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The Dutch Nitrogen Crisis and its Effects on the Development of Real Estate

Exploring the impact and effects of the existing institutional arrangement concerning nitrogen and Natura 2000

Master Thesis Environmental and Infrastructure Planning
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Preface

Dear reader,

Before you lies my thesis for the master's program Environmental and Infrastructure Planning at the Faculty of Spatial Sciences of the University of Groningen. The completion of this master thesis marks the end of my student life, as well as the first step into the professional field. Furthermore, the Master of Science (MSc) degree is the culmination of five years of studying. In addition, in my studies, I obtained a Bachelor of Science (BSc) degree in Spatial Planning, and I acquired a teaching qualification as a second-degree geography teacher through the educational minor. The knowledge I have gained throughout my studies has contributed to the strengthening of my interest in integral spatial issues. The process of writing this thesis has been challenging at times. Achieving this result would not have been possible without the support of several individuals, whom I would like to express my gratitude to.

First of all, I would like to thank my supervisor dr. Ferry van Kann for his guidance throughout the research process. The brainstorming sessions, discussions, and feedback have significantly contributed to the development of this thesis. I deeply appreciate your high level of involvement and support, which fostered a pleasant collaboration.

Second, I express my gratitude to the consulting and engineering firm of Lycens for providing me with the opportunity to write my thesis within their company. As of February, I have been interning here. This allowed me to tap into Lycens' extensive network for the data collection process and to gain firsthand insights into the real-world development of the issue under study. Furthermore, the discussions with my colleagues and their support have contributed to achieve this end result.

Finally, I would like to thank my loved ones for their support throughout the process of writing this thesis. This has helped me to keep making progress in this extensive research project. Furthermore, you have provided me with a constant source of encouragement throughout my studies to achieve the Master of Science degree.

I hope this thesis will provide valuable insights and I wish you an enjoyable read!

Bouke Kamphuis

Oldenzaal, July 2023

Abstract

The Netherlands is experiencing a so-called ‘nitrogen crisis’. The emission and atmospheric concentration of nitrogen are relatively high. As a result, there is an excessive deposition of nitrogen on the country’s Natura 2000 sites. However, the preservation of this network is formally protected under EU directives. Consequently, a conflict arises between the environmental quality and spatial developments involving an emission of nitrogen. Therefore, the Dutch government has designed institutions to govern this environmental/space-conflict.

It is perceived that these institutions might have negative effects on the development of real estate. Hence, this thesis explores the impact and effects of the existing institutional arrangement in the Netherlands concerning nitrogen and Natura 2000 on the development of real estate. Data from a policy review, expert interviews, and action research have been used to conduct this research.

The high population density and environmentally harmful activities, characteristics of Dutch Natura 2000, omission of compensatory measures, and sectoral environmental planning have been identified as causes contributing to the environmental/space-conflict, and thereby the nitrogen crisis.

The existing institutional arrangement concerning nitrogen and Natura 2000 adds to the complexity of developing real estate, resulting in an increasing dependency on and a boost for environmental consultancy. Besides, differences have been observed throughout the Netherlands. In response, actors involved in the development of real estate take measures in their processes and activities to mitigate potential effects. Examples of these measures are the precautionary assessment of nitrogen deposition, deployment of electrical equipment, phasing of the development, and application of internal and external offsetting. Hence, the existing institutional arrangement impacts the industry involved in the development of real estate.

Observed effects on the development of real estate include an increase in the costs, postponement, and cancellation. Furthermore, the development of various types of real estate and associated developments are affected, including housing, business parks, and an amusement park. Thus, this research reveals that the existing institutional arrangement concerning nitrogen and Natura 2000 has impeding effects on the development of real estate.

Finally, the analysis of the research reveals improvements for the institutional arrangement in the Netherlands concerning nitrogen and Natura 2000, which aim to mitigate the impact and effects on the development of real estate. These measures include enhanced involvement of relevant actors, improved implementation of compensatory measures, and the re-implementation of an exemption for the nitrogen emissions of the development of real estate. Further research could be conducted to investigate the feasibility and effectiveness of these recommendations and explore additional avenues for improving the institutional arrangement concerning nitrogen and Natura 2000.

Key words: Dutch Nitrogen Crisis, Environmental/space-conflict, Development of Real Estate, Natura 2000, Institutional Arrangement, Institutional Design

Table of contents

Index

List of figures

List of tables

List of abbreviations

CBS = Centraal Bureau voor de Statistiek (Dutch Central Office for Statistics)
EEA = European Environment Agency
EU = European Union
KDW = Kritische depositiewaarde (critical deposition value)
PAS = Programma Aanpak Stikstof (Programmatic Approach Nitrogen)
PBL = Planbureau voor de Leefomgeving (Dutch Environmental Assessment Agency)
RIVM = Rijksinstituut voor Volksgezondheid en Milieu (Dutch National Institute for Public Health and the Environment)
RNCs = Reactive nitrogen compounds, in particular nitrogen oxides (NO_x) and ammonia (NH_3)
Wnb = Wet natuurbescherming (nature protection act)

1. Introduction

1.1 Background

Nitrogen is a colorless and odorless gas that is all around us, approximately 78% of the atmosphere consists of nitrogen (Capsa et al., 2016). Molecular nitrogen (N_2), in its regular composition in the air, is not harmful to humans and the environment. However, the increasing deposition of reactive nitrogen compounds is harmful to human health and the environment (Wolfe & Patz 2002). These reactive compounds, specifically nitrogen oxides (NO_x) and ammonia (NH_3), are, in particular, emitted by a couple of human activities (RIVM, 2023a). The environment is affected by the accumulation of excessive concentrations of nitrogen oxides and ammonia, as the deposition of these compounds persists over extended periods. This deposition leads to various adverse effects such as eutrophication, biodiversity loss, soil acidification, changes in nutrient cycling, and air and water pollution (Hicks et al., 2011).

The Netherlands is a relatively densely populated country (CBS, 2023a). Given the country's large degree of urbanization, energy-intensive industry, and extensive transportation sector, the environmental pressure is high (EEA, 2020). Subsequently, relatively speaking, the emission and deposition of nitrogen in the Netherlands is among the highest of the European Union (EEA, 2019). In combination with the Natura 2000 sites allocated in the country, sources of nitrogen emission such as housing, transportation activities, farms, and factories are often closely located to protected Natura 2000 areas. This results in a substantially high nitrogen deposition in these protected natural areas.

In 1999, the Gothenburg protocol was enacted, which has been ratified by 25 countries and the European Union (UNECE, 2023). This multi-pollutant protocol has been designed to abate eutrophication, acidification, and ground-level ozone, including reactive nitrogen compounds, in the participating countries. Furthermore, to protect the species and habitats of nature areas, the European Union has established the Nature Directives (European Commission, 2023a). Adhering to these directives should contribute to preserving European nature. These directives focus especially on the preservation of Natura 2000 sites, this is a European network of protected nature reserves (European Commission, 2023b). In the Netherlands, there are 162 areas designated as Natura 2000 sites (Natura 2000, 2023). These sites are formally protected under the Birds Directive and the Habitats Directive (EEA, 2021a). For the Netherlands to preserve the Natura 2000 sites, the nitrogen emission and subsequent deposition must be reduced substantially (RIVM, 2023a).

To deal with this conflict of the relatively high emission and subsequent deposition of nitrogen on Natura 2000 sites, the Dutch government has developed the so-called 'Program Approach Nitrogen', often referred to as PAS (Aanpak Stikstof, 2023). This program started on July 1, 2015, and entails a policy framework to protect the domestic Natura 2000 sites (Rijksoverheid, 2023a). It included proposed compensatory measures to decrease the deposition of nitrogen in the designated protected natural areas where excessive concentrations of nitrogen oxides and ammonia threaten nature.

Initially, construction, renovation, and redevelopment of real estate was still possible under the PAS approach. However, in May 2019, the Dutch council of state ruled that the Dutch approach towards nitrogen was in breach of the EU regulations (Raad van State, 2019). Consequently, this has a significant impact on the construction sector (RVO, 2019). Ever since,

the Netherlands is suffering from a so-called nitrogen crisis. On July 1, 2021, a new law concerning nitrogen and Natura 2000 came into effect (Rijksoverheid, 2021). Part of this law was the exemption for the construction phase of projects, which enabled construction projects to restart again. This exemption entailed that in the process of applying for a nitrogen permit, temporary emissions during the construction did not have to be included. Nevertheless, on November 2, 2022, the Dutch highest administrative court ruled that this nitrogen exemption for the construction phase of projects was also in breach of the regulations (Raad van State, 2022).

In the existing situation, real estate projects that emit nitrogen require a nitrogen assessment for both the usage phase as well as the construction phase (NOS, 2023). If a permission for a construction project gets rejected due to a projected negative impact on the surrounding Natura 2000 sites, the project can come to a halt. The Dutch Economic Institute for Construction (EIB) expects that between 2022 and 2027, approximately 10.000 new houses per year will not be granted such a nitrogen permit (EIB, 2023). Moreover, a nitrogen permit is also required for renovations and redevelopments of existing real estate (Rijksoverheid, 2023b).

1.2 Societal relevance

The nitrogen crisis in the Netherlands affects many stakeholders and has extensive consequences (Stokstad, 2019). In May 2019, almost the entire construction sector in the Netherlands came to a standstill (NOS, 2019a), which was caused by the ruling of the Dutch Council of State that the Dutch approach towards nitrogen at that time was in breach of EU law (Raad van State, 2023). The Dutch ABN AMRO bank calculated that approximately 14 billion euros worth of construction projects, including the development of real estate, were at risk of being postponed or even completely canceled (Buijs, 2019). Furthermore, in the wake of the construction sector, many more actors were affected by the building stop such as engineering firms, subcontractors, and the transporters of building materials (NOS, 2019a). Whilst the Netherlands is suffering from a nation-wide shortage of housing that is even referred to as a ‘housing crisis’ (NOS, 2021). Moreover, these effects on the development of real estate may affect the major societal task of the energy transition (European Union, 2021).

In addition to the construction sector, various other sectors are significantly impacted by the rulings of the Dutch highest court on the policy concerning nitrogen and Natura 2000, as numerous activities that emit nitrogen are hampered (Stokstad, 2019). Some examples are agricultural practices, airports, and the speed limits on Dutch highways had to be lowered from 130km/h to 100km/h (de Goede, 2022). All these measures were taken by the Dutch government to decrease the nitrogen deposition and meet the European guidelines regarding the preservation of Natura 2000 sites (RIVM, 2023a).

The institutions implemented by the Dutch government to address the issue at hand have led to multiple large-scale protests by the affected sectors (e.g. Bosch, 2019; RTLnieuws, 2019). They felt that their interests were not heard and the scientific justification of the approach to be lacking (Schuttenhelm, 2019). Therefore, it is perceived that academic research into this relevant issue is required, as it will contribute to improve the understanding of the nitrogen crisis in the Netherlands.

1.3 Scientific relevance

In academic literature, previous environmental crises in the Netherlands such as the acid rain crisis and the pm-crisis have intensely been studied and discussed (e.g. Buijsman et al., 2005; Busscher, 2014). However, the current nitrogen crisis in the Netherlands is still understudied. This is likely to be explained by the fact that these issues are only recently gaining more attention in the public and academic debate (NOS, 2019b; Stokstad, 2019).

In addition, it has been identified that the nitrogen crisis in the Netherlands is having interdependencies with other relevant issues that are faced (Hicks et al., 2011; NOS, 2021). For example, the housing crisis and the energy transition. A comprehensive understanding of the issues in the Netherlands concerning nitrogen and Natura 2000 is perceived as lacking in academic literature. Hence, this is the research gap that has been identified.

Therefore, this study aims to contribute to the academic body of knowledge regarding the current nitrogen crisis and fill the identified research gap, with a focus on the development of real estate. The contribution of this research to the academic literature is twofold. First, it aims to add to the understanding of the nitrogen crisis in the Netherlands. Second, this study attempts to explore the impact and effects of the nitrogen crisis on the development of real estate and the industry involved. This should contribute to achieving an improved understanding of the conflict in the Netherlands between nitrogen and Natura 2000.

1.4 Problem statement

The Netherlands is facing a so-called ‘nitrogen crisis’, which has extensive consequences. According to the PBL Netherlands Environmental Assessment Agency, the institutional design concerning nitrogen and Natura 2000 could be a potential cause for this crisis (Vink & van Hinsberg, 2019). For the development of real estate, the institutional arrangement concerning nitrogen and Natura 2000 might have negative effects. Nonetheless, the prevailing nitrogen crisis and the impact and effects of the existing[1] institutional arrangement on the development of real estate are understudied.

1.5 Research objectives

The goal of this research is to explore the nitrogen crisis in the Netherlands, with a focus on the impact and effects on the development of real estate. This is being approached from my academic background in Environmental and Infrastructure Planning. Among other things, this master’s programme integrates the analysis and development of strategies and governance approaches for highly dynamic and complex planning situations with environmental related challenges (Rijksuniversiteit Groningen, 2023).

This research aims to achieve multiple objectives. First, the objective is to acquire an improved understanding of the Dutch nitrogen crisis and how it is affected by the institutions regarding nitrogen and Natura 2000. Second, it aims to gain an understanding of the impact and effects of the existing institutional arrangement concerning nitrogen and Natura 2000 on the

[1] Existing refers to the period in which this study has been conducted: February 2023 - July 2023

development of real estate. Finally, the research aims to explore how the institutional arrangement can be improved to mitigate the impact and effects on the development of real estate.

1.6 Research questions

Based on the problem statement and the research objectives, the main question of this research is:

Q1: "What are the impact and effects of the existing institutional arrangement in the Netherlands concerning nitrogen and Natura 2000 on the development of real estate?"

To provide structure and address the main research question, several sub-questions have been established. These questions are subsidiary to the main research question and have been used to clarify the main research question and provide more specific direction to this research. The following sub-questions have been formulated:

Q1.1: How can the nitrogen crisis be understood with the institutions regarding nitrogen and Natura 2000?
Q1.2: What is the impact of the existing institutional arrangement (rules of the game) on the industry involved in the development of real estate (play of the game)?
Q1.3: What are the effects of the existing institutional arrangement on the development of real estate?
Q1.4: How can the institutional arrangement be improved to mitigate the impact and effects on the development of real estate?

1.7 Reading guide

The first chapter introduced the background of the issue in the Netherlands concerning nitrogen and Natura 2000, highlighting its relevance, and presented the problem statement, research objectives, and research questions. Chapter 2 presents a theoretical framework that encompasses the key concepts relevant to this research. Chapter 3 delves into the methodology applied in this research, including the research design, research methods, and ethical considerations. Thereafter, Chapter 4 presents the results of this research, divided into four sections corresponding to the research sub-questions. Chapter 5 focuses on discussing the results and presenting answers to the research sub-questions. Then, Chapter 6 provides an answer to the main research question and implications for planning practice. This chapter includes a proposed solution to address the environmental/space-conflict between nitrogen and Natura 2000, with a focus on the development of real estate. Lastly, Chapter 7 presents a reflection on this research.

2. Theoretical framework

In this chapter, the theoretical background of this research is discussed in depth. The theoretical framework is based upon three main components introduced in Chapter 1. These are: (1) the emission and deposition of nitrogen in the Netherlands, and its impact on Natura 2000 sites, (2) institutional design for conflicts between the environmental quality and spatial development, and (3) the development of real estate. At the end of this chapter, a conceptual model is presented in which the interconnections of the main components discussed in this chapter, in relation to this research, are visualized.

2.1 Nitrogen and Natura 2000; a multi-scalar issue

The aim of this section in the theoretical framework is to provide an understanding of the complex spatial challenge that the Netherlands is confronted with, balancing the emission and subsequent deposition of nitrogen with the preservation of the country's Natura 2000 sites. First, the section elaborates upon the nitrogen cycle, the specific compounds of nitrogen that are referred to in the issue, and the sources and impacts of those compounds. Second, it is explained what role the protected Natura 2000 sites in the country have within this spatial challenge. Finally, the section introduces the concept 'environmental/space-conflict', and it is discussed why the issue in the Netherlands concerning nitrogen and Natura 2000 is to be regarded as such.

2.1.1 The disrupted nitrogen cycle

Nitrogen gas (N_2) makes up approximately 78% percent of the Earth's atmosphere by volume, making it the most abundant gas in the atmosphere (Capsa et al., 2016). As introduced in Chapter 1, nitrogen is not harmful to people and the environment per se. In fact, it is essential for all life on Earth. It is a crucial component of many biological molecules that are necessary for the growth and development of living organisms (Lea & Azevedo, 2006). It is also a critical nutrient for plants, and its availability plays a vital role in their growth, development, and overall health (Vitousek & Howarth, 1991). There are different forms of nitrogen that are important for ecosystems, including organic and inorganic nitrogen (Cleveland & Liptzin, 2007). Organic nitrogen is found in living and dead plant and animal material, as well as in soils, and is converted into inorganic nitrogen through microbial processes such as decomposition and mineralization. Inorganic nitrogen is used by plants and organisms as a source of nitrogen and present in multiple forms, for example ammonium (NH4+) or nitrate (NO3) (Fulgoni et al., 2020).

An important topic within the field of environmental science is the nitrogen cycle and its role in ecological processes (Gruber & Galloway, 2008). The nitrogen cycle is a natural process that involves the conversion of nitrogen between different forms in the environment, including the atmosphere, soil, water, and living organisms (Vitousek et al., 1997). The cycle plays a crucial role in maintaining the balance of nitrogen in ecosystems and ensuring that nitrogen is available to support plant growth and other biological processes. Although nitrogen is a vital element for the organisms on Earth, overall, excess nutrients in for example the soil have negative impacts on the soil quality, plant growth, and the water quality if not properly managed or remediated (Beegle et al., 2012). In addition to its supporting role in ecological processes, nitrogen plays a critical role in the Earth's climate system through reactive nitrogen compounds (RNCs). RNCs are defined as "all biologically, photochemically, and radiatively active N compounds in Earth's

atmosphere and biosphere" (Galloway et al., 2008, p. 889). These compounds are reactive in the sense that they can easily react with other chemicals in the environment, leading to a range of environmental and health effects. RNCs are potent greenhouse gasses, as those compounds have a relatively high global warming potential (GWP), for example compared to carbon dioxide (Fuzzi et al., 2015). Therefore, an increase in RNCs exacerbates global warming and climate change by functioning as both greenhouse gasses and atmospheric pollutants (Forster et al., 2007).

Prior to the Anthropocene, the accumulation of RNCs in environmental reservoirs, such as the soil, bodies of water, and animals, was minimal as the various processes involved in the nitrogen cycle were in a state of equilibrium (Galloway et al., 2008). However, human interference such as the burning of fossil fuels and intensive agricultural practices has dramatically altered the natural nitrogen cycle. This has led to an accumulation of reactive nitrogen in the environment in all sorts of forms, with peaks of RNCs in the Dutch delta (Galloway et al., 2008). Subsequently, this contributes to air pollution, soil pollution, water pollution, and it has negative impacts on biodiversity (van Grinsven et al., 2021). In the following sub-sections, among other things, the emission and deposition of RNCs will be elaborated upon.

2.1.2 Nitrogen emission

Nitrogen oxides and ammonia

The Dutch nitrogen crisis refers to a complex issue that, among other things, involves a high emission of RNCs, specifically nitrogen oxides (NO_x) and ammonia (NH_3) (RIVM, 2023a). Hence, these two molecules are referred to in the 'nitrogen' crisis that the Netherlands is facing. The issues in the Netherlands related to nitrogen are not a recent phenomenon (NOS, 2022). In the 1950s and 1960s, the emission of RNCs increased rapidly (Davidson et al., 2018). The intensification of farming practices, growth of industry and transportation, and the urbanization after World War II contributed to this trend. However, since the 1990s, there has been a significant reduction in nitrogen emissions. The emission of nitrogen oxides has decreased by nearly three-quarters over the past three decades due to measures implemented in factories, the energy sector, and transportation, such as the introduction of catalytic converters (Davidson et al., 2018). Next to that, the introduction of stricter regulations for manure in the Netherlands in 1991 has contributed to the decrease in ammonia emissions (Jongbloed, 1998). Notwithstanding these endeavors, the emission of nitrogen oxides and ammonia within the country is relatively high compared to other countries, with a rate four times greater than the European average (CEIP, 2023).

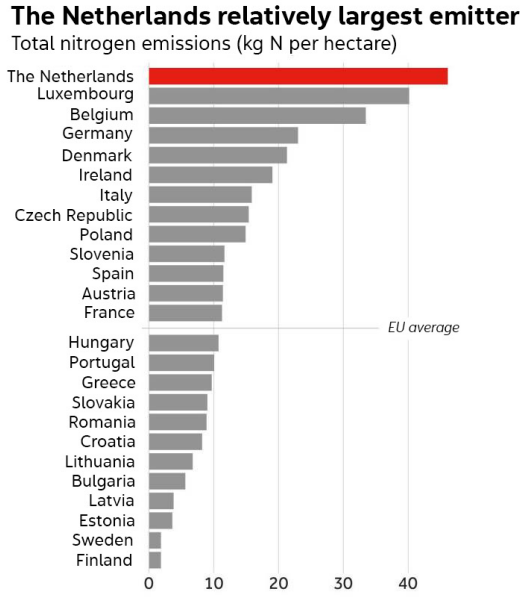
Modeling air quality

For the year 2021, it has been calculated that 155 million kilograms of RNCs were emitted in the Netherlands, of which 54 million kilograms were NO_x (35%) and 101 million kilograms were ammonia (65%) (CBS, 2023b). As previously mentioned, the emission of RNCs in the Netherlands exceeds the European average. In fact, relatively speaking, the Netherlands emits the most nitrogen of all of Europe (see Fig. 1). On average, European countries emit 11.2 kilograms of RNCs per hectare (EMEP, 2023). The emission of nitrogen from the Netherlands amounts to 46 kilograms of RNCs per hectare.

The quality of the air is influenced by various factors, and one of them is the presence and concentration of specific substances such as nitrogen oxides and ammonia (WHO, 2006). For the protection of public health and the environment, the Dutch National Institute for Health and Environment (RIVM) monitors the air quality in the Netherlands (RIVM, 2023b). Every year, the Dutch National Institute for Health and Environment (RIVM) presents reports on the air pollution in the Netherlands (RIVM, 2021).

However, it is important to note that, due to practical and technical limitations, it is not possible to measure the air quality everywhere in a country (RIVM, 2023b). Therefore, a combination of both calculations and measurements is applied to determine the air quality of a specific area. Furthermore, the process of monitoring the air quality involves assumptions and uncertainties to simulate the complex processes of atmospheric chemistry and dispersion (Giovannini et al., 2020). Through this approach, the RIVM aims to develop models of air quality that correspond best to the real-world conditions. This modeling encompasses multiple substances, including nitrogen oxides and ammonia, and covers their emission, concentration, and deposition (RIVM, 2023a). Subsequently, the results of these models are used by the RIVM to create maps in which the air quality is visualized. Likewise, the European Environment Agency presents reports, models, and maps on the European air quality (EEA, 2021b).

Understanding the spatial distribution of environmental pollution is essential for effective management and mitigation of it (Habibi et al., 2017). By analyzing how pollution is dispersed throughout the atmosphere, decision-makers can identify hotspots, patterns, and potential sources of contamination. Below, a map is shown in which the European atmospheric concentrations of the nitrogen oxide NO_2 in the year 2018 are visualized (see Fig. 2). This map illustrates that compared to the other European countries, the concentration of this specific RNC is particularly high in the Dutch atmosphere.



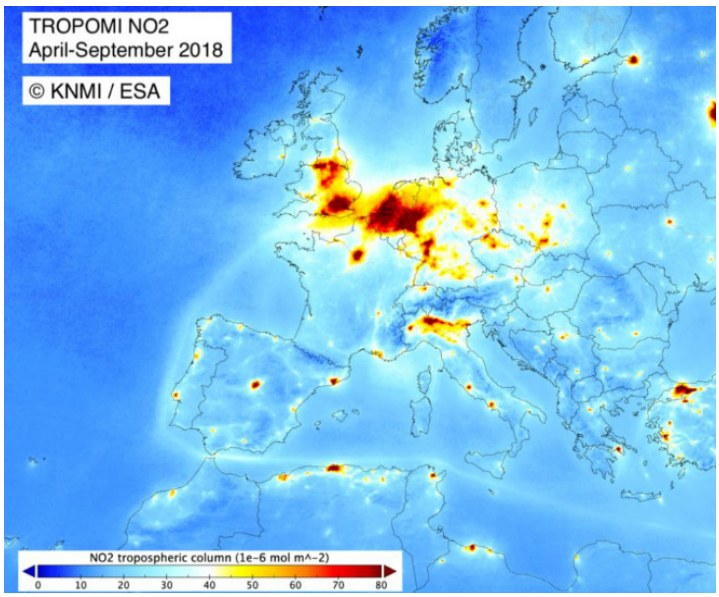


Figure 1 (left): Total emission of nitrogen per EU country (NOS, 2022, edited by author)
Figure 2 (right): atmospheric concentration of NO_2 in Europe (De Vries, 2019, edited by author)

Sources of RNCs

Nitrogen oxides and ammonia originate from distinct sources. Nitrogen oxides are mainly emitted during combustion processes, for example from traffic with internal combustion engines, and in industrial processes such as power plants and blast furnaces (RIVM, 2023a; Zhao et al., 2013). Ammonia is especially emitted by livestock, but also by other sources such as industrial processes, construction work, and traffic (RIVM, 2023a; Hicks et al., 2011). In Figure 3, the contribution of different sectors to the total emission of nitrogen oxides and ammonia in the Netherlands is visualized for the year 2021, the most recent year of which official numbers are presented by the Dutch Central Bureau of Statistics (CBS, 2023b).

The emission of real estate is for example, but not limited to, included in the categories of private households and industry. Furthermore, the development of real estate, on which this research focuses, also involves an emission of RNCs (Chang & Lin, 2018). This emission originates from several activities, including trucks and other equipment that is used in the development phase and burn fossil fuels. In Chapter 2.3.3, the emission of RNCs originating from the development and the use of real estate will be further elaborated upon.

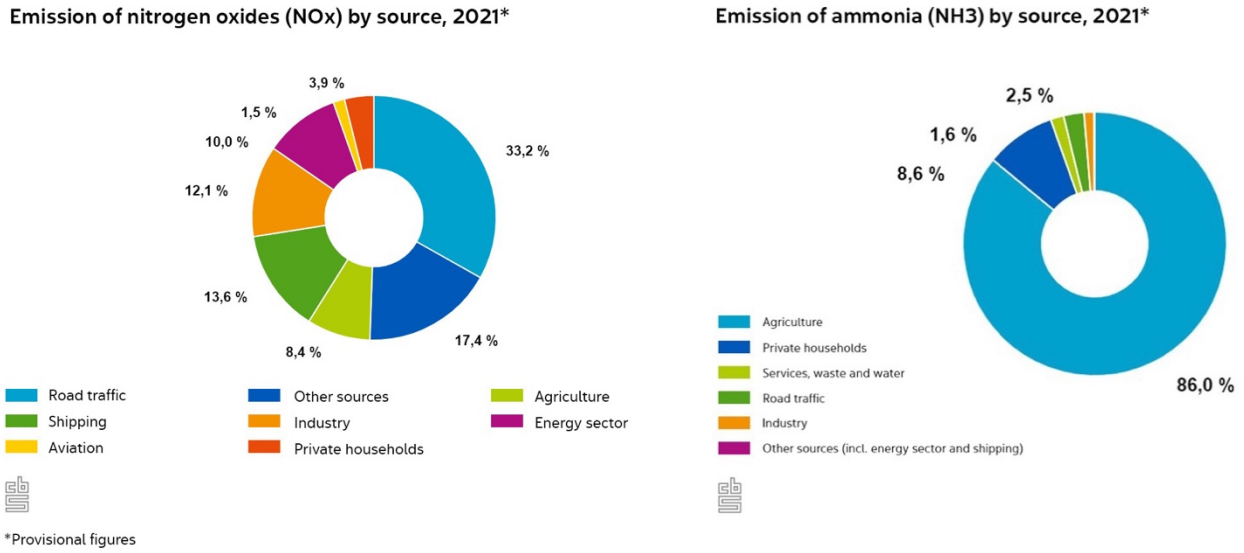


Figure 3: Emission of nitrogen oxides and ammonia in the Netherlands by sector (CBS, 2023b, edited by author)

2.1.3 Nitrogen deposition

RNCs can travel long distances through the atmosphere, leading to the deposition of it in ecosystems far from the source (Galloway et al, 2018). This process is called ‘atmospheric nitrogen deposition’, and it is a significant driver of excessive nitrogen deposition in many ecosystems (Galloway et al., 2018). According to the RIVM (2021), the concentrations of RNCs in the atmosphere are a gauge for nitrogen that deposits. Nitrogen deposition is described as: the input of reactive nitrogen compounds from the atmosphere to the biosphere in the form of either wet deposition or dry deposition (Hicks et al., 2011). Wet deposition occurs when RNCs are dissolved in rain or snow and deposited onto the ground, for example during rainfall. Dry deposition occurs when RNCs are deposited onto the ground through gas exchange between the

atmosphere and vegetation. Both these processes lead to the deposition of reactive nitrogen compounds on the Earth's surface.

As previously mentioned, the pollutants that contribute to excessive deposition of RNCs in the Netherlands derive mainly from the emission of nitrogen oxides (NOx) and ammonia (NH3) (RIVM, 2023a). While both ammonia and nitrogen oxides can be dispersed through the atmosphere, the distance that ammonia can travel through the atmosphere is relatively short, typically no more than a few hundred meters from the source (Hicks et al., 2011). Nitrogen oxides, by contrast, can form stable aerosols that travel relatively long distances. Furthermore, nitrogen oxides react with other compounds in the atmosphere leading to the formation of secondary pollutants such as particulate matter and ozone (Hicks et al., 2011).

According to Vitousek et al. (2013), excessive deposition of RNCs accumulates in ecosystems over time and this is due to a variety of factors. One reason is that nitrogen can be stored in soils, plant biomass, and other organic matter for extended periods, meaning that excess nitrogen inputs can accumulate over time and persist in the ecosystem. Another reason why excessive deposition of RNCs can accumulate in ecosystems is due to the limited capacity of ecosystems to absorb and process nitrogen inputs (Vitousek et al., 1997). In some ecosystems, such as wetlands or forests with shallow soils, excess nitrogen deposition can overwhelm the ecosystem's ability to process the RNCs, leading to accumulation over time. Additionally, excess nitrogen can lead to changes in the composition and function of ecosystems, which can further exacerbate the accumulation of RNCs over time (Vitousek et al., 2013). For example, excess nitrogen can lead to increased plant growth and changes in the composition of plant communities, which can alter nutrient cycling and further exacerbate nitrogen accumulation. In Figure 4, the process of nitrogen emission and deposition is illustrated.

RNCs are emitted locally and subsequently, as nitrogen disperses through the atmosphere, deposited across various locations, even extending beyond national borders. About 35% of the nitrogen that is deposited in the Netherlands is 'imported' from abroad, emphasizing the multi-scalar nature of this issue (CLO, 2023a). In addition, the Netherlands 'exports' a considerable amount of RNCs that affect neighboring countries. Thus, the issue regarding the emission and deposition of nitrogen cannot be confined to a specific geographical area.

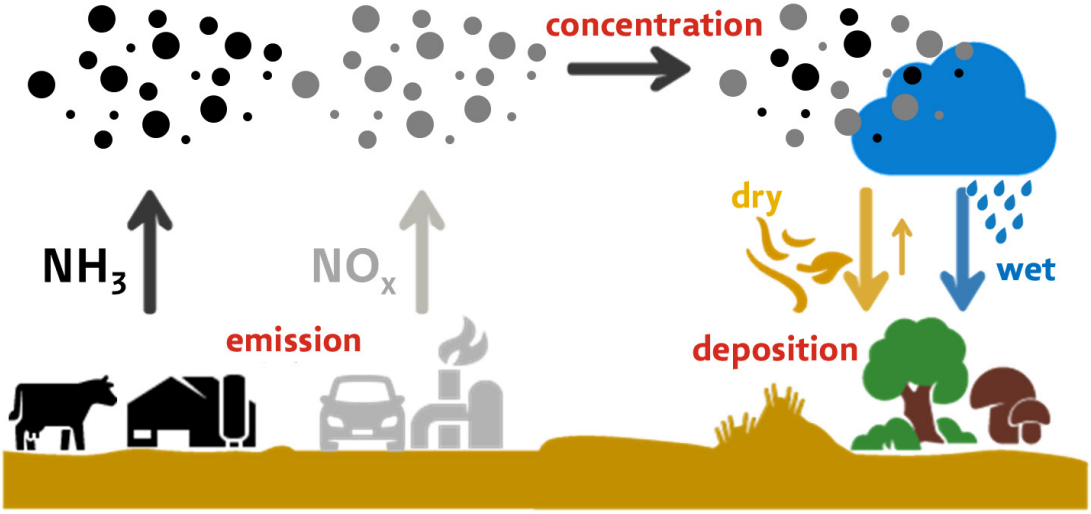


Figure 4: Illustration of emission and deposition of nitrogen (RIVM, 2023a, edited by author)

2.1.4 Natura 2000

In the previous sub-sections, the emission and deposition of RNCs in the Netherlands has been discussed, including its dispersion and the impact on nature. More specifically, this research focuses on Natura 2000 sites. Therefore, in this subsection, the Natura 2000 network and its sensitivity to nitrogen will be elaborated upon.

> "Natura 2000 is a network of protected areas covering Europe's most valuable threatened species and habitats. It is the largest coordinated network of protected areas in the world, extending across all 27 EU Member States, both on land and at sea" (EEA, 2023a, p. 1).

Safeguarding Europe's biodiversity

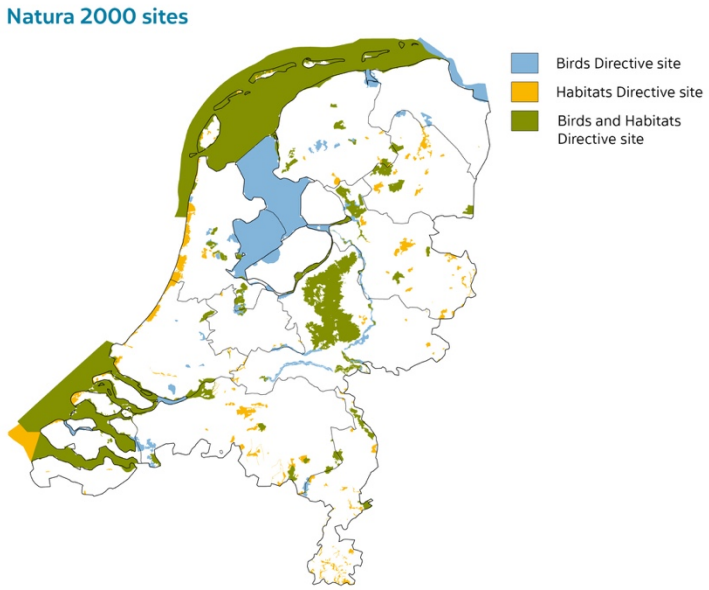
The Natura 2000 network comprises a vast array of protected sites, including terrestrial, freshwater, and marine environments. These sites are designated under the Birds Directive and the Habitats Directive - two pillars of EU environmental legislation aimed at safeguarding biodiversity. The network comprises protected natural areas that are designated for the preservation of habitats and species of European importance, with the aim of conserving biodiversity and promoting sustainable development (EEA, 2023a). For these Natura 2000 sites, objectives have been formulated for the natural habitats and species. These objectives can either be conservation for habitats and species that are already at the desired level, in terms of quality and quantity, or improvement for habitats and habitats of species that are not yet at the desired level. Furthermore, these targets set out by the European Union are of a progressive nature (Natura 2000, 2023). The EU's goal, within the framework of the EU Biodiversity Strategy, is to safeguard 30% of its terrestrial and marine territories by 2030 (European Commission, 2023c).

Designation of Natura 2000 sites

The Birds and Habitats Directives, also referred to as the 'Nature Directives', set out criteria for the selection of sites for the coordinated network (EEA, 2023a). It is then up to the EU member states themselves to designate the specific Natura 2000 sites within their country, based on these criteria.

In the Netherlands, the designation of Natura 2000 sites began in 1998, when the Dutch government submitted a list of proposed sites to the European Commission (de Vries & Beunen, 2009). In 2004, the European Commission approved the list of proposed Natura 2000 sites for the Netherlands, which includes 162 areas covering around 13% of the country's terrestrial surface and a significant portion of its territorial waters. As can be seen in Figure 5, the Natura 2000 areas within the Netherlands are spread throughout the country.

Once an area is designated as a Natura 2000 site, it becomes legally binding and it is difficult, or even impossible, to decrease or remove the area (Unnerstall, 2008). EU member states must follow a rigorous process to modify or exclude a designated area (EEA, 2023b). This process typically involves comprehensive assessments, consultations with relevant stakeholders, and obtaining approval from the European Commission.



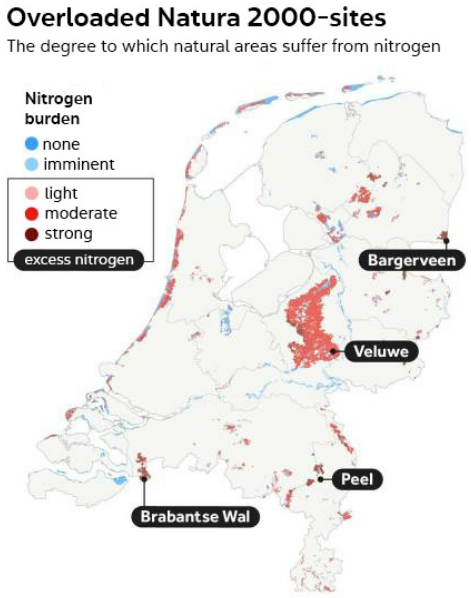


Figure 5 (left): Natura 2000 sites within the Netherlands (CLO, 2023b, edited by author)
Figure 6 (right): Dutch Natura 2000 sites overloaded with nitrogen (NOS, 2022, edited by author)

Critical deposition value

As mentioned earlier, nitrogen is an essential nutrient for plants, but when present in excessive amounts, it can cause a range of negative impacts on biodiversity, such as changes in plant and animal species composition, reduced plant growth, and increased soil acidification (Hicks et al., 2011). Research has shown that nitrogen deposition can have a negative impact on a variety of habitats and species in the Netherlands, including grasslands, forests, heathlands, and bird populations (Stevens et al., 2010). Different habitats and species exhibit varying degrees of sensitivity to nitrogen deposition. Therefore, to model the degree to which specific Natura 2000 sites within the country are overloaded with nitrogen, the Dutch government has established critical deposition values. The critical deposition value (abbr. in Dutch: KDW) is the level of nitrogen deposition above which adverse effects on habitats are expected to occur (Broekmeyer et al., 2012).

The Ministry of Agriculture, Nature, and Food Quality has established critical deposition values for all existing habitats in the Netherlands (Rijksoverheid, 2020). Wetland ecosystems, such as swamps and marshes, have a relatively high KDW. Sandy soil, on the other hand, has a relatively low KDW. Therefore, in these areas, nitrogen deposition can disrupt the soil relatively easily (Garcia-Gomez et al., 2014). 55% of the country's Natura 2000 areas are located on sandy grounds and therefore these soils have a relatively low KDW. Examples of common habitats in the Netherlands on these grounds are dunes and heathlands (Rijksoverheid, 2023c). Consequently, a substantial portion of the Dutch Natura 2000 sites is susceptible to excessive nitrogen deposition.

In Figure 6, it is visualized to what degree the specific Natura 2000 sites within the country are overloaded with nitrogen, based on the KDWs. While efforts to reduce nitrogen deposition and restore habitats are ongoing, the challenges regarding the preservation of Natura 2000 sites remain significant in the Netherlands (e.g. Schoukens, 2017; NOS, 2022).

To summarize the previous sub-sections, the Netherlands is a country with a high degree of urbanization, intensive agriculture, energy-intensive industry, and an extensive transportation sector (EEA, 2020). As a result, the emission and subsequent atmospheric concentration of nitrogen in the Netherlands is relatively high. Consequently, due to an excessive deposition of RNCs, the preservation of the country's Natura 2000 sites is under threat.

2.1.5 Environmental/space-conflict

Due to the relatively small land size and high population density, the available space in the Netherlands is limited (Gallego, 2010). This leads to tensions between environmental protection and conflicting spatial developments such as urban expansions (Smit, 1995). Over the years, urban areas have expanded whilst the Natura 2000 sites spread throughout the country have not decreased (Hoogerbrugge, 2020). As a result, the distance of sources of RNCs to protected Natura 2000 areas has decreased. Therefore, the limited availability of land in the Netherlands poses challenges of balancing economic growth and environmental conservation (Alpkokin, 2012).

The planning practice in the Netherlands is characterized by a somewhat chaotic and non-linear process, with social challenges and conflicts frequently arising (Borsboom-van Beurden et al., 2019). Managing the complex interplay between economic development, environmental conservation, and social interests is a significant challenge in the Netherlands, especially due to the country's spatial constraints (Borst et al., 1995). The concept 'environmental/space-conflict' is introduced to address the clash between environmental quality and spatial planning in a specific area or location (de Roo, 1999). This concept becomes particularly relevant in the context of this research, where conflicts arise due to the preservation of Natura 2000 sites conflicting with the competing use of space, primarily related to nitrogen emissions and subsequent deposition.

In conclusion, the environmental/space-conflict poses a significant challenge for policymakers and spatial planners in the Netherlands. They strive to balance the competing demands of economic growth with environmental conservation (Henle et al., 2008), particularly for the preservation of the country's Natura 2000 sites. Moreover, in section 2.1.3, the multi-scalar nature of the issue has been emphasized, as nitrogen disperses through the atmosphere and transcends national boundaries. Hence, the material environmental/space-conflict transforms into an administrative conflict on various levels of government.

2.2 Institutional design for environmental/space-conflicts; a multi-level affair

The first section of this chapter has elaborated upon the environmental/space-conflict that the Netherlands is facing regarding the relatively high emission of RNCs, and the subsequent excessive deposition on the country's protected Natura 2000 sites. Finally, it has been identified that this conflict poses significant challenges for the professionals involved.

In this section, it will be discussed how institutions can be designed to govern such an environmental/space-conflict. Institutional design refers to the deliberate process of creating and modifying formal rules, procedures, and structures within an organization or society to achieve specific goals or outcomes (North, 1990). It involves the development of institutions that shape the behavior of individuals and groups and guide decision-making processes.

> *"Institutions are the humanly devised constraints that structure political, economic and social interaction. They consist of both informal constraints (sanctions, taboos, customs, and codes of conduct), and formal rules (constitutions, laws, property rights)"* (North, 1991, p. 97).

Douglass North (1990) metaphorically describes institutions as 'the rules of the game' that shape and constrain the behavior of agents. Subsequently, the actions taken by the agents involved with these institutions can be considered as the 'play of the game'. The specific configuration of institutions within a particular context is referred to as the institutional arrangement (Hassenforder & Barone, 2019). It refers to how institutions are organized, structured, and interrelated within a given system or setting, and focuses on the practical arrangements and mechanisms through which institutions operate.

This section has been subdivided into the following sub-sections: institutional change, environmental governance, and environmental planning in the Netherlands.

2.2.1 Institutional change

Feedback loop

Institutional change can be considered as changing rules and expectations, also referred to as institutions, that govern human interactions and paths of development in society (Coccia, 2018). Change of institutions generally occurs along a feedback loop between practice and policy (Dacin et al., 2002). In this process, planning practice can shape the formation and evolution of rules and laws, while rules and laws in turn influence the practice. Planning practice refers to the day-to-day activities and behaviors of individuals and organizations involved in spatial planning (Healey et al., 2003). For example, when a particular practice is deemed to be problematic or unsustainable, it may trigger a policy response to regulate or change that practice through the introduction of new rules and laws. On the other hand, existing rules and laws can also shape practice by providing incentives, constraints, or norms that guide individuals and organizations in their behaviors.

Fast-moving and slow-moving institutions

The relationship between practice and policy is often dynamic and can involve negotiations, contestations, and compromises among different stakeholders, such as government agencies, interest groups, and civil society organizations (Sabatier, 2007). Considering this research, as previously mentioned, the Netherlands is facing an environmental/space-conflict. Simultaneously,

this conflict generates tension on the administrative level between environmental and spatial policies (de Roo, 1999). This tension can influence the direction and pace of institutional change and may result in incremental or radical changes to rules and laws, depending on the nature of the issue, the level of contestation, and the power dynamics among stakeholders (Hall, 1993).

Roland (2004) has proposed a dual classification for the pace of institutional change. In his article, he distinguishes between slow-moving and fast-moving institutions. An example of a slow-moving institution is culture, as this tends to change gradually, also referred to as incremental change. Political institutions on the other hand are subject to radical changes, as these are typically fast-moving institutions; exemplifying the nature of political institutions as fast-moving entities that have the potential to adapt and evolve rapidly to changing circumstances or events (Roland, 2004).

2.2.2 Environmental governance

The Netherlands is known for its progressive approach to environmental governance, employing a combination of hierarchical and collaborative modes of governance (Wurzel et al., 2013). Environmental governance is defined as:

> *"The set of regulatory processes, mechanisms and organizations through which political actors influence environmental actions and outcomes."* (Lemos & Agrawal, 2006, p. 298)

Here it is important to note that governance is not the same as government. Government typically refers to formal institutions, laws, regulations, and public authorities responsible for developing and implementing policies and laws (Bingham et al., 2005). It often implies a hierarchical and top-down approach to decision-making, with power concentrated in the hands of a governing body or authority. On the other hand, governance is a broader concept that encompasses both governmental and non-governmental actors and their interactions in decision-making processes (Lemos & Agrawal, 2006). It emphasizes the involvement of various stakeholders, including civil society organizations, businesses, communities, and individuals, in shaping policies and implementing solutions. Governance focuses on collaborative and participatory approaches, seeking to incorporate diverse perspectives, local knowledge, and expertise.

Modes of governance

Modes of governance refer to different approaches or methods used to govern and manage political affairs, including policy-making, decision-making, and implementation (Treib et al., 2007). These modes reflect the ways in which power is exercised, relationships are formed, and decisions are reached within a governance system. They can vary in terms of their level of centralization, involvement of stakeholders, and distribution of authority.

One prominent mode of governance in the Netherlands is decentralization, where decision-making authority and responsibilities are delegated to regional and local levels of government (Bruinsma & Koomen, 2018). This allows for greater flexibility and adaptability in addressing local environmental issues, as decisions can be tailored to specific contexts and local knowledge can be incorporated. Decentralization also promotes participatory approaches, involving local communities, civil society organizations, and other stakeholders in decision-making processes. An example of decentralized governance within the Netherlands are the Water Boards. These are regional governmental bodies that manage water resources, water quality, and flood protection

within their respective regions, and operate independently from the national government (Bressers et al., 1994).

However, as recognized by scholars (i.e. Driessen et al., 2012; Zuidema, 2016), decentralization also has potential downsides. It runs the risk of inconsistent and fragmented policies and practices among different local or regional authorities. For example, in the Netherlands, most environmental permits and subsequent procedures required for the development of real estate can be applied for at the respective municipality (Omgevingsloket, 2023). In this process, besides having its own institutions, the municipality must adhere to provincial and national institutions and associated procedures. Consequently, it can be challenging for the actors involved in the development of real estate to establish a process that complies with all applicable institutions (Geskus, 2020). In addition, when decision-making authority is devolved to lower levels of government or other local actors, it can result in varying approaches and priorities in addressing environmental issues (Zuidema, 2016). Consequently, decentralized bodies of government within the Netherlands might produce varying institutions, for example for the issue concerning nitrogen and Natura 2000. Therefore, it is crucial to carefully consider and address these potential negative aspects of decentralization in environmental governance to ensure that it is implemented in a manner that promotes sustainable environmental outcomes across all levels of governance (Newig & Fritsch, 2009).

Other prominent modes of governance applied in the Netherlands are market and individual incentives-based governance (Driessen et al., 2012). These involve the use of economic instruments, such as taxes, subsidies, and emissions trading, to create incentives for businesses and individuals to adopt environmentally friendly practices. Such mechanisms are employed to promote sustainable resource management, pollution control, and the energy transition, among other environmental objectives (Lemos & Agrawal, 2006). The Netherlands for example has environmental taxes for waste that goes to landfill and extensive subsidies and tax benefits to encourage the purchase of solar panels (Government of the Netherlands 2023; Noordover & Drahman, 2018). In addition, an example on a higher administrative level is the EU carbon emissions trading scheme (Sato et al., 2014).

Nevertheless, these modes of governance also have potential downsides (Jaffe et al., 2005). For instance, market incentives, such as subsidies or tax breaks, may not fully consider the externalities associated with environmental degradation. Moreover, these incentives may not always equitably distribute the benefits and costs of environmental governance, which can disproportionately affect certain groups or communities. In the context of this research, this could be experienced by actors involved in the development of real estate, whose projects came to a halt due to regulations regarding the emission of RNCs, resulting in severe financial losses (Buijs, 2019; NOS, 2019a). Whilst their share in the overall emission of nitrogen is marginal (Fissore et al., 2011).

Additionally, the Netherlands has embraced emerging hybrid modes of governance, which involve the collaboration of multiple stakeholders in decision-making and implementation processes (van Berkel & Borghi, 2007). This includes public-private partnerships, where government entities and private sector organizations work together to achieve environmental goals, as well as social-private partnerships, which involve collaboration between government, civil society, and private sector actors to address environmental issues in a participatory manner. A well-known example of this mode of governance is the Dutch approach called ‘polderen’.

Polderen is a consensual and collaborative approach to decision-making and problem-solving (Schreuder, 2001). It typically involves stakeholders from different sectors, such as the government, private sector, and civil society, working together to find solutions to complex issues.

Multi-level environmental governance

At the end of Chapter 2.1, the multi-scalar character of the environmental problem regarding Natura 2000 in relation to nitrogen has been emphasized. Lemos and Agrawal (2006) recognize that, socio-politically, such conflicts affect and are affected by institutionalized decision making at the local, regional, national, and supranational level. Therefore, as emphasized by the authors, multi-level governance is required to address this environmental/space-conflict. Subsequently, governance mechanisms across various levels of social and institutional aggregation must be designed.

Multi-level environmental governance refers to the coordination and cooperation among different levels of government, organizations, and stakeholders across different spatial scales to address environmental issues (Cash et al., 2006). The approach recognizes the interconnectedness of social, economic, and environmental systems at different administrative levels and seeks to coordinate actions and policies across these levels for more effective and sustainable outcomes. It is particularly relevant in addressing transboundary environmental challenges (Pahl-Wostl, 2015), as is the case in the environmental/space-conflict that the Netherlands is facing.

Through its membership in the European Union, the Netherlands has adopted multi-level governance approaches that recognize the interconnectedness of environmental issues across different spatial scales (Scholten et al., 2018). Furthermore, the decentralization within the Netherlands contributes to this by involving the provincial and local levels in environmental governance (Uddin, 2017). As a result, environmental policies and regulations are governed at various administrative levels, including the global, European Union, national, provincial, and local levels. The policies related to Natura 2000, arising from the EU Nature Directives, serve as an example of multi-level governance, emphasizing the interdependency between the European Union and the Netherlands in the context of environmental governance.

To comprehend the process of institutional design for addressing the environmental/space-conflict, it is crucial to delve into the realm of environmental planning. Environmental planning is an important instrument for considering environmental factors into spatial development (Slocombe, 1993). Therefore, the following subsection will specifically discuss this concept.

2.2.3 Dutch environmental planning

In the Netherlands, environmental planning has evolved over time and the policies, strategies, and actions involved have changed. According to the United Nations Environment Programme (UNEP, 2023), environmental planning is a process of developing and implementing policies, strategies, and actions that aim to manage and protect both the natural as well as the built environment. It involves assessing environmental issues, analyzing potential impacts of proposed projects or policies, and identifying appropriate measures to mitigate adverse effects while promoting sustainable development (de Roo, 2017).

Sectoral environmental planning

In the early years of environmental planning in the Netherlands, the focus has been on zoning and land-use planning to prevent environmental pollution (de Roo, 1999). This approach was of a technical nature and aimed at minimizing negative impacts on the environment through separation of incompatible land uses. The notion that a distinct segregation of residential, industrial, and agricultural areas through environmental zoning would guarantee the safeguarding of the environment and the health of individuals was widely accepted (Elmqvist et al., 2015).

Within environmental zoning, centrally imposed and framework-setting environmental standards were applied (de Roo, 1999). This approach towards environmental planning is also referred to as planning per se. It is characterized by environmental policy and subsequent norms that are established and enforced by a central authority, often the national government, and provides a framework for regulating environmental impacts on a specific sector or activity. It entails that standards and norms are based on sectoral environmental legislation with the aim to ensure that environmental impacts are minimized and controlled in a consistent and effective manner.

Integrating environmental planning

Planning per se has traditionally been the instrument for shaping environmental and spatial policies (Kuijpers, 1996). However, in the early 1980s, the formation of ideas about integrated environmental planning in the Netherlands gained momentum (van Hoorick, 1995). A series of environmental disasters and growing public concern about environmental issues led to a shift towards more integrated environmental planning. The Dutch government responded by implementing several policy changes, including the establishment of a Ministry of Housing, Spatial Planning and the Environment in 1982.

One of the key shifts towards integrated environmental planning occurred in 1989 with the introduction of the first ‘Nationaal Milieubeleidsplan’ (NMP1) (in English: Environmental Policy Plan). The NMP1 addressed a wide range of environmental issues, including air and water pollution, waste management, nature conservation, and sustainable energy. The arrival of this policy plan also entailed a new approach towards environmental planning. Instead of a system with sectoral environmental zoning, environmental standards and their related spatial zones were integrated into one environmental zone. This new system was called ‘Integrated Environmental Zoning’ (IEZ) (de Roo, 1999).

Despite integrating environmental aspects, the IEZ system has been acknowledged to have negative side effects. One notable limitation is its failure to consider non-environmental objects. As a result, the system presents challenges when attempting to balance integrated environmental standards with other societal interests and policy objectives. The spatial zones associated with the environmental standards tend to impede spatial developments (Zuidema, 2011). Furthermore, Lafferty & Hovden (2003) have stressed that integrating environmental objectives into non-environmental policy-sectors is of importance to achieve sustainable development. Along with this, the increasing complexity of balancing economic growth and environmental conservation in the Netherlands, as elaborated upon in Chapter 2.1.5., has led to the need of an integral approach towards environmental planning (De Roo, 1999).

A significant development to achieve this was the NMP4, launched in 2001. The NMP4 recognized that environmental issues cannot be addressed in isolation but that they are closely

linked to other policy areas, such as agriculture, energy, transport, and spatial planning. It aimed to integrate environmental concerns into these policy areas to achieve more sustainable development. The integration of environmental objectives with non-environmental policy objectives was executed through the coordination and cooperation between different policy areas. Among other things, the NMP4 encouraged different ministries to work together to ensure that environmental concerns were integrated into their policies.

In addition, the 'Wet ruimtelijke ordening' (Wro) (in English: Spatial planning act) implemented in 2008 contributed to integrating environmental planning in the Netherlands. This act integrated environmental concerns into land-use planning, with the aim of creating a more sustainable and livable environment by balancing economic, social, and environmental interests. The central rationale behind the Wro is: "decentralize what can be, centralize what must be" (Kistenkas, 2011). This means that the act aims to delegate spatial planning responsibilities to lower levels of government where possible, reflecting the decentralized mode of governance as discussed in the previous subsection. However, at the same time, the act recognizes that some issues require central government intervention, particularly those that are of a national interest.

In conclusion, the development of Dutch environmental planning can be described as a shift from a hierarchical and sectoral approach through environmental zoning towards a more decentralized and integrated approach. This shift has occurred along with the increasing complexity of balancing economic growth and environmental conservation. Furthermore, through the application of multi-level environmental governance, the Dutch institutional arrangement acknowledges the multi-scalar character of environmental issues.

2.3 Development of real estate in the Netherlands

This research explores the impact and effects of the existing institutional arrangement in the Netherlands concerning nitrogen and Natura 2000 on the development of real estate. Therefore, to gain an understanding of how the previously discussed concepts are related to the development of real estate, it is important to provide contextualization. This encompasses real estate and its development along with the associated institutions, processes, and activities. In addition, the Dutch housing crisis and the energy transition are relevant challenges within the country related to the development of real estate. Moreover, the energy transition contributes to reducing the emission of RNCs, highlighting its relevance within this research. Finally, it is important to elaborate upon the nitrogen emissions of real estate and its development. Therefore, in the following sub-sections, these aspects will be discussed.

2.3.1 Contextualizing relevant aspects

In this subsection, the concept of real estate, its development, and what types of properties are included are contextualized. Furthermore, a distinction has been made between the construction of real estate and the redevelopment and renovation. This approach enables the researcher to investigate whether there is a difference between the construction of real estate and the redevelopment and renovation of real estate, regarding the impact and effects of the existing institutional arrangement concerning nitrogen and Natura 2000.

Real estate

Real estate refers to land and any permanent structures or improvements that are attached to it (Ling & Archer, 2005). It encompasses not only the physical property itself but also the associated rights and interests, such as ownership, use, and possession. Considering Chapter 2.2, these aspects can be considered as the institutions encompassing real estate, comprising both formal and informal institutions. It is worth noting that the institutions associated with real estate extend beyond traditional property rights and may encompass additional considerations, such as the allowable emission levels of RNCs and associated permits (Follett & Hatfield, 2001).

Real estate can be divided into various categories based on its purpose and use, such as residential, commercial, industrial, or agricultural (Renigier-Bilozor et al., 2014). This research involves all types of real estate, recognizing the diverse nature of properties (Kaklasukas et al., 2021).

Development of real estate

The development of real estate refers to the act of improving or enhancing the value of an existing property or land (Graaskamp, 1992). It can include both the construction of new buildings as well as the renovation and redevelopment of existing buildings. The main goal of the development of real estate is to enhance the value and use of a property, either for the developer’s own use or for the benefit of other stakeholders.

Development of real estate is not to be confused with real estate development. Real estate development encompasses the broader process of creating new projects from scratch, including acquiring land, securing financing, and managing the construction, while the development of real estate refers to enhancing or improving existing properties to maximize their value through construction, redevelopment, or renovation (Heurkens et al., 2017; Voskresenskaya, 2019).

The process of the development of real estate is complex and multidisciplinary (Kohlhepp, 2012). It requires the coordination of various professionals, including architects, engineers, environmental consultants, and contractors (Smith & Tardif, 2009). Furthermore, to apply for the necessary permits in the Netherlands, government officials must be consulted.

The process of selecting a location for the development of real estate is influenced by a variety of factors, including economic, social, and environmental factors (Rymarzak & Sieminska, 2012). Economic factors include market demand, which will be elaborated upon in the following subsection. Social factors include demographics, lifestyle preferences, and cultural norms. And environmental factors include zoning regulations, environmental impact assessments, and sustainability considerations. These environmental factors will be touched upon in the last two sub-sections of this chapter.

The development of real estate fulfills a significant role in urbanization and economic growth (Ye & Wu, 2014). It can have positive effects such as a provision of housing and job creation. Moreover, the development of real estate plays a crucial role in the energy transition through the development of energy-efficient buildings and the adoption of sustainable building practices (Fastenrath & Braun, 2018). In Chapter 2.3.3, this energy transition will be elaborated upon.

However, it can also have negative impacts such as environmental degradation through urban sprawl and increasing emissions (Han, 2020). Considering this research, a relevant example of a negative impact of the development of real estate is the emission of RNCs, which has been discussed in Chapter 2.1 and will be further elaborated upon in Chapter 2.3.4.

In addition, a range of infrastructure and utilities are required for the development of real estate (Gómez-Ibáñez, 2006). First, adequate road infrastructure is critical for the development of real estate. The site must be accessible and connected to the surrounding road network. Second, reliable and sufficient electricity and gas supply is essential for the development of real estate. It must be ensured that there is sufficient capacity in the local electrical grid to support the development, and that gas pipelines are available where necessary. Besides that, access to clean water and effective sewerage systems, telecommunications, waste management, and public safety are essential to support development.

Construction of real estate

The construction of real estate refers to the process of building new structures or properties on a piece of land or property (Satankar & Jain., 2015). The construction of real estate can range from small-scale projects, such as single-family homes or small commercial buildings, to large-scale projects, such as high-rise buildings, business parks, and industrial complexes.

Renovation and redevelopment of real estate

The renovation and redevelopment of real estate refers to the processes and activities of making improvements, upgrades, or significant changes to existing properties or buildings (Zavadskas et al., 2014). These processes encompass a wide range of activities, from minor repairs and cosmetic upgrades to major structural modifications, such as expanding the surface area, enhancing energy efficiency, or rebuilding a property. Whether through renovation or redevelopment, the goal is to enhance the functionality, aesthetics, and overall value of the property (Weber, 2002).

2.3.2 Contemporary challenges

Dutch housing crisis

The Dutch housing crisis refers to the pressing need for adequate and affordable housing in the Netherlands (NOS, 2021). It is a complex issue driven by various factors, including population growth, urbanization, changing demographics, economic considerations, and environmental challenges (Oorschot, 2021). The market demand for housing in the Netherlands is notably high, primarily due to population growth, urbanization, and migration. Moreover, the lack of available space in the country, as discussed in Chapter 2.1, intensifies the demand for housing. In addition to the market demand and high population density, environmental considerations play a crucial role in the Dutch housing challenge. The pursuit of sustainable development, the energy transition, and environmental standards pose additional complexities to the development of real estate. Building upon Chapter 2.1.5, the high demand for housing and environmental considerations in the Netherlands exacerbate environmental/space-conflicts, involving further challenges for spatial development (Smit, 1995).

To make things concrete, the Dutch minister for Housing and Spatial Planning has presented that for the year 2030 at least an additional 900.000 houses are required in the Netherlands (Rijksoverheid, 2022). However, he has also acknowledged that there is a substantial shortage of sites to develop these houses on. Moreover, the housing challenge in the Netherlands extends beyond quantity to encompass quality and affordability, as there is a shortage of affordable housing options, especially for low-income individuals and families (Custers, 2022).

The energy transition

The energy transition is a fundamental transformation of the global energy system from one based primarily on the use of fossil fuels to one based primarily on the use of renewable energy sources (Sovacool & Dworkin, 2015). It involves a range of technological, economic, and social changes, including the development of technologies for renewable energy, changes in energy consumption patterns, and the restructuring of energy markets and institutions. Besides reducing carbon dioxide emission, on which the energy transition generally focuses, it involves a reduction in the emission of RNCs (Yuan et al., 2022).

Public acceptance and support fulfill a crucial role in driving the energy transition forward (Perlaviciute et al., 2018). However, the spatial claim of the transition is met with significant resistance and opposition within society, often resulting in NIMBYism (not-in-my-backyard) (Komendantova, 2021). This resistance arises from the characteristics of renewable energy sources, which are predominantly generated above ground and near areas of demand. For example, through wind farms and solar fields. Therefore, the spatial claim of the energy transition adds complexity to environmental/space-conflicts within the country (Dunlap, 2021).

The transition of real estate towards energy-efficient buildings is a vital aspect of the energy transition (Fastenrath & Braun, 2018). By upgrading existing buildings to be more energy-efficient, it contributes to reducing emissions, including RNCs. In response to the environmental challenges such as climate change, the concept of zero-energy homes has gained prominence (Al Faris et al., 2017). These homes aim to minimize energy consumption and maximize energy generation through various measures such as solar panels, disconnecting from the national gas grid, enhanced insulation, energy-efficient heating systems, SMART technologies, and the use of

electrical equipment. Therefore, these homes have no emissions, including RNCs. Following this, since 2018, it is prohibited in the Netherlands for new houses to be connected to the national gas grid (Omgevingsweb, 2018).

While the adoption of energy-efficient measures in renovated and new real estate leads to a reduction in lifetime emissions, it is important to acknowledge that these savings are accompanied by a temporary increase in emissions of nitrogen during the construction phase (Alcántara & Padilla, 2021). This is primarily due to the energy-intensive nature of construction activities (Lam et al., 2012). Subsequently, depending on the size of the development, permits must be applied for at the municipal and provincial levels of government (Rijksoverheid, 2023b). In the following subsection, the emission of RNCs from real estate and its development will be elaborated upon.

2.3.3 Nitrogen emission of real estate

To examine the impact and effects of the existing institutional arrangement concerning nitrogen and Natura 2000 on the development of real estate, it is crucial to delve into the nitrogen emissions associated with the development and use of real estate. Therefore, in this subsection, the emission of RNCs from real estate will be elaborated upon.

Development of real estate

The development of real estate, both for the construction as well as for the renovation of it, involves a temporary increased emission of RNCs, as fossil fuels are being burned by combustion engines (Lam et al., 2012). The processes in the development of real estate involving emissions can be subdivided into three different categories. First, the movements of vehicles to and from the project area generated by the activities that are conducted for the development (Chang & Lin, 2018). This consists of the transportation of building materials and people such as construction workers, contractors, and supervisors to and from the building site. Second, significant amounts of RNCs are emitted during the loading and unloading of construction materials by idling vehicles with combustion engines, such as trucks (Abolhasani et al., 2012). Third, the use of diesel-powered equipment and heavy machinery during construction activities emits significant amounts of RNCs (Zhu et al., 2019).

However, as discussed in the previous subsection, real estate renovation and redevelopment contribute to a decrease in the nitrogen emissions (Ramirez-Villegas et al., 2016). Therefore, despite the temporary increase of the emissions during the development, the overall emission of RNCs from a property decreases after it is renovated or redeveloped. Furthermore, as discussed in the previous subsection, since 2018, new homes in the Netherlands are prohibited from using natural gas, further reducing the environmental impact.

Use of real estate

The use of real estate generally entails an emission of RNCs (Toller et al., 2011). These emissions can broadly be divided into three categories. First, the generation of fossil fuel powered traffic to and from the property in the use phase. Second, the emission of RNCs originating from the buildings, for example caused by the combustion of natural gas. During the use of real estate, energy consumption plays a crucial role in nitrogen emissions. Heating and cooling systems, and stoves that rely on fossil fuels, such as natural gas, emit nitrogen oxides and ammonia (Perez-

Lombard et al., 2008). The number of emissions from real estate in the use phase depends on various factors, including the type of building and its energy consumption (Chau et al., 2015). Poorly insulated buildings for example require more energy to maintain comfortable temperatures, leading to higher emissions. Third, the emission of RNCs originating from equipment and heavy machinery within the property. This third category is most relevant for real estate that is used for commercial purposes.

In Figure 3 of Chapter 2.1.2, the sources of nitrogen oxides and ammonia in the Netherlands have been shown. Although the development and use of real estate are not shown as categories in this figure, the construction sector, including real estate, is a significant contributor to emissions of RNCs (Toller et al., 2011; Sepasgozar & Blair, 2021). The emissions related to the development and use of real estate are incorporated within the categories in the figure.

Local-level development, multi-scalar impact

In line with the decentralized mode of governance applied in the Netherlands as discussed in Chapter 2.2.2, the development of real estate is primarily regulated at the local level of governance, where individuals and organizations must apply for permits from their respective municipalities and provinces (Rijksoverheid, 2023c). These permits fulfill a crucial role in ensuring that the developments of real estate adhere to specific guidelines and environmental regulations (Stavins, 2003). Considering Chapter 2.1, although the emission of nitrogen from real estate and its development takes place at the local level, the emission of RNCs disperses through the atmosphere. Therefore, the deposition of nitrogen originating from real estate affects wider regions, including Natura 2000 sites.

Despite the decrease in emissions from new as well as renovated and redeveloped real estate, the temporary increase in emissions during the development pose challenges in the Netherlands (Hagelaars & van der Heul, 2023). Concludingly, the use of real estate and the temporary increase in emissions during its development contribute to the environmental/space-conflict concerning nitrogen and Natura 2000 in the Netherlands.

2.4 Conceptual model

In this chapter, the theory relevant for this research is discussed. The conceptual model below (Figure 7) provides an overview of how the main concepts are related to each other.

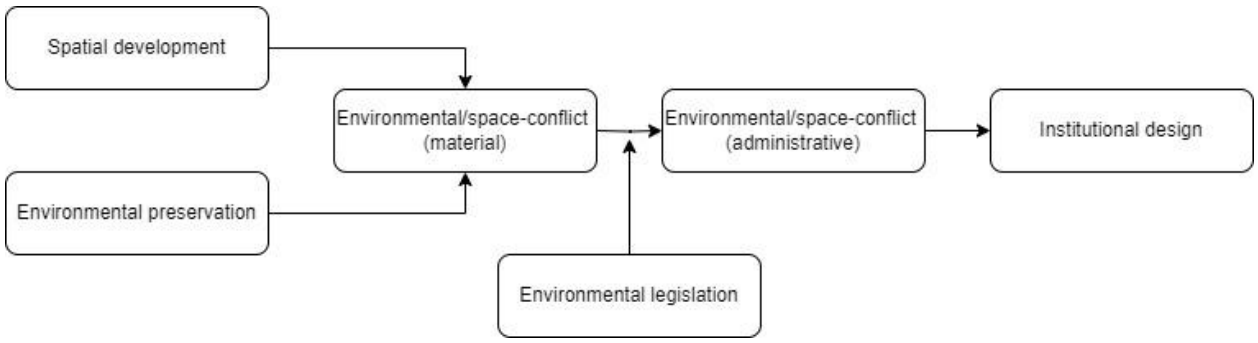


Figure 7: Conceptual model of the theoretical framework

2.5 Hypothesis

First, based on the theoretical framework, it is identified that the Netherlands is facing an environmental/space-conflict. This conflict arises between the spatial development, involving an emission and subsequent deposition of nitrogen, and the preservation of the country's Natura 2000 sites. Natura 2000 is coordinated and organized through EU environmental legislation, and its preservation is obliged under EU law. In turn, the material environmental/space-conflict transforms into an administrative environmental/space-conflict. Therefore, institutions have to be designed by the Dutch government to address the issue at hand.

Contemporary Dutch environmental planning acknowledges the multi-scalar nature of environmental/space-conflicts through the application of multi-level governance and integrated environmental planning. However, in the specific context of nitrogen and Natura 2000, the Dutch government seems to be reverting to sectoral environmental planning. Considering the complex challenge within the country of balancing spatial development with environmental preservation, this sectoral approach is expected to impede the development of real estate.

3. Methodology

This chapter explains the methodology applied in this research. Firstly, the research design is outlined. Secondly, the research methods that have been used are elaborated upon, including the data collection and data analysis methods. Lastly, the ethical considerations of this research are discussed.

3.1 Research design

A qualitative research design has been utilized to conduct this exploratory research. To gather data that addresses the main research question: "*What are the impact and effects of the existing institutional arrangement in the Netherlands concerning nitrogen and Natura 2000 on the development of real estate?",* a combination of three data collection methods has been employed. These are: a policy review, expert interviews, and action research. For the analysis of the data, this research has applied data triangulation, a method that helps to gain a comprehensive understanding of the phenomena under study (Patton, 2015). By cross-checking information from multiple sources of data, triangulation helps to reduce bias and increase the validity, reliability, and accuracy of the findings (Denzin & Lincoln, 2017).

The research was carried out in the Netherlands from February to July 2023 and conducted as follows. First, a literature review has been conducted to establish a conceptual framework of the concepts relevant for the empirical research. This provides a theoretical foundation for the subject of investigation in this research. Furthermore, the literature review forms the basis for the policy review and the interviews. In addition, action research has been conducted to help answer the research questions. By applying data triangulation, a convergence of the data sources contributes to comprehensively addressing the research questions.

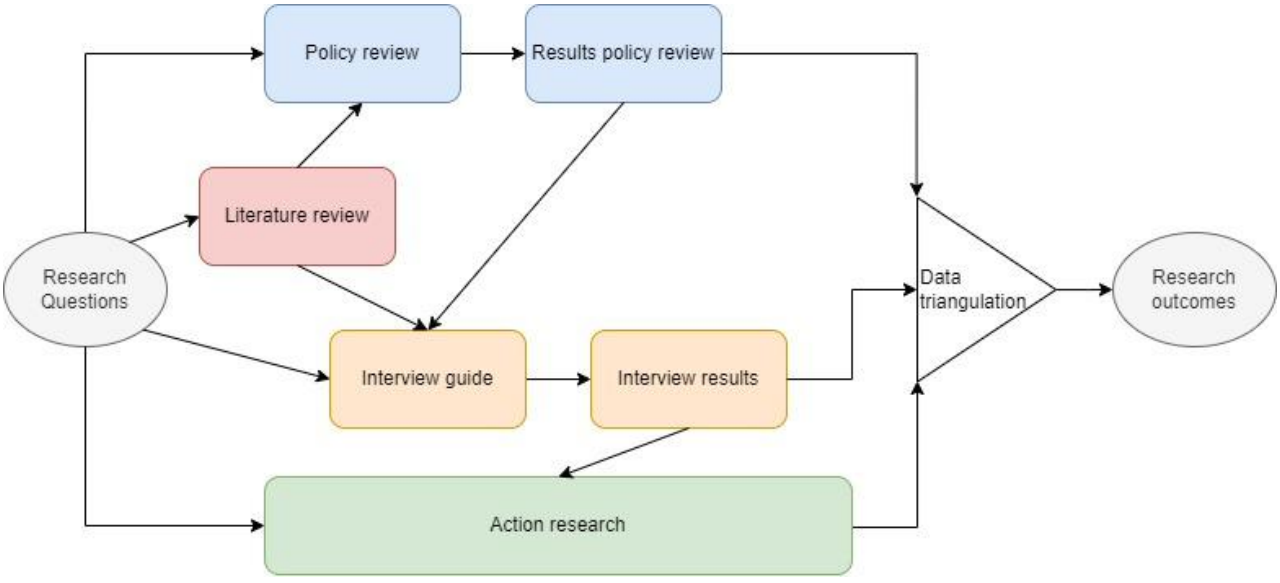


Figure 8: Schematic overview of the research design

3.2 Exploratory qualitative research

This research aims to shed light on social phenomena that have received limited scholarly attention. Hence, a comprehensive understanding of the issue under investigation is perceived as missing in scientific literature. Therefore, an explorative qualitative research method is considered most appropriate (Morgan & Smircich, 1980; Cresswell, 2014). Qualitative research is a research design that seeks to explore and understand social phenomena through the collection and analysis of non-numerical data, which can include documents, interviews, observations, and other data collection methods (Merriam, 2015). This research design is widely acknowledged in the social sciences because it provides detailed and context-specific information that allows researchers to gain a deep understanding of the social phenomena under study (Denzin & Lincoln, 2017). Moreover, qualitative research captures the complexity and diversity of social phenomena in a more holistic way than numerical data (Cresswell, 2014).

In addition, an exploratory research method has been applied in this research to gain an understanding of the understudied topic. According to Maxfield & Babbie (2017), exploratory research is a research method that aims to gain a preliminary understanding of phenomena to develop initial insights. These findings can then serve as groundwork for future research into the topics of nitrogen and Natura 2000, and its relation to the development of real estate. The exploratory research method is characterized by its flexibility and open-endedness, which allows for the emergence of new themes and insights during the data collection process (Jackson, 2015). It for example enables the researcher to adapt the questions and structure of the interviews to new information and unexpected findings. As a result, it provides a more nuanced and thorough research process compared to rigid research designs, delivering a rich understanding of the phenomena under study (Maxwell & Miller, 2013).

3.3 Data collection methods

3.3.1 Literature review

First, an in-depth literature review has been conducted that identifies the relevant concepts, definitions, theories, debates, and challenges of the Dutch issue concerning nitrogen and Natura 2000, institutional design for environmental/space-conflicts, and the development of real estate. This theory has been discussed in the theoretical framework (Chapter 2), and provides a foundation for the policy review, the interview guide, and the action research. The researcher has found the literature through a focus on key terms (see Table 1) and selected the literature based on relevance. The relevance of the literature was determined by evaluating its alignment with the research topic, research questions, and objectives of the study. Sources were selected based on their direct relevance to the research problem, contribution to the understanding of the topic, and provision of valuable insights to support the research objectives. Two databases, in particular, have been used to collect the literature, these are SmartCat and Google Scholar. Next to that, the library of the University of Groningen has been consulted for relevant literature. In addition, manual snowballing has been applied to find relevant sources. Manual snowballing is a sampling technique for collecting relevant literature beyond the primary literature search, which is executed by scanning the references of identified literature (Chapman et al., 2010). Besides academic literature, the review consists of grey literature originating from the Dutch government, the EU, and (independent) research organizations, such as the CBS and the EEA.

Nitrogen and Natura 2000	Institutional design	Development of real estate
Environmental/space-conflict	Dutch environmental planning	Development of real estate
Natura 2000	Environmental governance	Emission of real estate
Nitrogen crisis	Institutional arrangement	The Dutch housing crisis
	Institutional design	The energy transition

Table 1: Overview of key terms for the collection of literature

3.3.2 Policy review

To help answer the first sub-question of this research, and to provide input for the expert interviews and carry out the action research, a policy review has been conducted. This is a data collection method that involves examining policies to assess their development, implementation, and impact (Walt et al., 2008). Policy reviews can be conducted in several ways. Petticrew and Roberts (2008) describe two main approaches to policy reviews: systematic reviews, which involve a comprehensive search and synthesis of relevant policies, and targeted policy reviews, which focus on a specific policy or set of policies. For this research, a targeted policy review has been conducted, which involves a more focused approach to reviewing policies. The aim of this review is to provide an overview of the policies in effect in the Netherlands related to nitrogen and Natura 2000.

In addition, since policies interact at different administrative levels due to the multi-level governance, as identified in Chapter 2.2, it is important to understand the interdependence of these policies (Klein & Juhola, 2014). Therefore, the targeted policy review has identified relevant policies across three administrative levels, these are: global policies, European policies and policies on the national level. Below, a list is provided of all policies included in the policy review.

Policy	Source	Scale
Gothenburg Protocol	UNECE (2023)	Global
WHO Global Air Quality Guidelines	WHO (2021)	Global
EU Birds Directive	EUR-Lex (2019)	European
EU Habitats Directive	EUR-Lex (2013)	European
EU Ambient Air Quality Directive (AAQD)	EUR-Lex (2015)	European
Industrial Emissions Directive (IED)	EUR-Lex (2010)	European
National Emissions Ceilings Directive (NECD)	EUR-Lex (2016)	European
EU Nitrates Directive	EUR-Lex (2008)	European

Nationaal Samenwerkingsprogramma Luchtkwaliteit (NSL)	Kenniscentrum InfoMil (2023)	National
Wet natuurbescherming (Wnb)	Overheid.nl (2023a)	National
Programma Aanpak Stikstof (PAS)	Overheid.nl (2023c)	National
Wet stikstofreductie en natuurverbetering	Overheid.nl (2023b)	National

Table 2: Overview of policies for the policy review

3.3.3 Expert interviews

To help answer the research questions, in-depth expert interviews have been conducted. The interviews contributed to reflect upon how the institutional arrangement concerning nitrogen and Natura 2000 has developed, how it is interpreted and understood, what its impact and effects are, and how the industry involved in the development of real estate deals with it. Given the explorative aim of this research, the interviews were semi-structured. According to Seidman (2013, p. 13), semi-structured interviews are "a flexible and responsive form of interviewing that is guided by a set of open-ended questions or prompts but allows for the exploration of the topic in greater depth and detail than is possible through more structured approaches". Based on both the literature review and the policy review, an interview guide (see Appendix B) has been developed. This guide served as a guideline and provided some structure for the conversations. However, during the interviews, the researcher aimed at keeping the conversation open to facilitate the possibility for the expert to provide as much relevant information as possible, without setting strict boundaries. To avoid directive questions, the questions of the interview guide are all open-ended and do not contain findings of the literature review and the policy review. Furthermore, the interview guide was open to additions and adjustments throughout the data collection process. Through this approach, the researcher could follow up on unexpected findings and explore emerging themes.

Recruitment of the participants for the interviews has been performed through expert sampling, which is a purposive sampling method (Rai & Thapa, 2015). This type of non-probability sampling is most effective in studies that focus on a specific domain with knowledgeable experts within (Etikan et al., 2016). Furthermore, Etikan et al. (2016) stress that expert sampling is useful when investigating new areas of research, as is the case in this study. During the time this research has been conducted (February - July 2023), the researcher followed an internship at the environmental consulting and engineering firm Lycens. This company is, among other things, involved in the process of the development of real estate and deals with the institutional arrangement concerning nitrogen and Natura 2000. Therefore, the network of this company has been utilized to recruit experts for the interviews. To select experts for the interviews, a number of criteria have been drawn up: (1) the respondent must be employed within the Netherlands, (2) the respondent must have a professional background in either a public or a private organization, (3) the respondent must have professional experience with and/or knowledge on the development of real estate and/or environmental planning, (4) the respondent must have experience with the institutional arrangement concerning nitrogen and Natura 2000 and/or knowledge on institutional design for environmental/space-conflicts. Through this approach, the researcher intended to

select information-rich cases to develop an in-depth and comprehensive understanding of the phenomena under study. Due to the exploratory design of this research, the number of experts to be interviewed was determined along the data collection process. The interviews were conducted until the researcher perceived the data as saturated. Saturation of data occurs when “sampling and data collection are continued until no new information or themes are emerging from the data” (Guest et al., 2006, p. 59).

ID	Name	Function	Organization	Date & duration
Expert 1 (E1)	Merijn van Hoek	Team manager Spatial Planning	Consultancy and Engineering firm Lycens	28-3-2023, 13:00 (29 min.)
Expert 2 (E2)	Prof. dr. Gert de Roo	Professor of Spatial Planning	University of Groningen	29-3-2023, 14:00 (34 min.)
Expert 3 (E3)	Marc ter Laak	Commercial director	Consultancy and Engineering firm Lycens	30-3-2023, 13:15 (43 min.)
Expert 4 (E4)[2]	Respondent 4	Real estate developer	Planning and Area Development firm	4-4-2023, 11:00 (32 min.)
Expert 5 (E5)	Jeroen Buter	General director	Amusement Park Julianatoren	5-4-2023, 11:45 (30 min.)
Expert 6 (E6)	Justin Hendriks	Project manager Spatial Planning	Consultancy and Engineering firm Lycens	6-4-2023, 09:30 (58 min.)
Expert 7 (E7)[2]	Respondent 7	Advisor Housing	Province of Gelderland	7-4-2023, 09:00 (51 min.)
Expert 8 (E8)	Dirk Roskam	Developer and Project Leader	Housing Corporation Domijn	13-4-2023, 11:00 (30 min.)
Expert 9 (E9)	Ben ten Oever	Project manager Ecology	Consultancy and Engineering firm Lycens	13-4-2023, 13:00 (46 min.)
Expert 10 (E10)	Thijs Elderink	Policy officer Housing	Province of Overijssel	14-4-2023, 15:30 (40 min.)

Table 3: Overview of participants in the expert interviews

[2] Personal details partly anonymized based on respondent’s preferences

3.3.4 Action research

Action research is a methodology in the social sciences that involves the collaboration between a researcher and practitioners. Action research is particularly useful in addressing practical problems in real-world settings (Bradbury & Reason, 2008), as is the case in this study. The primary goal of it is to generate practical knowledge, to improve social practices. Besides being a methodology, action research can be used as a data collection method (Mertens, 2007). Multiple types of data sources can be used to conduct action research, examples are observations, interviews, and surveys.

For this research, observation of a companies' practices has been performed. These observations involve directly observing behavior and activities within the research setting (Kemmis & McTaggart, 2005). This has been done at the company where the researcher followed an internship at the time this research has been conducted. This enabled the researcher to observe cases that were valuable for the purpose of this research. Through the action research, the researcher gained an improved understanding of the relevant institutions for the issue concerning nitrogen and Natura 2000, how the industry involved in the development of real estate is impacted, and what the effects on the development of real estate are.

3.4 Data analysis

For the analysis of the qualitative data that has been collected, an inductive approach was applied. Such an approach towards data analysis is flexible and the analysis is driven by the observations and analysis of all the collected data (Azungah, 2018). Subsequently, the findings arise directly from the analysis of the raw data, not from a priori expectations or models (Thomas, 2006). Therefore, this approach is perceived as suitable for the exploratory design of this study. The data analysis was performed as follows.

Firstly, an extensive policy review has been conducted of all the policy pertaining to nitrogen and Natura 2000 in the Netherlands (see Appendix A). Subsequently, through a comprehensive analysis of the policy review, and consultation with the experts and professionals involved in this research, the specific institutions relevant for understanding the institutional arrangement concerning nitrogen and Natura 2000 have been identified.

Secondly, the expert interviews have been recorded using the Dictaphone app on the researcher's Apple device. Afterwards, these interviews have been transcribed using Word Online. Then, all the raw data from the interviews has been explored and analyzed in Atlas.ti through the application of descriptive coding. In this process, major subjects, unexpected findings, and interesting quotes have been highlighted to identify patterns and recurring themes. Subsequently, the data of the highlighted parts has been grouped into wider themes and categories most relevant to the research objectives. This grouping and categorization are presented in the inductive code book that has been established along the data analysis (see Appendix E).

Thirdly, an analysis of the action research has been carried out. During the action research, notes have been made of the observations perceived as relevant for and contributing to this research. This includes observations that serve to improve the understanding of the topic under study, corroborate the results of the other data collection methods, and provide practical examples for this study. Subsequently, these notes have been examined to identify patterns, themes, and recurring observations.

Finally, through cross-checking of the results from the policy review, expert interviews, and action research, triangulation of the data has been applied. Subsequently, the findings have been synthesized and summarized into the format presented in the results (Chapter 4), which is subdivided into four sections corresponding to the research questions.

3.5 Ethical considerations

When conducting scientific research, a variety of ethical matters must be considered, as it will ensure the validity and reliability of the research (Clifford et al., 2010). Ethical considerations refer to the principles and guidelines that researchers follow to ensure that their research is conducted in a manner that is respectful, responsible, and protects the rights and well-being of participants (Bryman et al., 2016). The data collection methods of this research involve humans and personal data. Therefore, the Ethical Checklist of the Research Ethics Committee of the University of Groningen's Faculty Spatial Sciences has been used to ensure that all relevant ethical matters are considered. This resulted in the need for brief attention regarding the privacy of the participants in the interviews and the action research. In consultation with the thesis supervisor, this has been resolved by specifically asking for permission from the participants, prior to the data collection. Below, among other things, this will be elaborated upon.

It is of paramount importance to ensure informed consent from all participants in the research, and maintain confidentiality throughout the research process (Bryman, 2016). Accordingly, the interviews started with a statement in which the respondent was informed about the purpose of the research, that participation in the study is voluntary, and that the respondent has the right to withdraw from the research at any time. Furthermore, an information sheet (Appendix C) and a consent form (Appendix D) needed to be read and signed by every respondent before the interviews could start. The consent form included the question whether the respondent preferred to have their real name being stated in the results or a pseudonym. In addition, the respondents were asked for their permission whether the interview could be recorded. At the end of the interviews, the respondents were thanked for their participation. The data of the respondents has been securely stored with two-step verification and can only be accessed by authorized researchers. Moreover, the respondents were informed that a copy of the recordings and notes can be sent upon request and that they can make corrections or request the erasure of any materials.

Besides the expert interviews, the data obtained through the action research involves personal data, which required attention to consider ethical matters. In consultation with the company where the action research has been conducted, it was decided to process only generic information based on observations. This approach ensures the protection of privacy by avoiding the inclusion of specific sensitive data that could be linked to individual employees.

In addition, it is important to be transparent and honest in the research to avoid any conflicts of interest that may compromise the integrity of the study (Edwards & Mauthner, 2002). Any potential biases or conflicts of interest that may affect the research findings should be included. Hereby, the researcher claims no conflicts of interest.

Lastly, the broader implications of this research must be considered to contribute positively to wider social, economic, and environmental goals (Edwards & Mauthner, 2002). For this research, this for example includes engaging with relevant stakeholders to ensure that the findings are used to inform planning practice with the aim to foster beneficial development.

4. Results

In this chapter, the results of the research are presented. The chapter is divided into four sections that correspond to the research sub-questions. First, the institutions in the Netherlands concerning nitrogen and Natura 2000 will be elaborated upon. Second, the impact of the existing institutional arrangement on the industry involved in the development of real estate will be discussed. The third section presents the effects of the existing institutional arrangement on the development of real estate. In the final section, proposed improvements for the institutional arrangement to mitigate the impact and effects on the development of real estate will be revealed.

4.1 Institutional arrangement concerning nitrogen and Natura 2000

As part of this research, a review has been conducted of the policy and associated documents regarding nitrogen and Natura 2000 in the Netherlands (see Appendix A). In this section, the development of the relevant institutions will be elaborated upon. Subsequently, the perceived causes of the environmental/space-conflict between nitrogen and Natura 2000 will be discussed.

4.1.1 Natura 2000

EU Birds Directive

The policy review, in combination with section 2.1.4 of the literature review, have contributed to gaining an understanding of the institutional design and institutional arrangement regarding Natura 2000.

First, the Birds Directive was adopted in 1979 and has since been updated several times, most recently in 2009. The Birds Directive requires EU member states to take measures to protect all species of wild birds that are naturally occurring in the EU, including migratory birds, from hunting, disturbance, and destruction of their habitats. The directive also requires member states to establish a network of protected areas, known as Special Protection Areas (SPAs), for the conservation of important bird habitats. The SPAs are designated based on scientific criteria and must cover a sufficient range of habitats to ensure the long-term conservation of bird populations.

EU Habitats Directive

The EU Habitats Directive was adopted in 1992 and has been amended multiple times. The Habitats Directive requires EU member states to take measures to maintain or restore natural habitats and species of wild fauna and flora that are listed in its annexes. The annexes list species and habitats of European importance that are considered to be in need of protection and conservation. Member states are required to establish a network of protected areas, called Special Areas of Conservation (SAC), for the conservation of these habitats and species.

Establishment of Natura 2000

Simultaneously, in the year 1992, the Natura 2000 network was founded, building upon the EU's Nature Directives presented above. Together, the SPAs of the EU Birds Directive and the SAC of the EU Habitats Directive comprise the Natura 2000 network. Natura 2000 is designated based on scientific criteria and must cover a sufficient range of habitats to ensure the long-term

conservation of biodiversity. As identified in Chapter 2, according to EU policy, countries are obliged to conserve these protected sites.

While the EU Nature Directives, including policies regarding Natura 2000, are legally binding on member states, they offer flexibility for countries to develop policies in accordance with their national circumstances and priorities. The Nature Directives represent a European-level agreement that requires the implementation of policies at the national level, acknowledging the multi-level governance of EU policies (E10). As noted by experts 2, 3, and 9, the directives establish preservation targets and guidelines for Natura 2000. Subsequently, it is the responsibility of the member states to formulate policies in this regard.

Both directives prioritize abstract preservation targets rather than specific environmental standards, for example concerning emissions. By employing these abstract targets, the directives allow for flexibility in implementation, enabling member states to tailor conservation efforts to their specific contexts and ecological conditions. This approach allows countries to establish policies that suit their needs if the overall objectives of the directives are met. The European Commission oversees directive implementation and takes legal action against member states that fail to comply with their provisions (European Commission, 2023d).

Dutch Nature Protection Act

Following the Directives, it is the responsibility of the Dutch government to design institutions that comply with the European Directives and associated guidelines pertaining to Natura 2000. In alignment with this, the Netherlands has introduced the Nature Protection Act (abbreviated as Wnb in Dutch). Expert 7 has highlighted the importance of adhering to European directives. During the analysis of the policies, it has been observed that European regulations, particularly the EU Birds and Habitats Directive, provide the framework and starting points for this legislation.

The Wnb, enacted on January 1, 2017, is a Dutch law that governs the safeguarding and management of natural wildlife and habitats within the country. This legislation consolidates three previous laws and is primarily based on European directives, particularly the EU Birds and Habitats Directive. Its primary objective is to protect and preserve the natural environment and biodiversity in the Netherlands by regulating activities that may harm protected areas, including Natura 2000 sites. One of the major changes brought about by the Wnb was a decentralization in the governance for the preservation of Natura 2000. The local and provincial levels of government, rather than the national government, are now the competent authorities.

Under the Wnb, activities, such as construction and agriculture, that have the potential for significant impact on protected natural areas or species, necessitate a permit. These permits must be applied for at the respective municipal or provincial government. The permits are granted following a rigorous assessment of the activity's potential impact and the proposed measures to mitigate any adverse effects. The purpose of these permits is to ensure that activities are conducted in a manner that avoids or minimizes harm to protected species, habitats, and ecosystems.

The Wnb also incorporates provisions for compensation measures, such as the creation of new natural habitats, to offset any detrimental effects caused by permitted activities. Furthermore, the legislation includes mechanisms for enforcing nature protection measures, including penalties for non-compliance. Additionally, the Wnb promotes public participation and

consultation in decision-making processes concerning the protection and management of natural areas.

4.1.2 Institutional design regarding nitrogen and Natura 2000

Relation to Natura 2000

"That's where it all comes from because these areas are legally binding. Natura 2000 is not necessarily focused on nitrogen, however in the Netherlands, it translates into a nitrogen issue because it has one of the most critical values." (E7)

The policies presented above do not have nitrogen as their primary focus. However, as discussed in Chapter 2, RNCs do have a substantial impact on Natura 2000 sites in the Netherlands. Experts 7, 8, 9, and 10 have emphasized that nitrogen poses a significant threat to the preservation of these protected sites within the country. Already 10 to 15 years ago, it became increasingly clear that nitrogen could pose a problem (E7). Nevertheless, it was noted by experts 1, 5, and 9 that, until 2015, there was no specific policy addressing the issue of excessive nitrogen deposition on Natura 2000. However, the policy review revealed that the institutions concerning nitrogen and Natura 2000 have gained significant momentum over the last years, also highlighted by expert 5. Following this, as noted by expert 9, the permitting for activities that potentially harm Natura 2000 sites became part of the Wnb. Along with this, the policy concerning nitrogen and Natura 2000 has become stricter (E5, 9).

Programmatic Approach Nitrogen (July 2015 - May 2019)

The Dutch "Programma Aanpak Stikstof (PAS)", in English: Programmatic Approach Nitrogen, was launched in 2015. It embodies the first attempt of the Dutch government to address the growing concerns about nitrogen emissions and their impact on protected natural areas, particularly Natura 2000 sites (RIVM, 2017).

The policy review revealed that the PAS was established to balance the needs of economic development and the preservation of natural habitats. Based on the PAS, permits could be granted for activities that may potentially harm protected natural areas, in anticipation of future positive effects by conservation measures. This entailed that the emission of activities could be compensated by measures taken elsewhere. These measures for example include the restoration of natural areas or the creation of new habitats. In addition, under the PAS, projects that generated nitrogen emissions could apply for permits that would allow them to continue or expand their activities, provided they could demonstrate that their emissions would not cause significant harm to protected areas.

In November 2018, the European Court ruled that the positive effects of the measures included in the program must be predetermined beforehand, instead of anticipating future positive effects (Raad van State, 2019). Only then, the Dutch government is allowed to provide a permit for a new activity that potentially harms the preservation of Natura 2000. Since the PAS does not meet that requirement, it cannot be used as a legal basis for granting permission for new activities. Moreover, it has been identified that, in practice, compensatory measures included in permits issued under the PAS did not take place (E2, E3, E7). Therefore, in May 2019, the Dutch Council of State ruled that the PAS was in breach with EU law (Raad van State, 2019). Consequently, the

PAS was invalidated. In response, a new policy was introduced to address the issue concerning nitrogen and Natura 2000 in the Netherlands.

Nitrogen Reduction and Nature Improvement Act (July 2021 - present)
On July 1, 2021, the 'Nitrogen Reduction and Nature Improvement Act' came into force (Rijksoverheid, 2021). This is a legislative proposal included in the Wnb, aiming to reduce nitrogen deposition on sensitive habitats within Natura 2000 areas and improve the biodiversity within those areas. The law was enacted in response to the invalidation of the PAS, as revealed by the policy review and emphasized by expert 9.

The Nitrogen Reduction and Nature Improvement Act contains three result-oriented obligations for a reduction in the deposition of RNCs. Next to that, the law mandates a program of measures to achieve this reduction and restore nature. Moreover, the law regulates interim monitoring and, if necessary, adjustments. The following three obligations are included in the law: by 2025, at least 40% of the area of nitrogen-sensitive habitats in protected Natura 2000 areas must be below the KDW; by 2030, at least half of the area; and by 2035, at least 74%. As elaborated upon by expert 6, this KDW is perceived as a sectoral and strict environmental standard. Furthermore, it is important to note that new habitats are still being added to existing Natura 2000 areas (E9), because of which the KDW decreases.

In addition, a provision of this law is the exemption for demolition, construction, and development activities, in short, the construction exemption. In the process of applying for a Wnb permit, for the aspect of nitrogen, only the deposition on Natura 2000 sites during the usage remains relevant. As a result, a nitrogen permit was not required for the realization phase of real estate (E4). This exemption simplified the permit process for activities involving an emission of nitrogen by focusing solely on the deposition during the usage phase, without requiring an assessment of the effects from temporary emissions during the realization. The goal of introducing an exemption for the construction sector was to enable construction projects again, considering that the construction sector contributes relatively little to nitrogen emissions (Rijksoverheid, 2021). However, on November 2, 2022, the Council of State, in the 'Porthos ruling,' declared the construction exemption inapplicable (Raad van State, 2022). Just like the PAS, this measure, implemented by the Dutch government, proved to be legally unfounded.

Prior to the rulings of the Council of State, the developments of real estate were exempt from obtaining a nitrogen permit, regardless of their potential impact on Natura 2000 sites through the deposition of RNCs (E4). The policy analysis revealed that the Dutch government implemented the PAS and the construction exemption to address the challenges related to nitrogen and Natura 2000. These measures aimed to strike a balance between environmental preservation and facilitating construction activities. However, expert 10 emphasized that the preservation of Natura 2000 has been deficient due to deposition of RNCs. Therefore, *"the Council of State has swept this legislation of the table"* (E6). Additionally, the judge stressed that efforts need to be taken to reduce the excessive deposition of nitrogen on Natura 2000 sites before activities that potentially harm overloaded Natura 2000 sites are allowed to resume (E7).

4.1.3 Existing institutional arrangement concerning nitrogen and Natura 2000

Permitting under the Wnb

In response to the rulings of the Council of State, the policy concerning nitrogen and Natura 2000 has become stricter (E4, 9). The Dutch government has determined that developments within the country, such as of real estate, are prohibited from having a negative impact on the conservation of Natura 2000 sites (Rijkswaterstaat, 2023).

"The nitrogen policy as we know it now did not exist. The policy has come into being through the rulings of the Council of State." (E3)

In the existing situation, for each activity that involves an excessive deposition of RNCs that potentially harm Natura 2000 sites, a nitrogen permit must be obtained under the Wnb. For granting that permit, the competent authority, either the municipality or province, assesses whether negative effects on conservation objectives within Natura 2000 areas can be excluded. This means that developments are not allowed to produce an additional deposition of RNCs on Natura 2000 sites in which the KDW is exceeded. However, if a development is expected not to involve an excessive deposition of RNCs, a nitrogen permit is not required. Therefore, prior to any development, it is necessary to assess the deposition of RNCs.

AERIUS Calculator

The action research has clarified how the procedure regarding the application for a nitrogen permit under the Wnb works in practice. For new developments, an assessment must be made of the existing situation compared to the intended situation. This is done by performing a so-called 'nitrogen deposition calculation'. To determine if a proposed activity results in excessive nitrogen deposition on surrounding Natura 2000 areas, the Dutch government has developed the AERIUS Calculator. This tool models the deposition of RNCs on Natura 2000 deriving from the sources entered into the Calculator. In accordance with Chapter 2.3.4, the sources include the traffic generation, emission from idling vehicles, and the use of equipment. Moreover, the calculation is divided into two components, one for the development phase and one for the use phase.

The AERIUS Calculator models the total deposition, the background deposition, and the deposition of RNCs from the activities involved in the development. Subsequently, based on this calculation, an accompanying report regarding the nitrogen deposition of the proposed activity on Natura 2000 needs to be written. This report illustrates and elaborates upon the deposition of RNCs on the surrounding Natura 2000 sites. If there is no modeled deposition of nitrogen according to the Calculator, the proposed development does not cause a significant increase in nitrogen deposition on Natura 2000, and negative effects are ruled out. In that case, for the aspect of nitrogen, it is not required to apply for a permit under the Wnb. However, if there is modeled deposition of RNCs on surrounding Natura 2000 sites, a permit under the Wnb must be applied for. Experts 1, 9, and 10 have observed that, when developing real estate, the permissible deposition of RNCs on Natura 2000 sites is regularly exceeded.

Despite the rulings of the Council of State and the policies implemented in response, there are still measures that can be taken to allow activities that deposit RNCs on overloaded Natura 2000 sites to take place. Examples are the internal offsetting and the external offsetting of the

nitrogen emissions. In fact, these measures have also been added to the AERIUS calculator (E9). In Chapter 4.2.3, among other things, the application of these measures is discussed.

4.1.4 Perceived causes of the environmental/space-conflict

Density of the Netherlands and characteristics of Natura 2000

When asked about causes of the nitrogen crisis in the Netherlands, most of the experts started with the same answer. This answer came down to the following: in the Netherlands, we live with too many people in a relatively small area (E1, 2, 6, 7, 8, 9, 10). Furthermore, as noted by experts 2, 4, 7, and 8, there is a high degree of urbanization with environmentally harmful activities. Consequently, this involves a relatively high emission and subsequent deposition of RNCs.

In addition, consistent with the policy review, experts recognize that Natura 2000 is the thing around which the issue concerning nitrogen evolves (E3, 7, 8, 9, 10). Expert 10 has highlighted that the substantial area of Natura 2000 sites within the country contributes to the issue. Also, as explained by expert 6, Natura 2000 sites are scattered throughout the country. Furthermore, the Netherlands has many unique heath and dune areas, which are relatively sensitive to RNCs (E9). In fact, of the 162 Dutch Natura 2000 sites, 129 are nitrogen-sensitive, meaning that these have a relatively low KDW (Vink & van Hinsberg, 2019). Experts 2 and 6 emphasized that the Dutch government may have designated too many 2000 sites, as its presence is having major implications. The previous has also been observed during the action research, and expert 9 summarized this as follows:

> *"So many people in a small country.* [...] *However, in the Netherlands,* at the same time *there are approximately 160 Natura 2000 sites, of which, off the top of my head, 80 to 90% are sensitive to nitrogen."* (E9)

Omission of compensatory measures, resulting in strict requirements

Due to the failure to implement the proposed compensatory measures included in the PAS and the construction exemption, addressing the issue concerning nitrogen and Natura 2000 has been postponed while construction proceeded (E10). As previously discussed, countries have relative freedom in implementing EU directives. However, when it comes to nitrogen, the Netherlands has somewhat neglected this (E2). With the PAS and the construction exemption, "*the Dutch government has bought itself time*" (E7). Furthermore, as revealed by the action research and noted by respondent 7, in practice, constant shortcuts are taken to proceed with developments within the existing policy.

Prior to the rulings of the Dutch Council of State, the requirements regarding nitrogen for the development of real estates were perceived as doable (E4, 5, 9). However, as discussed in the previous subsection, the requirements have become much stricter in recent years. Consequently, in the current-day situation, even small-scale developments are hindered by the requirements regarding nitrogen (E4). These requirements include the environmental standard of the KDW that must be adhered to (E6). Expert 2 noted that the Dutch government intervened too late in addressing the specific issue concerning nitrogen and Natura 2000, and this comes at a high cost. The previous is highlighted by the following quotes:

"We have postponed the problem and now we are with our backs against the wall." (E8)

"We have been living on borrowed time. [...] The policy has fallen short, resulting in the issues we are currently facing with developments." (E7)

4.2 Impact on the industry involved in the development of real estate

This section will discuss the impacts of the existing institutional arrangement in the Netherlands concerning nitrogen and Natura 2000 on the industry involved in the development of real estate. These impacts have been observed through the expert interviews and the action research. First, the main impacts on the industry will be presented. Second, identified differences throughout the Netherlands will be elaborated upon. Third, the measures taken in the activities and processes associated with the development of real estate will be discussed.

4.2.1 Main impacts

Increasing complexity

The action research revealed that prior to the implementation of the AERIUS Calculator, the required assessment of the emission and subsequent deposition of RNCs from a proposed development was perceived as manageable. However, under the current circumstances, the developments of real estate are more under pressure, also highlighted by expert 4. Even small-scale real estate projects are facing obstacles due to the stricter requirements implemented following the rulings of the Council of State (E3).

Under the existing institutional arrangement concerning nitrogen and Natura 2000, when it comes to the development of real estate, nitrogen poses a constant challenge (E5). As described in Chapter 4.1.3, for planned developments, it is imperative to assess the deposition of RNCs on the surrounding Natura 2000 sites. The AERIUS Calculator and accompanying reporting must be utilized for modeling the deposition of RNCs. This planning requirement adds an additional aspect to the process of the development of real estate (E8). Furthermore, experts 1 and 9 have explained that the Calculator is constantly changing and becoming stricter, also observed during the action research. Comparable assessments for the aspect of nitrogen that, until recently, did not create barriers for the development of real estate are now more troublesome.

Despite the increasing challenges of developing real estate due the existing institutional arrangement concerning nitrogen and Natura 2000, in practice, it is possible to proceed with the development of real estate that potentially harms Natura 2000 sites. However, be it with considerable effort and ingenuity, as stated by expert 7 and observed through the action research. This endeavor entails more assessment than before and requires additional permits. Moreover, it necessitates consideration of more drastic measures to be taken in the processes and activities involved in the development of real estate (E10). These measures will be discussed in section 4.2.3.

Dependency on and boost for environmental consultancy

As previously discussed, it has been identified that the existing institutional arrangement concerning nitrogen and Natura 2000 entails an assessment of the nitrogen deposition on surrounding Natura 2000 sites. To execute this, a so-called AERIUS calculation and

accompanying reporting needs to be carried out. It has been observed that, because of this, the actors involved in the development of real estate are increasingly dependent on external environmental consultancy firms (E3, 4, 5, 6, and 9). This applies even to companies that, prior to the required nitrogen assessment, could conduct all environmental assessments by themselves (E5, 9). Expert 4 mentioned that the requirements concerning nitrogen are nowadays part of the development of real estate, which requires involving a consultancy firm.

Along with this, the action research revealed that this assessment concerning nitrogen and Natura 2000 has become an additional product that is now being delivered by consultancy firms. More specifically, spatial planning or ecology departments are generally involved in this *"and these* [departments] *have received a significant boost due to the nitrogen issue"* (E3). In fact, the action research has revealed that, within the observed company, the department of ecology was partly established due to the nitrogen crisis. The requirement assessment of nitrogen deposition on Natura 2000 for the development of real estate has caused a significant increase in the workload of the company. Furthermore, the action research has revealed that the lead time for these assessments can take up to a month. In addition, conducting these assessments could easily take up to a working day, to which costs are attached. The quotes below highlight the boost for consultancy firms:

"The nitrogen policy, in addition to existing consultancy, has added an extra piece of consultancy with an emphasis on it." (E1)

"The consulting world thrives quite nicely under these kinds of crises." (E6)

4.2.2 Differences throughout the Netherlands

Through the expert interviews and the action research, differences throughout the Netherlands have been identified when it comes to the impacts of the existing institutional arrangements concerning nitrogen and Natura 2000 on the development of real estate.

Distance to Natura 2000

Experts 1, 7, and 10 have recognized that these impacts differ due to the varying proximity of Natura 2000 to different the development of real estates. Moreover, during the action research, it has been observed that the closer a proposed development is located to Natura 2000, the bigger the impact of the existing institutional arrangement on the development of real estate.

Furthermore, as observed during the action research and emphasized by expert 7, who is employed in a Dutch provincial government, it was found that the AERIUS Calculator applies a cut-off limit of 25 kilometers. This means that when conducting a nitrogen assessment, Natura 2000 located up to 25 kilometers from the proposed development is included in the Calculator. Subsequently, any development located further from Natura 2000 than the cut-off limit does not have a modeled deposition of RNCs on surrounding Natura 2000. Nevertheless, as revealed by the action research, due to the wide distribution of Natura 2000 throughout the Netherlands, these protected areas are generally located within 25 kilometers of any proposed development.

Interpretation and varying approaches

Another cause found for the differences throughout the Netherlands are different interpretations and varying approaches on decentralized levels of governance towards the issue at hand. Expert

1 has recognized that, under the existing institutional arrangement, there is much room for interpretation. During the action research this also has been observed. Comparable assessments of nitrogen deposition from proposed developments are evaluated differently by responsible governmental officials from respective authorities, resulting in different outcomes concerning the granting of authorization. In addition, expert 3 explained that: *"with the arrival of environmental agencies* [in Dutch: omgevingsdiensten]*, there is some additional clarity, knowledge, and expertise compared to that at the municipality. However, this also leads to more differences in interpretation"*. Environmental services perform tasks for municipalities and provinces and are specialized in environmental monitoring and enforcement (Rijksoverheid, 2021).

Furthermore, it has been identified that different governmental authorities apply varying approaches to address the environmental/space-conflict between nitrogen emission of the development of real estate and the preservation of Natura 2000. For example, the provincial government of Overijssel has decided that external offsetting is suspended in the province (E10). According to the province, there is not enough reduction of nitrogen deposition occurring through the implementation of these measures. Whereas, in the province of Gelderland, the application of external offsetting to develop real estate is still permitted (E7).

4.2.3 Measures taken

It has been identified that several measures are taken by the industry involved in the development of real estate in response to the existing institutional arrangement concerning nitrogen and Natura 2000.

Precautionary nitrogen assessment

As highlighted by experts 1 and 9, actors involved in the development of real estate perceive the requirements concerning nitrogen and Natura 2000 as a legal gray area, lacking clarity on the exact circumstances in which the assessment is required. As a result, more and more actors are applying for nitrogen permits just to be on the safe side, even when they turn out not to be needed. Likewise, during the action research, it has been observed that it is becoming increasingly common for real estate developers to conduct a nitrogen assessment or apply for a permit for every development, even though there are costs involved in this procedure. This is done to mitigate potential effects of the existing institutional arrangement concerning nitrogen and Natura 2000 on the development of real estate.

Adjusting development for AERIUS Calculator: running hours, electrical equipment, and phasing

To conduct the nitrogen assessment and be granted authorization for the development of real estates, the AERIUS Calculator must be utilized. As mentioned during the expert interviews and observed during the action research, to ensure that this assessment does not impede a proposed the development of real estate, developments are regularly adapted according to it. This can be done via several approaches.

First, according to expert 9 and observed during the action research, a measure regularly applied is to bring down the running hours required for fossil fueled equipment and machinery involved in the development of real estate. As a result, the modeled emission and subsequent deposition of RNCs on surrounding Natura 2000 sites decreases.

Second, as highlighted by experts 3, 4, 7, 9, and 10, the deployment of electric machinery and equipment contributes to lowering the deposition of RNCs on surrounding Natura 2000 sites. In addition, during the action research it was observed that it is often advised to real estate developers to deploy electric machinery and equipment during a development. However, an important note to make is that it is not common for real estate developers to possess electrical machinery and equipment (E3).

A third measure regularly applied is the phasing of the development of real estate over multiple years (E4, 9). As recognized by expert 9, underlying this is the fact that the AERIUS Calculator applies calendar years in the modeling (Bij12, 2023a). Therefore, when the development of real estate is phased over different years, the modeled deposition of RNCs on surrounding Natura 2000 sites will also be divided. This increases the likelihood that, based on the required assessment regarding nitrogen, the development is allowed to proceed.

After all, an intriguing observation made during the interviews is that, in the industry involved with the development of real estate, *"there is a lot of tampering with the AERIUS Calculator"* (E1). The expert further elaborated that, to prevent additional procedures, extensive conversion of the data to be entered into the AERIUS Calculator is conducted.

Internal and external offsetting

If a proposed development of real estate cannot proceed based on the AERIUS Calculator and its accompanying report, there are measures that can be implemented to still carry out the development. The data analysis revealed two measures, in particular, that can be applied to proceed with a development. These measures are internal offsetting and external offsetting.

Internal offsetting occurs when an activity is modified or expanded in a way that results in equal or less deposition of RNCs on the surrounding Natura 2000 areas compared to a reference situation (Bij12, 2023b). As emphasized by expert 9, internal offsetting must be applied within the same location as the intended the development of real estate. Expert 7 explained that internal offsetting can for example be applied by taking over emission rights from a former activity, such as a farm, that was located on the property. Another example of the application of internal offsetting has been observed during the action research. A developer was planning to expand a shopping center in the vicinity of Natura 2000, involving a modeled excessive deposition of nitrogen on Natura 2000 based on AERIUS. However, since the shopping center will be disconnected from the national gas grid, the overall emission of RNCs decreases, allowing the development to proceed.

Whereas internal offsetting must be applied within the same location of the development, external offsetting involves the acquisition of emission rights from another site located in the surrounding area (E4). External offsetting involves acquiring nitrogen emission rights from a company located in the proximity that ceases operation either fully or partially (Bij12, 2023c). Therefore, due to a net decrease in the modeled nitrogen deposition by applying offsetting, developments are allowed to presume under the existing institutional arrangement concerning nitrogen and Natura 2000.

4.3 Effects on the development of real estate

It has been observed that the existing institutional arrangement concerning nitrogen and Natura 2000 is having effects on the development of real estate. In this section, these effects will be elaborated upon. First, the overall effects will be discussed. Thereafter, the effects on the construction, and on the renovation and redevelopment will be discussed.

4.3.1 Overall effects

The expert interviews and the action research have revealed three effects, in particular, of the existing institutional arrangement concerning nitrogen and Natura 2000 on the development of real estate.

Increasing costs

First, as highlighted by experts 4 and 5 and observed during the action research, an effect is the increase in the costs to develop real estate. Expert 4 has explained that the deployment of electric equipment, which often must be hired, and the phasing of developments, requiring construction workers to be paid for a longer period, contributes to increasing costs for the development of real estate. Besides that, the action research has revealed that there are significant costs involved in performing the AERIUS calculations and drawing up accompanying reports. Expert 4 concluded that the institutional arrangement concerning nitrogen and Natura 2000 results in the realization of housing becoming less affordable and altogether "*this has resulted in homes becoming €20,000 to €30,000 more expensive".*

Postponement

Second, experts 1, 3, 4, 5, and 10 recognize that the existing institutional arrangement concerning nitrogen and Natura 2000 results in the postponement of the development of real estate. Expert 10 stressed that the ongoing assessments concerning nitrogen, which are required, contribute to this. Furthermore, expert 10 emphasized that several developments of real estate are temporarily on hold because of the existing institutional arrangement. In contrast, expert 8 experienced that: *"nitrogen is becoming a significant problem, but it has not yet led to postponement* [of the development of real estate]". However, the expert also emphasized that conscious choices must be made in the process of developing real estate to prevent postponement. In addition, as recognized by expert 4 and observed during the action research, the phasing applied in the development of real estates, in response to the institutional arrangement, results in postponement because developments take longer.

Cancellation

Third, besides increasing costs and postponement, the cancellation of the development of real estates is an observed effect of the existing institutional arrangement concerning nitrogen and Natura 2000. In addition to the developments of real estate being temporarily on hold, there are developments completely on hold (E10). The interviews with experts 1, 3, and 6 are consistent with this, and expert 3 stressed that: *"purely because of nitrogen, some projects have also failed to proceed at all"*. Expert 1 highlighted that numerous developments of real estate cannot proceed under the current policy concerning nitrogen and Natura 2000. The preceding sections are aptly encapsulated by expert 1, who summarized that:

"The nitrogen policy has an impact on the development of real estate. Ultimately, most developments do happen, but much later. Additionally, there have also been projects that did not proceed due to the issue regarding nitrogen." (E1)

4.3.2 Construction of real estate

Through the expert interviews and the action research, several effects of the existing institutional arrangement concerning nitrogen and Natura 2000 on the construction of real estate have been observed.

Housing

First, expert 10 emphasized the effects of this institutional arrangement, revealing that certain housing projects are being delayed or even canceled due to concerns about high emissions of RNCs. The expert observed that, in the Province of Overijssel, approximately one-sixth of the housing demand, equivalent to 10,000 homes, is hampered by the existing institutional arrangement concerning nitrogen and Natura 2000, affecting 22 housing projects. Next to that, it is perceived that the requirements concerning nitrogen and Natura 2000 for the realization of real estate continue to become stricter, making housing construction increasingly impossible (E4, 5).

Business parks & Prerequisites

In addition to housing, the construction of business parks is affected by the existing institutional arrangement concerning nitrogen and Natura 2000, as highlighted by expert 7. This expert further mentioned that grid congestion contributes to the challenges faced in this regard. Essential prerequisites for the realization of real estate, including a connection to the electricity grid, are frequently not granted permission under the existing institutional arrangement. Participant 7 provided an example of challenges faced in constructing an electrical substation in the Dutch province of Gelderland. These difficulties arose from the failure to acquire the required permits associated with nitrogen-related regulations. Correspondingly, the action research revealed a growing difficulty in obtaining permits, specifically related to nitrogen, for pipeline construction.

Amusement park

The effects of the existing institutional arrangement concerning nitrogen and Natura 2000 are not limited to the construction of housing and business parks. Expert 5, the owner of a Dutch amusement park in the proximity of Natura 2000, explains that the institutional arrangement impedes the construction of attractions, parking lots, and other facilities. The expert stated that expanding the amusement park while complying with the requirements regarding nitrogen would necessitate reducing the number of visitors allowed. Moreover, the action research revealed that every small-scale development conducted at the amusement park is impeded by the existing institutional arrangement as measures, such as phasing and the deployment of electrical equipment, must be taken to comply with the required nitrogen assessment.

The energy transition

Furthermore, as identified by expert 7, the effects of the existing institutional arrangement concerning nitrogen and Natura 2000 on the prerequisites for real estate might also impede the energy transition. Corresponding, expert 1 emphasized that the policy concerning nitrogen and

Natura 2000 has an impact on the energy transition as it causes postponement and cancellation of real estate projects that also involve relevant developments for the energy transition. During the action research, an example of such a development has been observed. Obtaining permission for the nitrogen-related aspect has become increasingly challenging in the construction of electric vehicle charging stations as part of real estate development.

Construction versus renovation and redevelopment
Finally, experts 3 and 9 stated that the construction of real estate is more challenging compared to renovating and redeveloping real estate. This is also observed during the action research, and it is primarily because prior to renovation and redevelopment a certain level of nitrogen emission is already permitted at the respective location, allowing for internal offsetting. In contrast, for the construction of real estate, these nitrogen emission rights still must be obtained under the Wnb. Expert 10 corroborated the previous, highlighting the complexities with constructing real estate in non-urban areas under the existing institutional arrangement concerning nitrogen and Natura 2000.

4.3.3 Renovation and redevelopment of real estate

Application of internal offsetting
Expert 10 has elaborated that the renovation of real estate is still manageable under the existing institutional arrangement because of internal offsetting, provided the deposition of RNCs on Natura 2000 is below the reference situation. This is substantiated by expert 9 who explained that, in general, the emissions of real estate decrease due to a renovation. As observed during the action research, such redevelopments utilize nitrogen emissions that are already granted a permit under the Wnb for the aspect of nitrogen. In addition, expert 5 noted that small-scale renovations usually do not require a permit under the Wnb for the nitrogen emission, as those developments do not entail an excessive deposition of RNCs on surrounding Natura 200 sites.

However, as argued by expert 6 and observed during the action research, even projects reducing the emission of RNCs during the usage phase can face obstacles related to nitrogen under the existing institutional arrangement. This is due to a temporary increase in the deposition of RNCs on surrounding Natura 2000 sites during the renovation or redevelopment, which has the potential to lead to excessive deposition.

Legal gray area
According to expert 1, for the construction of real estate, either a nitrogen assessment or a permit for nitrogen under the Wnb is practically always required. However, the expert stated this is not the case for every real estate renovation or redevelopment. Nevertheless, the expert did not know exactly in what cases the assessment or permit are required for the renovation of real estate. Corresponding, expert 9 stated that it is a *“gray area when the Wnb, and thus also the nitrogen assessment, are exactly necessary”.* Hence, according to actors involved in the development of real estate, the existing institutional arrangement concerning nitrogen and Natura 2000 lacks a clear demarcation regarding the necessity of conducting a nitrogen assessment for real estate renovation and redevelopment projects.

During the action research, it has been observed that this legal gray area often leads to uncertainty about the necessity of obtaining a nitrogen permit among actors involved in the development of real estate. Subsequently, as previously discussed, it is becoming increasingly common for actors involved in the development of real estate to conduct a precautionary nitrogen assessment or apply for a Wnb permit. Furthermore, as discussed, civil servants responsible for assessing these projects tend to interpret the requirements differently, resulting in varying outcomes. For instance, there have been cases where two comparable projects had different assessments regarding the need for a nitrogen permit under the Wnb.

4.4 Proposed improvements for the institutional arrangement

During the data collection process, improvements for the institutional arrangement concerning nitrogen and Natura 2000 have been identified. These improvements have the goal to mitigate potential negative impacts and effects on the development of real estate. Below, the two main improvements that have been identified will be presented.

4.4.1 Improved process and implementation

According to the experts involved, the existing institutional arrangement concerning nitrogen and Natura 2000 does not necessarily have to be improved. However, there is room for improvement in the process. Expert 10 emphasized that a better process in the past would have resulted in better functioning policy regarding nitrogen at present. In line with this, expert 3 highlighted that a significant part of the policy pertaining to nitrogen and Natura 2000 is commendable, yet the implementation of said policy falls short. Expert 2 exemplified this by discussing the compensatory measures proposed in the PAS. The expert argued that the proposed measures were *“beautiful promises”.* However, as discussed, these measures have never been taken.

Furthermore, experts 2 and 5 observed that the issue concerning nitrogen is too much of a political game to date, and that it must be addressed nationwide for an effective approach. In addition, it is perceived that the problem regarding nitrogen is media driven and that society knows little about the challenges concerning nitrogen and Natura 2000 (E8). Moreover, expert 3 recognizes that relevant actors are not adequately involved in the process. The previous is also summarized by expert 6 who mentioned that nitrogen is an issue *“that is now being played out in the media and in the political arena.”*

As a result of this top-down approach, a mismatch has arisen between the Dutch government and society (E10). In addition, expert 10 noted that bottom-up initiatives should be stimulated to address the issue concerning nitrogen and Natura 2000, as these tend to generate support in society. Therefore, as noted by experts 3, 9, and 10, for an efficient process towards the issue at hand, it is important to involve all relevant actors in the process. Next to that, it is of paramount importance to stick to the same policy for an extended period, instead of constantly reforming the institutional arrangement towards the issue at hand (E3).

4.4.2 Reintroduction of a construction exemption

Besides improving the process, a reimplementation of the construction exemption has been proposed by experts involved in this research. Experts 1 and 3 argued that such an exemption should be applicable to sectors facing other significant challenges. Expert 3 highlighted that other challenges with substantial societal implications, such as the housing crisis, are compromised by

the existing institutional arrangement concerning nitrogen and Natura 2000. Subsequently, expert 1 indicated that, considering nitrogen and Natura 2000, the existing institutional arrangement can be maintained. However, besides nitrogen, the interests of concurrent crises should also factor into the decision whether to develop real estate. Expert 10, who is a policy officer involved with housing employed within a Dutch province, substantiates the previous and the following quote summarizes this:

> *"Having a roof over your head is a fundamental right and that is now being restricted because in some places we are being held back by nitrogen. [...] From my position, in my view, you should actually have some kind of construction exemption. [...] So, I think housing should have some kind of exemption position."* (E10)

5. Discussion

In this chapter, the results (Chapter 4) of this research are discussed through a comparison with the theoretical framework (Chapter 2) to provide answers to the research sub-questions.

5.1 Institutional arrangement concerning nitrogen and Natura 2000

In this section, the first sub-question of this research is answered: *"How can the nitrogen crisis be understood with the institutions regarding nitrogen and Natura 2000?"* To answer this question, first a policy review has been conducted. Thereafter, through analysis of the expert interviews and the action research, phenomena relevant for understanding the nitrogen crisis have been identified.

As identified through the data analysis, the EU's Nature Directives do not specifically focus on nitrogen. However, as elaborated in Chapter 2.1, the excessive deposition of RNCs poses a threat in the Netherlands to the preservation of Natura 2000, presenting an environmental/space-conflict. The policy review reveals that as of 2015, the Dutch government has designed several institutions to address the environmental/space-conflict between nitrogen and Natura 2000, to adhere to the EU Directives and balance the competing demands of spatial development and environmental conservation. However, the Dutch Council of State has annulled a substantial part of this policy as proposed compensatory measures were not taken and it is in breach with European law. In response, the Dutch government has implemented new and stricter policy concerning nitrogen and Natura 2000.

In Chapter 2.2.1, a dual classification has been discussed for the pace of institutional change. This research identified that the institutions regarding nitrogen and Natura 2000 have been changing constantly. Therefore, the relevant policies are fast-moving entities that adapt and evolve rapidly to changing circumstances and events. The institutions in the Netherlands concerning nitrogen and Natura 2000 might serve as a prime example of fast-moving institutions.

Chapter 2.2 concludes that Dutch environmental governance is interconnected through the application of multi-level governance. In addition, contemporary environmental planning has shifted from a sectoral approach towards an integrated approach. This shift occurred along with the increasing complexity of balancing economic growth and environmental conservation within the country. The results of this research highlight that the institutions pertaining to Natura 2000, in particular the Birds and the Habitats Directives, are European Directives for which policy has to implemented by the respective EU Member States. Furthermore, a decentralization in environmental governance has been brought about in the Netherlands by the implementation of the Wnb. These European directives and the decentralization of the Wnb resonate with the characteristics of multi-level environmental governance presented in the literature.

Besides, the results present that the Dutch government has determined that developments within the country are prohibited from having a negative impact on the conservation of Natura 2000 sites. The AERIUS Calculator, and accompanying reporting, are a requirement for developments to assess the deposition of RNCs on surrounding Natura 2000 sites. Considering Chapters 2.1.4 and 2.2.3, the critical deposition value (KDW) included in the Calculator can be characterized as sectoral environmental planning. Therefore, this sectoral approach, involving framework-setting environmental standards, is contradictory to the integrated environmental planning that would be expected based on the theoretical framework.

This research has revealed several causes contributing to the nitrogen crisis in the Netherlands. To summarize, the high population density and environmentally harmful activities, characteristics of Dutch Natura 2000, omission of compensatory measures, and sectoral environmental planning have been identified as causes contributing to the environmental/space-conflict between nitrogen and Natura 2000, and thereby the nitrogen crisis.

5.2 Impact on the industry involved in the development of real estate

This section answers the second sub-question of this research: *"What is the impact of the existing institutional arrangement (rules of the game) on the industry involved in the development of real estate (play of the game)?"* The policy review, analysis of the expert interviews, and the action research have contributed to examine the existing institutional arrangement and identify the impact on the development of real estate.

Corresponding to Chapter 2.2, this research has identified that the relationship between the industry involved in the development of real estate (play of the game) and the institutional arrangement concerning nitrogen and Natura 2000 (rules of the game) is dynamic and subject to a feedback loop in which planning practice and policy influence one another. On the one hand, over the years, the Dutch government has implemented several policies to address the issue at hand. On the other hand, the industry involved in the development of real estate is impacted by the policies, takes measures in response, and tries to take shortcuts to proceed with developments under the existing institutional arrangement concerning nitrogen and Natura 2000. The measures taken by the industry include precautionary nitrogen assessments, deployment of electrical equipment, phasing of developments, adjustment of developments' running hours for the AERIUS Calculator, and the application of internal and external offsetting. In turn, the government adapts the policies again to prevent shortcuts taken by the industry and adhere to the European guidelines and rulings of the Council of State regarding the preservation of Natura 2000.

In Chapter 2.3.1, it is discussed that the process of the development of real estate is complex and multidisciplinary. Numerous professionals are involved, and governments must be consulted to obtain the necessary permits. The results related to the impact on the industry involved in the development of real estate affirm the previous. In fact, the institutional arrangement concerning nitrogen and Natura 2000 entails an increasing complexity to develop real estate. In particular, the required AERIUS Calculation and accompanying reporting contribute to this. All types of real estate developments are subject to these requirements. In addition, the institutions and associated regulations are constantly changing and becoming stricter, posing additional challenges for the industry involved in the development of real estate. As a result, the dependency on environmental consultancy has increased, resulting in a boost for these firms.

Moreover, this research has identified that the impact of the institutional arrangement on the industry involved in the development of real estate is different throughout the Netherlands. Multiple causes have been found for this. First, the closer a development is located to a Natura 2000 site, the bigger the impact. Second, the AERIUS Calculator applies a cut-off limit of 25 kilometers because of which developments located further away do not involve a modeled deposition of RNCs on surrounding Natura 2000 sites. Third, a difference in interpretation, as well as varying approaches among decentralized modes of governance towards the issue regarding nitrogen and Natura 2000.

In Chapter 2.1, it is concluded that the issue regarding nitrogen and Natura 2000 cannot be confined to a specific geographical area. This because emitted RNCs disperse through the atmosphere and deposit in ecosystems far from the source. However, the scale at which the issue concerning nitrogen and Natura 2000 manifests and the scale at which the specific issue is addressed through the 25km cut-off limit seem to be contradictory. It is therefore questionable to what extent the required nitrogen assessment, by using the modeling of the AERIUS Calculator and accompanying reporting, corresponds to the actual situation. Next to that, the identified difference in interpretations and varying approaches resemble the pitfalls of decentralized modes of governance discussed in Chapter 2.2.2, as these show characteristics of inconsistent policies and practices.

5.3 Effects on the development of real estate

In this section, an answer is provided to the third research sub-question: *"What are the effects of the existing institutional arrangement on the development of real estate?"* Through triangulation of the data from the policy review, the expert interviews, and the action research, these effects have been identified.

This research reveals three overall effects of the existing institutional arrangement concerning nitrogen and Natura 2000 on the development of real estate. These are: an increase in the costs to develop real estate, postponement, and cancellation of the development of real estate. While presented separately in the results, it is important to recognize that the effects are not independent entities but rather intertwined with one another. The increasing costs are a result of the required nitrogen assessment, deployment of electrical equipment, and phasing of the development. Simultaneously, as identified, these identified causes contribute to a potential postponement or cancellation of the development of real estate. Furthermore, this research observed that the development of various types of real estate and associated developments are affected by the existing institutional arrangement, including housing, business parks, and an amusement park.

Next to that, the analysis of the data revealed a difference between the effects on the construction of real estate and the renovation and redevelopment of it. This is caused by the nitrogen rights that are already granted for real estate that is to be renovated or redeveloped, allowing for internal offsetting. This measure cannot be applied at sites where real estate is planned to be constructed. As noted in Chapter 2.3.3, as of 2018, new real estate in the Netherlands is prohibited from using natural gas and therefore not emitting RNCs. However, the construction activities of real estate typically involve a temporary increased emission of RNCs. Consequently, proposed constructions of real estate regularly involve an excessive deposition of RNCs on surrounding Natura 2000 sites, because of which developments cannot proceed. As a result, the sectoral environmental planning impedes the construction of real estate.

Nevertheless, the renovation and redevelopment of real estate is also impeded by the existing institutional arrangement concerning nitrogen and Natura 2000. A temporary increase in nitrogen emission during activities involved in the renovation and redevelopment of real estate potentially results in an excessive deposition on Natura 2000. Furthermore, the data analysis revealed that the demarcation of when a nitrogen assessment or a permit for nitrogen under the Wnb is required is perceived as a legal gray area, resulting in uncertainty for all types of real estate development.

5.4 Proposed improvements for the institutional arrangement

This section provides an answer to the final sub-question of this research: *"How can the institutional arrangement be improved to mitigate the impact and effects on the development of real estate?"* Through the analysis of the expert interviews, this research has identified two improvements in particular.

The first proposed improvement emphasizes the need to enhance the process and implementation of the institutions concerning nitrogen and Natura 2000. The importance of an improved implementation of compensatory measures and providing clarity to society is highlighted in the results. Furthermore, the existing institutional arrangement is perceived as top-down by experts involved in this research, entailing that relevant actors are not involved in the process to address the issue at hand. In the theoretical framework (see Ch. 2.2.2), it is identified that modes of governance involving the market and society are prominent within the Netherlands. Nevertheless, as identified through this research, such modes are not implemented yet to address the specific conflict between nitrogen and Natura 2000.

The second proposed improvement involves the reintroduction of a construction exemption for the emission of RNCs in the development of real estate. Sectors facing substantial challenges involving significant social implications, such as the housing crisis discussed in Chapter 2.3.2, could be granted an exemption for the aspect of nitrogen. This measure will mitigate the impact and effects of the existing institutional arrangement on the development of real estate. However, in accordance with Chapter 2.3.3, the temporary increase of the nitrogen emissions during the development is likely to involve an excessive deposition of RNCs on Natura 2000 sites. As a result, the preservation of Natura 2000 is threatened, and the measure might be revoked by the Dutch Council of State as it is in breach with EU law. Therefore, within the existing institutional arrangement concerning nitrogen and Natura 2000, this measure does not fit.

6. Conclusion

In this chapter, an answer to the main research question is presented. Furthermore, this chapter elaborates on the implications of the findings for planning practice. The answers to the research sub-questions and accompanying discussion presented in the previous chapter have provided the necessary information to answer the main research question and elaborate upon the implications.

6.1 Answering the main research question

This research aimed to explore the impact and effects of the existing arrangement in the Netherlands concerning nitrogen and Natura 2000 on the development of real estate. Therefore, the following research question was formulated:

"What are the impact and effects of the existing institutional arrangement in the Netherlands concerning nitrogen and Natura 2000 on the development of real estate?"

To answer this question, first, the existing institutional arrangement concerning nitrogen and Natura 2000 had to be identified. Thereafter, the impact and effects on the development of real estate were examined.

The EU has implemented the Nature Directives to safeguard Europe's biodiversity through the establishment of Natura 2000. In the Netherlands, RNCs pose a threat to the preservation of Natura 2000 sites. The findings reveal that sectoral environmental planning is applied by the Dutch government to address the issue concerning nitrogen and Natura 2000. Proposed activities are prohibited from causing an excessive deposition of RNCs on surrounding Natura 2000 sites. Under the existing institutional arrangement, an assessment of the deposition of RNCs on surrounding Natura 2000 must be carried out to determine whether a proposed development may proceed. This assessment involves strict environmental standards.

The required assessment concerning nitrogen and Natura 2000 adds to the complexity of developing real estate, resulting in an increasing dependency on a boost for environmental consultancy. Besides, differences have been observed throughout the Netherlands. The findings have presented several causes for this, including characteristics of the AERIUS Calculator, and varying approaches as well as different interpretations among decentralized bodies of governance. In response, the industry involved in the development of real estate takes multiple measures to mitigate potential effects. Examples of these measures are the precautionary assessment of nitrogen deposition, deployment of electrical equipment, phasing of the development, and application of internal and external offsetting. Hence, the existing institutional arrangement impacts the industry involved in the development of real estate.

The effects of the existing institutional arrangement in the Netherlands concerning nitrogen and Natura 2000 on the development of real estate include an increase in the costs, postponement, and cancellation. Furthermore, the development of various types of real estate and associated developments are affected, including housing, business parks, and an amusement park. Besides, it has been identified that in particular the construction of real estate is impeded. Nevertheless, the renovation and redevelopment are also impeded due to a legal gray area regarding the permitting and a potential excessive deposition of RNCs on Natura 2000

of the activities involved. In conclusion, this research has revealed that the existing institutional arrangement concerning nitrogen and Natura 2000 impedes the development of real estate.

Finally, the findings of this research present improvements for the institutional arrangement concerning nitrogen and Natura 2000 to mitigate the impact and effects on the development of real estate. The proposed improvements include improved implementation of compensatory measures, enhanced involvement of relevant actors, and the reintroduction of a construction exemption for the emission of RNCs involved in the development of real estate. However, for the latter, caution is necessary to ensure the preservation of Natura 2000 sites.

6.2 Implications for planning practice

This research provides initial insights of the impact and effects of the existing institutional arrangement in the Netherlands concerning nitrogen and Natura 2000 on the development of real estate. Through this exploratory research, the researcher aimed to gain a preliminary understanding of a topic that is relevant yet understudied. Although this research focuses on the Netherlands and the specific environmental/space-conflict between nitrogen and Natura 2000, this research does present findings that can be linked to other geographical contexts and conflicts, if contextual particularities are considered. Other countries within the European Union must also deal with the directives pertaining to Natura 2000. Furthermore, environmental/space-conflicts occur not only with RNCs but also with other substances. Therefore, with this study, the researcher hopes to offer valuable insights and lessons that can be applied to similar conflicts faced not only in the Netherlands but also in other countries.

One of the main implications for planning practice highlighted by this research is the contrast between the Dutch government's approach to the environmental/space-conflict between nitrogen and Natura 2000 and the expectations set by the existing literature. The theoretical framework describes contemporary environmental planning in the Netherlands as integrated, aiming to effectively balance the environmental quality with spatial development. However, this study reveals a divergence from this integrated approach, as the Dutch government adopts a sectoral environmental planning approach to address the conflict between nitrogen and Natura 2000. This divergence is particularly evident in the mandatory nitrogen assessment and accompanying AERIUS Calculator, which applies a sectoral environmental standard for RNCs. The existing institutional arrangement prioritizes the preservation of Natura 2000 over the development of real estate, leading to impediments in spatial development and resulting in a deadlock in the environmental/space conflict between nitrogen and Natura 2000. The previous confirms the hypothesis of this research stated in Chapter 2.5.

Based on the insights gained from this research, a proposed solution to address the environmental/space conflict between nitrogen and Natura 2000 is presented, focusing on the development of real estate. This approach involves the application of integrated instead of sectoral environmental planning. In Chapter 2.3.3, it is identified that the activities involved in the construction, renovation, and redevelopment of real estate temporarily lead to an increased emission of RNCs. Therefore, due to the existing sectoral environmental planning, the development of real estate is impeded. However, Chapter 2.3.2 discusses that the development of real estate contributes to a decrease in nitrogen emissions. This reduction is attributed to a disconnection from the national gas grid and the transition to more sustainable energy sources and zero-energy homes. In conclusion, stimulating the development of real estate potentially

resolves the environmental/space conflict between nitrogen and Natura 2000. By encouraging the development of real estate and facilitating the transition to cleaner energy sources, a net reduction in the emission of RNCs can be achieved. As a result, this contributes to the preservation of Natura 2000 because the deposition of nitrogen on these sites decreases. Moreover, this approach contributes to addressing the contemporary challenges in the Netherlands of the housing crisis and the energy transition.

7. Reflection on research

7.1 Strengths and limitations in relation to the validity

7.1.1 Strengths

Conducting interviews with professionals in the field provided valuable insights and expert knowledge, adding depth and richness to the research findings. The expert interviews contribute to the validity of this research by incorporating diverse perspectives and experiences. In addition, conducting action research contributed to gain firsthand insights into the real-world development of the issue under study. The expert interviews and the action research allowed for real-time data collection and analysis, providing a comprehensive and in-depth understanding of the institutional arrangement concerning nitrogen and Natura 2000, its impacts on the industry involved in the development of real estate, and the effects on the development of real estate.

Moreover, the convergence of multiple sources of data, including a policy review, expert interviews, and action research, increases the reliability and credibility of the outcomes. Hence, as discussed, the triangulation of the different sources of data enhances the validity of the research.

The aim of this research has been to explore the impact and effects of the existing institutional arrangement concerning nitrogen and Natura 2000 on the development of real estate. This to provide a preliminary understanding of a topic that is relevant yet understudied. As a researcher, it is not possible to state that the research outcomes are to be perceived as grounded theory. Nevertheless, through the data collection methods and subsequent analysis, recurring patterns have been identified.

7.1.2 Limitations

First, due to the scope of the research, the findings may be limited in their generalizability. The research has been conducted within the geographical context of the Netherlands. Besides, the network of the consulting firm of Lycens has been used for a large share of the data collection. This sample might not be representative for the population involved in the development of real estate. Therefore, the outcomes of this research may involve findings that are only applicable within the specific scope of the research.

Another potential limitation of the research is selection bias during the data collection. The choice of experts for the interviews and observations for the action research may introduce selection bias if they do not represent a diverse range of perspectives. This could limit the validity of the research. For example, improvements for the institutional arrangement concerning nitrogen and Natura 2000 to mitigate the impact and effects on real estate development have been explored. However, all respondents involved in this research benefit from real estate development because it is in their economic interest. Therefore, the respondents might be biased in their opinion on the institutional arrangement and how to address the environmental/space-conflict between nitrogen and Natura 2000.

7.2 Recommendations for future research

This research has provided a preliminary understanding of the impact and effects of the existing institutional arrangement concerning nitrogen and Natura 2000 on the development of real estate.

However, as discussed in the previous section, the scope of the research and selection bias during the data collection might be limitations when it comes to the validity and generalizability of the outcomes. Therefore, future research could be conducted to broaden the scope, and involve a broader range of perspectives regarding the issue. This to increase the validity and generalizability of the research.

Next to that, in the theoretical framework, it has been discussed that the development of real estate contributes to the energy transition. Furthermore, improving the energy-efficiency of buildings decreases the emission of RNCs. However, as identified in this research, the existing institutional arrangement concerning nitrogen and Natura 2000 impedes the development of real estate, including its energy transition. Although the existing institutional arrangement concerning nitrogen and Natura 2000 serves to reduce the deposition of RNCs on Natura 2000 sites, its impact on the development of real estate may have counterproductive effects. Therefore, it would be valuable to investigate such effects of the existing institutional arrangement concerning nitrogen and Natura 2000. By examining how the impeded development of real estate affects the energy transition, and thereby the emission of RNCs, future research can contribute to gain a more comprehensive understanding of the environmental/space-conflict between nitrogen and Natura 2000.

Lastly, conducting future research into the feasibility and effectiveness of the two proposed improvements and exploring additional avenues to enhance the institutional arrangement is recommended. This will help determine the practicality and impact of the proposed measures, as well as identify potential areas for refinement or alternative approaches to address the conflict between nitrogen and Natura 2000.

7.3 Reflection on personal process

Finally, I would like to reflect on my personal process throughout the writing of this master thesis. The idea for the relevant research topic came to me quickly. However, developing a suitable theoretical framework proved to be challenging, and so this took considerably more time than expected beforehand. Thankfully, with the guidance of my thesis supervisor, I was able to develop the theoretical framework. Next to that, the research process was perceived as iterative, involving constant back-and-forth. It was at times challenging to maintain a clear overview and the feeling of making progress throughout this extensive research project. However, discussions with my thesis supervisor, colleagues, and loved ones helped to keep making progress in writing my thesis.

To end on a positive note, the practical approach applied within my research significantly contributed to develop an understanding of the environmental/space-conflict in the Netherlands concerning nitrogen and Natura 2000, and its impact and effects on the development of real estate. Conducting my thesis within a company proved to be of great value for the data collection process. Not only did it allow me to carry out action research, but I also tapped into Lycens' network to gather a substantial amount of relevant data. Moreover, it made the research interesting as I have gained firsthand insights and witnessed its real-world development. Combining writing a master's thesis with working in a company was demanding but also a valuable learning experience. After all, I am proud to conclude my studies with this master thesis and I am eager to put the knowledge I have gained during my studies in the professional field.

8. References

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Appendices

Appendix A: Overview policy review

a. Global policies

WHO Global Air Quality Guidelines (AQGs)

The WHO Global Air Quality Guidelines have been developed and updated over several decades. The first set of guidelines was published in 1987, and since then, they have been revised and expanded to include additional pollutants and updated scientific evidence.

The most recent update to the guidelines was published in 2021, which provides new recommendations for the levels of six key air pollutants: particulate matter (PM2.5 and PM10), ozone (O3), nitrogen dioxide (NO2), sulfur dioxide (SO2), and carbon monoxide (CO). The 2021 update also includes new recommendations for addressing the health impacts of household air pollution, which is a major contributor to premature death and disease in many low- and middle-income countries.

The WHO Global Air Quality Guidelines provide recommendations for the levels of air pollutants that are considered safe for human health. The guidelines are intended to help countries and regions develop their own air quality standards and policies, and to provide guidance on reducing the health impacts of air pollution.

The WHO Global Air Quality Guidelines cover a range of air pollutants, including particulate matter (PM2.5 and PM10), ozone (O3), nitrogen dioxide (NO2), sulfur dioxide (SO2), carbon monoxide (CO), and lead (Pb). The guidelines are based on a comprehensive review of the scientific evidence on the health effects of air pollution, including the latest research and data.

The guidelines provide both short-term (hours to days) and long-term (years to decades) exposure limits for each pollutant. The short-term limits are designed to protect against acute health effects, such as respiratory symptoms, while the long-term limits are intended to protect against chronic health effects, such as heart disease and lung cancer.

In addition to setting exposure limits, the WHO Global Air Quality Guidelines provide guidance on reducing exposure to air pollution, including measures to reduce emissions from various sources, such as industry, transport, and households. The guidelines also emphasize the importance of monitoring air quality and providing information to the public on the health risks of air pollution.

The WHO Global Air Quality Guidelines are not legally binding, but they provide a framework for countries and regions to develop their own air quality standards and policies based on the latest scientific evidence. The guidelines are widely recognized as a key resource for policymakers, health professionals, and researchers working on air pollution and public health.

1999 Gothenburg protocol

The 1999 Gothenburg Protocol is a treaty negotiated under the United Nations Economic Commission for Europe (UNECE) Convention on Long-Range Transboundary Air Pollution (CLRTAP), and it includes the 28 memeber states of the European Union (EU) as well as other UNECE member countries. As of 2021, there 51 parties to the protocol. The protocol was adopted in Gothenburg, Sweden, in December 1999 and entered into force in 2005.

The main aim of the Gothenburg Protocol is to reduce transboundary air pollution by setting national emission ceilings (NECs) for four main air pollutants: sulfur dioxide (SO2), nitrogen oxides (NOx), volatile organic compounds (VOCs), and ammonia (NH3). The protocol also sets emission reduction targets for fine particulate matter (PM2.5) and establishes a system for reporting emissions data and progress towards meeting the NECs.
The NECs set by the Gothenburg Protocol are legally binding limits on the total amount of each pollutant that can be emitted by each signatory country. The NECs are designed to limit the impact of transboundary air pollution on human health and the environment by reducing the amount of pollutants that are transported across national borders.
The Gothenburg Protocol has been successful in reducing emissions of the targeted pollutants in Europe. According to the UNECE, between 1990 and 2015, emissions of SO2, NOx, VOCs, and NH3 decreased by 78%, 56%, 50%, and 17%, respectively, in the countries that have ratified the protocol. Emissions of PM2.5 have also decreased, although progress towards the reduction target has been slower.
The Gothenburg Protocol has been amended several times since its adoption to reflect new scientific evidence and to strengthen its provisions. The most recent amendment, adopted in 2012, sets new, more ambitious NECs for the targeted pollutants and introduces new provisions for reducing emissions from shipping and small combustion sources.

b. European policies

EU Birds Directive (Council Directive 2009/147/EC)
The Birds Directive is a European Union (EU) law that aims to protect wild birds and their habitats across the EU. The directive was first adopted in 1979 and has since been amended several times to strengthen its provisions.
The Birds Directive requires EU member states to take measures to protect all species of wild birds that are naturally occurring in the EU, including migratory birds, from hunting, disturbance, and destruction of their habitats. The directive also requires member states to establish a network of protected areas, known as Special Protection Areas (SPAs), for the conservation of important bird habitats. The SPAs are designated based on scientific criteria and must cover a sufficient range of habitats to ensure the long-term conservation of bird populations. Together with the Special Areas of Conservation (SAC) presented in the next directive, the SPAs form the Natura 2000 areas.
In addition to the protection of wild birds and their habitats, the Birds Directive also requires member states to regulate the trade in live and dead birds, their eggs, and their parts to prevent illegal trade and poaching. Member states are also required to monitor the populations of wild bird species and report on their conservation status.
The Birds Directive is one of the key pieces of EU legislation for the protection of biodiversity and is closely linked to other EU nature conservation laws, such as the Habitats Directive. It is implemented by national laws and policies in each member state, and the European Commission monitors its implementation and takes legal action against member states that fail to comply with its provisions.

EU Habitats Directive (Council Directive 92/43/EEC)

The EU Habitats Directive is a European Union directive aimed at protecting and conserving natural habitats and wild species of flora and fauna in the EU. The directive was adopted in 1992 and has since been amended several times to strengthen its provisions.

The Habitats Directive requires EU member states to take measures to maintain or restore natural habitats and species of wild fauna and flora that are listed in its annexes. The annexes list species and habitats of European importance that are considered to be in need of protection and conservation. Member states are required to establish a network of protected areas, called Natura 2000, for the conservation of these habitats and species. Natura 2000 sites are designated based on scientific criteria and must cover a sufficient range of habitats to ensure the long-term conservation of biodiversity.

The directive also requires member states to monitor the conservation status of the habitats and species listed in its annexes, and to take appropriate conservation measures to ensure their favorable conservation status. Member states must also take measures to avoid or mitigate adverse effects on these habitats and species, including through the regulation of activities that could have a negative impact on biodiversity, such as infrastructure development, agriculture, and forestry.

The Habitats Directive is one of the key pieces of EU legislation for the protection of biodiversity and is closely linked to other EU nature conservation laws, such as the Birds Directive. It is implemented by national laws and policies in each member state, and the European Commission monitors its implementation and takes legal action against member states that fail to comply with its provisions.

EU nitrates directive (Council Directive 91/676/EEC)

The "EU Nitrates Directive" is a European Union directive that regulates the use of nitrogen-based fertilizers in agriculture to reduce water pollution caused by nitrates. The directive was adopted in 1991 and is aimed at protecting water quality and preventing eutrophication (excessive growth of algae and other aquatic plants) in surface and groundwaters.

Under the EU Nitrates Directive, member states are required to identify vulnerable areas where the concentration of nitrates in water is high or at risk of becoming so. Farmers in these areas are required to implement measures to reduce nitrogen pollution, such as using fertilizers in a way that minimizes leaching and runoff or applying them at the right time to maximize plant uptake.

The directive also sets out standards for the application of nitrogen-based fertilizers, such as a limit on the total amount of nitrogen that can be applied per hectare of farmland, and requires member states to monitor and report on nitrogen levels in water and soil.

In addition, the EU Nitrates Directive requires member states to establish action programs to address nitrogen pollution in vulnerable areas and to promote good agricultural practices that reduce nitrogen loss to water.

Concludingly, the EU Nitrates Directive is a key tool in protecting water quality in the European Union and promoting sustainable agricultural practices that minimize negative impacts on the environment.

National Emissions Ceilings Directive (NECD) (Council Directive 2016/2284/EU)

The "National Emissions Ceilings Directive" (NECD) is a European Union directive that aims to reduce air pollution by setting national limits on emissions of certain pollutants. The directive was first adopted in 2001 and has since been revised and updated.

Under the NECD, member states are required to set and achieve 'national emissions ceilings' (NECs) for four pollutants: nitrogen oxides (NOx), non-methane volatile organic compounds (NMVOCs), sulfur dioxide (SO2), and ammonia (NH3). These pollutants contribute to the formation of ground-level ozone, fine particulate matter, and acid rain, which can have negative impacts on human health, ecosystems, and climate.

The directive sets binding NECs for each member state, with the aim of achieving a significant reduction in air pollution by 2030. The directive also requires member states to develop and implement national air pollution control programs, including measures to reduce emissions from transport, industry, agriculture, and households.

Under the National Emissions Ceilings Directive (NECD), the Netherlands is required to meet national emissions ceilings (NECs) for several pollutants, including nitrogen oxides (NOx) and ammonia (NH3). For nitrogen oxides, the NEC for the Netherlands is set at 128 million kilograms per year for the year 2030. This represents a significant reduction from the baseline emissions level of 566 million kilograms per year in 2005. For ammonia, the NEC for the Netherlands is set at 103 million kilograms per year for the year 2030. This also represents a significant reduction from the baseline emissions level of 130 million kilograms per year in 2005. The Netherlands has developed a national air pollution control program, which is called the NSL and will be elaborated upon later in this review, to meet these NECs, which includes measures to reduce emissions from agriculture, transport, industry, and households. The country is also required to monitor and report on its emissions levels to the European Union.

In addition, the NECD requires member states to monitor and report on their air quality and emissions levels, and to provide information to the public on air quality and health risks.

In conclusion, the NECD is a key tool in the European Union's efforts to reduce air pollution and improve public health and environmental quality. The directive sets binding targets for member states, promotes cooperation and information sharing among countries, and encourages the development and implementation of effective air pollution control measures.

EU Ambient Air Quality Directive (AAQD) (Council Directive 2008/50/EC)

The EU Ambient Air Quality Directive (AAQD) is an EU directive that aims to improve air quality by setting standards and objectives for ambient air quality. The directive sets legally binding limit values and target values for a range of air pollutants, including nitrogen dioxide (NO2), sulfur dioxide (SO2), particulate matter (PM10 and PM2.5), lead (Pb), benzene, carbon monoxide (CO), and ozone (O3).

The AAQD requires EU Member States to monitor ambient air quality, assess their exposure to air pollution, and report their findings to the European Commission. The directive also requires Member States to establish air quality plans that outline the measures they will take to achieve the air quality standards and objectives set out in the directive.

The AAQD also requires EU Member States to inform the public about the quality of the air they breathe and to take measures to reduce exposure to air pollution in sensitive areas such as urban areas and near schools, hospitals, and other public places.

The AAQD has been revised several times since its adoption in 2008 to reflect new scientific evidence and to strengthen its provisions. The most recent amendment to the directive, adopted in 2021, sets more ambitious air quality objectives for 2030 and introduces stricter emission limits for certain pollutants, such as PM2.5.
Overall, the AAQD is a key piece of environmental legislation in the EU that aims to protect public health and the environment by improving air quality and reducing the harmful effects of air pollution on human health and the ecosystem.

Industrial Emissions Directive (IED) (Council Directive 2010/75/EU)
The Industrial Emissions Directive (IED) is an EU directive that regulates the emissions and pollutants from various industrial activities across Europe. The main objective of the IED is to prevent or reduce the negative impact of industrial activities on the environment and human health by setting minimum requirements for the permits that industrial operators must obtain before starting or operating their activities.
The Industrial Emissions Directive (IED) was adopted by the European Parliament and the Council of the European Union in 2010. It entered into force on January 6, 2011, and the EU Member States were required to transpose the directive into their national laws by January 7, 2013.
The IED replaces seven previous directives, including the Large Combustion Plants Directive, the Waste Incineration Directive, and the Integrated Pollution Prevention and Control Directive. It sets out common rules for permitting and regulating the environmental performance of industrial installations in the European Union, regardless of their location, size or nature.
The directive covers a wide range of industrial activities, including energy production, chemical production, waste management, and intensive farming. The IED sets out emission limit values (ELVs) for pollutants, including nitrogen oxides, sulfur dioxide, dust, heavy metals, and other pollutants that are released into the air, water, or soil during industrial processes.
The IED requires that industrial operators comply with the best available techniques (BAT) to minimize emissions and prevent pollution. It also requires that they develop and implement environmental management systems to continuously monitor, assess and improve their environmental performance.
The IED is a significant piece of environmental legislation in Europe, and it aims to ensure that industrial activities are carried out in a sustainable and environmentally responsible manner, while also safeguarding human health and promoting innovation in environmental technologies.

c. National policies

Nationaal Samenwerkingsprogramma Luchtkwaliteit (NSL)
The "Nationaal Samenwerkingsprogramma Luchtkwaliteit" (NSL), in English is a Dutch national program aimed at improving air quality in the Netherlands. The program was launched in 2009 and is currently in its second phase, which runs from 2015 to 2020.
In essence, the NSL is a tool used by the Dutch government to implement measures to comply with the NECD, by setting national targets for air quality improvement and coordinating efforts to reduce emissions of air pollutants.

The NSL focuses on reducing air pollution caused by fine particulate matter (PM10) and nitrogen dioxide (NO2), which are known to have negative effects on human health and the environment. The program sets national targets for reducing air pollution levels and outlines specific measures to achieve these targets.
Under the NSL, the Dutch government works together with provincial and local authorities, as well as industry and other stakeholders, to implement a range of measures aimed at reducing air pollution levels. These measures include traffic management and congestion reduction, promoting cleaner transportation options such as electric vehicles and cycling, and promoting energy efficiency and the use of renewable energy sources.
The NSL also includes monitoring and reporting requirements to track progress towards the national air quality targets. The program aims to ensure that air quality in the Netherlands meets European Union standards and to improve the health and well-being of citizens by reducing exposure to harmful pollutants.
Overall, the NSL represents an effort by the Dutch government to address the issue of air pollution and to improve the quality of life for citizens in the Netherlands.

Wet natuurbescherming
The "Wet natuurbescherming" (Wnb), in English the Nature Protection Act, is a Dutch law that regulates the protection and management of natural areas and wildlife in the Netherlands. The law came into effect on January 1, 2017, and replaces several earlier laws and regulations, including the Nature Conservation Act (Natuurbeschermingswet), the Flora and Fauna Act (Flora- en faunawet), and the Forestry Act (Boswet).
European regulations, particularly the EU Birds and Habitats Directive, provide the framework and starting points for this legislation. The Wnb aims to protect and preserve the natural environment and biodiversity in the Netherlands by regulating activities that could have a negative impact on protected areas, such as Natura 2000 sites. The law also provides for the management and restoration of natural habitats and ecosystems, as well as the protection of endangered plant and animal species.
Under the Wnb, activities that could have a significant impact on protected areas or species, such as construction or agriculture, require a permit. Permits are issued based on a strict assessment of the potential impact of the activity and the measures proposed to mitigate any negative effects. The Wnb also includes provisions for compensation measures, such as the creation of new natural habitats, to offset any negative impact of permitted activities.
The law also provides for the enforcement of nature protection measures, including penalties for non-compliance. Additionally, the Wnb includes measures to promote public participation and consultation in decision-making processes related to the protection and management of natural areas.
Overall, the Wnb represents an effort by the Dutch government to protect and preserve the natural environment and biodiversity in the Netherlands, while also balancing the needs of economic development and other human activities.

Programma aanpak stikstof (PAS)
The "Programma Aanpak Stikstof" (PAS) is a Dutch program that translates to “Programmatic Approach Nitrogen” in English. It is designed to reduce nitrogen emissions and their impact on

natural areas, particularly those protected under the European Union's Natura 2000 network. The program was launched in 2015 and was in operation until May 2019 when it was invalidated by the Dutch Council of State.
The PAS was created to balance the needs of economic development and the preservation of natural habitats. It aimed to achieve this balance by allowing certain activities to continue while reducing their nitrogen emissions, compensating for these emissions through measures such as the restoration of natural areas or the creation of new habitats.
Under the PAS, projects that generated nitrogen emissions could apply for permits that would allow them to continue or expand their activities, provided they could demonstrate that their emissions would not cause significant harm to protected areas. The program also included measures to reduce nitrogen emissions from agriculture, such as incentives to reduce fertilizer use and improve livestock management.
However, in May 2019, the Dutch Council of State ruled that the PAS was not in compliance with EU law, as it did not sufficiently protect Natura 2000 areas from nitrogen emissions. As a result, the PAS was invalidated, and new measures, including the Wet stikstofreductie en natuurverbetering (Nitrogen Reduction and Nature Improvement Act), were introduced to address the issue of nitrogen emissions in the Netherlands.

Nitrogen Reduction and Nature Improvement Act
"Wet stikstofreductie en natuurverbetering" is a Dutch term that translates to "Nitrogen Reduction and Nature Improvement Act" in English. This act is a piece of legislation passed in the Netherlands in December 2019, which aims to reduce nitrogen emissions and improve the country's natural environment. The law came into force on July 1, 2021.
The law was enacted in response to a ruling by the Dutch Council of State that declared the country's PAS to be illegal. The ruling came after it was found that the high levels of nitrogen emissions in the country were causing damage to the natural environment, including to the habitats of rare and endangered plant and animal species protected under the EU's Nature Directives.
The Nitrogen Reduction and Nature Improvement Act regulates three performance obligations for nitrogen reduction, including: by 2025, at least 40% of the area of nitrogen-sensitive nature in protected Natura 2000 areas must have a healthy nitrogen level; by 2030, at least half of the area; and by 2035, at least 74%. The law mandates a program of measures to achieve this reduction and restore nature. The law also regulates interim monitoring and, if necessary, adjustments. Furthermore, the law allows for a partial exemption from the nature permit requirement for nitrogen-related activities in the construction sector, the so-called 'construction exemption'.
The Nitrogen Reduction and Nature Improvement Decree further elaborates on this law, including the construction exemption. The exemption applies to construction, development, and demolition activities. The exemption does not apply to the operational phase of the constructed or developed entity. This for example means that a nature permit may still be required for the nitrogen deposition caused by traffic on a newly constructed road.
The 'Wet stikstofreductie en natuurverbetering' seeks to address this issue by setting new limits on nitrogen emissions from a variety of sources, including agriculture, construction, and transportation. The act also includes provisions for improving the natural environment by investing in nature restoration projects and expanding protected areas for wildlife.

Overall, the Wet stikstofreductie en natuurverbetering act represents an effort by the Dutch government to reduce the negative impact of human activities on the natural environment and to protect the country's biodiversity for future generations.
However, on November 2, 2022, the Administrative Jurisdiction Division of the Council of State, in the 'Porthos ruling,' declared the construction exemption inapplicable. The ecological assessment underlying the construction exemption did not meet the requirements of the European Habitat Directive. The elimination of the construction exemption means that, in the current situation, a permit under the Nature Protection Act (Wnb) must now be obtained for each new construction project, not only for the operational phase but also for the construction phase.

Appendix B: Interview guide

Introductie

Hallo, mijn naam is Bouke Kamphuis en momenteel zit ik in de afrondende fase van mijn masteropleiding Environmental and Infrastructure Planning aan de Rijksuniversiteit Groningen. De laatste fase van deze studie omvat het schrijven van een masterscriptie en de resultaten van dit interview zullen worden gebruikt om dit onderzoek uit te voeren.

Zoals al besproken is het doel van mijn onderzoek om uit te zoeken wat de effecten zijn van het huidige Nederlandse stikstofbeleid op de (her)ontwikkeling en de energietransitie/verduurzaming van vastgoed. Met de energietransitie wordt gedoeld op de overstap naar duurzame vormen van energie en alle maatregelen die worden genomen om het energieverbruik van een gebouw te verminderen. Hierbij is elke type vastgoed inbegrepen, denk bijvoorbeeld aan huizen, winkels, kantoorpanden, en bedrijven. Aangezien er in de academische literatuur nog veel onbekend is over de effecten van de Nederlandse stikstofcrisis, heeft dit onderzoek een verkennend ontwerp. Dit betekent dat het voor mij als onderzoeker van tevoren niet mogelijk is om exact te weten wat er allemaal nog onbekend is en wat er allemaal relevant is om te bespreken. Het doel van dit interview met u is dan ook om kennis te vergaren, nieuwe inzichten op te doen en kritisch te kijken naar de huidige stikstofproblematiek in Nederland, het daarop gebaseerde beleid, en de effecten daarvan. De vragen die ik heb opgesteld dienen enkel als basis en om wat structuur te geven aan het interview. Mochten er tijdens het interview zaken bij u te binnen schieten die relevant zouden kunnen zijn voor mijn onderzoek, dan bespreek ik deze graag.

Hierbij wil ik graag nog even bevestigen dat we voor dit interview samen het informatieformulier en het toestemmingsformulier hebben doorgenomen en ingevuld.

Heeft u nog vragen voordat we beginnen met het interview?

1. Zou u uzelf voor willen stellen?
2. In welke functie heeft u ervaring met/op welke manier bent u betrokken bij de huidige stikstofproblematiek in Nederland, en de (her)ontwikkeling en energietransitie van vastgoed?

Stikstofuitstoot- en depositie

3. Hoe zou u het huidige probleem in Nederland omtrent de stikstofuitstoot en -depositie omschrijven?
    a. Hoe denkt u over de rol die Natura 2000 gebieden spelen in dit probleem?
    b. Wat is uw visie over het aandeel van de bouwsector, met name de (her)ontwikkeling van vastgoed, ten opzichte van andere sectoren in het huidige probleem omtrent stikstof?

Het Nederlandse beleid omtrent stikstof

4. Hoe zou u het Nederlandse stikstofbeleid omschrijven?
    a. Hoe heeft het Nederlandse stikstofbeleid beleid zich volgens u door de tijd heen ontwikkeld?
    b. Wat weet u over het internationale beleid omtrent de aanpak van stikstof en de invloed hiervan op het Nederlandse beleid?
    c. Wat zijn volgens u, in het algemeen, de effecten van het Nederlandse stikstofbeleid?
    d. Hoe denkt u over de effectiviteit en gerichtheid van het stikstofbeleid voor het aanpakken van het specifieke probleem omtrent stikstof?
    e. Zou u kunnen verklaren waarom, ten opzichte van andere Europese landen, de huidige problematiek rondom stikstof vooral in Nederland een grote impact op de samenleving lijkt te hebben?

De (her)ontwikkeling en de energietransitie van vastgoed

5. Beïnvloed het Nederlandse stikstofbeleid u in uw werkzaamheden, en zo ja hoe?
    a. Heeft het huidige Nederlandse stikstofbeleid een verandering teweeg gebracht in uw werkzaamheden/de werkzaamheden van uw organisatie, en zo ja welke?
    b. Neemt u/uw organisatie maatregelen in de werkzaamheden om eventuele effecten van het Nederlandse stikstofbeleid te voorkomen en/of verminderen? En zo ja, zou u deze kunnen omschrijven?
    c. Ervaart u in uw werkzaamheden en/of binnen uw organisatie dat het huidige Nederlandse stikstofbeleid effecten heeft op de (her)ontwikkeling van vastgoed, en zo ja welke?
    d. Ervaart u in uw werkzaamheden en/of binnen uw organisatie dat het huidige Nederlandse stikstofbeleid effecten heeft op de energietransitie/verduurzaming van vastgoed, en zo ja welke?
    e. Zijn er hierin verschillen tussen de ontwikkeling van nieuw vastgoed en de renovatie van bestaand vastgoed, en zo ja welke?
        - Hoe wordt er bijvoorbeeld gedacht over grote onderhoudsopgaves?
        - Wat is demarcatie tussen wanneer wel en wanneer niet een stikstofberekening nodig is?
    f. Zijn er binnen Nederland ook verschillen met betrekking tot de invloed van het stikstofbeleid op (her)ontwikkeling en energietransitie van vastgoed?

Aanvullende vragen

6. Zijn er nog zaken die u te binnen schieten die niet besproken zijn in dit interview maar die wel relevant zouden kunnen zijn voor mijn onderzoek?
7. Zijn er vragen die u gedurende dit interview gemist heeft en die ik mogelijk zou kunnen verwerken in mijn volgende interviews?

Afsluitende vraag

Ten slotte, aangezien u op een professionele basis betrokken bent met de stikstofproblematiek in Nederland en het daarop gebaseerde beleid, ben ik benieuwd naar uw mening.

8. Stel dat we de opname nu zouden stoppen en nog even verder zouden praten over de huidige stikstofproblematiek, zou u dan hetzelfde hebben geantwoord?

Opname stoppen of laten lopen o.b.v. antwoord respondent

9. Denkt u, en zo ja waarom en hoe, dat het Nederlandse stikstofbeleid verbeterd zou kunnen worden om eventuele negatieve effecten op de (her)ontwikkeling en energietransitie van vastgoed tegen te gaan?

Einde

Heel erg bedankt voor uw antwoorden. Zijn er nog onderdelen waar u op terug zou willen komen? En heeft u nog vragen of opmerkingen? Mocht u nog terug willen komen op uw antwoorden of deelname aan dit onderzoek, dan hoor ik dit graag uiterlijk 1 mei.

Nogmaals bedankt voor uw deelname en een fijne dag gewenst!

Appendix C: Interview information sheet

Informatiebrief – o.b.v. Ethische Commissie Onderzoek (REC) FRW RUG

Voor het onderzoeksproject:
Titel: *De stikstofcrisis in Nederland en de effecten op vastgoedontwikkeling.*
Studie: Master (MSc) Environmental and Infrastructure Planning

Allereerst, heel erg bedankt dat u de tijd heeft genomen om te overwegen om deel te nemen aan mijn onderzoeksproject. Het doel van mijn onderzoek is om uit te zoeken wat de effecten zijn van het huidige beleid in Nederland omtrent stikstof op de (her)ontwikkeling en de energietransitie van vastgoed. Met de energietransitie wordt gedoeld op de overstap naar duurzame vormen van energie en alle maatregelen die worden genomen om het energieverbruik van een gebouw te verminderen. Hierbij is elke type vastgoed inbegrepen, denk bijvoorbeeld aan huizen, winkels, kantoorpanden, en bedrijven. Momenteel is er nog veel onbekend over de effecten van het stikstofbeleid. Het doel van een eventueel interview met u is dan ook om kennis te vergaren, nieuwe inzichten op te doen en kritisch te kijken naar de huidige stikstofproblematiek in Nederland, het daarop gebaseerde beleid, en de effecten daarvan. Hierbij ligt de focus op de (her)ontwikkeling en de energietransitie van vastgoed. Het interview zal naar verwachting ongeveer 30 tot 45 minuten duren.

Vertrouwelijkheid en rechten van deelnemers:

- De interviews worden opgenomen en er worden notities gemaakt tijdens het interview.
- U heeft het recht om te vragen om de opname uit te schakelen wanneer u dat wilt en u kunt op elk gewenst moment het interview beëindigen.
- Indien gewenst ontvangt u een kopie van de interviewnotities, en u heeft de mogelijkheid om correcties aan te brengen of om materiaal te wissen dat u niet wilt laten gebruiken.
- De informatie die u verstrekt zal vertrouwelijk worden bewaard in een afgesloten faciliteit of een beveiligd bestand met tweestapsverificatie tot vijf jaar na voltooiing van mijn onderzoek.
- Het hoofdzakelijke doel van de informatie die u verstrekt is om mij te helpen met mijn masterscriptie, welke na voltooiing publiekelijk toegankelijk zal zijn op internet.
- De gegevens kunnen ook worden gebruikt voor eventuele vervolgpublicaties
- Tenzij u expliciete toestemming heeft gegeven, worden persoonlijke namen of andere informatie waarmee u als informant geïdentificeerd zou kunnen worden niet opgenomen in dit onderzoek of in toekomstige publicaties of rapporten die voortkomen uit dit project.

Als deelnemer heeft u het recht om:

- niet deel te nemen;
- te weigeren om een bepaalde vraag te beantwoorden;
- te vragen dat de audio-opname op elk moment wordt uitgeschakeld;
- op elk moment het interview te beëindigen;
- zich terug te trekken uit de studie tot op het moment dat het onderzoek is gepubliceerd;
- op elk moment tijdens deelname vragen te stellen over de studie;
- en te vragen om enig materiaal te laten wissen dat u niet wenst te laten gebruiken in rapporten van deze studie.

Nogmaals bedankt dat u de tijd heeft genomen om meer te weten te komen over mijn onderzoek. Ik ben uiteraard beschikbaar voor eventuele vragen die u zou kunnen hebben. U kunt ook contact opnemen met mijn begeleider op het onderstaande adres.

Met vriendelijke groet,
Bouke Kamphuis

Contactgegevens onderzoeker : Naam: Bouke Kamphuis Email: boukekamphuis@gmail.com Telefoon : +31 6 34775137	Contactgegevens begeleider: Naam: dr. F.M.G. van Kann Email: f.m.g.van.kann@rug.nl

Appendix D: Interview consent form

Toestemmingsformulier interview onderzoek masterscriptie

Voor het onderzoeksproject:
Titel: *De stikstofcrisis in Nederland en de effecten op de energietransitie van vastgoed.*
Studie: Master (MSc) Environmental and Infrastructure planning

Allereerst, heel erg bedankt dat u bereid bent om de tijd te nemen voor dit interview en mij zo te helpen bij mijn onderzoeksproject. Dit onderzoek heeft als doel om uit te zoeken wat de effecten zijn van het huidige beleid in Nederland omtrent stikstof op de (her)ontwikkeling en de energietransitie van vastgoed. Het doel van dit interview met u is om kennis te vergaren, nieuwe inzichten op te doen en kritisch te kijken naar de huidige stikstofproblematiek in Nederland, het daarop gebaseerde beleid, en de effecten daarvan. Hierbij ligt de focus op de (her)ontwikkeling en de energietransitie van vastgoed. Het interview zal naar verwachting ongeveer 30 tot 45 minuten duren.

Hierbij verklaar ik dat (gelieve JA of NEE te omcirkelen of antwoorden bij elk van de volgende vragen):

Ik heb de informatiebrief van dit onderzoeksproject gelezen en begrijp deze. JA / NEE

Ik heb de gelegenheid gehad om dit onderzoek te bespreken, en ik ben tevreden met de antwoorden die ik heb gekregen. JA / NEE

Ik begrijp dat deelname aan dit onderzoek vrijwillig is en dat ik het recht heb om me terug te trekken uit het onderzoek tot het moment dat het onderzoek is gepubliceerd, en dat ik het recht heb om individuele vragen in het onderzoek niet te beantwoorden. JA / NEE

Ik geef toestemming voor het opnemen van mijn interview op audio JA / NEE

Ik wens anoniem te blijven voor dit onderzoek
JA / NEE

Indien JA
Mijn functie mag worden vermeld in dit onderzoek JA / NEE
Mijn voornaam mag worden vermeld in dit onderzoek JA / NEE
OF
Een pseudoniem naar keuze mag worden gebruikt in dit onderzoek JA / NEE
(bijvoorbeeld: respondent 1)

“Ik stem ermee in om deel te nemen aan dit individuele interview en erken ontvangst van een kopie van dit toestemmingsformulier en de informatiebrief van het onderzoeksproject.”

Handtekening deelnemer: _____Datum: _____

“Ik ga akkoord met de voorwaarden zoals uiteengezet in de informatiebrief en ik zorg ervoor dat er tijdens dit onderzoek geen schade wordt toegebracht aan enige deelnemer.”

Handtekening onderzoeker: _____ Datum: _____

Vul alstublieft de volgende informatie in. Het emailadres wordt alleen gebruikt als u een kopie van de interviewnotities wilt ontvangen, zodat u de mogelijkheid heeft om correcties aan te brengen.

Naam:
E-mail:

Appendix E: Inductive code book

Concepts	Code group	Codes
Institutional design	Dutch institutional design regarding nitrogen	Causes of the environmental/space-conflict Development (of the institutions) Existing (institutions) Proposed improvements
Industry	Impact on the industry involved in the development of real estate	Differences throughout NL Impact (on the industry) Measures taken
Development of real estate	Effects on the development of real estate	Construction Energy transition Overall effects (on development) Renovation & redevelopment