measure is monitored over the course of three years (Vattenfall, 2018). Thirdly, the national government wished to maximize the number of turbines in the windfarm (interviewee 18).

When planning and compensating for the turbines in the forest, a few important legal aspects required consideration. Firstly, a part of the forest is an assigned silent area. Although the turbines are not located in this area, research in the planning phase outlined that they would exceed the accepted noise levels. However, due to the limited effect of this alignment on tree felling – sustaining more of the NNN area – this exceeding of noise levels is considered acceptable by the municipality and the provincial government (Rijksoverheid, 2015). And, as a representative from the municipality explains, due to the proximity of the highway, the silent area of the forest was not truly silent at the start of the project (interviewee 9). The Robbenoordbos is part of the NNN. The construction of the turbines caused permanent felling and temporary felling of trees part of the NNN, which requires compensation. Furthermore, construction of wind turbines is only allowed in the NNN if proven that it is of great societal importance, there are no reasonable alternatives, and that requirements for compensation are met (Rijksoverheid, 2015). In the integration plan (*inpassingsplan*), the initiators argue that the wind farm is of great societal importance, and therefore justifies constructing wind turbines in the forest (Rijksoverheid, 2015). Finally, the felling of trees for the installation of the turbines in the Robbenoordbos required compensation (Rijksoverheid, 2015; Buizer, 2014). Vattenfall is responsible for the compensation, which is carried out by BWZ Ingenieurs[4]. They restore temporary felling around the turbines in the forest, and carry out forestation to compensate for permanent felling. For the latter purpose, a patch of land formerly used for agriculture was chosen (Pondera Consult, 2014; BWZ Ingenieurs, n.d.; see figure 12).

Figure 12: The plot (outlined in black) selected for reforestation (Buizer, 2014).

Resources and power

In the policy arrangement of this case, the national, provincial, and local governments played an important role in decision-making. They worked closely together in coordinating the project (interviewee 9). Landowner Staatsbosbeheer are also ascribed a powerful role. They have a decisive position. If they had opted against allowing the project on their land, the four turbines could not have been realised (interviewee 3 & 9). Interviewee 9 also ascribed them a powerful influence as safe guarder of nature conservation values. Other NGOs had a less profound role in the process (interviewee 3 & 9). Interviewees 3 and 4 argue that citizens should have a more profound role in the project.

Discourses

[4] Advisory and engineering office that designed and carried out forest restoration and forestation (see figure 12).

The dominant discourse in the Wieringermeer case is the opportunity discourse. Staatsbosbeheer views the installation of wind turbines in the forest as an opportunity to generate revenue used for nature conservation. Another discourse that can be recognised in this case is the local approach. The municipality of Hollands Kroon collaborated with the provincial and national government and a set of other stakeholders, but nonetheless played a leading role in the execution of the project. Because of the existing turbines in the area, no other areas outside of the polder were considered as alternatives.

How did the policy arrangement evolve?

In conclusion, the policy arrangement of the Wieringermeer case has been subject to change. The wish of the municipality and provincial government to restructure, repower, and expand the existing turbines in the polder have been important in the development in this case. This is related to the dominance of the local approach; as a large number of turbines was already located in the polder, a different location does not seem to have been considered. The introduction of the energy agreement also played an important role, as this assigned the province of Noord-Holland a clear goal in the climate change policy domain. One of the purposes of the four turbines in the Robbenoordbos is to serve as a pilot case for wind energy generation in forests in the Netherlands, as this had previously been observed in other countries. Changes in the international and technical development indicators of the societal context have thus had an influence of the development of the policy arrangement. Furthermore, legislation enabled the installation of the turbines in the forest. The forest is not part of the Dutch Natura 2000 areas. The rules for reforestation also allowed for sufficient compensation of damaged forest area. The project did however not comply with the rules on the silent areas in the forest. As the discourse of opportunity is most prominent in this case, it was decided that – due to the great societal importance of the project, and the positive impact on the NNN compared to the alternative alignments – non-compliance with this legislation was deemed acceptable. The forest, and biodiversity and nature policy domains have thus been researched and considered when planning the turbines in the forest. However, these policy domains have mostly been influential to the extent that existing legislation posed constraints on the possibilities in the forest.

5.4 German cases

Like the Dutch cases described above, the German cases – the states (*Bundesländer*) Thüringen and Baden-Württemberg – have some important similarities on national and European level. These characteristics are described in this section. Sections 5.5 and 5.6 consequently analyse the development of the policy arrangements in Baden-Württemberg and Thüringen.

5.4.1 Societal context

The Energiewende (energy transition) describes Germany's plans to move away from fossil fuels and nuclear power and increase renewable energy production (Feldhoff, 2016). The "ambitious Energiewende goals had already set the country on course to become one of the world's most energy-efficient and green economies" (Feldhoff, 2016, p.90). The nuclear disaster in Fukushima in 2011 played a role in pushing the Energiewende, as it accelerated the planned nuclear phase out. In the same year, 8 of the 17 nuclear plants were shut down, and the remaining 9 were to be shut down before 2022 (Feldhoff, 2016). Furthermore, the disaster is associated with rapid expansion of wind energy generation in Germany. Around the same time, wind energy generation in forests started increasing in some states Germany, in order to expand wind energy and avoid competition with other land uses or sighting turbines too close to housing (interviewee 23). Of the total number of wind turbines in forests, 87% has been built since 2010 (see figure 13; FA Wind, 2019a). Interviewee 18 explains that "after Fukushima, most of the municipalities said that they need [renewable energy], and want wind energy. And since it takes 2-3 years, a lot of systems were built in 2015 and 2016".

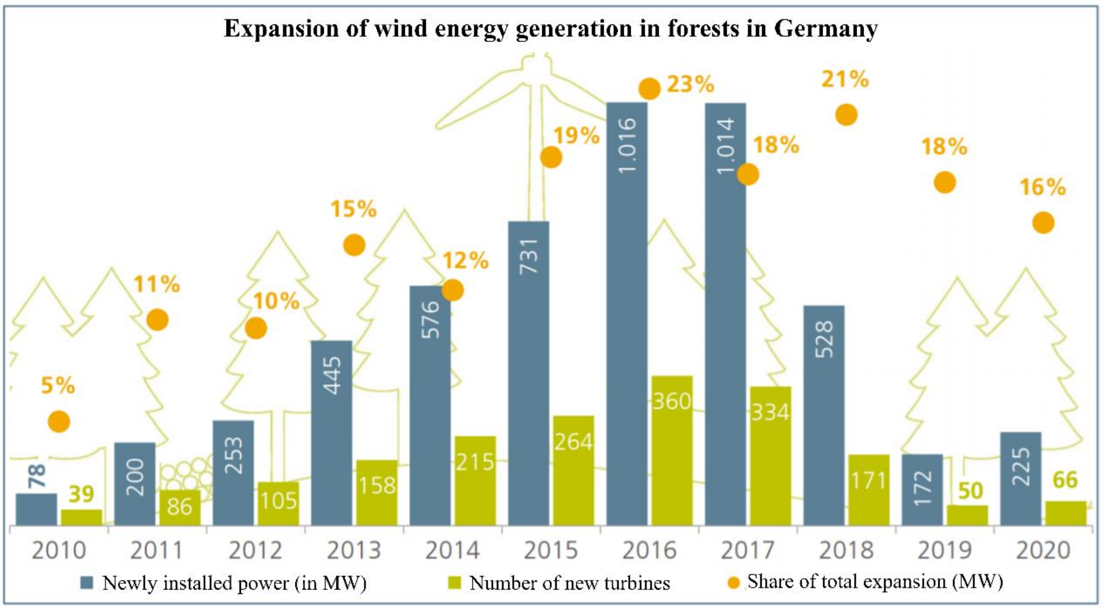

Figure 13: Number of new wind turbines in operation in the forest per year (adapted from FA Wind, 2021b).

However, after 2017, a decreasing trend of wind energy expansion in forests can be observed (figure 13). “Then came the rollback, the citizens' initiatives got stronger, the authorities paid more attention, and the systems were of course getting higher and higher. And then there was resistance in practically every municipality” (interviewee 18). This trend is not exclusive to wind energy in forests, but can be observed for onshore wind energy in general (FA Wind, 2021b). There is a number of explanations for this trend. Firstly, lawsuits are an important barrier for the expansion of wind energy. Most common are law suits due to concerns about species protection (FA Wind, 2019b; interviewee 21). Other causes for lawsuits include procedural errors, and concerns about noise. Lawsuits are most often initiated by nature protection organisations, citizens’ initiatives, and individuals (FA Wind, 2019b). As interviewee 19 explains, “you have hundreds of groups with different interests, so at least one group will lose something or thinks they lose [something], and they go to the court” (interviewee 19). Species protection regulations are not always clear and project approval authorities do not know how to apply the laws. For example, the Federal Immission Control Act (*Bundes-Immisionsschutzgesetz*) prohibits killing and injuring of species, but makes exceptions for certain projects, as long as they do not have a significantly larger risk of killing (*signifikant erhöhtes Tötungsrisiko*) (Bundesministerium der Justiz und für Verbraucherschutz, 2009). However, “no one can really say what it means” (interviewee 14). Another important reason for the decreased expansion rate is a reform of the funding regime as part of the EEG in the beginning of 2017. Previously, wind energy projects received fixed remuneration (FA Wind, 2021a). Now, all project plans need to be submitted for a tender (interviewee 21). Interviewee 18 sums up the stalling of the expansion by explaining that “the main problems [are] unclear legislation with regards to nature conservation, the great amount of citizens' initiatives going to the courts, and the caution of the approval authorities”. The dominant thought is that the settlement of wind energy expansion can primarily be attributed to societal resistance (interviewee 10), but one could also argue that political decisions are hindering the expansion.

5.4.2 Rules of the game

A number of laws at the national and international level have been important in the development of the policy arrangements of the two German cases, table 5 summarises these laws.

Law	Aim
Paris Agreement	Limit “global warming to well below 2, preferably to 1.5 degrees Celsius, compared to pre-industrial levels” (UNFCCC, 2021, para.2). This goal has been translated into NDCs.
Federal Climate Protection Act (*Bundes-Klimaschutzgesetz*)	Aims to reduce national GHG emissions by 55% (compared to 1990) by 2030 (translates the Paris Agreement into national legislation) (Bundesministerium der Justiz und für Verbraucherschutz, 2019).
Federal Immission Control Act (*Bundes-Immisionsschutzgesetz*)	Protect “human beings, animals and plants, the soil, water, the atmosphere as well as cultural assets and other material goods against harmful effects on the environment” (Bundesministerium der Justiz und für Verbraucherschutz, 1974, para. 1).
Birds Directive and Habitats Directive (Natura 2000 network).	Aims to protect animal and habitat species, and improve biodiversity (European Commission, n.d. d).
Federal Nature Protection Act (*Bundesnaturschutzgesetz*)	Outlines rules for nature and species protection (Bundesministerium der Justiz und für Verbraucherschutz, 2009).
Renewable Energy Act (*Erneuerbare-Energien-Gesetz; EEG*)	This Act aims to facilitate expansion of renewable energy generation (Bundesministerium der Justiz und für Verbraucherschutz, 2014).
State Forest Act (*Bundeswaldgesetz*)	Outlines guidelines for forest protection and conservation (Bundesministerium der Justiz und für Verbraucherschutz, 1975).
Spatial Planning Act (*Raumordnungsgesetz*)	Contains guidelines for spatial planning projects. This law also stipulates that locations for energy systems, power lines and necessary infrastructure are determined on state level (Bundesministerium der Justiz und für Verbraucherschutz, 2008).

Table 5: Relevant laws in Germany.

The Federal Climate Protection Act outlines annual GHG emission reduction targets. The law aims to “ensure that national climate protection targets are met and that European targets are met in order to protect against the effects of global climate change” (Bundesministerium der Justiz und für Verbraucherschutz, 2019, para. 1). The act enshrines the goals of the Paris Agreement into national law.

An important aspect of the approval process of wind energy projects is checking adherence to the Federal Immission Control Act (Bundesministerium der Justiz und für Verbraucherschutz, 1974; interviewee 12, 13, 17 & 23). The act aims to protect animals, environment and humans from potential damage caused by projects, renewable energy projects but also other projects. This includes consultation of various actors, including official authorities – specialised in, among others building, forest management, species protection, and aviation – citizens, and nature conservation NGOs. A representative from a wind power company explains that they “have to go through 10 or maybe 15 different topics to check if the site really is suitable for wind power plants or if the wind power plants conflicts with anything else that is already installed” (interviewee 12). If the project contains 20 or more wind turbines, an environmental impact assessment (*Umweltverträglichkeitsprüfung*) is required (LUBW, 2014; interviewee 13).

The Federal Nature Protection Act contains rules for nature and species protection, and also includes the European Natura 2000 legislation. This act thus also needs to be complied with when planning a wind energy project in the forest (Bundesministerium der Justiz und für Verbraucherschutz, 2009; interviewee 14 & 23). For example, in order to examine potential harm of a project to species protected under this act, observation of species is carried out to map their habitat and assess potential impacts (interviewee 18).

Thirdly, the Renewable Energy Act is of great importance to wind energy expansion. Its aim is to achieve 65% renewable energy of total energy consumption by 2030. The law was enacted in 2000, and "guarantees a feed-in tariff for renewables for 20 years; gives renewables priority access to the national grid; and exempts owners of renewable energy installations for their own use of electricity (…) from the surcharge paid by consumers" (Feldhoff, 2016, p.92; Bundesministerium der Justiz und für Verbraucherschutz, 2014). In 2017 the subsidy scheme was changed to a tendering process. This procedure was introduced to establish "competitive determination of payment entitlements", thus enhancing competitiveness among energy companies (FA Wind, 2021a, p.5). Project planners submit a bid and those able to realise a project in the most cost-effective manner get awarded public funding (interviewee 23).

The State Forest Act outlines rules for the management of forests. Among others, the law provides rules for reforestation. The law also assigns various responsibilities – such as assigning protected areas, and approving felling of areas – to the individual states (Bundesministerium der Justiz und für Verbraucherschutz, 1975).

As previously mentioned, the decision to allow wind energy generation in forests is taken on a state level (FA Wind, 2021b). This is outlined in the Spatial Planning Act. This law determines that location selection for projects is conducted on a state level (Bundesministerium der Justiz und für Verbraucherschutz, 2008). Interviewees affirm that the states have such different characteristics that decisions on wind energy generation in forests can best be made on a state level (interviewees 11, 12, 14, 22 & 23).

5.4.3 Actors

Table 6 provides an overview of actors involved in wind energy projects in the German cases.

Actor group	**Thüringen**	**Baden-Württemberg**
Governments	• National government • Landesverwaltungsamt • Landkreise • Municipalities	• National government • Regierungspräsidien • Landkreise • Municipalities
NGOs	• Nabu Thüringen • BUND (*Bund für Umwelt und Naturschutz Deutschland*)	• Nabu Baden-Württemberg • BUND (*Bund für Umwelt und Naturschutz Deutschland*)
Research and advisory agencies	• Thüringer Energie- und GreenTech-Agentur GmbH (ThEGA)[5] • BfN (*Bundesamt für Naturschutz*) • Fachagentur Windenergie an Land	• Forstliche Versuchs- und Forschungsanstalt Baden-Württemberg (FVA) • BfN (*Bundesamt für Naturschutz*) • Forum Energiedialog • Fachagentur Windenergie an Land
Landowners (of forests)	• ~ 41% is privately owned • ~ 41% is owned by the state • 16% is owned by municipalities and districts • The remaining ~ 2% is so-called trust forest and is being privatised (ThüringenForst, n.d. a).	• 40% is owned by municipalities and cities • 36% is privately owned • ~ 24% is owned by the state • The remaining < 1% is owned by the national government (FA Wind, 2021b).
Energy companies	N.a.[6]	• ABO Wind • Uhl Windkraft
Citizens	Local residents, and others who are interested in or concerned about wind energy generation in forests. Some citizens organise themselves in citizens' initiatives (*Bürgerinitiative*), either for or against wind energy projects. For example, the group *Vernunftkraft* is critical about wind energy expansion (interviewee 10).	Local residents, and others who are interested in or concerned about wind energy generation in forests. Some citizens organise themselves in citizens' initiatives (*Bürgerinitiative*), either for or against wind energy projects. For example, the group *Vernunftkraft* is critical about wind energy expansion (interviewee 10).

Table 6: Overview of actors involved in wind energy projects in forests in Germany.

5.4.4 Resources and power

State governments have significant power. They make decisions on whether or not wind turbines are allowed in the forests (interviewee 16 & 21). Local governments are also attributed a large influence, as they have decisive power in the approval process for wind energy projects (interviewee 14 & 19).

Research and advisory agencies are involved in the planning and approval process. They provide data or conduct research on the effects of project plans on nature and species. These findings may have a decisive role in the project's approval (interviewee 18). Forum Energiedialog in Baden-Württemberg helps municipalities mediate conflicts when disputes about wind energy projects arise, by providing

[5] ThEGA is Thüringen's energy agency. The agency advises "municipalities, companies and citizens on the topics of the energy transition" (ThEGA, 2021b, para. 1).
[6] Currently, no wind turbines are under construction in the forest.

guidance, and organising public events (interviewee 20). NGOs are also officially involved in the approval process and often asked to provide a statement about the project plans (interviewee 14 & 15). However, representatives from NGOs do not consider themselves powerful actors in the decision making process (interviewee 14). Governmental research and

Landowners in forests are also attributed an important role. If they do not want wind energy on their land, wind turbines cannot be constructed there (interviewee 14, 15, 16 & 18). This may hinder the project's process. This role is especially apparent if the forest is owned by a municipality or an individual. The state-owned forests are managed by separate institutions, namely ForstBW in Baden-Württemberg, and ThüringenForst in Thüringen (ForstBW, n.d.; ThüringenForst, n.d. a; interviewee 11). In Baden-Württemberg, the state is in favour of wind energy in forests and aims to expand the number of turbines on its sites (Bündnis 90/Die Grünen & CDU, 2021). 85 of the 334 turbines in the forest are located in state-owned forests (FA Wind, 2021b). In Thüringen, the state government has voted against wind energy in all forests (interviewee 11).

5.4.5 Discourse

Interviewees indicate that wind energy is an emotional topic in Germany (interviewee 11, 13 & 14). The first discourse highly values climate protection, and therefore accepts or even supports wind energy generation in forests. The other discourse is characterised by a strong emphasis on nature protection, and thus rejects wind energy generation in forests. The two discourses are explained here.

<u>Climate protection discourse</u>

The climate protection discourse is represented by those who, alongside nature protection, also are concerned about meeting climate protection goals. Actors endorsing this discourse thus do not disregard nature protection. Indeed, nature conservation NGOs like Nabu, BUND, but also federal agency BfN advocate for an "environmentally friendly energy transition" (*Naturverträgliche Energiewende*) (interviewee 14 & 20). The NGOs are in favour of wind energy generation in forests, as long as biodiversity and nature are taken into account (BUND, n.d.; Dialogforum Erneuerbare Energien und Naturschutz, 2021; interviewee 15). BUND adds that areas with high natural values such as national parks should be excluded (BUND, n.d.). Like the minority government in Thüringen, the ruling parties in Baden-Württemberg ascribe to this discourse.

<u>Nature conservation discourse</u>

Some politicians and citizens' initiatives are concerned about the conservation of species, and the degradation of the forest. The opposition parties in Thüringen represent this discourse. Actors fear that wind energy generation in forests may harm forest quality or species protection (Kruger, 2019; interviewee 13 & 20). They are advocating for the use of other locations for wind turbine installation, or do not wish turbines are built in their area at all (Kruger, 2019). Interviewee 10 explains that “opponents of wind energy – that are usually part of the community around the site where the wind farm is planned – justify their position through arguments that have to do with conservation, usually with the protection of the landscape, which I think in their understanding is also part of their definition of the environment”.

5.5 Thüringen

Thüringen has a size of 16,202 km² (Thüringer Landesamt für Statistik, n.d. a; see figure 5). Of the state's area, 34% is covered in forest (FA Wind, 2021b), earning the state the nickname "the green heart of Germany" (interviewee 11). As stated in the state's climate law, the state government aims to fully cover all energy consumption with renewables by 2040 (currently 15%). To this end, the government has expressed the aim to use 1% of the land area for wind energy generation (currently 0.4%) (Kruger, 2019; ThüringenForst, n.d. b; energiezukunft, 2021a). In June 2016, forests were opened for wind energy generation (Thüringer Landtag, 2020; energiezukunft, 2021a). The construction of two turbines was completed, before the state government decided to no longer allow wind energy generation in forests in December 2020 (energiezukunft, 2021b).

<u>Societal context</u>

Over the past years, forests in Thüringen have been severely damaged by storms, droughts, and the bark beetle (interviewee 11 & 15). Especially the latter has caused large problems in forests. From January till September 2020 alone, the three factors together "caused around 5.7 million cubic meters of damaged wood" (Süddeutsche Zeitung, 2020, para. 2). Approximately half of this amount is caused by bark beetle alone. Between 2018 and 2020, an estimated total of 12.5 million cubic meters of wood got damaged (Süddeutsche Zeitung, 2020; 2021).

A recent political development has led to a change in the policy arrangement of this case. Following elections in October 2019, the previously ruling 'red-red-green' – consisting of the Left, SPD, and the Green party – government no longer had a majority in parliament to form a coalition again (interviewee 21). After a tumultuous formation process, the three parties formed a stability pact with the CDU, and called for new elections in 2021 (MDR, n.d.). Despite the stability pact, the CDU –positioning themselves against wind energy generation in forests – joined the opposition party FDP's plea to exclude forests as suitable sites for wind energy. In the summer of 2020, the FDP and CDU submitted a call for the exclusion of forests, stating that the choice of such a location will lead to deforestation, and damage biodiversity (Thüringer Landtag, 2020). The parties stated they would approve the state's annual budget, if wind energy in forests would be banned. In December 2020, the parliament unanimously voted in favour of the suggested alteration of the Forest Act. The coalition parties did not support the alteration, but did so to gain the CDU's approval of the budget, which the party had linked to the approval of the proposed amendment (Bizz Energy, 2020). The exclusion of forests for wind energy generation was thus a political decision (interviewee 11 & 21).

Rules of the game

Before 2016, project planners adhered to an action recommendation issued by the Thuringian Ministry for Construction, Regional Development and Transport in 2007. In this recommendation, forests are listed among exclusion criteria for wind energy (Bunzel et al., 2019). This changed after the 2014 elections, when the red-red-green government was formed. In the coalition agreement, the parties outlined plans for opening the forests for wind energy generation (FA Wind, 2021b). In 2016, this change in the wind energy decree (*Windenergieerlass*) was enacted, allowing for wind energy generation in forests, outside designated protected areas. Locations for wind energy were to be selected in the regional planning (*Regionalplanung*), drafted for four planning districts (*Planungsregionen*); Mittelthüringen, Ostthüringen, Nordthüringen, and Südwestthüringen (Freistaat Thüringen, n.d.; energiezukunft, 2021b). They are drafted by the counties (*Landkreise*) and county-free cities (*kreisfreie Städte*; Erfurt, Gera, Jena, Suhl, and Weimar) in the district. Figure 14 shows the four planning districts, as well as the counties and county-free cities (Thüringer Landesamt für Statistik, n.d. b). The districts were advised to specifically consider forest locations that were damaged by heavy weather events and the bark beetle. In the four years that wind energy generation in forest was allowed, two turbines have been constructed in the forest (energiezukunft, 2021b).

Figure 14: The state of Thüringen, the four planning districts, and the counties and county-free cities (adapted from Thüringer Landesamt für Statistik, n.d. b)

Actors

The decision to open up the forest was met with resistance. Municipalities with more than 10,000 inhabitants can contribute their ideas to the regional planning, but the "problem is that the projects happen in the small villages […] they can't bring in about this topic" (interviewee 11; Jenkis, 2018). There are approximately 50 citizens' initiatives fighting against local wind energy projects (interviewee 11; energiezukunft, 2021b).

Wind planners were not pleased with the change in legislation after only two years. ThEGA manages a seal for fair wind energy, that is awarded to planning companies that handle projects transparently and actively engage the local community in the project. 43 companies carry this seal, and 12 of those companies were planning wind energy projects in Thüringen's forests (interviewee 11; ThEGA, 2021a). The companies have secured space in the forest, but will have to wait with construction until 2023, when the law will be re-evaluated (FA Wind, 2021b; interviewee 11).

Resources and power

Considering the legality of wind energy generation in forests is decided on a state-level, the state government is a powerful actor in the policy arrangement. Nevertheless, according to interviewees, the citizens' initiatives also have an important voice in the debate (interviewee 10, 11 & 15). They are well organised, and visible in the societal debate around the topic (interviewee 12, 14, 17 & 19). Some even argue that the opposition parties may have positioned themselves against wind energy generation in forests in an effort to gain votes for the elections (interviewee 11). Nature conservation NGOs have not played a large role in the policy arrangement.

Discourses

Both discourses can be recognised in this case. Citizens' initiatives that oppose wind energy generation in forests argue that forests should remain clear of further damage, on top of that already inflicted on the forests in the past years. They are also concerned about species protection (interviewee 13 & 15). The opposition party FDP had positioned themselves against wind energy in the forest, considering themselves the "parliamentary arm of the wind power opponents" (Kruger, 2019, para.7). The CDU hold the same view. In a joint statement, the parties assert that "the main concern of the Thuringian Forest Act, namely the preservation and protection of the forest, must be given top priority" (Thüringer Landtag, 2020, p.1). Some opponents problematize that the green party is in favour of wind energy generation in forests (interviewee 10).

Proponents of wind energy in forests, on the other hand, argue that wind energy generation in forests is necessary to meet the state's climate goals, and stress the state's goal to use 1% of the area for wind energy generation (energiezukunft, 2021a). The large amount of forest cover in the state, the forested mountainous areas – which are more suitable for wind energy generation than the open valleys – and the rules for set-back distances from residential areas[7] make wind energy expansion outside of the forest difficult (FA Wind, 2021b; 2021d). Furthermore, proponents argue that the ban on wind energy in forests might aggravate the financial problems landowners in the forests are facing. The lease landowners get from allowing turbines on their site as an income may compensate losses and finance forest restoration (MDR, n.d.).

The damaged forests are thus used as an argument by both opponents and proponents of wind energy generation in forests in the state. It should be noted, however, that there is no consensus among forest owners; some support wind energy generation in forests, whereas other reject it (interviewee 13). Interviewee 18 stresses the difficulty of the issue; the different discourses can cause a divide among the population. Some inhabitants are hesitant to publicly state their opinion, out of fear for rejection from friends and acquaintances (interviewee 18).

How did the policy arrangement evolve?

In conclusion, the policy arrangement of the Thüringen case has been subject to change over the past years. The state government has had a large impact on this policy arrangement, and can thus be seen as a powerful actor. First, the change in the wind energy decree in 2016 can be attributed to the discourse adopted by the red-red-green government. The parties represent the climate protection discourse and agreed to change legislation, assigning planning districts the task of allocating suitable locations for wind turbines in the forests. A change in the power relationships between the parties in the state government has been influential for the second change in the policy arrangement in this case. After the elections in 2019, the parties endorsing the climate protection discourse no longer had a majority in government. Instead, the opposition parties, endorsing the nature conservation discourse, used their power to change legislation in favour of this discourse. Legislation shifted from a focus on achieving goals set in the climate change policy domain, to a focus on the forest, and biodiversity and nature policy domains. The societal context of natural disasters – drought, storms, and the bark beetle – striking the forests in the state, has influenced this shift in focus. The citizens' initiatives opposing wind turbines in forests – endorsing the nature conservation discourse – also contributed to the change, as the opposition party FDP sides with these groups.

[7] The legally required distance between turbines and residential areas is 750 meters for wind turbines shorter than 150 meters, and 1,000 meters for taller wind turbines (FA Wind, 2021c). This means that repowering options are limited (energiezukunft, 2021 b).

5.6 Baden-Württemberg

Baden-Württemberg has a size of 35,751 km^2 and a forest cover of 38% (FA Wind, 2021b; interviewee 13; see figure 5). Baden-Württemberg is one of the seven states where wind energy in forests is allowed (see figure 6). At the end of 2020, a total of 334 wind turbines had been installed in forests. Thereby, the state ranks third in the list of states with the most wind turbines in forests. The wind turbines in forests in the state amount to 57% of wind energy generated, and 44% of wind turbines in Baden-Württemberg (FA Wind, 2021b). In 2020, 41% of gross electricity generation in the state was covered by renewable energy sources, contributing to the state's goal of achieving climate neutrality by 2050 (Ministerium für Umwelt, Klima und Energiewirtschaft, 2021; Bündnis 90/Die Grünen & CDU, 2021).

Societal context

Although wind energy generation in forests has never been forbidden in Baden-Württemberg (interviewee 14, 15, 16, 17 & 18), wind energy generation has only become possible since technological developments increased the height of the turbines, making them suitable for this location (interviewee 13, 18 & 21). Furthermore, interviewees quote 2011 as an important year for wind energy generation in the forest in the state, because of the new coalition after elections in that year (interviewee 13, 16, 18, 19 & 21). The Green party formed a coalition with the SPD, and, although no longer in a coalition with the SPD, has been in power since. A change in legislation in 2012 enabled wind energy generation in the forest, so that "suitable locations can be identified" (Bündnis 90/Die Grünen & SPD, 2011; p. 41). Participation of the Green party in the ruling coalition has been quoted as an important cause for the expansion of wind energy generation in forests (interviewee 14, 16, 19 & 21). As interviewee 18 explains, "[it was] a political decision".

Aside from political support, interviewee 14 mentions location selection as an explanation for wind energy in the forest in Baden-Württemberg. Wind conditions are best at higher altitudes, and these altitudes are mostly found in the state's forests (Nabu, n.d.; interviewee 16 & 17). In addition, constructing wind turbines in open landscapes is often obstructed by species protection legislation (interviewee 12 & 22). For instance, the red kite – protected under Natura 2000 legislation – primarily lives in open landscapes and thereby prevents wind energy generation in these areas (Sachsen-Anhalt Natura 2000, n.d.; interviewee 12).

Actors

Following the elections in 2016 and 2021, the Green party has remained in power, in a coalition with the CDU. This coalition too has shown continued support for the expansion of wind energy in forests (Bündnis 90/Die Grünen & CDU, 2016; SWR Aktuell, 2021). In the most recent coalition agreement, the parties explicitly advocate for the expansion of wind energy in forests, stating that they will “designate new wind power locations in the state forest” (Bündnis 90/Die Grünen & CDU, 2021, p.8). The coalition plans to construct 1,000 new wind turbines in state-owned forest, which make up almost a quarter of the total forest area in the state (interviewee 14, 17 & 23; FA Wind, 2021b). With currently less than 100 turbines in state-owned forests, this plan can be called ambitious (interviewee 17; FA Wind, 2021b). Furthermore, the government aims to “push ahead with further legally secure simplifications and accelerations for approval procedures for wind turbines, including repowering, in all legal areas relevant to wind power” (p.27) in an effort to encourage wind power expansion throughout the state (Bündnis 90/Die Grünen & CDU, 2021; interviewee 17).

Rules of the game

In 2012, the state government altered the state planning act (*Landesplanungsgesetz).* Previously, the regional associations (*Regionalverbände*; see figure 15) could outline both priority and exclusion zones for wind energy in their area, marking this in the regional planning (*Regionalplanung*). The change in the state planning act, however, resulted in regional plans only containing priority areas for wind energy; areas in which wind energy has to be given priority over other land uses. Exclusion zones may no longer be identified on this level of planning (Ministerium für Wirtschaft, Arbeit und Tourismus, n.d.; interviewee 17). Nevertheless, national parks, and nature reserves are taboo zones for wind energy generation (Bündnis 90/Die Grünen & CDU, 2016). A recommended distance of 200 meters should be observed when planning wind turbines in the vicinity of such areas (Bunzel et al., 2019).

An important aspect of the approval process of wind energy projects is checking adherence to the Federal Immission Control Act. The approval is conducted by the counties (see figure 15). However, if the file is too complicated for the county, it is dealt with on the level of the regional council (interviewee 12). The approval process requires the inclusion of obtained permits for the project and involves experts from various authorities and organisations that are involved in or affected by the project (interviewee 19 & 22). As part of the process, the documents are publicly available for approximately a month. Citizens can use this opportunity to voice their opinion about the plans (interviewee 17). This can result in several hundred to thousands of complaints, which may partly overlap, but all need to be answered (interviewee 17 & 19). That way, the public opinion is weighed in the process. Nature conservation NGOs are also consulted in the process (interviewee 14). The approval process takes approximately 4 to 5 years (interviewee 13 & 17).

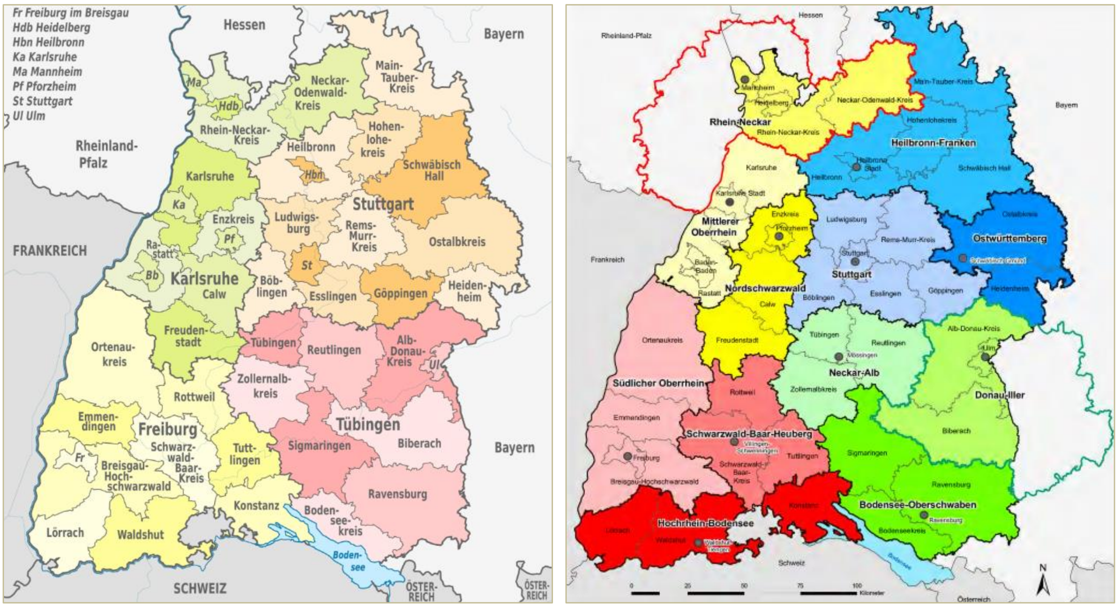

Figure 15: Overview of governmental bodies in Baden-Württemberg

*On the left: the 25 counties (*Landkreise*), and four regional councils (*Regierungsprädidien*). On the right: the twelve regional associations (*Regionalverbände*) (GeocachingBW, n.d.; Ministerium für Wirtschaft, Arbeit und Tourismus, n.d.).*

Adherence to species protection law is one of the most important parts of the approval process. There are 302 Natura 2000 areas in Baden-Württemberg (Ministerium für Umwelt, Klima und Energiewirtschaft, n.d.). There is specifically a concern about the capercaillie, which resides, among other places, in the Black Forest, in mountainous areas. Although the bird does usually not risk collision with the turbines, researchers have noticed the species' are affected by the turbines. Turbine construction causes habitat fragmentation and as such poses a threat to conservation of the species (interviewee 16). The species is protected under Natura 2000 legislation. The FVA conducts research about the species and when necessary, advises governments about interference of wind energy projects with this species (interviewee 16). The FVA also advises landowners on measures they can take to maintain or recover favourable conditions for the capercaillie in the area. Interviewee 16 remarks that landowners might not consider these measures, as some prefer to not have the species on the land, to make room for turbines.

Resources and power

Three actor groups are said to have powerful positions. Firstly, the landowner. If the landowner does not want wind energy generation on their land, it will not happen (interviewee 12, 13 & 22). By focusing on state-owned forest for expansion of wind energy, the coalition has thereby already secured locations. Secondly, power is ascribed to the counties and regional councils, as they can assign locations for wind energy projects (interviewee 19). Additionally, they are in charge of the approval process for wind energy projects. Different research groups may come to different conclusions when conducting research on the impact of wind turbines in a certain location on, for instance, a specific bird species (interviewee 18). Approval authorities thus have a large influence, as they have to assess the information gathered for approval, and are in charge of granting the permits (interviewee 14). Thirdly, the state government is deemed powerful, as their decision to allow wind energy generation in the forest has been vital. Interviewee 16 explains: “politics depends on commercial parties, […] they want to create circumstances that encourage commercial parties to build wind turbines, so at the next elections they can say: *we built so many wind turbines in Baden-Württemberg*. That is the political goal. […] [B]ut in the end, politics, I think, has the most power”.

Discourses

Like in Thüringen, citizens’ initiative protesting against wind energy generation in forests can also be found in Baden-Württemberg. Resistance to wind turbines in forests may be lower than in open landscapes because turbines are less visible in forests (interviewee 18 & 22). “Opinions are mixed. Many feel that their landscape aesthetics are disturbed. Others are concerned about the green lungs of Baden-Württemberg. Still others worry about the species that live there and conjure up ecological disasters” (interviewee 23). Nevertheless, resistance to wind turbines in forests may be lower than in open landscapes because turbines are less visible in forests (interviewee 18 & 22). Additionally, (financial) participation is likely to increase societal acceptance for wind energy projects (interviewee 11, 12, 13, 18 & 22). Interviewee 17 adds that “if [the mayors] support the project and try to convince the community of the benefits of it, it's much easier”.

In the ruling coalition, the climate protection discourse is dominant. Although there is attention for species protection in this case, influential actors have opted for wind energy generation in forests. The ruling government does not see climate protection through wind energy generation in forests as hindering nature protection in the state, and often mentions them together in the coalition agreement (Bündnis 90/Die Grünen & CDU, 2021). Interviewee 14, from the BUND, also stresses the importance of climate protection, also for the sake of nature protection, and explains that forests should not be excluded upfront, as “there are big differences between ecological high-quality forests and other intensively used or damaged forests”. Interviewee 16 from the FVA also stresses that there are important differences between quality of forests that should be taken into consideration when making wind energy generation plans. Furthermore, interviewees argue that legislation (such as the Federal Nature Protection Act) provides sufficient measures to protect species and biodiversity, and demands compensation of these values if necessary (interviewee 17, 20, 21 & 23).

How did the policy arrangement evolve?

In conclusion, the policy arrangement of the Baden-Württemberg case has been stable over the past decade. The state government in Baden-Württemberg has had a large influence on the policy arrangement. The Green party has been in power for the past 10 years, which is an important explanation for the continued prevalence of the climate protection discourse. Together with the other coalition party – first the SPD and since 2016 the CDU – the Green party has continuously enacted legislation that is favourable for meeting goals in the climate change policy domain. This case also exhibits attention for the biodiversity and nature policy domain. Regulations for nature and species protection is checked as part of the approval procedure for new projects in the Federal Immission Control Act. Nevertheless, some actors – such as landowners that financially benefit from the construction of wind turbines on their land – exhibit a preference for wind energy over species protection. Attention for the forest policy domain is also recognised in this case. Areas with high ecological values – national parks and nature reserves – are excluded from the potential wind energy generation sites. Additionally, actors stress that a distinction between poor quality, monoculture forests and high-quality forests need to be made when selecting suitable locations.

6. Conclusion and discussion

6.1 Conclusions

In this section, the main conclusions of this research are discussed. First, the sub-questions are addressed. The first two, as well as the second two sub-questions are interrelated and will therefore be answered together. Afterwards, the main research question is answered.

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1. How did the policy arrangements of the four cases evolve?

2. How can these evolutions be explained?

The final paragraphs of the results section of each case (sections 5.2, 5.3, 5.5, and 5.6) describe how the policy arrangement of each case evolved and how these evolutions can be explained. Here, these sections are briefly summarized.

The policy arrangement of the Veluwe case has been stable over the past years. The potential for wind energy generation in the area remains subject of research. The case is characterised by the supra-regional approach discourse, as possibilities are explored across multiple RES regions. A conflict between two nexus domains in the rules of the game dimension can be recognised here; the rules for species conservation hinders achieving goals set in the climate change domain. For powerful actors representing the opportunity discourse, emphasis seems to lie on the latter domain. NGOs are found to represent the careful consideration and exclusion discourses, emphasizing the goals outlined in the nature and biodiversity policy domain. Focus on the forest policy domain is limited in this case, as no locations for turbines have been identified yet.

The policy arrangement of the Wieringermeer case has been subject to change over the past years. Initiated by the wish to expand existing wind energy infrastructure, the polder has significantly changed. Here, one finds the local approach discourse, as no other locations seem to have been considered for the wind park and preparatory research is centred around the polder. The decision to place turbines in the Robbenoordbos resulted from the aim to maximize capacity in the area, and to serve as a pilot project for wind energy in the area. Furthermore, the revenue of the turbines is seen as an opportunity for Staatsbosbeheer to enhance nature protection. This case is thus characterised by an opportunity discourse. Not all involved actors represent this discourse, as some NGOs have expressed concerns about wind energy generation in forests.

The evolution of the policy arrangement of the Thüringen case has also been subject to is characterised by change. Whereas in 2016 the ruling government opened up the forest for wind turbines, legislation to prohibit wind energy generation in forests in the state was passed in December 2020. One can observe a change in the dominant discourse in the government following a change in the division of power among the parties. As a result, the nature protection discourse gained dominance. This discourse also resonates with citizens' initiatives that position themselves against wind turbines in the forest. The severe damage forests in the state endured in the past years can be seen as an explanation for the prominence of this discourse; actors aim to protect the forest from further damage. Citizens representing the climate protection discourse disagree with this thinking and see damaged forest sites as suitable locations for wind turbines.

The policy arrangement of the Baden-Württemberg case has been stable over the past decade. The Green party has been dominant in the state government since 2011. As a result, the climate protection discourse gained dominance. Enacted legislation has encouraged expansion of wind energy generation in forests in the state. Focus on the forest policy domain is also prominent, as location selection is carefully evaluated in the approval procedure and ecologically valuable forests are excluded from potential sites. The approval procedure similarly is organised in a manner that aims to reach goals in the biodiversity and nature domain. Nevertheless, some citizens' initiatives fear that the emphasis on this policy domain is insufficient.

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3. How are these evolutions similar and how are they different?

4. How can the similarities and differences be explained?

Many similarities and differences between the evolutions of the policy arrangements can be highlighted. In this section, these similarities and differences are explained by comparing the cases with one another, and by analysing similarities and differences between the countries. In order to limit duplication – governments were identified as powerful actors across all cases – the most important similarities and differences between the cases are highlighted.

<u>Similarities and differences between Baden-Württemberg and Thüringen</u>

As two German states, both Thüringen and Baden-Württemberg were characterised by attention to the forest, and biodiversity and nature policy domains. However, in Thüringen, attention for the climate change domain has decreased with the passing of a change in the law. Some stakeholders are concerned about the state's ability to meet its renewable energy goals. In Baden-Württemberg, the CDU has been in power with the Green party since the elections in 2016. They have shown themselves in favour of wind energy generation in forests, characterised by the climate protection discourse. In Thüringen, however, the party – in collaboration with the FDP – was responsible for the change in legislation regarding this subject. The influence of citizens' initiatives opposing wind energy generation in forests is larger in

Thüringen than in Baden-Württemberg and can be associated with the change in state government after elections in 2019.

Similarities and differences between Veluwe and Wieringermeer

A similarity between these two cases is that they are both characterised by dominance of the opportunity discourse. The goals set in the climate change policy domain are driving influential actors to install wind turbines in forests. Also in both cases, local governments are seen as influential actors, whereas NGOs consider their position less powerful. An important difference between these is that the Veluwe is a Natura 2000 area, whereas the Robbenoordbos in the Wieringermeer is not. In the first case, this legislation obstructs the aim of realising wind energy generation in forests. In the Robbenoordbos, no significant interference of the project plans with the goals in the biodiversity and nature policy domain was found.

Similarities and differences between Veluwe and Baden-Württemberg

The main similarity that can be observed between these two cases is the attention paid to the interference of protected bird species when drafting project plans for wind energy generation in the forest. In Baden-Württemberg, the effects of new plants on the red kite and capercaillie need to be evaluated, whereas in the Veluwe the honey buzzard needs to be considered. Additionally, governments are considered powerful actors in both cases. Furthermore, both policy arrangements are stable, although different. In Baden-Württemberg, there is an abundance of wind turbines in forests, enabled by legislation that allows their construction. In the Veluwe case, on the other hand, legislation actually obstructs wind energy plans.

Similarities and differences between Veluwe and Thüringen

An important similarity between these two cases is that, at the time of writing, project proposals for wind energy in forests in these cases will not be approved. In the Veluwe, this is because interference with the conservation objective for the honey buzzard cannot be ruled out. In Thüringen, it is simply illegal. A difference between the two cases is that in Thüringen, a strong emphasis on preserving forest quality can be observed. In the Veluwe case, this policy domain received the least attention.

Similarities and differences between Wieringermeer and Baden-Württemberg

In both these cases, wind turbines are currently generating energy in forests. There is an emphasis on achieving goals in the climate change policy domain. Nevertheless, values in the other policy domains are also weighed in the approval of projects in the cases. An important difference lies in the societal context. In the Wieringermeer the turbines are the first in project in a forest in the Netherlands, replicating a practice already performed in other countries. In Baden-Württemberg, wind turbines have been a sight in forests for years.

Similarities and differences between Wieringermeer and Thüringen

The policy arrangements in both these cases have been subject to change over the past years. In Thüringen, wind energy generation in forests was first encouraged by a change in law, and consequently made illegal after another legal change. In the Wieringermeer, goals in the climate change policy domain are an important explanation for the development of the wind turbines in the forest. An important difference between the two cases can be found in the discourse. In the Wieringermeer, the opportunity discourse reflects an emphasis on the climate change policy domain. On the contrary, the nature protection discourse highlights the importance actors in this case attribute to the forest, and biodiversity and nature policy domains.

Similarities and differences between the countries

The societal context in the countries is similar. In all cases, the question of whether or not a wind turbine can be placed in forests would not have emerged if technological developments would not have allowed this. The societal discourses are also similar. A difference can be found in the fact that Germany already has a history of wind energy generation inn forests, whereas this topic is relatively novel in the Netherlands.

Interestingly, the discourses found in the two countries are different. In the Netherlands, the discourses centre around location selection for wind turbines, where some actors see opportunities when installing wind turbines in forests, some stress the need for careful evaluation, and again others argue that forests are an unsuitable location for wind energy generation. These discourses can be explained by the fact that currently no legislation regarding the legality of wind energy generation in forests exists in this country. In the German cases, the discourses correlate with the prioritization of either the climate change, or the nature and biodiversity policy domain. In the Netherlands, the primary question underlying these discourses is the open question '*where should wind turbines be located?*', whereas in Germany the question centres around the duality of: '*should wind turbines be located in forests?*'. In the Netherlands, the distinction between the local approach discourse, and supra-regional discourse is recognised. Such a discourse was not found in the German cases. Here, a general decision on the permissibility of wind turbines in forests is made for the entire state. However, the fact that these discourses were identified in the Dutch cases and not in the German cases can also be explained by the methodological choice made in the current research (elaborated on in section 6.3).

The role of actors is similar across the two countries. Similar actor groups were identified across the cases. The roles of governments and landowners are seen as influential. NGOs, research, and advisory agencies are involved in approval processes for projects. Citizens can provide input on project plans once these have been made public as part of the approval processes for the project. Their role, however, is often seen as limited. A difference in the actor dimension is that citizens' initiatives opposing wind energy projects were not identified in the Dutch cases. There is no doubt that such groups exist, but the level of organisation found in the German cases has not been seen in the Dutch cases.

A significant difference between the two countries is legislation. In contrast to Germany, in the Netherlands, no generic rules about the permissibility of wind turbines in forests exist. The countries are similar however, in that they are both have legalisation regarding forest quality and reforestation in case of felling. They are also similar in the regard that European Natura 2000 legislation sometimes hinders project plans.

What are the similarities and differences in the evolution of the policy arrangements of the nexus in the Veluwe, Wieringermeer, Thüringen, and Baden-Württemberg, and how can these similarities and differences be explained?

In conclusion, a large number of similarities and differences can be found across the four cases. The similarities and differences are described in the previous sections. These can be explained by differences or similarities in the PAA dimensions. These dimensions are, in turn, shaped by similar or different foci on the policy domains involved in the nexus.

6.2 Theoretical contributions

Theoretically, this research contributes to existing research by adding a fifth dimension to the PAA, namely the societal context. The PAA is already an extensive framework, covering four dimensions when analysing questions regarding policy arrangements. Nevertheless, the addition of the fifth dimension contributes to the comprehensiveness of the framework, by including the indicators shocks, political developments, international developments, technological developments, and societal discourses in the framework. In the current research, the addition of this dimension allowed for the inclusion of more observations from the national context in the analysis, although it should be noted that indicators of this dimension were also observed on the local level. The definition of the societal context indicators is a subjective decision. Other indicators – for instance economic developments – could also have been selected for this dimension. If this indicator would have been selected, the research conclusions could have centred more around division of wealth. Had the dimension not been introduced at all, important explanations for the development of the policy arrangements would not have been identified. The role of Fukushima on the development of onshore wind energy in Germany, as well as the effects of technological developments would likely not have been recognised.

Furthermore, the combination of the PAA with the nexus approach in this research introduces a novel conceptual framework. The combination of these two approaches allows for analysis beyond a single policy domain, which is important considering changes in policy domains commonly affect other policy domains. For a comprehensive evaluation of projects, such effects should be recognised and taken into consideration. The integration of the nexus approach in the PAA strengthen the research by including more empirical facets in the analyses of the four cases. If the nexus had not been included in the analysis, important drivers of the policy arrangement would likely have been out of the scope of this research. For instance, the emphasis on the forest, and biodiversity and nature policy domains is apparent in all cases. Had the nexus approach not been used, these emphases may have still been discovered, but not recognised as important drivers of the policy arrangement.

In short, by adding a fifth PAA dimension, and making the nexus approach central in the analysis of the policy arrangement, this research contributes to integrative governance literature. It stresses the interconnections of a local policy arrangement with the society it is embedded in by adding the societal context to the PAA. By adding the nexus approach, this research also highlights interconnectedness between goals set in different policy domains.

6.3 Limitations

The current research is also characterised by some limitations. The broad scope of the research did not allow for thorough investigation of some interesting topics. As four cases were chosen and consequently analysed using an extensive conceptual framework, the scope of the research did not allow for a thorough exploration of some concepts like the nature-inclusive energy transition. Although the effects of European policies are briefly addressed, a more thorough exploration of this topic could have resulted in interesting insights in the effects of European policymaking – especially Natura 2000 legislation – on Dutch and German legislation relevant for wind energy generation in forests.

The policy domain wind energy in forests was central to the nexus approach in this research. Originally, the approach does not aim to integrate the other sectors in the first, but instead considers the involved policy domains as equally important (Benson, Gain & Rouillard, 2015). The scope of the research, however, did not allow for equal consideration. Considering the four cases that were chosen in this research, in-depth exploration of all policy domains was beyond the scope. In the current research, the wind energy in forests policy domain was taken as a starting point, consequently analysing the relevance of the other three policy domains in light of this domain.

Unfortunately, it proved difficult to reach stakeholders from Thüringen. As a result, with two interviewees, this case is underrepresented in the list of interviewees (see Appendix c). Three interviewees representing national organisations provided information about both cases. Nevertheless, the few interviews for this case limit the reliability of the conclusions provided for this case.

The methodological choice of the cases also poses a limitation to the current research. The Dutch cases concern individual projects in specific areas, whereas the German cases are states. As a consequence, the analysis of the Dutch cases focused more on details regarding the location, and (plans for) the wind farm, and its impacts on specific forest sites and species. The German cases are researched using a wider scope. Therefore, these cases focus more on legislation, elections, and ruling governmental parties. The differences in case selection limit comparability of the conclusions.

6.4 Other scientific debates

Interestingly, the environmentally friendly energy transition is a concept that receives attention in both countries. As this research has shown, aligning renewable energy targets with goals set in the forest, and biodiversity and nature policy domains may pose problems. This issue is closely tied to the SDGs (briefly introduced in section 1.3). In order to achieve the SDGs by 2030, achieving the environmentally friendly energy transition implies striving for synergies between SDGs 7, 13 and 15 (Pradhan et al., 2017). This means that the goals in the policy domains are to be set in such a way that they strengthen, instead of hinder one another.

Discussions about the environmentally friendly energy transition can also be linked to the debate about transformative change. This body of literature calls for radical change by focusing on changing the "root causes" of ecological and environmental decline, defined as "the interconnected economic, sociocultural, demographic, political, institutional, and technological indirect drivers behind the direct drivers" (Díaz et al., 2019, p.1). Rather than focusing on small changes in the status quo, transformative change calls for "change that becomes sweeping" (IPBES, 2019b, para. 4). For example, a reduction of energy consumption can help meet renewable energy targets. If less energy is needed, this may even eliminate the need to consider forests as locations for wind turbines, as other renewable sources produce significant amounts of energy to meet demand. This requires a shift in focus from the status quo of continuously striving for more (energy, but also other commodities like clothes or exotic food) to questioning societal discourses such as economic growth.

Section 3.1.5 introduces governance literature, stating that governance is conducted by a wide variety of stakeholders, including but not limited to governments. In the four cases in this research, however, it becomes apparent that governments have a large influence on the policy arrangements. In the German cases, state governments decide whether or not wind energy generation in forests is allowed. In the Dutch cases, municipal and provincial governments play an important role in leading (potential) projects. Furthermore, in the Baden-Württemberg, and Wieringermeer cases, location choices are skewed towards publicly owned forest. In the Veluwe case, preparatory research for wind energy generation along highways also focused on government owned land. So, it can be concluded that governments are powerful actors in the policy arrangements. Finally, the European Natura 2000 legislation played a big role in the possibilities for wind energy generation in forests. This research thus does not comply with the shift from government to governance (Rhodes, 2012). Instead, it highlights a large impact of governments on the evolution of the policy arrangements. This may be the fact that the energy transition is seen as a task that is too complicated to be executed by other actors, such as market parties, and needs to be coordinated by governments.

6.5 Suggestions for future research

On the basis of the current research, a variety of topics for future research emerges. In the Dutch cases, some interviewees express concerns about the extent to which monitoring is currently executed. Monitoring of impacts of wind turbines' effects on biodiversity is an important topic for research. This also raises the question of how monitoring can best be performed; which methods and standards are used. Another, related matter of concern, is the extent to which the cumulative effects of proposed wind energy projects and other (renewable energy) projects on biodiversity and nature are measured. Finally, in documents and conversations there is an increasing emphasis on linking opportunities. New research could critically analyse how linking opportunities are defined, and consequently how they can best be designed.

Like for the Dutch cases, analysis of the Germany cases sheds light on topics that require further research. Firstly, future research can reveal – if desired – how the current stagnation of the expansion of onshore wind energy throughout Germany can be resolved. Secondly, in Thüringen, future research can reveal how the state's wind energy target can be met without wind energy generation in forests. Furthermore, the influence of mediation between stakeholders, as done by Forum Energiedialog in Baden-Württemberg, on acceptance of wind energy projects could be analysed.

Suggestions for future research relevant for both countries is a research approach centered around the influence of European legislation on wind energy in forest. Research adopting a comparative European politics design can highlight if and how European policy-making and consequent transposition into national law influences national policymaking for this topic. Finally, future research could explore the nature-inclusive energy transition (*Naturverträgliche Energiewende*, and *natuurinclusieve energietransitie*). This term was mentioned by interviewees from both countries. Future research can identify how linking opportunities to research this aim can be defined and how they should be designed.

6.6 Recommendations

From the research in this thesis, some recommendations can be distilled. Firstly, participation and conversation are highly important. Multiple interviewees quoted this as a vital point for societal acceptance of wind parks. More specifically, the work conducted by Forum Energiedialog in Baden-Württemberg can serve as an example for the other cases. Wind energy projects have the potential to lead to social tensions. Citizens are often asked to contribute to plans by commenting on them, but constructive debate between actors groups representing opposing discourses is not yet conducted in many locations. Introducing such debates should not be seen as a panacea, but is a tool for increasing participation and has the potential to make citizens feel heard. Introducing more room for constructive debate may not only be beneficial for wind energy projects in the forests, but also those in open, more visible landscapes. Successful participation processes in one location can also serve as a good example, and have spill-over effects, reducing opposition in other projects. If increased participation leads to more acceptance of wind energy projects in open landscapes, this may result in reducing the number of projects in the forest, in turn alleviating the tension amongst opposing groups around this topic.

Opposition against wind energy projects in forests often stems from worries about ecological values such as forest quality and species protection. Although initiators of the projects hire research agencies to investigate these impacts, doubt about the validity of these conclusions persist. Actors have concerns about the independency of the research and highlight that different agencies employ different research methods. It is thus advisable – in order to increase validity and trust in the research – to streamline and communicate research methods. If the same methods are used to research different cases, worries about independency can be diminished. Communicating about the methods used and the results further help citizens understand the conclusions drawn. Additionally, as the turbines in the Robbenoordbos are seen as a pilot project, this case could serve as an informative example of the potential for wind energy generation in forests in the Netherlands. Intensifying communication across the border can also help share knowledge and experiences, hopefully enhancing the quality, safety, and acceptance of new projects.

Finally, although not a novel recommendation, the importance of thoroughly researching the impact of wind energy projects on forest, biodiversity and natural values should be stressed. In light of meeting the goals agreed upon in the Paris Agreement and thereby mitigating climate change as much as possible, achieving goals in one domain cannot come at a large cost of achieving goals in the other.

Appendix A: Other energy sources in relation to climate change, forest, and biodiversity and nature

Renewable energy sources

Renewable energy sources have an important climate change mitigation potential, as they are associated with lower GHG emissions than fossil fuels (Immerzeel et al., 2013; Gasparatos et al., 2017; Correa et al., 2017). However, like wind energy, other renewable energy sources are associated with negative impacts on biodiversity and nature (Gasparatos et al., 2017). Moreover, some renewable energy installations are built in forests or make use of forest resources, causing forest degradation and affecting (local) biodiversity and nature (Gasparatos et al., 2017; Gibson et al., 2017). This has instigated ongoing scientific and societal debates about a sustainable balance between renewable energy production, forest conservation, and biodiversity and nature (Santangeli et al., 2015; Gasparatos et al., 2017; Gibson et al., 2017; Hernandez et al., 2014). Finally, although renewable energy generation has relatively low GHG emissions, these emissions should not completely be ignored (Gibson et al., 2017). In this appendix, first an overview of renewable energy generation and its influence on biodiversity and nature, forests, and climate change is provided. This overview focuses on four sources of renewable energy, namely bioenergy, solar energy, hydropower, and geothermal energy. As wind energy is already discussed in the main text, the four remaining sources of renewable energy and their effects on biodiversity, climate change, and forests are discussed here. Consequently, the effects of nuclear power are explained. Discussions about whether or not nuclear power should be considered a type of renewable energy are ongoing. Finally, in order to draw a comparison, the effects of fossil fuels on forests, climate change, and biodiversity and nature is outlined.

Bioenergy

Biodiversity and nature

Bioenergy accounted for approximately 8% of total global renewable energy generation in 2017. This bioenergy considered here consists of solid biofuels (including solid municipal waste and bagasse), liquid biofuels and biogas (IRENA, 2019d). Bioenergy is created by converting biomass into energy. Biomass consists of organic matter from three main sources, namely residues and waste, forestry, and crops and grasses (IEA & FAO, 2017). So, biomass may originate from crops grown for the purpose of converting them into bioenergy, or of residual, agricultural and forest waste. The bioenergy created is in turn used to create bio-heating, bio power and biofuels (Sauerbrei et al., 2017; Correa et al., 2017; Gasparatos et al., 2017; IEA & FAO, 2017). A distinction can be made between first, second and third generation biomass. In the first generation, biomass consists of food crops that are grown for the purpose of generating bioenergy (Correa et al., 2017). The biomass products include sugar cane, corn, palm oil, soya, and canola (IEA & FAO, 2017). Second generation bioenergy is generated using lignocellulose crops, primarily grasses and trees, as well as waste and residue feedstocks (Manning, Taylor & Hanley, 2014; IEA & FAO, 2017). As these types of biomass primarily concern leftover products, their production does not compete with other land use purposes, but does compete with alternative use of these products (IEA & FAO, 2017). Third generation bioenergy is created using algae, a process that is still in the experimental phase and will not be elaborated upon here (Gasparatos et al., 2017).

First generation bioenergy is critiqued for its land-intensive and polluting process. The cultivation of biomass crops competes with land-use for food production. It thus pushed agriculture away from the arable land to other locations, which may increase the magnitude of land-use change and may result in higher global food prices. This type of biomass production also heavily impacts biodiversity and nature, through the removal of biodiverse systems to clear land for biomass cultivation. Immerzeel et al. (2013) find that "[l]and-use change appears as the key driver of biodiversity change, whereas the associated habitat loss, alterations in species richness and abundance are the main impacts addressed" (p.205). Biomass cultivation also has an indirect effect on biodiversity as land use change results in an increase in GHG emissions, air pollution and water use (Correa et al., 2017; IEA & FAO, 2017). Second generation bioenergy also has negative consequences for biodiversity (Immerzeel et al., 2013; IEA & FAO, 2017). For instance, hedges and grassland that are used as biomass can otherwise provide shelter for birds (Immerzeel et al., 2013; Sauerbrei et al., 2017). Third generation bioenergy is often seen as a promising alternative to first- and second-generation bioenergy, as it has a less profound impact on biodiversity and nature (Correa et al., 2017).

Forests

One of the possible feedstocks for biomass is wood. The generation of bioenergy may thus directly cause deforestation. This deforestation may be counteracted by planting new trees to replace the felled ones. New trees, however, need time to grow and develop the same carbon storing capacity as the felled trees carried. Bioenergy thus causes a temporary increase in carbon emissions, as a result of the time delay between the felling and combustion of mature trees and the growth of new trees. However, sometimes forest residues, such as by-products of timber demand, are used as biomass. Then, the associated deforestation can no longer be solely attributed to bioenergy (Siljander & Ekholm, 2018).

Climate change

Amponsah et al. (2014) focus on dedicated biomass and energy from waste. The first entails systems in which "biomass comes from areas of land areas dedicated to the growth of the source material" (p.467). In the process of waste treatment, on the other hand, energy is generated from residues from forests, industry, households, or agriculture. The life cycle of dedicated biomass is associated with 14 to 650g CO_2-eq/kWh. GHG emissions of energy generated from waste range between 97 and 1000 g CO_2-

eq/kWh. Of the renewable energy sources summarised in this section, GHG emissions from bioenergy are the highest (Amponsah et al., 2014).

Solar energy

Biodiversity and nature

Solar electricity is generated either through photovoltaic (PV) cells, concentrated solar power (CSP), or through solar heating and cooling. Solar energy provided approximately 7% of total global renewable energy in 2017 (IRENA, 2019d). Since the largest share of solar energy is generated by PV cells, this technology is the focus on this chapter (IEA, 2019). With this technology, sunrays are captured and used to generate electricity (Gasparatos et al., 2017). The effects of solar energy on biodiversity and nature are often considered minimal, as this type of renewable energy generation is less dependent on specific locations and is easily applicable in urban regions. Nevertheless, large scale solar farms and their supporting infrastructure require considerable amounts of land and can thus cause fragmentation and loss of habitats (Katzner et al., 2019). Furthermore, solar energy installations cause bird fatality. Birds may collide with PV installations, as they are confused by the reflective surface of the panels or perceive the panels as a water body (Ho, 2016; Visser et al., 2019). Nevertheless, bird fatality due to solar energy installations is much less frequent than bird fatality due to other sources. It is associated with 37,800 to 138,600 cases annually in the United States. In comparison, building and window collisions are associated with 365 to 988 million cases annually in the same country (Walston et al., 2016). Furthermore, some solar energy installations require the use of great amounts of water, often retrieved from the installation's direct surroundings. Contrary to the less often used CSP technology, PV systems need little water (0.02 m^3/MWh), as the water is only used to keep the PV cells clear of dirt (Gasparatos et al., 2017; Hernandez et al., 2014).

Forests

Solar energy systems are mostly installed in open spaces, such as grasslands, deserts, or urban areas. Although limited in frequency, solar energy systems are also set up in forests. This results in deforestation, leading to higher GHG emissions than solar energy systems installed elsewhere. Habitat loss and fragmentation may be more severe when solar energy systems are installed in forests, as biodiversity is denser in these areas (Turney & Fthenakis, 2011).

Climate change

Aside from its effects on biodiversity and nature, this type of renewable energy is associated with GHG emissions. Although these emissions are considerably lower than those associated with fossil fuels, they should not be neglected. Amponsah et al. (2014) find that the life cycle of PV systems is associated with a mean of 91.1g CO_2-eq/kWh. If deforestation is required for the installation of solar energy systems, this impact is higher, as forests' capacity to store carbon is diminished. Almost all GHG emissions are caused by the manufacturing of the solar cells (Turconi, Boldrin & Astrup, 2013). Manufacturing of solar cells also requires the use of valuable raw materials, such as tellurium, indium and gallium (Rabe, Kostka & Stegen, 2017). Availability of these resources, however, is scarce. This may pose problems of availability in the future, as demand is expected to continuously rise. Recycling of these materials may offer a solution, but this strategy is not employed at a large scale yet (Rabe, Kostka & Stegen, 2017; Redlinger, Eggert & Woodhouse, 2015). Finally, the aforementioned amounts of water used to cool CSP installations, may cause competing interests regarding the use of local water bodies in locations prone to water scarcity (Hernandez et al., 2014).

Hydropower

<u>Biodiversity and nature</u>

Providing for more than 67% of total renewable energy in 2017, hydropower is generated by running water through turbines and thereby generating electricity (Gasparatos et al., 2017; IRENA, 2019d). One of the primary manners in which this type of renewable energy is generated is by the construction of dams that keep water contained in a large reservoir and regulate the outflow of the water. Aside from generating power, dams can also be used to control water levels in case of anticipated floods or droughts. Reservoirs for the generation of hydropower require great amounts of land, which results in habitat loss. Further habitat loss and fragmentation is caused by the necessary roads and transmission lines connected to the reservoirs (Gibson et al., 2017). Additionally, many pluvial species' habitats are confined to either the reservoir or the river of the hydroelectric dam, which is especially problematic for migratory species (Gibson et al., 2017; Gasparatos et al., 2017). Gibson et al. (2017) further argue that "[d]ams regulate water flow and disrupt natural flow cycles, creating homogenized, disturbed conditions that favor the spread of non-native species that in turn threaten many native species" (p.927). Still, the creation of water reservoirs has also been proven advantageous for some species, as a reservoir created in the Brazilian Amazon resulted in an increase in the local otter population (Gibson et al., 2017).

<u>Forests</u>

Like other renewable energy installations, hydropower systems require connection to the power grid and roads for accessibility. Their construction induces deforestation. Furthermore, the space required for the reservoirs and dams also cause felling of trees (Gibson et al., 2017; Moran et al., 2018). In the earlier mentioned case of the Amazon, for instance, a "reservoir flooded more than 3000 km2 of undisturbed rainforest" (Gibson et al., 2017, p.925). This deforestation causes habitat loss and fragmentation, thus impacting biodiversity and nature.

<u>Climate change</u>

Hydropower is associated with significant GHG emissions (Gibson et al., 2017; Amponsah et al., 2014). Amponsah et al. (2014) find that the life cycle of hydropower installations is associated with a mean of 20g CO_2-eq/kWh. Nearly all GHGs were emitted during the commissioning and decommissioning stages (Turconi, Boldrin & Astrup, 2013). A significant amount of these emissions can also be explained by the deforestation and biodiversity loss associated with hydropower installations (Gibson et al., 2017).

Geothermal energy

Biodiversity and nature

Geothermal plants use the heat of the earth to generate energy (Gasparatos et al., 2017). In 2017, geothermal energy contributed to the global renewable energy generation by nearly 1.4% (IRENA, 2019d). This method of energy generation requires little amounts of land (Katzner et al., 2019). Nevertheless, in the process of retrieving heat from the earth's crust, various instruments are used, including pipelines, silencers, turbines, and cooling towers. Although research on the effects of geothermal energy generation on biodiversity and nature is limited, the installation and operation of these instruments are likely to negatively impact local biodiversity (Katzner et al., 2019; Gasparatos et al., 2017). Gasparatos et al. (2017) argue that "[a]ctivities such as site clearing, road construction, well drilling and seismic surveys, may cause disturbances that could affect the breeding, foraging and migration patterns of certain species" (p.170). This is especially the case when geothermal power projects are located in valuable nature areas with high levels of biodiversity. Additionally, although the use of geothermal for energy generation emits less GHGs than that of fossil fuels, geothermal energy is associated with the emission of some toxic substances (Gasparatos et al., 2017).

Forests

Research on the effects of geothermal installation on forests is limited. The available information on the potential interference of geothermal energy installations with forests report no negative effects caused by the installations (Kagel, Bates & Gawell, 2005; Bussotti et al., 1997).

Climate change

Amponsah et al. (2014) find that the life cycle of geothermal energy systems is associated with mean emissions between 40 and 60g CO_2-eq/kWh. The majority of these emissions stem from the construction of the installations and the transport of the materials.

Nuclear energy

Biodiversity and nature

The use of nuclear power is much debated topic. Proponents advocate for this source of energy arguing it is safe, sustainable, and necessary component in the energy mix to replace fossil fuels. Opponents, on the other hand, have expressed worries about treatment of the radioactive waste that results from nuclear power and fear that uranium supplies are insufficient in the long run (Brook & Bradshaw, 2014). The nuclear disasters in Chernobyl and Fukushima intensified the debates about this method of energy generation. Nevertheless, according to Schneider and Froggatt (2020), nuclear energy was responsible for 10.35% of the global gross electricity generation in 2019. Although not regarded as a source of renewable energy by some, "[n]uclear energy derived from fission of uranium and plutonium […] is capable of replacing most, if not all, of the stationary tasks now performed by the combustion of fossil fuels" (Brook et al., 2014, p.9). Nonetheless, nuclear energy is not free of environmental impacts. The two primary risks identified by Prăvălie and Bandoc (2017) are that of nuclear waste and that of nuclear reactor accidents. The former risk is caused by the large amounts of high level waste, "waste that contains 95% of the nuclear power radioactivity, and consists mainly of uranium spent nuclear fuel" (p.88), produced by nuclear reactors, which is estimated at 25-30 tons per reactor per year. A part of this waste can be reprocessed, but the majority is stored underground in special containers, in locations with low permeability. Although not all countries employing nuclear energy currently have such permanent storage in place, many sites are under construction. As a consequence, nuclear waste is currently not yet securely stored and even at the storage sites under construction, total safety of the environment cannot be secured, as "certain possible geological perturbations can be triggered over the course of hundreds of thousands of years of operation" (p.89). The second risk of nuclear accidents is caused by failures in the cooling system of a reactor, leading to core meltdown. Aside from the two accidents in Chernobyl and Fukushima, there have been approximately 18 other, smaller incidents in the past 70 years. The consequent leak of radioactive material results in contamination of the surrounding environment has major consequences for both ecosystems and human health (Prăvălie & Bandoc, 2017).

Forests

Aside from sources reviewing negative effects of the Chernobyl and Fukushima disasters on surrounding forests, nuclear energy does not have significant effects on forests (Bird & Little, 2013; Miura, 2016).

Climate change

Amponsah et al. (2014) did not include nuclear energy in their analysis of life cycle GHG emissions of energy sources. Brook and Bradshaw (2014) however, report that nuclear energy is associated with 16 CO_2/kWh. Thereby, it is "estimated that nuclear power is preventing the annual release of 1.2–2.4 Gt CO_2 emissions globally" (Prăvălie & Bandoc, 2017, p.83).

Fossil fuels

Biodiversity and nature

The focus in this section on fossil fuels is on the impact of natural gas, oil and coal. These fossil fuels have significant detrimental effects on biodiversity and nature. Indirect impacts are primarily caused by climate change, largely induced by GHG emissions associated with fossil fuels (Dale, Parish & Kline, 2014; Harfoot et al., 2018). Aside from the indirect impacts, some direct impacts have also been recognised. Harfoot et al. (2018) found that oil, gas and coal extraction infrastructure “occurred at locations with substantially higher species richness and range rarity than locations where no exploitation was taking place” (p.3). These findings hold true for infrastructures found on land and in the sea (Harfoot et al., 2018). Extraction of fossil fuels causes disturbance and induces fragmentation and loss of local habitats. Furthermore, extraction leads to pollution of water and soil. In marine environments, oil extraction may lead to spills leading to long-lasting detrimental effects for the marine environment (Butt et al., 2013; Dale, Parish & Kline, 2014). On land, fossil fuel extraction induces deforestation and soil erosion. As the extraction of fossil fuels is still expanding, more locations globally will become subject to these adverse, long-lasting effects (Butt et al., 2013). Furthermore, fossil fuel combustion causes soil and air pollution. Aside from emitting large amounts of CO_2, fossil fuel combustion and consumption are correlated to methane, sulphur dioxide and nitrogen oxide emissions, which in turn result in severe negative effects on human health and the environment (Perera, 2017; Nicoletti et al., 2015). Fossil fuel combustion furthermore results in pollution by heavy metals such as cadmium, which contaminate the soil. Soil pollution may in turn lead to water pollution and damage to crops (Martín et al., 2015; Kelepertzis, 2014).

Forests

There is little research available on deforestation for fossil fuel extraction. Deforestation and fossil fuels both heavily contribute to climate change. As Okia (2012) reports, “[re]lease of the carbon dioxide due to global deforestation is equivalent to an estimated 25 per cent of emissions from combustion of fossil fuels” (p.15). Forests’ capacity to capture and store carbon is vital for the reduction of global emission levels, largely caused by fossil fuel combustion (Houghton, 2012).

Climate change

Throughout their life cycle, these energy systems are associated with considerable GHG emissions. For non-renewable energy and heating sources Amponsah et al. (2014) do not report specific numbers. From figure 1, one can deduce the approximate GHG emission means of these sources. Natural gas is associated with an approximate mean of 500g CO_2-eq/kWh; oil with 733g CO_2-eq/kWh; and coal with 888g CO_2-eq/kWh (Amponsah et al., 2014). In 2018, coal, oil and natural gas combustion accounted for 89% of total global CO_2 emissions (which represent 92% of total GHG emissions) (Olivier & Peters, 2020).

Benefits of renewable energy

As previously mentioned, the primary benefit of renewable energy generation is that it is associated with significantly lower levels of GHG emissions than fossil fuel-based energy (Gasparatos et al., 2017; Amponsah et al., 2014; Santangeli et al., 2015). Also, despite the abovementioned threats renewable energy generation poses to biodiversity and nature, some benefits have also been recognised. Some landscapes used to grow resources for the generation of bioenergy "can provide habitat, food and other supporting ecosystem services compared to other agricultural practices" (Gasparatos et al., 2017, p.173). A good example is perennial grasses, which get cropped but not extracted to harvest the biomass needed to generate energy, therefore continuously providing benefits for certain species (Werling et al., 2014; Bellamy et al., 2009). Hydropower installations may negatively impact the habitat of various local species. Nevertheless, the damming off of previously flowing water provided beneficial circumstances for some predatory fish species (Palmeirim, Peres & Rosas, 2014). Marine energy generation, as well as offshore wind energy, may provide a benefit for marine animals in terms of protection. The energy generation installations may inhibit fishing, thereby protecting fish and other marine species. Marine renewable energy installations may thus indirectly serve as a marine protected area (Ashley, Mangi & Rodwell, 2014). In short, this appendix aims to provide a brief overview of the impacts of renewable energy sources on forests, climate change, and biodiversity and nature. However, to put these impacts in perspective, an overview of the impacts of fossil fuel combustion and usage was also provided. It can be concluded that, even though renewable energy generation is not free of negative effects on forests, climate change, and biodiversity and nature, the adverse effects caused by fossil fuel extraction are generally greater (Dale, Parish & Kline, 2014).

Appendix B: Information sheet interviews

Windturbines in bossen - Masterscriptie

Wie ben ik en waar gaat dit onderzoek over?

Ik ben Roos van der Reijden, masterstudent Environment and Society Studies aan de Radboud Universiteit. In mijn masterscriptie onderzoek ik het beleid rondom windturbines in bossen in Nederland en Duitsland. In Nederland richt ik mij specifiek op het Robbenoordbos in de Wieringermeer in Noord-Holland, waar sinds september 2020 vier windturbines staan, en op de Veluwe, waar plannen om windturbines te plaatsen voorlopig niet door lijken te kunnen gaan.

Wat houdt deelname aan dit onderzoek in?

Om te onderzoeken hoe het beleid in Nederland tot stand is gekomen, interview ik stakeholders die betrokken zijn (geweest) bij het debat of de uitvoering van een of beide projecten. Ook ben ik geïnteresseerd in de ervaringen van omwonenden of mensen die anderszins door de projecten worden beïnvloed. In het interview zal ik u voornamelijk vragen naar de meningen en ervaringen van u of uw organisatie. Als u besluit deel te nemen aan dit interview, zou ik graag een afspraak van 30-60 minuten met u inplannen. Het interview zal plaatsvinden via videoconferentie programma Webex. Als u hiermee instemt, zal het interview wordt opgenomen. De opname staat mij toe om het interview samen te vatten en deze samenvatting tijdens de analyse nog eens te raadplegen. De opname en samenvatting kunnen worden ingezien door mijn begeleiders en worden opgeslagen in de archieven van de Radboud Universiteit.

Wat gebeurt er met de informatie uit het interview?

De inzichten uit het gesprek worden meegenomen in de analyse. Delen van het gesprek (merendeels korte citaten) kunnen worden opgenomen in mijn scriptie. Hierbij zal ik echter niet uw naam noemen, maar refereren aan de organisatie waarbij u betrokken bent en eventueel de functie die u bekleedt. Als ik een letterlijk citaat uit het interview in het onderzoek opneem, zal ik hierover contact met u opnemen, om te verifiëren dat ik uw uitspraak juist heb geïnterpreteerd.

Als u nog vragen heeft, kunt u contact met mij opnemen:
Roos van der Reijden

Wind energy generation in forests – Master thesis

Who am I and what is this research about?

I am Roos van der Reijden, master student Environment and Society Studies at the Radboud University in Nijmegen, the Netherlands. My research focuses on the policies regarding wind energy generation in forests in Germany and the Netherlands. In Germany, my focus is on two states, namely Thüringen and Baden-Württemberg.

What does participation in this research entail?

In order to research how the policies regarding wind energy in forests in Germany have come about, I am interviewing stakeholders who are or who have been involved in the debate about this topic in Thüringen or Baden-Württemberg. Additionally, I am interested in hearing about the experiences of people who have otherwise been affected by or involved in projects for wind energy generation in forests. In this interview, I will primarily ask about your (organisation's) experience and opinions about this topic. If you decide to take part in the interview, I would like to schedule a meeting of 30-60 minutes. The interview will take place using the video communication tool Webex. If you agree, the interview will be recorded. The recording will allow me to transcribe the interview and consult the transcription during the analysis. The recording and transcription may be consulted by my supervisors and will be stored in the achieves of the Radboud University.

How will the information from the interview be used?

The insights from the interview will be used for analysis. Parts of the conversation (primarily short statements) could be included in my thesis. If this is the case, I will not state your full name, but instead refer to your organisation and, if necessary, your position within the organisation. If I include a direct quote from you in my thesis, I will inform you about this beforehand.

Should you have any further questions about the research or the interview, please feel free to contact me:
Roos van der Reijden

Appendix C: Interview guides

Interview guide for the Dutch cases

1. Kunt u de organisatie waarbij u werkt en uw positie daarbinnen introduceren?
2. Hoe kijkt uw organisatie aan tegen windenergie in het bos?
3. Welke maatschappelijke veranderingen van de afgelopen jaren hebben er volgens u toe geleid dat er nu windenergie in het bos wordt opgewekt?
4. Hoe kan het opwekken van windenergie in bossen verenigd worden met het behalen van doelstellingen voor biodiversiteit, bosbeheer en natuurbehoud?
5. Kunt u beschrijven hoe een project voor windenergie in bos tot stand komt; welke actoren zijn daar bij betrokken en welke rol spelen ze?
6. Hoe is uw organisatie betrokken (geweest) bij projecten rondom windenergie in bos?
    a. Met welke actoren/partners heeft u hierbij samengewerkt?
7. In mijn onderzoek kijk ik onder andere naar machtsverhoudingen.
    a. Welke actoren hebben een grote invloed op windenergie projecten in het bos?
    b. Zijn er actoren die volgens u nog onvoldoende betrokken zijn?
8. Wat is het belangrijkst voor het behalen van de doelen voor duurzame energie? Hoe verhoudt dat zich tot de doelen voor biodiversiteit en natuurbehoud?
9. Zijn er nog belangrijke ontwikkelingen of andere punten die nog niet aan bod zijn gekomen die u zou willen bespreken?

Interview guide for the German cases

1. Could you please introduce the organisation you work for and your position within that organisation?

National level

2. Throughout Germany, a large increase in wind energy generation in forests can be observed since 2010/2011. What caused this large increase?
3. Who decides which forest sites are suitable for wind energy generation, who is the responsible authority?
4. What led to the decision to handle wind energy planning on a regional level, rather than a federal level?
5. Since 2017/2018, a decrease in onshore wind energy expansion can be observed. What has caused this stagnation?

State level

6. How does your organisation view wind energy generation in forests?

7. How does the general public view wind energy generation in forests in Baden-Württemberg/Thüringen?
8. How is the approach to wind energy generation in forests in Baden-Württemberg/Thüringen different from or similar to approaches adopted by other states in Germany?
9. In my research I am also looking at power relations. Which actors have a lot of influence when it comes to wind energy generation in forests? Which actors do not (yet) have a large say in the matter?
10. What organisations and individuals does your organisation mostly collaborate with?
11. How, in your opinion, can wind energy generation in forests be combined with meeting goals related to biodiversity, forest management, and nature conservation? What are some important considerations that need to be made?
12. How do you think wind energy generation in forests will develop in the upcoming years?
13. Is there anything about this topic that we have not yet discussed, but that you would still like to discuss?

Thüringen (questions specific to the situation in this state)

14. The development of wind energy generation in forests in Thüringen has been forbidden by law since late 2020.
    a. What has led to the passing of this law?
    b. Was development of wind energy generation in forests in Thüringen allowed before the passing of this law?
    c. What changes have been observed in the past decade(s)?
    d. Which actors have been involved in this decision? What has their role been?

Baden-Württemberg (questions specific to the situation in this state)

15. When did development of wind energy generation in forests in Baden-Württemberg start?
    a. What caused this development?
    b. Has this changed in the past decade(s)?
16. Could you describe how a project for wind energy generation in forests develops?
    a. Which actors are involved, who takes the lead?
    b. What is the role of your organisation in these projects?

Appendix D: List of interviewees

As some interviewees have requested to not be included in this research by name, the following provides a list of the organisations the interviewees represent.

#	Position	Organisation	Case(s)	Date of interview
1	Business developer	Staatsbosbeheer	Wieringermeer	23-02-2021
2	Staff member department of Public Affairs	Natuurmonumenten	Wieringermeer and Veluwe	02-03-2021
3	Project member renewable energy, nature, and agriculture	Natuur & Milieufederatie Noord-Holland	Wieringermeer	03-03-2021
4	Director	Nederlandse Vereniging Omwonenden Windturbines (NLVOW)	Wieringermeer and Veluwe	03-03-2021 and 05-03-2021
5	Team member energy transition	Province of Gelderland	Veluwe	05-03-2021
6	Project leader wind energy	RES Noord-Veluwe (on behalf of the province of Gelderland)	Veluwe	22-03-2021
7	Landscape architect	PhD at Wageningen University and Amsterdam University of the Arts, previously researcher for agency Wing	Wieringermeer and Veluwe	23-03-2021
8	Project member renewable energy and nature	Natuur & Milieufederatie Gelderland	Veluwe	23-03-2021
9	Project manager Prinses Ariane Windpark	Municipality of Hollands Kroon	Wieringermeer	16-04-2021
10	Postdoctoral researcher	Faculty of Environment and Natural Resources, Albert-Ludwigs University of Freiburg	Thüringen and Baden-Württemberg	21-05-2021
11	Project leader	Thüringer Energie- und GreenTech-Agentur (ThEGA)	Thüringen	26-05-2021
12	Project manager	Uhl Windkraft	Baden-Württemberg	26-05-2021
13	Project leader planning	ABO Wind	Baden-Württemberg	07-06-2021
14	Project Leader Dialog Forum Renewable Energies and Nature Conservation	BUND Baden-Württemberg	Baden-Württemberg	09-06-2021
15	Energy expert	Nabu Thüringen	Thüringen	14-06-2021
16	Researcher	Forstliche Versuchs- und Forschungsanstalt (FVA) Baden-Württemberg	Baden-Württemberg	18-06-2021
17	Legal advisor	Regierungspräsidium Tübingen	Baden-Württemberg	23-06-2021
18	Teamleader	Forum Energiedialog	Baden-Württemberg	23-06-2021
19	Member of the technical inspection department	Landratsamt Breisgau-Hochschwarzwald	Baden-Württemberg	01-07-2021
20	Expert nature protection and renewable energies[8]	Bundesamt für Naturschutz	Thüringen and Baden-Württemberg	28-06-2021
21	Consultant for nature and species protection[8]	Fachagentur Windenergie an Land	Thüringen and Baden-Württemberg	02-07-2021
22	Head of the environmental department[8]	Landkreis Sigmaringen	Baden-Württemberg	06-07-2021
23	Advisor for Renewable Energies[8]	Ministerium für Umwelt, Klima und Energiewirtschaft Baden-Württemberg	Baden-Württemberg	17-07-2021

[8] Interview conducted in written form, sent via email.

Appendix E: Coding scheme

Nexus approach

Concept
Wind energy in forests
Biodiversity[9]
Nature[9]
Forest(s) [9]
Climate change[9]

Policy arrangement approach

Concept	Indicators
Societal context	Shocks, political developments, international developments, technological developments, societal discourses
Resources/power	Resource constellation, power relations
Actors	Actor constellation, interaction patterns
Rules of the game	Legislation, procedures, political culture
Discourses	Paradigms, utopias, policy programmes

[9] In the context of wind energy. Not all sections about these concepts are relevant, but only when they relate to wind energy in forests.

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