Game over – Offshore wind development in the case: the North Sea Wind Power Hub.

*Who are the players, how do they play and by which rules?*

Geziena Oenema

Environmental and Infrastructure planning
Faculty of spatial sciences
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| **Author** | G. R. (Geziena) Oenema BSc, BA. |
| **Scientific supervisor** | Dr. F. (Ferry) van Kann<br>University of Groningen |
| **Corporate supervisors** | D. (Daimy) Abdoelkariem, LLM<br>B. (Bryan) Brard, Msc.<br>TenneT TSO |
| **Second reader** | Dr. ir. T (Terry) van Dijk<br>University of Groningen |
| **For obtaining the degree of** | Master of Science in Environmental and Infrastructure Planning |
| **Address 1** | University of Groningen<br>Faculty of Spatial Sciences<br>Landleven 1<br>9747 AD Groningen<br>www.rug.nl/frw |
| **Address 2** | TenneT TSO B.V.<br>Utrechtseweg<br>www.tennet.eu |
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For my thesis I came into contact with the Dutch transmission system operator, TenneT, resulting in a graduation internship concerning the development of offshore windfarms. This research provided me the opportunity to combine both my interest of sustainable energy and international relations, resulting in the topic of multi-lateral hybrid offshore infrastructure projects.

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Please enjoy reading this thesis,

Geziena Oenema,

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## Abstract

Currently there is no existing framework for multi-lateral hybrid offshore infrastructure projects on the North Sea. The Netherlands, Germany and Denmark have their national development framework for developing offshore wind, but no framework exists to combine it with interconnection to other countries. This thesis provides insights in what the rules of the game are for playing the multi-lateral hybrid offshore infrastructure projects game. The case study for this thesis was the North Sea Wind Power Hub. A program of the Dutch, German and Danish TSO and Gasunie to develop large scale wind farms on the North Sea with cross-border interconnection. The main actors are the national governments of the Netherlands, Germany and Denmark, its TSOs and the European Commission. Theories used in this research were multi-level governance (MLG) and game theory (GT). The results are derived from desk-research and expert interviews and, subsequently, analyzed through the lens of MLG and GT to establish the power balances between the actors. The priorities between the actors are not aligned resulting in a complex game.

**Keywords:** Offshore Wind Energy, Interconnection, Multi-level governance, game theory, multi-lateral hybrid offshore infrastructure, windfarm development frameworks, North Sea.

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## List of abbreviations

| | |
|---|---|
| ACER | Agency for the Cooperation of Energy Regulators |
| BMWi | The Federal Ministry for Economic Affairs and Energy (Germany) |
| BNetZa | Bundesnetzagentur, Federal Network Agency of Germany |
| BSH | Federal Maritime and Hydrographic Agency (Germany) |
| CBA | Cost-Benefit Analysis |
| CEF | Connecting Europe Facility |
| DEA | Danish Energy Agency |
| EC | European Commission |
| EEZ | Exclusive Economic Zone |
| EFSI | European Fund for Strategic Investment |
| EIA | environmental impact assessment |
| ENTSO-E | European Network of Transmission System Operators for Electricity |
| EnWG | Energy Industry Act (Germany) |
| ERDF | European Structural and Investment Funds |
| EU | European Union |
| EZK | Ministry of Economic affairs and Climate Policy |
| IenM | the Ministry of Infrastructure and Water Management |
| INEA | Innovation and Networks Executive Agency |
| KF GCS | Kriegers Flak- Grid Combined Solution |
| MLG | multi-level governance |
| MOG | Meshed Offshore Grid |
| MSP | Marine Spatial Planning |
| NECP | National Energy and Climate Plan |
| NEP | Grid Development Plan (German: Network Entwicklung Plan) |
| NRA | National Regulatory Authority |
| NSCOGI | North Seas Countries Offshore Grid Initiative |
| NSOG | Northern Seas Offshore Grid |
| NSWPH | North Sea Wind Power Hub |
| O-NEP | Offshore Grid Development Plans (German) |
| PCI | Projects of Common Interest |
| RES | Renewable Energy Sources |
| TEN-E | Trans-European Networks for Energy |
| TSO | Transmission System Operator |
| TYNDP | Ten-Year Network Development Plan |
| UNCLOS | the United Nations Convention on the Law of the Sea |
| WindSeeG | Windenergie-auf-See-Gesetz |

# CHAPTER 1: INTRODUCTION

## 1.1 RELEVANCE OF THE RESEARCH

### 1.1.1 GOVERNMENT SUPPORT FOR AMBITIOUS OFFSHORE WIND TARGETS

Countries in the European Union are striving to become carbon neutral in 2050, following the normative agenda of the Paris agreement of 2015 and more recently the EU's 'Fit for 55' plan (European Commission, 2021). To reach a low-carbon sustainable future based on diminished use of fossil fuels, the electrification of sectors within the economy will be one key element. Consequently, not only a greater amount of electricity produced will be required (Sangster, 2016), but also a system change towards a greater use of renewable energy sources.

One great potential for contributing to the scaling up of clean energy is the use of offshore wind energy in the North Sea (NSEC, 2017; World Energy Council, 2017). European countries have started to increase their offshore wind capacity as it is becoming more competitive compared to traditional fuels (World Energy Council, 2017). The challenge is to reach the climate goals as voiced in the Paris Agreement in a cost-efficient way. "[…] the success of offshore wind, and other renewables on the North Sea, depends on the ability to bring the energy to end consumers in an efficient way. Thus, parallel to the increased offshore implementation, ways to bring the energy to shore efficiently need to be developed." (World Energy Council, 2017, p. 6). The offshore wind industry is maturing and increasingly gaining more trust as a cost competitive technology. This subsequently increases potential government support across Europe for offshore wind projects and interconnection projects (PwC, 2018).

### 1.1.2 NEED FOR ADDITIONAL INTERCONNECTION

A cooperation of the North-West European countries in developing a grid on the North Sea has several advantages. Instead of building wind farms separately, joining forces will make it easier for the involved countries to manage the generation of electricity, which would be variable when coming from many distributed sources (Wieczorek et al. 2015). This raises concerns for the security of supply with the increased reliance on renewable energy sources, as they are subject to varied weather conditions (Altin et al. 2018). However, interconnection can aid the instabilities inherent to renewable energy sources and therefore improve security of supply in the event of low load factors in a particular country (Jay & Toonen, 2015; Patt et al. 2011; Watson, 2012). Moreover, it would also decrease the need for costly storage facilities and ensures security of supply in a more cost-effective manner compared to individually installed generation capacity (ENTSO-E, 2018). And importantly, it would help reaching a carbon-free future (Wieczorek et al. 2015) and to decrease dependency on countries outside of the EU (Leal-Arcas, 2015).

## 1.2 RESEARCH PROBLEM

### 1.2.1 NO EXISTING FRAMEWORK FOR INTERCONNECTION INTEGRATED WITH OFFSHORE WIND

New forms of cross-border regional cooperation are characterized by different institutional strategies and designs. Having institutional support from various levels on cross-border cooperation aids the development of new transnational relationships (Scott, 1999). The current European electricity grid is increasingly more transboundary, which suggests that a greater regional (cross-border) approach is the way forward to secure energy supply in Europe (Jay & Toonen, 2015). However, this has mainly been happening onshore, but electricity generated offshore also requires appropriate infrastructure to connect and integrate to the onshore electricity grid of the country and possibly between countries. However, mainly point-to-point interconnection via sea cables have been developed until now, with no multilateral interconnection with integrated offshore wind energy. Thus far, only one bilateral project has integrated wind, the Kriegers Flak - Combined Grid Solution, a cooperation between Denmark and Germany in the Baltic Sea (Marten et al. 2018; Sunila et al. 2019).

## 1.3 Research objective

### 1.3.1 Research goal: Identifying the rules of the game

The research objective is to identify the rules of the game in order to facilitate multilateral offshore infrastructure projects, specifically on the North Sea. There are many barriers for joint initiatives for offshore grids and a lack of frameworks for energy infrastructure clusters (Jay & Toonen, 2015; NSEC, 2017). Such barriers are related to technique, market, regulation and governance.

The institutional design aims to address the governance systems, in terms of energy laws and regulations and allocation of roles and responsibilities of the most important agencies and actors in a multi-level field. These *rules of the game* can be both formal and/or informal (Helmke & Levitsky, 2004). Institutional design criteria that may shape actor behavior which are currently underdeveloped. The objective of this research is to assess the complex game in the early stages between multiple countries for developing a multi-lateral hybrid infrastructure hub for wind energy. Who are playing the game, which are the rules and how are the relations between the players.

### 1.3.2 The role of the planner

Developing multi-lateral hybrid offshore infrastructure projects on the North Sea is quite complex. The role of the planner is how to plan those offshore wind parks, or windhubs, in the correct manner regarding to the use of resources, and as effective as possible. Spatial planning encompasses activities related to the preparation, implementation, execution, monitoring and evaluation of spatial planning policy. Spatial planning aims to consciously intervene in the order and the organization of spatial interventions policy (Woltjer et al. 2014). An essential aspect of interventions is the matter that space can only be allocated once within a certain timeframe. Moreover, when considering interventions, a form of scarcity both in time, space and resources play a role. Not everything can be done at the same time. As a society, we simply cannot do without a careful and well-considered spatial policy (Woltjer et al. 2014). Planning insights regarding multi-lateral hybrid offshore infrastructure projects can potentially contribute of how to steer offshore wind developments with possible interconnection can be steered into the right direction. In short, there is a lack of a clear assessment framework, which makes it unclear of who plays the spatial intervention game, in what way, and based on which rules.

## 1.4 Introducing the game

As stated earlier, there are currently no frameworks for developing multi-lateral hybrid offshore infrastructure networks. The North Sea Wind Power Hub program aims to be the first one of such scale and complexity to be developed of such scale and complexity on the North Sea. Due to its scale and complexity, and multiple actors, in this research the project is approached as if it were a game. To provide a greater understanding of the decision-making processes of the actors involved in the current available frameworks.

The complexity of the game is illustrated by the difficulty is assessing *what* are the stakes, *who* are the players, and what are their relationships and the possibility of an imbalance of power dynamics. The so-called *board* on which the game is played is the North Sea, and in particular the pieces of land in the North Sea which belong to Denmark, Germany, and the Netherlands, as they are three of the countries that are participating in the North Sea Wind Power Hub (NSWPH). Possibly more countries will be involved in the eventual project, however those three countries have the three main actors involved in the consortium. (NSWPH, 2021)

The *players* of this multi-lateral hybrid offshore infrastructure game are the participants who all have a stake in the outcome. Each player in this game may not be equal, and they are not necessarily playing on the same level. Besides each country's own stakes, there is also an overarching goal of the European Union regarding climate

change. The European Union can be distinguished as operating on a larger scale than the nation-states, the countries. Within the three participating countries, other players are present including the government and grid operators, they have a different scale as the European Union, and as such possibly operate on a different level. This will all be addressed in this research. This research will aim to enlighten which possible organisations are involved, and whether these are the correct organisations to ensure a successful outcome of the project. And if possible, parties that have been omitted but should have been included. Besides formal institutions (the rules), also informal institutions can have an impact on how the game will be played. These will all be addressed in the theoretical framework.

The goal of the project is to generate electricity from offshore wind, with the possibility of converting that electricity to hydrogen, and interconnect each country to transport electricity. An unclear component is the material. These are the elements, the material aspect of the game. Countries need to find an agreement of what exactly will be built in the North Sea, what kind of material to use, the type of cable (for what price) and how to get the electricity onshore and via which route. These are all essential parts off the material component, as generating wind on its own without securing a way to get it transported to land is useless.

In this research the North Sea Wind Power Hub is the case study for the so-called *game* conducted in this research. Further explanation on this case study and research approaches are given in the methodology.

## 1.5 Research Questions

The following research questions are devised to meeting the previously defined objective of the research.

The main research question is:

**What are the current rules of the game to build a multi-lateral hybrid offshore infrastructure hub in the North Sea?**

*Who are the players, how do they play and by which rules?*

In order to answer the main research question, the following sub-questions are formulated:

1. How are institutional designs identified in academic literature and how do these theories form the basis to play the game of multilateral hybrid offshore infrastructure projects?
2. What are the roles and responsibilities of the involved actors for the development of cross-border projects, on what level, and to what extent influences the European Union this process?
3. What is the current state of affairs of the national processes for designating offshore wind farms per country and increasing interconnection?
4. What are the underlying power dynamics between the three involved countries to co-operate in multi-lateral hybrid offshore infrastructure projects?
5. What are barriers and how can they be overcome in order to ensure a successful and efficient cooperation?

## 1.6 Research Design

The previously formulated research questions are divided into two different stages for this research. The first part of this research consists of theoretical research. The second part focusses on the empirical research. The research design is visible in figure 1:

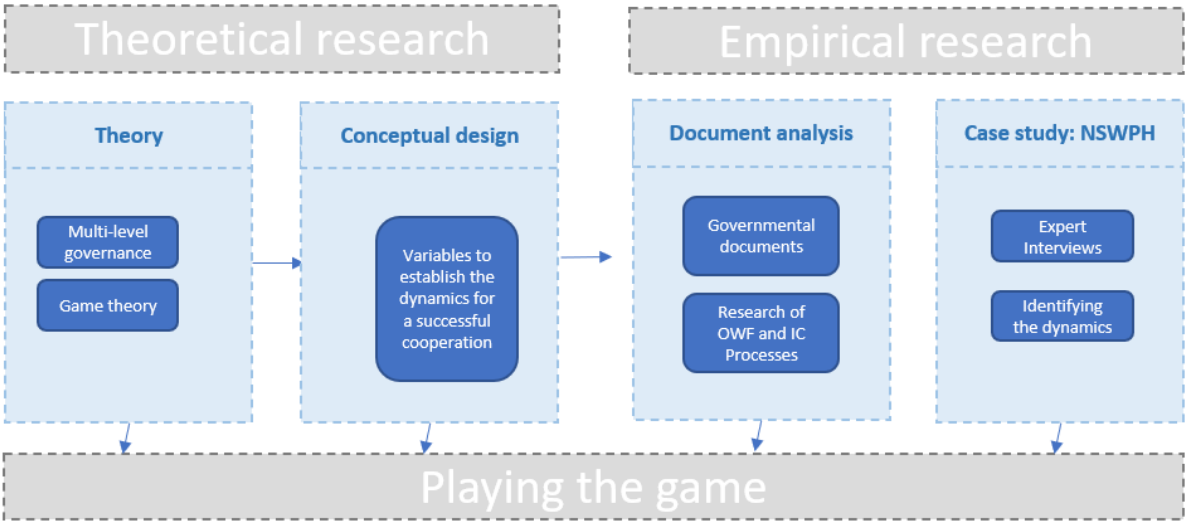


FIGURE 1: RESEARCH DESIGN (AUTHOR, 2021)

## 1.7 STRUCTURE OF THE RESEARCH

To answer the research question, a case study will be applied: the project of the North Sea Wind Power Hub (NSWPH). This project is the first multilateral infrastructure project on the North Sea for offshore wind, with at least three member states involved with the project. The NSWPH is the first project that meets the criteria of multilateral offshore infrastructure projects.

The research questions, which focus on this case study, will each have its dedicated chapter. The NSWPH is further discussed in the methodology, thereafter the thesis follows the structure of macro to micro level. An overview of each chapter:

Chapter 2 represents the first sub-question of how institutional designs are represented in the literature. The theoretical framework sets out the academic status quo on institutional design which will serve as the theoretical basis for setting out the playing field. Several theories will form the basis for the theoretical framework, such as game theory, institutional design, and multi-level governance. Those three theories will provide a greater understanding how the actors (coined as players in this research) can be defined, and the institutional and material aspect of the project and its decision-making processes on multiple levels. The chapter will conclude with a conceptual framework which constitutes the core of this research.

Chapter 3 discusses the methodology of this research. First, a further introduction is given to the case study of this research, the North Sea Wind Power Hub. Thereafter, research methods are presented which were used to gather data, such as reviewing documents and having interviews of experts on this topic of multi-lateral hybrid offshore infrastructure projects and the case study presented in this research. This research was done in collaboration with one of the partners in the consortium of the North Sea Wind Power Hub.

Chapter 4 elaborates on the second sub-question. The chapter aims to provide a deeper understanding of the current roles and responsibilities of the involved actors in Projects of Common Interest projects, and specifically the actors involved for the development of the NSWPH, and on which level. These will involve the project promoters, and in specific the role of the TSOs, the regulators and the role of the European Commission.

Chapter 5 answers the third sub-question. The chapter focuses on the national processes for designating locations of offshore wind farms for each country, namely: the Netherlands, Germany and Denmark. Moreover, it explains the lack of framework of national approaches towards interconnection. Furthermore, the main similarities and differences between the countries are discussed.

Chapter 6 aims to provide an answer to the fourth sub-question, regarding the power dynamics between the countries. The cooperation between the participating parties within the consortium of the NSWPH. But, also

the interaction with actors outside of the consortium, who still are involved within the decision-making processes in the current frameworks for either designating offshore windfarms or interconnection between countries. The theories mentioned in chapter 2 will be used as a tool to analyse those interactions. Moreover, chapter 6 elaborates on possible solutions to overcome the hurdles, or gaps and flaws, of the current institutional design for cross-border cooperation for multi-lateral hybrid offshore infrastructure projects, and in particular the NSWPH.

Lastly, chapter 7 provides the conclusions of this research and answers the main-research question. Moreover, it provides suggestions for further research. Lastly, it concludes with a reflection on the research process.

# CHAPTER 2: THEORETICAL FRAMEWORK

This chapter provides the theoretical framework of this research by describing the insights gathered from literature. The chapter is divided in three sections. The first paragraph focuses on game theory, giving a deeper understanding of different types of games and how certain aspects may influence decision-making processes. The second paragraph expands on the notion of institutions and institutional design, which highlights the importance of the need for rules to frame the game. Both paragraphs conclude that not only the game and the rules of the game are relevant, but also the actors who play the game. Therefore, the third paragraph elaborates on the actors by presenting the theory of multi-level governance, which discusses multiple actors on multiple levels in decision-making processes. The main concepts discussed are summarized by the conceptual model, which can be found in the final paragraph of this chapter. With that, this chapter forms the theoretical bases to answer the main research question: *What are the current rules of the game to build a multi-lateral hybrid offshore infrastructure hub in the North Sea?*

## 2.1 GAME THEORY

In literature many different models for game theory are described. Game theory is often applied to model economic or market situations, a simple example is bargaining or negotiating between buyers or sellers (Morrow, 1994). However, game theory has also been applied in the field of international relations and politics. Snidal (1985) states as nation-states often have interdependencies to each other and seek after their own goals (Snidal, 1985). Game theory can help to gain new findings and understandings when used in empirical research (Snidal, 1985). Game theory encompasses a variety of games with each their own characteristics and purposes. Which provide tools to help explain strategic choices of players (Brams, 2011)

In general, games can be categorized in either cooperative or non-cooperative. This also translates to game theory, where in non-cooperative games, opponent's gain automatically results in loss of similar equivalency to the other. In cooperative games, both opponents can lose or gain (un)equally to each other (Dunne et al. 2013). Game theory highlights the difficulty of coming towards an outcome in which all parties are equally satisfied. It is a theory of "interdependent decisions – when the decisions of two or more individuals jointly determine the outcome of a situation. The "individuals" can be persons or collective entities that make consistent choices." (Marrow, 1994, p.2). Game theory is the study of the interactive decision-making of participants, in which the action of one may affect the outcome for all

In this research several players can be identified, each with their own motives, but with a similar goal for playing the game. Game theory can explain how a certain decision in the process of this project was influenced. The payoffs of certain agreements are determined by strategic bargaining. The solution aimed towards can be referred to as 'pareto-optimal', this underlines the notion that there are no outcomes in which one participant in the game can gain extra benefits without making the other participant in the game equally worse off. This highlights the interdependency between the players. However, the role of power must also be taken into account when bargaining for outcomes. Bargaining between the players is of significant importance and also within institutional design. To reach a collectively agreed outcome between the players there is a need of regularity in the procedures and rules for their decision-making. (Dunne et al. 2013; Heywood, 2011). From literature a few games have been derived, its characteristics are used in this research to provide a greater understanding of how certain stances within the game can influence the dynamics and decision-making processes.

1. Competition vs. cooperation:

   Each player has their own objective and as such choose their own strategy from the set-go, however no player can attain its desired outcome independent of the choices and strategies made by the other (Snidal, 1985). This implies the need for cooperative interactions, as they

The players may not all have the same interests and desires in the game, which can result in competition. In the extreme case this can result in a zero-sum game in which no further decisions can be made due to unwillingness of certain players to continue the negotiations and to which the decision-making will come to a halt. (Harper)

2. Symmetry vs. asymmetry:

   Symmetry entails the similar options for all players, the same starting situation and the players stand on equal ground. Whereas in asymmetry this implies the opposite.

3. Incomplete vs. complete information

   Transparency of information to the players.

4. Sequential vs. simultaneous:

   This entails the pace in which decisions are taken and execution of the processes. The process of the planning can be sequential, from one decision or action to the next. Each decision made in the process can also be considered sequences of simple games in itself (Snidal, 1985). Moreover, certain aspects in the process can be simultaneous. Certain decisions within the same game but with different aspects can be simultaneous.

## 2.2. FRAMING THE RULES

### 2.1.1 INSTITUTIONAL DESIGN

The institutional design, for this research, is the arrangement between actors that regulate their relations, tasks, responsibilities, allocation of costs, benefits, risks. According to Alexander, it means designing institutions – "the devising and realisation of rules, procedures, and organisational structures that will enable and constrain behaviour and actions to accord with held values, achieve desired objectives or execute given tasks. By this definition institutional design is pervasive at all levels of social deliberation and action, including legislation, policymaking, planning and programme design and implementation." (Alexander, 2006, p. 4). An institutional design is positioned between a technological and process design (Koppenjan & Groenewegen, 2005). Institutional design provides tools to examine the effects of the current arrangements within the institutional setting, and the specific dynamics that may affect the institutional stability and change (Poteete, 2010).

Institutional design can be on various levels and scales, further clarification is provided in section 2.3, where multi-level governance theory is discussed. The institutions, or 'rules of the game', represent the environment in which actors operate and are influenced and possibly determining policy outcome (North, 1990; Scholten & Künneke, 2016). In the market aspect of energy infrastructures, institutions are highly relevant to ensure socially desirable outcomes and have an efficient functioning market. The aim of the institutional design, in turn, is to ensure that the intended goals of markets or energy systems are met through incentivizing or guiding actor behaviour" (Scholten & Künneke, 2016), p. 11). The formal institutions are the actual rules of the game, such as laws, regulations and state bodies and should be designed in such a way that it will contribute to overall societal welfare (Scholten & Künneke, 2016).

### 2.2.2 FORMAL AND INFORMAL INSTITUTIONS

Institutions are a key concept used in the social sciences and are often explained as being ‘’the rules of the game’’. They can best be explained as agreements and rules that shape human interaction and enable and constrain behaviour (Helmke & Levitsky, 2004; Hodgson, 2006). Institutions can be seen as a social construct that regulate the social environment, based on the sociological institutionalism perspective (Hall & taylor 1996). Following this perspective, a division should be made between formal institutions and informal institutions (Helmke & Levitsky, 2004). Formal institutions encompass rules that are enforced through official channels. Laws and regulations are examples of such rules, which are enforced by state institutions like bureaucracies and courts. Organisational rules that officially determine how organisations function, can also be categorized as formal institutions (Helmke & Levitsky, 2004; Koppenjan and Groenewegen, 2005).

Informal institutions are rules that are not formally decided upon, are usually not noted, and are enforced through unofficial channels. These rules are therefore elusive and difficult to research. Informal institutions are based on cultural behaviour, common practices and norms and values (Helmke & Levitsky, 2004). Examples of these type of institutional rules are the relational interactions between the stakeholders in the action situation. Which As Helmke and Levitsky (2004) state, the effect and impact of informal institution depends on the strength of the formal institutions (a weak formal institution leaves more room for an informal one to have a large impact), and on the amount of overlap in the goals of the formal and informal institutions. If these goals are divergent, formal and informal institutions can become conflicting. (Helmke & Levitsky, 2004).

## 2.3 MULTI-LEVEL GOVERNANCE

The previous subsections result in the understanding that not only rules and the type of game are relevant, but also which actors play a role in the game, and therefore might influence on the outcome of the game. Therefore, another theory will be used which is multi-level governance (MLG). MLG will help to understand why multiple actors on various levels are relevant in the decision-making processes, which is especially relevant in a project such as the North Sea Wind Power Hub that is both multi-lateral and hybrid in its very nature.

Institutional design addresses the governance of offshore wind energy systems, in terms of formal rules and regulations, contractual arrangements and organization of agencies and actors. Norms and values are typically related to the formal rules of the game. There are three levels of governance

On the micro scale, regional or local institutions, regarding development plans and spatial regulations that can have an impact on how benefits and discomforts of offshore wind energy are distributed. On the meso-scale, National regulations with respect to the rights and responsibilities of various stakeholders influence property and ownerships of assets. The transmission network can in turn influence the reliability of energy supply. Institutions on the macro scale are the following are the international regulations from the European Commission and agreements.

To analyse the institutions and relations between the institutions, the 9-cells approach by de Roo & Voogd (2019) is used (see figure 2 below). The 9 cells approach to planning practice is coined by Gert de Roo (2013). It exists of 9 cells which represent the interdependencies between the material, organizational, institutional aspect towards planning, and on which level these practices are: the macro, meso and micro level. (De Roo & Voogd, 2019).

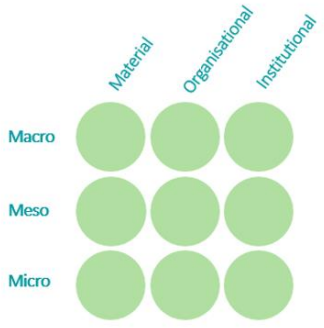


FIGURE 2: MULTI-LEVEL GOVERNANCE WITHIN THE 9-CELLS APPROACH (DE ROO, & VOOGD 2019)

Material refers to what exactly needs to happen, it is central to the planner in its observation. The site and the situation that attracts the planner its interest, in this case the North Sea. It is both the physical and social facts and values of the site. In the theory, the citizens are often involved in the material aspect as well. However, they will have less influence in the aspect of the NSWPH. Since they are not directly affected by the project. The cables and the wind farms Organizational intervention itself is prepared, planned, executed and evaluated. Institutional is the process of decision-making to intervene in the material world. Which has been discussed upon earlier in the theoretical framework.

## 2.4 CONCEPTUAL FRAMEWORK

The following figure is the conceptual framework of this research:

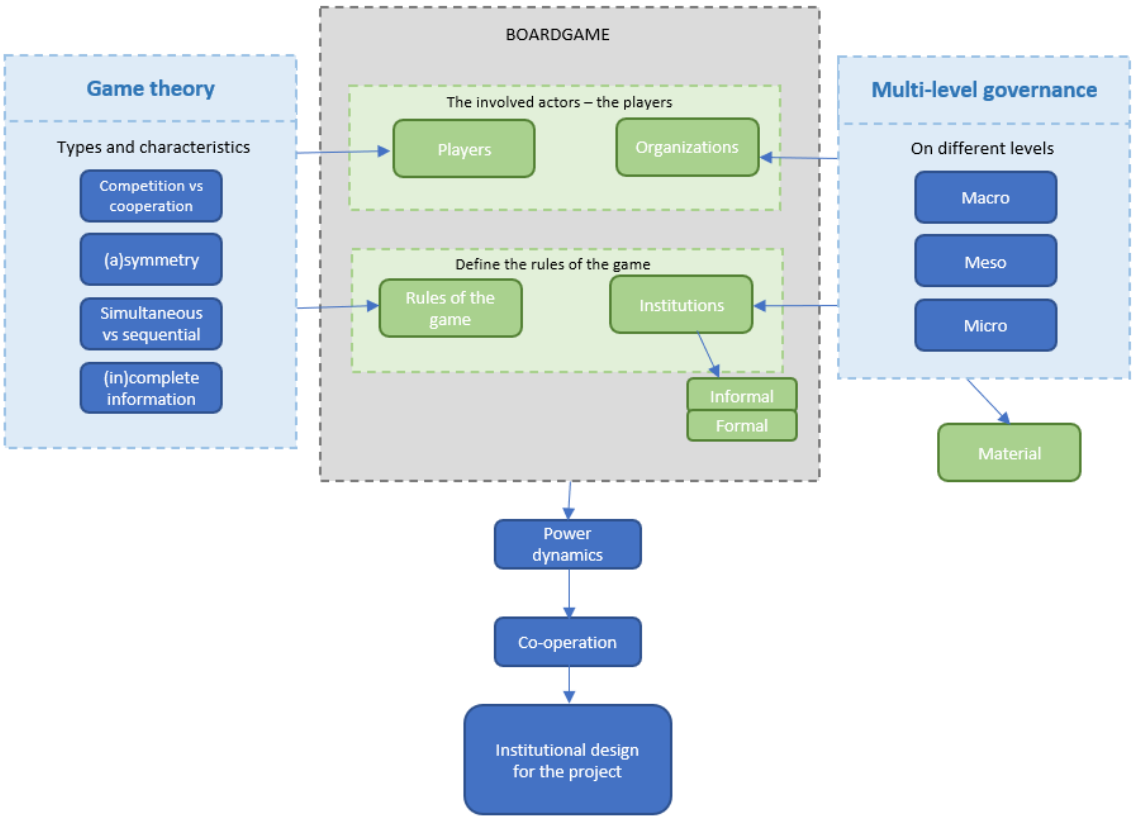


FIGURE 3: THE CONCEPTUAL FRAMEWORK (AUTHOR, 2021)

The multi-level governance and game theory are the two of the main theories used in this research, which are separate theories but enhance each other for this research. Research on institutional design was used to provide further insights on the role of institutions. As explained previously, multi-level governance (MLG) consists of macro, meso and micro. In this research, those are mainly explained for the institutional and organizational aspect, as those two factors are the dynamic factors in the so-called *boardgame* of this research. The material aspect is an important factor, however, it will not directly influence the relations between organizations and institutions. The material aspect is the wind hub (and its components), which is the end-goal of all the players involved, but the wind hub is also the incentive for the players to play the game, to collaborate.

These players play the rules on macro level, but these players also consist of other parties within, which also have to deal with different rules. The dynamics between the players on all different levels will influence each other, who will have to collaborate in order to reach their combined goal, the NSWPH. Those dynamics between the players are influenced by their stance taken on how to play the game, which relates back to the characteristics of game theory, mentioned earlier. Players who acknowledge the importance of cooperation to reach their desired goal will have a positive effect on the game played. In such a case transparency of knowledge and information will be beneficial, which will influence the level playing field. The timeline and actions of the players also may influence the game. Different players may prioritize certain moves, which might not align with the other players. In this research it is assumed that the NSWPH will not be commissioned if there is only one player left, due to the scale of the project and its definition that it will cross border(s). Therefore, collaboration is of high importance to the players. However, for some stakeholders who are not directly seen as main players in this game the stakes may be completely different.

# Chapter 3: Methodology

The first chapter discussed the topic of this research and its relevance. The chapter also introduced the *game* aspect of this research and that the potential new multi-lateral hybrid offshore infrastructure project, North Sea Wind Power Hub (NSWPH) and its participants, will form the *board and players* of this game. The second chapter discussed relevant literature regarding the theories used for this research: game theory, which laid out which games exist and how they can influence the playing field. Both game theory and literature on institutions brought the rules of the game and how this can influence decision-making processes. Multi-level governance provided a greater understanding of interactions of multiple actors on multiple levels. Concluding with the conceptual framework which forms the foundation of this research. This chapter starts with a greater introduction of the case study used for this research, the North Sea Wind Power Hub. Subsequently, the chapter elaborates on the research approach and method appropriate for conducting the data. Subsequently the method of data collection is discussed, with emphasis on the selection of experts for the interviews. The chapter concludes with the ethics under consideration when conducting the data.

## 3.1 Case study: North Sea Wind Power Hub

North Sea Wind Power Hub program is striving to integrate offshore wind in an offshore grid with interconnection between multiple participating countries. This program, which is still in its first stages of development, will be the case study for this research. This research aims to give a greater understanding of the decision-making processes for the development of the NSWPH by providing an analysis of the current interaction of three of the participating countries: the Netherlands, Germany, and Denmark. To the extent there is no established framework for cooperation due to the project being in its early stages, this research aims to provide insights on the current situation and the frameworks available.

The NSWPH is a multilateral offshore hybrid infrastructure project which requires international cooperation between the different parties involved. The NSWPH consortium consists of TSOs (Transmission System Operators) TenneT the Netherlands, TenneT Germany and Energinet of Denmark. Gasunie, which owns the national transmission grid of gas (NSWPH, 2017). However, currently there is no established framework for efficient cooperation among the involved parties.

The consortium has conducted several scenarios, and one, specifically tailored to the COP21 Paris Agreement, estimates that there will be 180 GW of offshore wind power generation capacity in the North Sea by 2045 (Muller et al. 2017; NSWPH 2019). The study stipulates the relative ease of reducing CO2 emission from electricity generation compared to other actions required to reach the Paris climate goals. As such, high priority is desired to achieve CO2 neutrality in this aspect, in particular integrating renewable energy and increasing interconnection between countries (Muller et al. 2017).

The NSWPH is not a matter of just single lines of interconnection between countries, but the offshore wind parks are physically interconnected to each other across national borders. As such, a significant technological change of the existing infrastructure will be required. The wind farm of the NSWPH will probably be in synergy with innovative techniques such as power to gas at the site of the wind park. Therefore, it could function as storage and would alleviate the problem of intermittency of wind energy

The technical design employed by project developers and institutional (policy) design requires a trade-off between values held by different groups. The technical design of such a North Sea grid builds on the idea to create a technically efficient network across borders if technology is aligned to allow for connectivity at efficient costs. A possible conflict with this may be that wind farms might be more oriented toward economic probability than societal expectations about a fair distribution of local costs and benefits.

External regulations and uncertainties are one of the main challenges for collaboration. Technical details of connecting power systems also require adaptations of organizational and regulatory arrangements. It is all connected in the energy policy choices with other subjects such as costs allocations and how the hub will affect the spatial environment.

## 3.2 Research approach

This research aims to develop an improved institutional design, by exploring the main research question: *"What are the current rules of the game to build a multi-lateral hybrid offshore infrastructure hub in the North Sea?*" In order to answer this question, this research focuses on academic theories regarding institutional designs and theories of multi-level governance and game theory. The corresponding variables to the theory are outlined in the conceptual model of chapter 2**,** these variables are relevant to provide answer to the research question and developing an institutional design for multi-lateral hybrid infrastructure projects.

The research methods are of a qualitative nature and comprises both desk research and empirical research. To provide an improved institutional design the research focuses on a case study of multi-model hybrid infrastructure project, the NSWPH, which was further introduced in the previous paragraph. Before gathering empirical data by semi-structured interviews, desk research consisting of both literature study and document analysis is derived.

## 3.3 Literature review

The literature review for this research was conducted to devise academic theories which provide the foundation for the research, as presented in the theoretical framework. These academic theories outline, of which the core is represented in the conceptual model, provide the relevant input variables for answering the research question and to visualize the so-called boardgame for this research. The literature also forms the basis for the document analysis and the empirical research. The publications of public and research institutions are used, as they provide the most accurate information on government processes regarding the national development frameworks. Unfortunately, there are not official frameworks available yet for the interconnection processes which resulted in a lack of official documentation on the decision-making processes in that regard. Moreover, regulations of the European Commission are reviewed to provide

## 3.4 Data collection

As mentioned earlier, document analysis is part of this research. The main objective of the document analysis is to obtain information regarding the current processes to designate offshore wind farms and subsequently deciding upon interconnection between countries. The relevant documents for this research are official government documents in which the development framework has been set out. These documents were found as a result of desk research and recommendations of the supervisors at TenneT TSO. Due to the use of national documents, some required documents were only accessible in their original language. However, the interviews held with representatives of both Germany and Denmark of the TSOs provided the possibility to discuss the obtained data from the document analysis and verify whether it was understood correctly. The use of semi-structured interviews for this research is further elaborated on in the next paragraph.

## 3.5 Interviews

### 3.5.1 Semi-structured interviews

Interviews are a valuable method to gain in-depth knowledge of practices, cooperation, and interests (Poteete, 2010). Therefore, in this research has been chosen to carry out interview to gain valuable information regarding multi-lateral hybrid offshore infrastructure projects in addition to the literature and document research.

Interview guides are used in order to ensure key that topics are covered within the interviews (Taylor et al. 2016). The interview guides (see appendix X) are tailored towards the interviewee in order to ask the relevant questions in their field of expertise. Due to time constraints with some interviewees, some interviews did not consist of open-ended questions or conversation starters to ensure the relevant interview questions are answered.

Semi-structured interviews enable the opportunity for probing, to derive from the set-questions to ask for specific descriptions or other details from their experience. When deemed necessary, additional questions are asked to clarify certain topics or uncertainties. (Taylor et al. 2016).

The interviews are not recorded, per the wish of TenneT TSO. However, this also has its advantages, the interviewee will be more comfortable and freer to express themselves (Vaccaro et al. 2010). Moreover, there is no need to record the interview as it is not required for this research to transcribe and have exact quotes of the interviewee in order to answer the research question. Furthermore, not recording the interview helps the interviewer to focus and does not give a false sense of security, meaning becoming too comfortable and subconsciously putting less effort to deeply engage. Besides, opting for not recording also omits the possibility of technical failure leaving no record of the interview (Vaccaro et al. 2010). During the interview, notes were taken digitally and directly after the interview the most important information was reviewed and put onto paper. The interview guide made it easy to take notes and to ensure every topic was covered, and notes were made in a concise and to-the-point manner. In case of uncertainties regarding specific statements, follow-up questions were asked. Due to this thesis being Follow-up e-mails were sent in case a specific statement or opinion had to be double-checked or verified.

### 3.5.1 Selection of the interviewees

This paragraph will provide an overview of the interviewees and why those have been selected. An overview of the interviewees are in table 1 on the next page. The table also displays when and how the interview were held.

An important aspect in the development of a cooperation framework for the North Sea are the regulatory aspects. Agroup called PROMOTioN is conducting research regarding meshed HVDC offshore transmission networks, researching all aspects involved in developing these meshed grids. To ensure the accurate coverage of the regulatory considerations for this research, an interview was held with an expert of PROMOTioN, C. Nieuwenhout.

An important part of the institutional design are the political dynamics within the Netherlands and its stakeholders, but also with the European Union. Nikkels is an advisor of public affairs and has contacts with the relevant stakeholders involved in the development of offshore wind farms in the Netherlands. He has provided valuable insights on the relations between different parties of offshore development.

Development framework and stakeholder management. The development framework in the Netherlands, up until 2030 does not specifically include offshore wind in combination with interconnection towards other countries. An expert on the development framework within TenneT, Jaarsma, will be able to provide insights in the current processes of how to develop the framework, and how interactions are with other stakeholders.

Vis is an expert on the NSWPH and the workstream lead for the project scoping. Interviewing Vis has made possible an awareness of what exactly is required to get the first hub on the North Sea, but also what current possible hurdles may exist and that could possibly threaten a successful cooperation. The first hub will be set up by the first half of 2030-2035. Moreover, Larsen, from Energinet also works for the consortium, his expertise is Markets and Regulation. He was also able to provide the Danish perspective for this research. Moreover, the German perspective was also represented with an expert interview. The lead political affairs of TenneT Germany, T. Chuvilina-Buschgens was interviewed, she was able to provide insights in both the internal affairs of Germany and their perception of the North Sea Wind Power Hub. The team of NSWPH works closely with both Larsen and Chuvilina-Büschgens, therefore they were willing to provide an interview to gain further insights for this research.

| # | Date | Name of the respondent | Organization | Function | Place | Form of interview |
|---|---|---|---|---|---|---|
| R1 | December 10, 2019 | C. Nieuwenhout | PROMOTioN, University of Groningen | Researcher | Arnhem | Face-to-face |
| R2 | December 16, 2019 | J. Vis | TenneT TSO NL | Senior advisor NSWPH, Workstream Lead Project Scoping | Arnhem | Face-to-face |
| R3 | December 18, 2019 | H. Nikkels | TenneT TSO NL | Senior advisor public affairs | Arnhem | Face-to-face |
| R4 | January 6, 2020 | S. Jaarsma | TenneT TSO NL | Senior advisor offshore NL | Arnhem | Face-to-face |
| R6 | January 15, 2020 | P. Larsen | Energinet TSO NL | Workstream lead Market and Regulation NSWPH | Arnhem | Telephone call |
| R6 | January 17, 2020 | T. Chuvilina-Buschgens | TenneT Gmbh Germany | Lead political affairs | Arnhem | Telephone call |

TABLE 1: OVERVIEW OF INTERVIEWS

## 3.6 ETHICAL CONSIDERATIONS

This research was conducted as part of an internship at Tennet TSO. TenneT is the grid operator of the Netherlands and has also the mandate to connect cables offshore to the onshore grid. Tennet TSO is part of the consortium of the North Sea Wind Power Hub program. The internship was within the Dutch department for offshore projects, and particular in the working group for the NSWPH. Due to the sensitive information regarding this project, TenneT TSO asked for the interviews to not be audio-recorded.

Interviewees consented up front, either via e-mail or verbally, that the information obtained during the interviews could be used in the thesis. Interviewees were asked to flag whenever information disclosed by them had to stay private. Sometimes, that information was told to give some deeper understanding of the material or current affairs with certain parties. In these instances, the private information in its entirety was not written in the notes and not included as part of this research. Some interviewees discussed such information to provide a deeper understanding of the project and relations. After the interviews, the collected information from the interview was immediately collected and organized digitally. During the interviews, extensive notes were made and in case certain specific information was regarded highly relevant for this research, interviewees were directly quoted, with their due permission.

# CHAPTER 4: EUROPEAN POLICY ON CROSS-BORDER PROJECTS

The aim of this chapter is to lay out the current processes available for the development of offshore interconnection and offshore wind energy projects. The focus is to research the process made available by the European Union and how they are framed within the current regulations. The chapters starts by providing information regarding offshore wind energy and jurisdiction. Subsequently the main regulations of the European Union are discussed from which the main tool to facilitate offshore wind are formed. Moreover, marine spatial planning and clean energy packages are reviewed.

## 4.1 OFFSHORE WIND ENERGY

As with any type of energy generation, there are both advantages and disadvantages associated to wind power generation. Wind energy is variable: the amount of energy that will be generated cannot be controlled nor forecasted with absolute certainty. Besides that, offshore wind energy has spatial challenges regarding other activities on the North Sea such as shipping and fishing (Gorenstein Dedecca et al. 2016). The costs of offshore wind farms increase with the distance from shore and depth of the seabed.

However, offshore wind is less variable than onshore wind, and the North Sea area has higher wind speeds than on land, representing a significant advantage of offshore over onshore wind. (Gorenstein Dedecca et al. 2016). The countries adjacent to the North Sea are leaders in the development of wind energy, and this mainly due to the favourable circumstances of the region (Rodrigues et al. 2015). The relative low water depth combined with the high wind speeds resulted in a flourishing environment for the development of an offshore wind energy market.

### 4.1.1 OFFSHORE JURISDICTION

Coastal states have full sovereignty over their internal and territorial seas, as set out in the United Nations Convention on the Law of the Sea (UNCLOS) of 1982. (DeCastro et al. 2019; UNCLOS, 1982). The territorial seas are up to 12 miles from the coast, and the Exclusive Economic Zone (EEZ) is up to nautical 200 miles. Both in the territorial sea and EEZ, the state can exploit and manage its resources, as described in article 56 in the UNCLOS. The article explicitly mentions the states' jurisdiction for the "[…] establishment and use of artificial islands, installations and structures; […]" (UNCLOS, 1982, p. 43). This means the state has the right to construct installations such as offshore wind farms, and due to having exclusive jurisdiction over these structures, may issue regulations and laws (Roggenkamp et al. 2010). Due to the exclusivity, and lack of harmonization required by the European Union, the laws and regulations may vary between the involved countries. This may pose significant difficulties for a joint effort in realizing an offshore grid of interconnection and wind farms.

To facilitate the development of multi-lateral offshore hybrid infrastructure projects, an important aspect is the legal framework. Currently, there is no regulatory framework specifically aimed for projects such as the NSWPH. No harmonized regulatory regime exists between the three countries involved with the project. To develop an offshore grid, and specifically, the NSWPH, requires harmonization and coordination (Roggenkamp et al. 2010) of such a framework between the three countries.

### 4.1.2 MARINE SPATIAL PLANNING

The European framework for Maritime Spatial Planning (signed 2016) requires countries in marine regions (in this case the North Sea) to coordinate and also cooperate in order to optimize the use of marine space. The member states are responsible for designing the plans for their marine waters. "Over the last decade, a number of EU member states have implemented legislation and associated zoning in their Exclusive Economic Zones (EEZ). However, this has largely been done from a national perspective, where cross-border cooperation rarely occurs or takes place through consultation in a very late stage of the process only […]." (EC, p. 16).

Marine Spatial Planning (MSP) is increasingly being developed and implemented around the world; however, it still faces challenges, both conceptually and in practice. These challenges range from political to institutional challenges, but also in the social, economic, scientific and environmental domain (Frazão Santos et al.

2019). A solid policy and institutional framework are essential for a successful MSP. Governments are the responsible party for the planning initiatives and have the public trust authority. Without regulatory and legislative policy there will be no support for an MSP. Furthermore, stakeholders should be engaged in order to gain support and acceptance to the adoption of the MSP. "It is well recognized that accurately reflecting the existing complexity of socio-spatial relationships in a planning area, together with understanding stakeholder practices, expectations and current and future interests is fundamental to balance economic, social, and environmental objectives in MSP, and to reduce conflicts among ocean users." (Frazão Santos et al. 2019). A transnational perspective is needed due to the likely tension between (shared) national interests within territories. Planning authorities should work with neighbouring countries when it concerns cross-border implications (Jay et al. 2016)

## 4.2 TEN-E Regulation

### 4.2.1 Trans-European Network for Energy

The Trans-European Network for Energy (TEN-E) regulation, which went into force in 2013, is the main law to facilitate better interconnection between national governments and companies in the form of promoting Projects of Common Interests (PCIs). The TEN-E programme has been revised due to the changes in the energy landscape of the European Union and the introduction such as the third energy package and the establishment of ACER (ACER, 2017) Furthermore, the revision of the TEN-E programme was required as the framework was not efficient in in leading to sufficient energy cross-border infrastructure investments.

The TEN-E regulation's objective is the "development and interoperability of trans-European energy networks and connection to such networks, cannot be sufficiently achieved by the Member States and can therefore be better achieved at Union level […]" (EC regulation 247/2013, p. 44). The guidelines within the TEN-E regulation are to support the completion of the internal energy market within the European Union, to diversify and secure the energy supply. Refurbishing and creating new energy infrastructure is of great importance to achieve the climate objectives of the EU. (EC regulation 347/2013). The general and specific objectives of the TEN-E were defined in the Impact Assessment which accompanied the 2011 proposal for the new TEN-E regulation. The objectives of those are described within textbox 1, which are objectives new interconnection projects should help to further achieve those.

**"General objective**

- Further develop the internal energy market by interconnecting Member States and connecting island, landlocked and peripheral Member States with the central regions of the Union, so as to ensure energy provision at affordable prices to European customers,
- ensure security of supply,
- meet the EU's energy and climate goals, both in terms of binding targets up to 2020 and of longer term emission reduction.

**Specific objectives**

- Streamline permit granting procedures to significantly reduce their duration for projects of common interest and increase public involvement and acceptance for the implementation of such projects;
- Facilitate the regulatory treatment of projects of common interest in electricity and gas by allocating costs depending on the benefits provided and ensuring allowed returns are in line with risks incurred;
- Ensure implementation of projects of common interest by providing necessary market-based and direct EU financial support."

**TEXTBOX 1: OBJECTIVES OF THE TEN-E REGULATION AS DESFRIBED IN THE IMPACT ASSESSMENT (EUROPEAN COMMISSION, 2011)**

### 4.2.2 Projects of common interest

In the TEN-E regulation a new approach is specifically mentioned regarding regulation and financing that is required for new energy infrastructure, and in particular new infrastructure that will cross borders. This is specifically being underlined by supporting new Projects of Common Interest (PCI), which are part of 12 strategic priorities the EC has identified, which cover different areas and themes in the field (EC regulation 347/2013).

The process to become a PCI, the identification and selection of the PCI process and its corresponding criteria are defined in articles 3 and 4 of the TEN-E Regulation. The main criteria for the PCIs are their contribution towards market integration, sustainability and security of supply. The regional groups will evaluate the proposed projects on these aspects. Furthermore, the regional groups take into consideration the urgency in order to meet the energy policy targets, other Member States that may be affected by the project and ensure equal opportunities. Moreover, the project's contribution to cohesion and its complementarity regarding other proposed projects (EC regulation 347/2013). An overview in figure X of the TYNDP and PCI process is on page X.

A requirement for the Project of Common Interest is being part of the Ten-Year Network Development Plan (TYNDP). The TYNDP, formulated within the third energy package and built upon the TEN-E regulation, presents and assesses all submitted projects on a pan-European scale by project promoters, the projects were valued against a set of possible futures in scenarios regarding the transition and development of the internal electricity market of Europe (ENTSO-E, 2017). However, the scenario building will become a standalone product in the future. The current infrastructure is assessed for the values mentioned earlier and whether further infrastructure is needed. The projects who are submitted for the TYNDP will have to mitigate the needs within the assessed infrastructure. The system assessment of the infrastructure, was formally attached to the TYNDP, however, these have now become a standalone product of the ENTSO. Nevertheless, within the scenario building member states are consulted and eventually required to take this into consideration for their NECP (see previous chapter). The Scenario building consists of four characteristics of Sustainable transition, distributed generation, global climate action and EUCO30, more information on this in textbox X.

### 4.2.3 The roles within the PCI process

#### Project promoters

The project promoters who apply to become a PCI must submit several documents in the beginning of the process. First of all, the project's contribution to its corresponding corridor needs to be assessed. Second, a CBA analysis illustrating the economic viability of the project as well as its cost-effectiveness. Third, the criteria outlined in article 4 of the TEN-E regulation need to be met. The process of becoming a PCI has been set out in figure X.X on the next page.

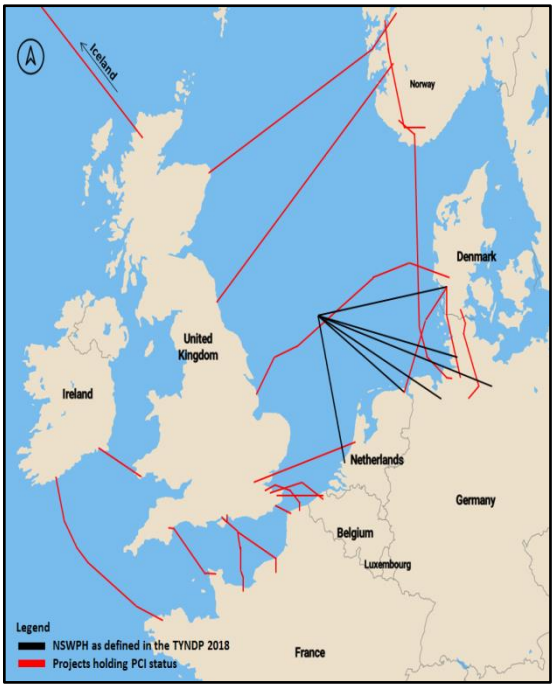


**FIGURE 4: THE NSWPH IN THE FIRST APPLICATION FOR TYNDP STATUS (AUTHOR, 2021. BASED ON TYNDP)**

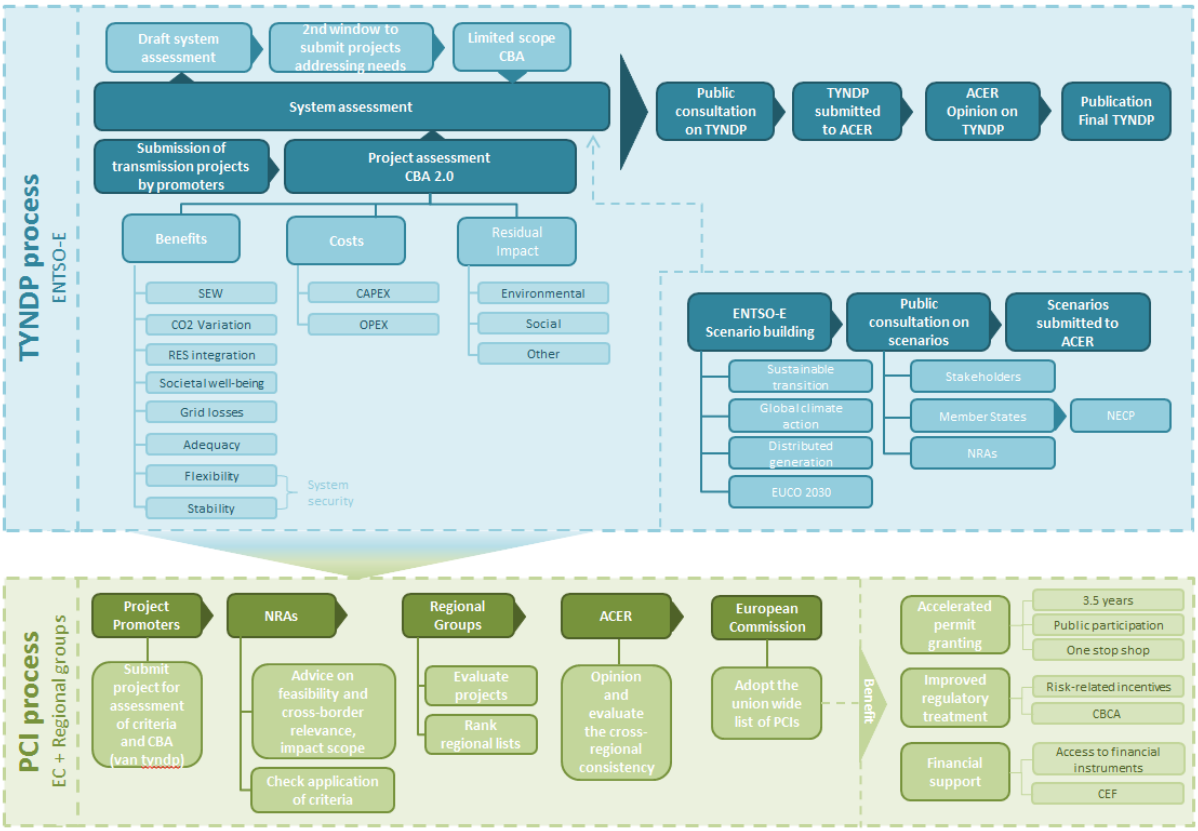


FIGURE 5: OVERVIEW OF THE TYNDP AND PCI PROCESS (AUTHOR, 2021)

### REGIONAL GROUPS

Regional groups coordinate the PCIs, and specifically targeted towards their type of infrastructure. Which is electricity in the case of the NSWPH, consisting of four groups. The group dedicating towards the North Sea is the Northern Seas Offshore Grid (NSOG). Central within this group is the integration of offshore electricity grid and interconnection. These regional groups are an important contribution to the process, as they foster high-level political commitment.

The regional groups, which have been established by the ENTSO-E, consist of the representatives of the Member States, NRAs, TSOs, ACER and the ENTSO-E. Project promoters eligible for PCI status are invited by the Regional Groups, as well as other representatives such as the national administrations. The regional groups prepare the material for the decision-making and approve the assessment methodology for the PCI. They identify project information, assess the proposal, agree on the weighting for project evaluation. The regional groups also co-ordinate with other regional groups to assure there is coherence over all the projects in Europe and agree on the draft regional project list.

### ACER

The role holds no legal influence over the whole TYNDP or PCI process. The projects and list are submitted to ACER to be reviewed, they monitor the project and issue a formal opinion; however, their suggestions are not legally binding.

### REGULATORS

The NRAs must make sure that the data the project promoters have delivered is correct, and whether the methodology is applied in a consistent matter. Moreover, the regulator will evaluate the project as a whole, not only for the Member State, but also from an EU perspective and the contribution towards reaching the climate objectives.

#### National Energy and Climate plans

The EU countries are required, under the regulation of the European Parliament to draft a National Energy and Climate Plan (NECP) according to the new energy union and climate action rules that were enforced in December of 2018 and with the Clean Energy Package. These new plans need to have integrated the five dimensions of the energy union up to the period of 2030, the legal obligations of the 2030 Climate Action Regulations. These are not in line with Europe's net-zero 2050 (Matthias et al. 2019). In 2020 the European Parliament added a new rule, the 70% rule to the Clean Energy Package. The Clean Energy Package is a rulebook by the European Union. In 2019 the EU released the Clean Energy for all Europeans rule book. The 70% rule of the interconnection from the Clean Energy Package is seen as one of the biggest obstacles for the NSWPH by the interviewees. One of the interviewees stipulated the 70% rule of the Clean Energy Package as the biggest hurdle on the regulation of interconnection and as such the NSWPH. The interviewee underlines the need to assess this regulation, otherwise the NSWPH will not work out.

### 4.2.4 PCI Benefits

Being a PCI comes with several benefits. First of all, the permit granting process is accelerated, with a maximum of 3.5 years for the pre-application procedure and the statutory permit granting procedure. The competent authority, which has been selected as requirement of the TEN-E regulation, is the one who coordinates and facilitates the permit granting process, called the 'one-stop-shop'. Without the coordination in the hands of one party, the permitting process can take up to more than a decade. Moreover, the PCI status holds priority within the Member State, which often results in improved regulatory treatment.

Project promoters are able to apply for funding under the Connecting Europe Facility, in the forms of grants for studies and works. CEF is the grant specifically appointed for PCI projects, however other project promoters may also apply for other financial instruments such as the European Fund for Strategic Investment (EFSI) and the European Structural and Investment Funds (ERDF). Moreover, the project promoters will deal with less administrative issues as the environment assessment procedure is streamlined and in coherence with EU law. (ENTSO-E, 2018).

## 4.3 Assessment of the processes and PCI

The manner in which the system is assessed should be adjusted towards a longer framework. The scenario building process of the ENTSO-E does not have a direct influence on the process of this system assessing, however, as they are the same institution, it may affect the way the system is assessed, whereas lays the opportunity to adjust the assessment of the current grid network in Europe and to add the grid offshore. One of the interviewees, J. Vis, mentioned that the system should be assessed to include offshore, as it is currently not suitable to apply for the North Sea Wind Power Hub

During the process of building the future scenarios, there is a moment where stakeholders are consulted to any suggestions. There lays the opportunity for the stakeholders and Member States to lobby for a greater focus towards offshore wind and the explicit implementation of offshore wind into the system assessment for the TYNDP. First of all, the TYNDP should include the network of offshore wind, but also a longer time frame such as 20 or 30 years.

Renewable Energy Sources schemes differ widely between States. The citizens of generous country do not accept that neighbours are benefitting from a production that they have not financed, and they are equally reluctant to finance facilities outside the border.

In the system assessment, national offshore is not accounted for in the system assessment in the EU. Currently, the scenario-building is not binding. However, there is a factor in which parties possibly could influence,

this is the National Energy and Climate plans. If they put targets within those plans, in a way the member states can influence the system assessment.

The scenario-building contains what could be expected to In the scenario building, is what they expect to have on offshore wind. Which in turn is input for measuring the goals of interconnection. However, it does not consider carefully any possible combinations of interconnection. It is purely seen as input for measuring whether interconnection is useful or not. However, it is lacking the infrastructure required for the building of offshore wind farms. Thus, input is more focused on the wind and setting ambitions for the future, but nothing concretely to support.

There is a separate process for interconnection and a separate process for designating offshore wind, there is no coordinated process.

in the North Seas Countries Offshore Grid Initiative (NSCOGI) reflected the active call for further development of grids on a supranational level (Watson, 2012 in Jay & Toonen, 2015). The NSCOGI reflects the support of large-scale offshore development and connecting different nations. The Memorandum of Understanding was also participated by the European Commission and the transmission system operators of the participating countries (Jay & Toonen, 2015).

## 4.4 From Europe to NSWPH

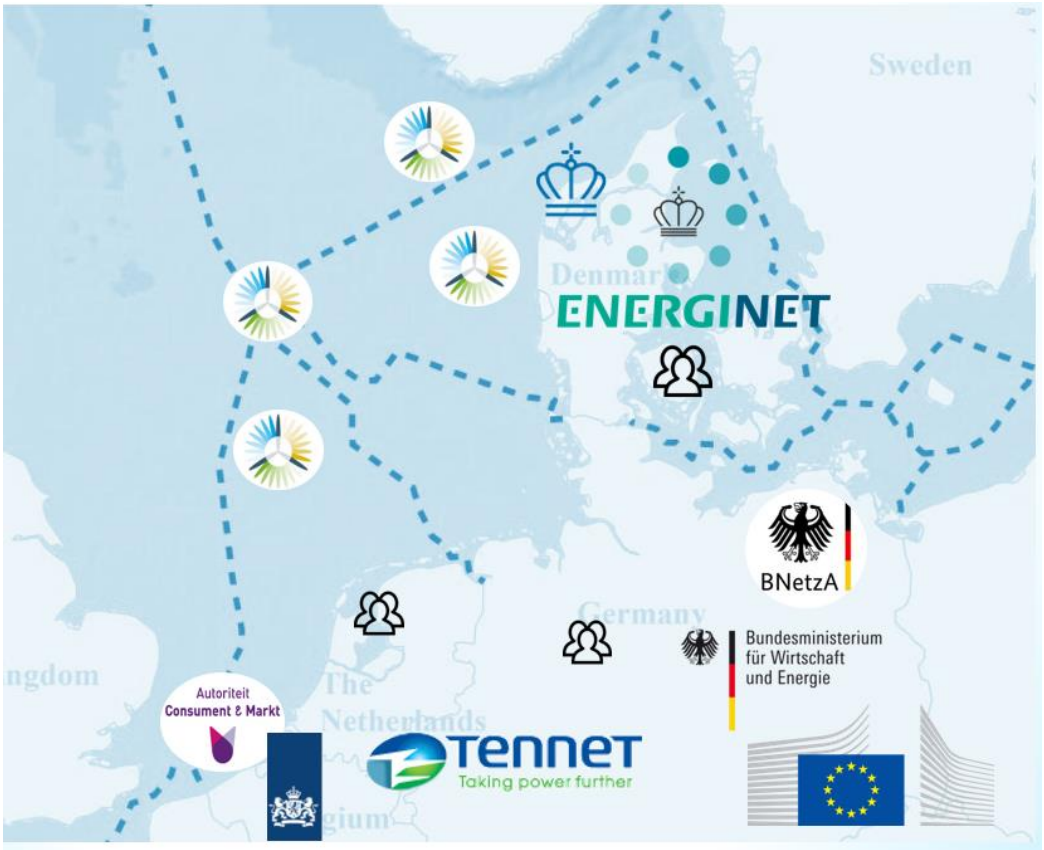


FIGURE 6: OVERVIEW OF THE MAIN ACTORS IN THE DECISION-MAKING PROCES FOR THE NSWPH (AUTHOR, 2021)

The current stakeholders for windfarm development on the North Sea, specifically for the NSWPH are set out in figure 6. Each stakeholder will be addressed in the following sections when discussing the windfarm development in each involved country.

# Chapter 5: National processes of offshore wind farm development

The previous chapter elaborated on European policy cross-border projects and which tools are available on the macro level to facilitate interconnection with integration of offshore wind. This chapter discusses the meso-level of the *board-game*, elaborating on the national processes to designate offshore wind locations. The countries under discussion are the three countries involved in the case study of the North Sea Wind Power Hub (NSWPH). The current processes for wind farm development will be elaborated upon for each country: the Netherlands, Germany, and Denmark. Also, the lack of existing frameworks for interconnection will be addressed. After discussing the three countries, a short analysis is given of all three countries combined. The similarities and differences in the decision-making processes within the existing frameworks of the three countries are discussed.

## 5.1 Wind farm development in the Netherlands

### 5.1.1 Development framework of the Netherlands

The Netherlands has a development framework for designating offshore wind on the North Sea. The development framework is up until the year of 2030. The development framework lays out the timelines for the development of offshore wind energy and their designated locations. The ministry of economic affairs and climate policy is the responsible body to develop and approve the framework, pursuant to the electricity law of 1998. The aim of the development framework is to outline the design, construction and availability for the offshore grid. (EZK, 2020).

The process of selecting offshore wind farms by the institutions is set out in the following scheme:

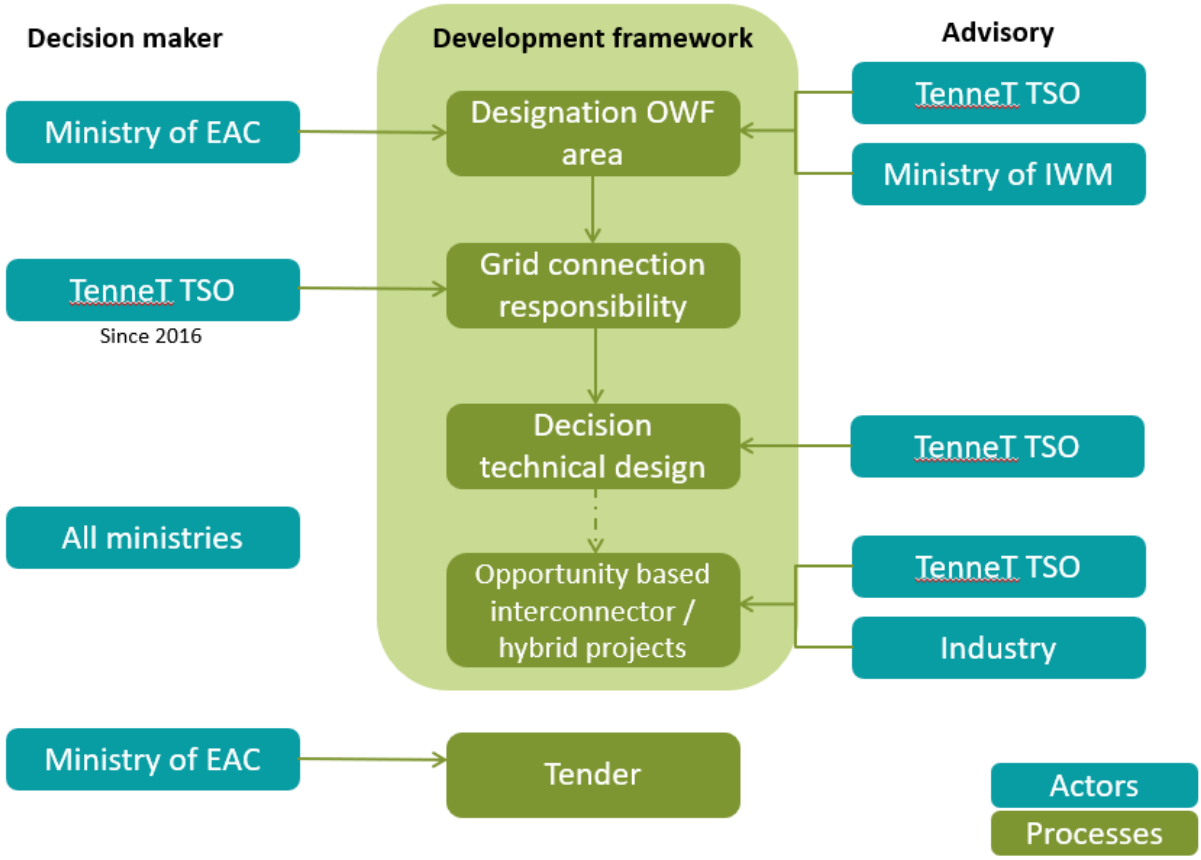


FIGURE 7: DEVELOPMENT FRAMEWORK FOR OFFSHORE WIND IN THE NETHERLANDS (AUTHOR, 2021)

First, potential locations for the wind farm are decided upon by the Ministry of Economic affairs and Climate Policy (EZK), the Ministry of Infrastructure and Water Management (IenM) is consulted within this process. The location sites are appointed in coherence with article 4.1 of the Waterwet, the Dutch law of 2009 regarding water management.

When making the decision in site location for wind farms, the ministry of EZK takes the following into consideration: Societal function of the sea, efficient use of space; consequences for third parties; environmental and ecological interest (no N2000 areas); development and construction costs of the wind farm; importance of an efficient connection of a wind farm to a grid. (EZK, 2020)

## 5.2 Windfarm development in Germany

### 5.2.1 Development framework of Germany

Germany has a different approach for windfarm development than the Netherlands. To further clarify the differences, the development framework of Germany is discussed.

The federal government of Germany supports the development of offshore wind energy and has as such amended their legislation. In 2012, the German Energy Act (*Energiewirtschaftsgesetz,* EnWG) has been amended. Since then, TSOs are required to draw up offshore grid development plans in addition to their onshore grid development plans (KPMG, 2013).

Since 2017 there has been an offshore wind energy act regarding the planning, tenders or designated areas. The energy act also includes the licensing procedures regarding offshore wind farms, called *Windenergie-auf-See-Gesetz* (WindSeeG). For the development and the regulation within this framework the two most important actors are the Federal Network Agency (*Bundesnetzagentur,* BNetZA) and the Federal Maritime and Hydrographic Agency (BSH). For the process of licensing and operating of offshore wind farms the BSH is the relevant authority. (Gerbaulet, 2018)

Off all the different interests involved in a wind farm project, the BSH is the authority who needs to balance those interest. They do this in a so-called weighing-up procedure. In this procedure, all the required permits for a project are concentrated.

The Federal Ministry for Economic Affairs and Energy (BMWi) has responsibility for the development of the energy policy of the government. Currently, offshore wind projects depend on support schemes from the German government to be feasible. (Gerbaulet, 2018)

Next to the BSH and BNetzA, other government agencies are also involved on the federal level when developing for offshore wind energy. Such as the Federal Agency for Nature Conservation, Federal Environmental Agency, military administration, all agencies affected by the development of a potential offshore wind farm.

In the Energy Industry Act (EnWG), the competences are specified regarding to power supply grids. For example, the Federal Network Agency reviews the drafts of scenarios designed by the TSOs, or the whole offshore wind park plan in general. In the case of the TSO, the presented plan will need to be approved by BNetzA. (Schomerus & Maly, 2017).

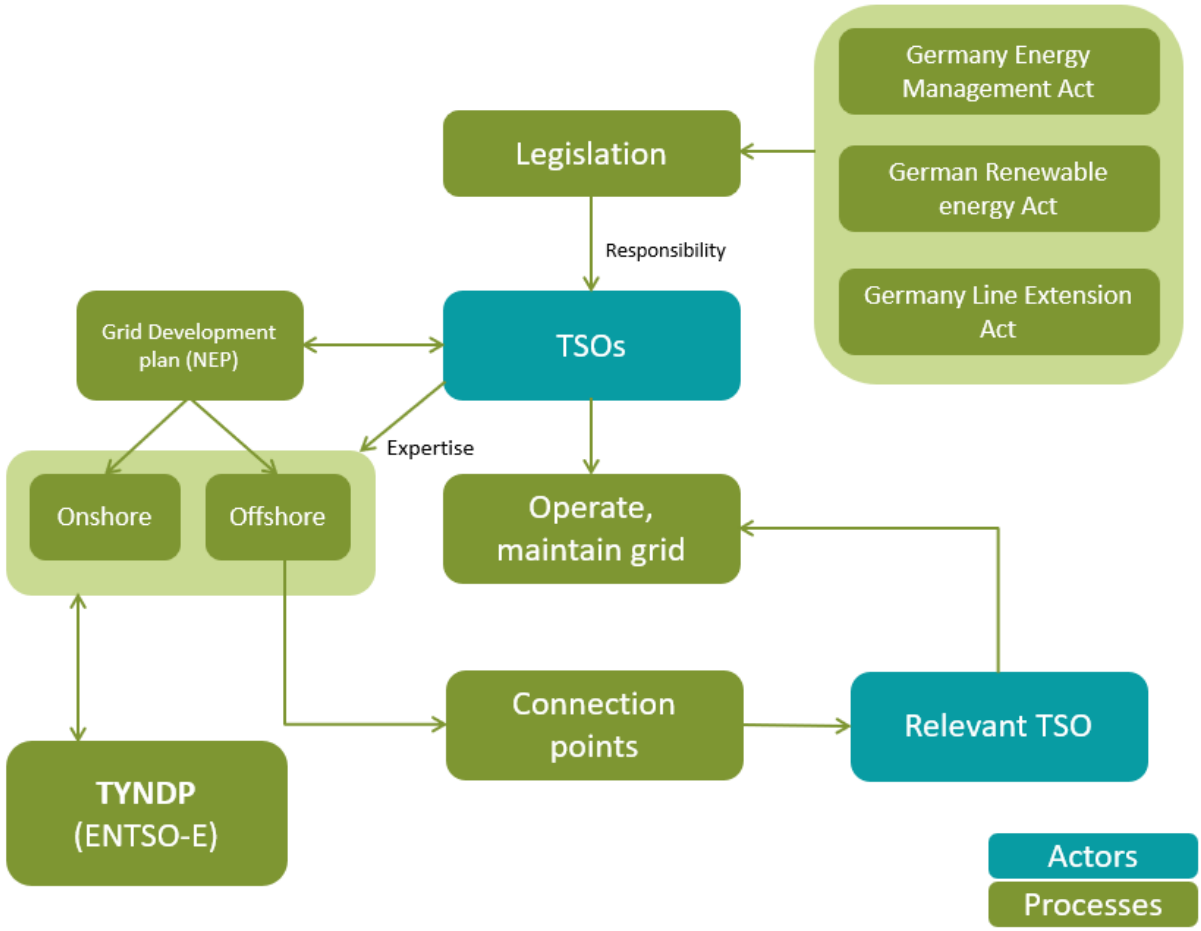


FIGURE 8: DEVELOPMENT FRAMEWORK FOR OFFSHORE WIND IN GERMANY (AUTHOR, 2021)

The figure above shows that the TSOs have the responsibility for quite a few laws in Germany, and have the expertise for the development of the Grid Development Plan (NEP, German: Network Entwicklung plan). Both for onshore and offshore grid development plans (NEP). Moreover, in the NEP possible projects are outlined, which have potential to be included in future TYNDPs. Moreover, the NEP contains the grid connection points, which of course are important for the TSOs.

### 5.2.2 Power distribution

Wind farms and cables within 12 miles of the German coast fall under national law. However, the sea belongs to the coastal state that borders it. (Schomerus & Maly, 2017). In Germany the power is distributed between the federal state and the sixteen provinces of Germany. (Schomerus & Maly, 2017). Lower Saxony is the province that is of the greatest importance for this research as it located in the Northwest of Germany. Therefore, the EEZ of Lower Saxony will be the area that will be and subsequently of the greatest importance due to its EEZ being the area where possibly a hub may be located or at least connect cables to the shore from the NSWPH.

The other TSOs in Germany besides TenneT GmbH are 50Hertz, Amprion and Transnet BW, they are also responsible for the security of supply and stability of the electricity grid. These TSOs are not directly tied to the possible hubs of the NSWPH, due to not being in the Northwest of Germany, but they are in control of the other transmission cables which are also connected to transmission cables in control of TenneT. Even though they are not directly connected to the NSWPH project, they can be affected by it when the NSWPH will come into operation, as their transmission load of the cables may change as well. Therefore, they are included as players in this game.

## 5.3 Wind farm development in Denmark

### 5.3.1 Development framework of Denmark

Denmark is a frontrunner in the renewable energy sector, in their draft NCEP they also stress they want to increase their international position regarding renewable energy, improvements in energy efficiency, research and development and energy regulation, and to continue to be the world's leading offshore wind nation. There is a common consensus among the political parties in Denmark to work towards net zero emission in accordance with the Paris Agreement, also promoting this target in the European Union by 2050 at the latest. To reach this target it is emphasized that it will need to be achieved in a cost-effective way (KEFM, 2018).

There is increasing awareness of the relevance of cross-border aspects of the energy system, acknowledging the importance of an integrated energy market. This is supported by arguments such as energy security and the fluctuation of renewable energy, which corresponds to arguments mentioned in the introduction. Co-operation with neighbouring countries is stressed in the draft NECP. An increase of interconnectors will contribute to enhance security of supply in Denmark and across borders, however, as Denmark already has a high level of interconnectivity there are no specific objectives to reach a certain level in the future. Any new potential interconnectivity should take into account the overall socio-economic value (KEFM, 2018) and as such also the NSWPH will need to take this into consideration. This project is also mentioned within the North Sea Energy Cooperation as a potential project, and within the NECP the Dogger Bank has been appointed as the possible location for the NSWPH within the consortium with TSOs TenneT (Germany and the Netherlands) and Energinet (Denmark) along with its other project partners. "The Dogger Bank project would consist of an artificial island which could serve as a hub for offshore wind power production and then connect the island to the European mainland using interconnectors." (KEFM, 2018, p. 34).

Wind farm development in Denmark is carried out by the competent authority the Danish Energy Agency (DEA), which has the mandate to plan and issue licenses. License to establish offshore wind turbines. Before this license can be granted, an environmental impact assessment (EIA) must be carried out. License to exploit wind power is for 25 years, afterwards the license may be prolonged. The approval to produce electricity must be in compliance with the legislation. The license for the grid connection must be included in the license to establish offshore wind turbines when the project is small. However, for larger projects the approval must be given separately, this is also relevant for the NSWPH, which is a project of a considerable larger scale than any projects previously in Denmark. (Gorrono et al. 2018).

In the Danish case, new offshore wind farm projects can be established according to two different procedures: a government tender or an open-door procedure. The procedures have been gradually developed as experience has been gained since the first offshore wind power projects. Government tender is carried out to realize a political decision to establish a new offshore wind farm at the lowest possible cost. In projects covered by a government tender, Energinet typically constructs owns and maintains both the transformer station and the underwater cable that carries the electricity to landform the offshore wind farm. However, this has been changed since 2019, since then Energinet does not have the mandate anymore for the offshore cable. This now is given to the developer.

In the national energy export strategy published by the Danish Government no formal objectives have been mentioned regarding competitiveness. However, their aim is to double the exports of Danish energy technology and services till 2030, which requires innovative solutions to be competitive on the growing global market (KEFM, 2018).

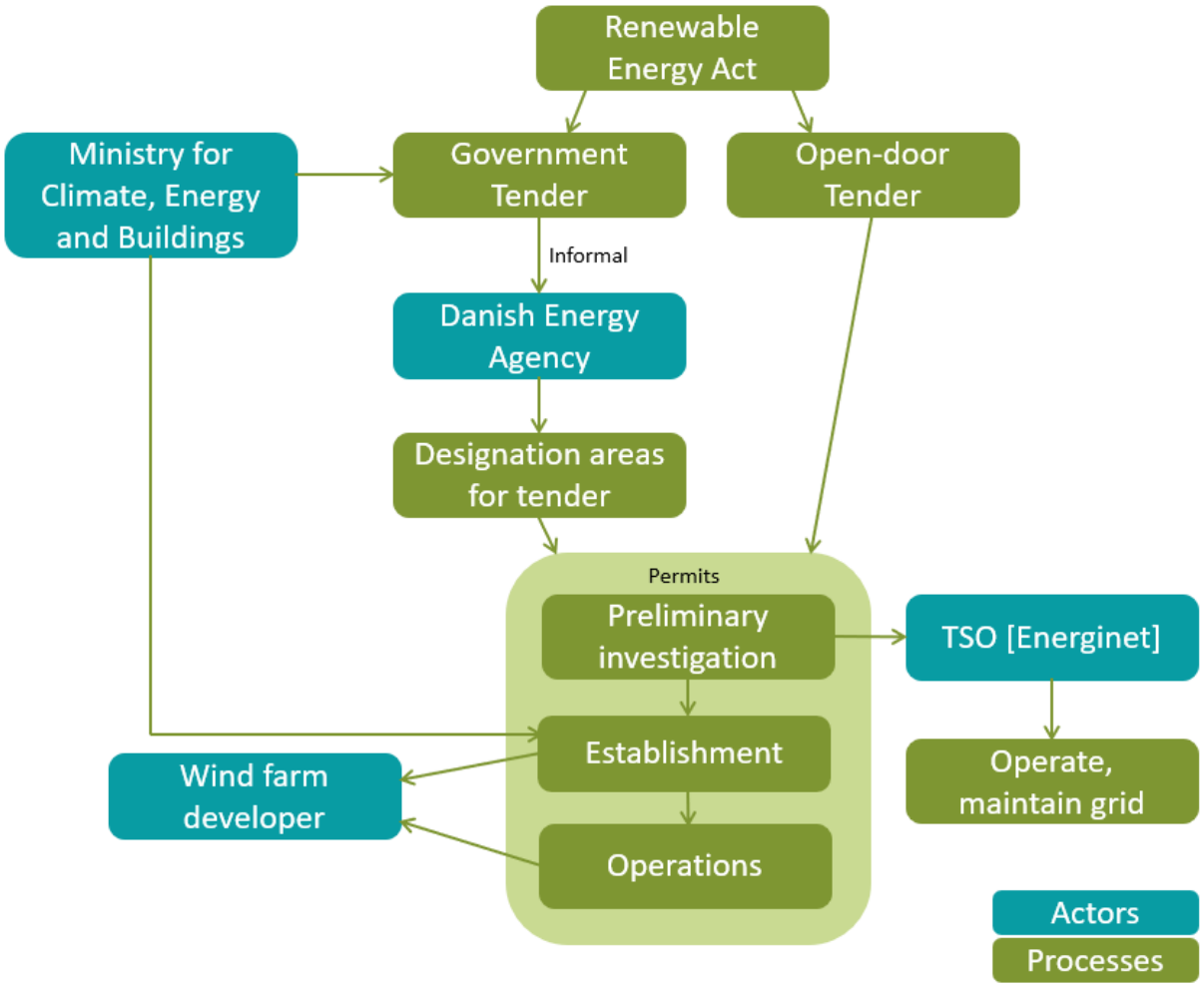


FIGURE 9: DEVELOPMENT FRAMEWORK FOR OFFSHORE WIND IN DENMARK (AUTHOR, 2021)

### 5.3.2 Kriegers Flak – Grid Combined Solution

In the first chapter of this research the Kriegers Flak – Combined grid solution was shortly mentioned as the first project that integrated interconnection with offshore wind. Kriegers Flak – Combined Grid Solution is located in the Baltic Sea and connects Denmark with Germany. The partners in this project were the TSO of Denmark, Energinet and another TSO operator from Germany, 50Hertz. There are three offshore wind platforms that are connected, the Danish Kriegers Flak B and the German Baltic 1 and 2. The platforms are located 25 kilometres from each other and have been connected to each other (Marten et al. 2018). The combined grid became operational December of 2020 (Energinet.dk, 2021) In the previous chapter, the 70% rule of the clean energy package was given as one of the biggest hurdles by the inerviewees. Since then, in 2020 Kriegers Flak: Grid combined solution has been exempted from this rule.

## 5.4 Analyzing the current national processes of the three countries

The previous sections of this chapter discussed the national development frameworks of each country which is participating within the NSWPH. Also, the internal power distribution within those countries were discussed. This sub-section focuses on the similarities and differences within those three countries and which current frameworks exist for offshore wind farm development. Insights in the processes for interconnection and offshore wind development are both from analyzing the frameworks, literature review and from the expert interviews.

### 5.4.1 Business-as-usual

The current process for designating wind farms and the possibility of interconnection could be defined as business as usual. Business as usual in this case means that the government designates areas, in which wind farms may be developed. No possible interconnection is indicated when deciding upon where wind farms can possibly be developed.

### 5.4.2 Offshore cable mandate differences

In Denmark Energinet does not hold any longer the mandate for the grid on the North Sea. When the NSWPH was first mentioned and the consortium started, Energinet did have the responsibility for the offshore grid. However, since 2019 the Danish government has decided that the onshore and offshore grid are unbundled. This is different in the case of Germany and the Netherlands. TenneT TSO has the mandate for offshore grid development and connecting cables to the onshore grid. However, in the interviews there has been given no implication that this will have an effect on the power balance within the consortium. Due to the Danish Government being very keen on having more offshore windfarm development, Energinet still holds a strong position to promote the project.

### 5.4.3 Transaction costs

The more stakeholders involved, the greater the transaction costs will be and the greater the need for consultation work. The process will result in more time need for completion as well as increased complexity. Therefore, the aim should be to create a problem that is smaller. The complexity within this project could be defined in the middle of the spectrum of de Roo & Voogd (2019).

Strategically thinking about a spatial planning issue that is on a far time horizon, but in order to accomplish that there is already action needed in order to accomplish it. Because of the uncertainty of the future, it is difficult to have decision-making in the process with absolute certainty. Material aspect. The current institutional design is not aligned with the challenges ahead for the development of the windfarms with future technologies which may change. In the material aspects are already uncertainties, therefore in the regulatory framework not uncertainty to anticipate on.

The development of interconnection is neither entirely bottom-up or top-down. Bottom-up in the sense of spontaneous development in the case of interconnection. However, on the scale it is happening it can also be defined as sectoral (operational). Institutional Design is a medium in order to achieve the goal. Not a goal itself. How to set up a process in such a way to achieve the goal.

First assumption is we neither have unlimited space nor unlimited resource. Therefore, careful decision-making upon where windfarms with interconnection is placed is required. Weighing alternatives, choosing, political decision-making. Goal is to achieve a vision in which the variables aid the overall problem. The current institutional design is not sufficient, the game is not fundamentally different.

### 5.4.4 Different legislation in countries

The following tables provide the legislation for each country regarding the planning and licensing for offshore windfarms. These are some of the rules the countries must abide by when developing offshore wind farms.

| Region | Planning, licensing, environmental protection | Year |
|---|---|---|
| Denmark | Promotion of Renewable energy act (VE-Lov) | 2009 |
| Germany | Offshore Wind Act (WindSeeG) | 2017 |
| The Netherlands | Offshore Wind Energy Act (Wet Wind op Zee) | 2015 |
| EU | Marine spatial planning directive 2014/89/EU | 2014 |

| | | |
|---|---|---|
| | Habitats Directive 92/43/EEC | 1992 |
| | Birds Directive 2009/147/EC | 2009 |
| | Marine Strategy Framework Directive 2008/56/CE | 2008 |
| | Strategic Environmental Assessment Directive 2001/42/EC | 2001 |
| | Strategic Environmental Impact Assessment Directive 2014/52EU | 2014 |

TABLE 2: OVERVIEW OF KEY LEGISLATION FOR DEVELOPMENT OF OFFSHORE WIND FARMS IN EUROPE (DECASTRO ET AL. 2019)

| Country | Main licenses required | Main consent bodies | Consent body does | Tender |
|---|---|---|---|---|
| **Denmark** | 1 License to carry out preliminary works<br>2 License to install offshore wind farms<br>3 License to exploit offshore wind farms | The Danish Energy agency | Carries out preliminary investigation and processes the main steps of the licensing procedure<br><br>One stop shop | Centralized / open door |
| **Germany** | 1 Planning approval (to install offshore wind farms in the EEZ)<br>2.Cabling approval (to lay cables in the territorial sea) | 1 BSH<br>2 Authorities of the relevant German coastal state | BSH carries out preliminary investigations and processes the main steps of the licensing procedure | Centralized |
| **The Netherlands** | The wind license (single consent that combines land tenure and permission to build) | RVO | Carries out preliminary investigations and processes the main steps of the licensing procedure, on behalf of EZK | Centralized |

TABLE 3: OVERVIEW OF LICENSES OF THE INVOLVED COUNTRIES (DECASTRO ET AL. 2019)

# CHAPTER 6: POWER DYNAMICS OF THE THREE COUNTRIES

This chapter sets out the power dynamics among the three involved countries in the NSWPH. The previous chapter set out the dynamics on the macro level, whereas the dynamics of the actors within these three countries will be on the meso level. Within literature, the dynamics between Denmark, Germany and the Netherlands has not yet been identified due to the NSWPH being the first cross-border project of this scale in the offshore windfarm sector and interconnection. Besides analyzing the power dynamics among the involved countries, the dynamics among the actors within the involved countries will be of relevance to the extent that they can have varying impacts and influence the process of designating windfarms nationally and internationally.

## 6.1 PERCEPTION OF THE NSWPH

The NSWPH is not an ordinary project, there is not a specific roadmap of how to designate windfarms on the North Sea and possible interconnection with neighboring countries. The current national processes do not have a framework that can easily be adapted for international processes. This is also acknowledged by the parties within the consortium. The interviewees who are directly involved within the NSWPH, acknowledge that this a major factor that contributes to the complexity of a project of such a scale. However, the NSWPH has been received positively by the European Commission. This also traces back to their nomination being part of the TYNDP. The interviewees confirm the positive perception of the NSWPH with the ENTSO-E, but also outside of these parties.

The initial perception of the project varied severely between the countries. The government of Denmark immediately "*embraces"* the project. The Dutch government perceived the project as a good idea on the long term, as they want to achieve their goals for more sustainable energy. However, there is not just offshore wind on the North Sea, but also other activities such as fisheries and marine spatial planning in general. Which is a different process, but also the question of how the electricity fits within the current Electricity network. The latter is also of great concern in Germany. They already struggle with the electricity network within their own borders, and the connection capacity to the shore is limited. This has resulted in some resistance towards NSWPH by the governmental parties, both the Federal government and the *Bundesländer* (federal states).

## 6.2 VERTICAL AND HORIZONTAL RELATIONSHIP BETWEEN THE INVOLVED PLAYERS

In the figure below, figure 10 provides an overview of the players involved in this game, how they interact with each other and whether they are considered playing on the same level, and if the relationship is horizontally or vertically. The players in this game operate on various levels, which has been demonstrated in the previous chapters. Those levels, which were derived from MLG are put into the figure with their corresponding player acting on that specific level. Also, additional lines between the players have been added when they have a direct interaction with each other. In case the relationship between the players are not equally balanced, an arrow will be used to demonstrate the unbalanced relationship. The player with the greater power will be on the side of the tail end of the arrow, and the player with less power on the side of the head of the arrow.

The subsections following the figure will provide further explanation regarding the contents of the figure 10.

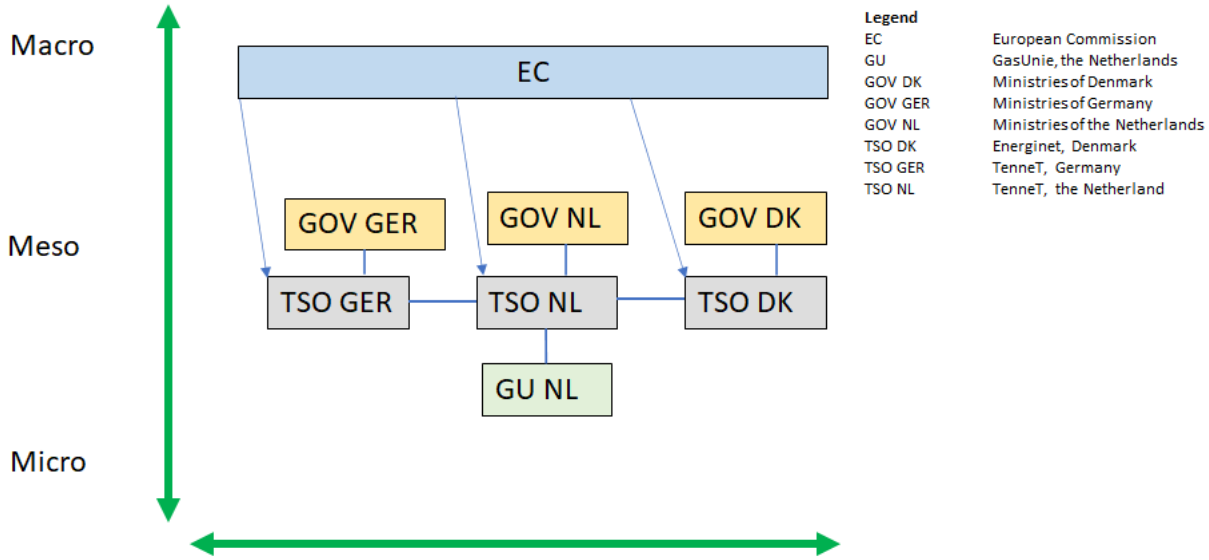


FIGURE 10: VERTICAL AND HORIZONTAL RELATIONSHIPS (AUTHOR, 2021)

The consortium of the NSWPH, exists of the players TenneT (representing both Germany and the Netherlands), Energinet and Gasunie (representing the Netherlands, and northern part of Germany). Those players, who are the driving force (project promoters) behind the NSWPH are operating from a meso level. They represent their respective country in the grid infrastructure network for either gas or electricity, both for Energinet of Denmark. Even though they have cross-border characteristics, they have to adhere to the legislation of their respective country.

The Dutch part of TenneT has significant ties to the Dutch government. TenneTs sole shareholder is the Dutch ministry of finance. Without the approval of the Dutch government, there will be no approval for the major investments in this project. However, another ministry within the Dutch Government, EZK, gives approval for the development framework. Without the backing of both ministries, TenneT NL would not able to develop the NSWPH. However, a small connotation must be made, because as a PCI European Funding may be possible, which would alleviate the financial burden of the government. However, the amounts that are able to come from European funding are marginal in the greater scope of the whole project if the NSWPH will come to full force. Nevertheless, European funding is very beneficial in the early stages (exploratory) of the project. = for research (As mentioned in chapter 4). Proper research will provide a stronger foundation to present ideas for the NSWPH to the government. The research could detail technical aspect, which in turn will relate back to the material aspect of this research. New technical developments may help convince other parties. However, proposal for this research requires a strong description in the application for the Connecting Europe Facility funding, as discussed in the fourth chapter.

Even though the European Union has no mandate to instruct countries to build on the North Sea, due to the nature that the Exclusive Economic Zone (EEZ) belongs to a particular country, they still can provide their support for innovative ideas. Therefore, an arrow has been drawn from the European Commission to the project promoters of the NSWPH (TSOs, Gasunie). However, there is a no major power imbalance between the European commission and project promoters, this is due to the EC is able to financially support the project promoters, but the promoters are not completely financially dependent upon them. Also, when looking to the overall costs for this project, especially future possible costs, they will almost completely be for the governments of the countries. In the case of the latter, the money comes from the taxpayers (micro). However, the EC can support projects such as the NSWPH by providing subsidies for research regarding technological developments regarding hydrogen, or for example reports regarding the market. In that manner, the European commission could express their support for projects such as the NSWPH. Backing from the European Commission also provides a greater position for the project promoters to negotiate with their respective governments.

## 6.3 National processes for development of offshore wind do not align

### 6.3.1 Internal issues

Previously was said that Germany struggles with their electricity distribution within their own borders. The internal network must first be resolved. This is what brought the greatest tension between the consortium and the German government. The electricity generated from the NSWPH would be connected in the North of Germany, whereas the southern part of Germany is the area where the power is greatly needed. The internal network within the borders is lacking the capacity of this amount and there is uncertainty whether this problem will be solved before the NSWPH is put into operation.

In order to solve this problem, either the network onshore must be strengthened, a greater demand near the shore where the NSWPH will be connected, or convert the generated power to another resource (e.g hydrogen. However, the latter is not as a possibility at this moment. Which will be discussed in the next subsection.

### 6.3.2 Inclusion of hydrogen possibly affecting the playing field

One possible scenario in the NSWPH may be the inclusion of hydrogen, by either converting it on a hub or on shore. One major player who will be pro hydrogen is Gasunie, which operates in the Netherlands and also in the Northern part of Germany. Gasunie has its already existing infrastructure of gas pipelines, which in the future may be refurbished to be able to hydrogen.

| Country | Actor for Gas |
|---|---|
| Denmark | Energinet |
| Germany | Gasunie |
| Netherlands | Gasunie |

If no electricity to hydrogen conversion is included within the NSWPH the logical conclusion is that Gasunie has no role within this game. Therefore, within the game Gasunie will hold a competitive stance, as it is either in or out. This is different in the case of Denmark, due to Energinet also being in control of the gas industry in Denmark. Therefore, Energinet will always be in the game, who can both vie for it's stakes concerning electricity and hydrogen, who as such can take on a cooperative role.

However, due to the internal issues within Germany the inclusion of Hydrogen will be highly unlikely. In the previous section was discussed that hydrogen may be a possible solution to handle the internal congestion problem of Germany. However, as derived from the interview, the main priority of the German government is to handle the internal congestion problem first, even before adding an additional influx of offshore wind in the North of Germany.

### 6.3.3 Modular development

The North Sea Wind Power Hub will not be built in its entirely, which is simply not feasible due to the scale of the project. It is probable that in time the hubs will be outrolled. During that time technological advancement in building techniques are highly probable. A solution for this is to have an adaptive governance approach. First concentrate on the first hub, and then continue to go to the other hubs. Also, anticipate on changing techniques. However, one interviewee also mentioned to simply accept that techniques changes and it is difficult to anticipate on changing techniques when developing the grid planning now.

### 6.3.4 Cultural differences

There are also cultural differences between the countries. The interviewees acknowledge a different approach between the countries in terms of communication. Germany is regarded, expressed by the Dutch interviewees as "more hierarchical", while the Netherlands and Denmark are more "open". This requires a different approach, which may possibly hinder the process of collaboration and getting towards agreements.

## 6.4 Establishing a successful cooperation

The first step in the process of a project of such an enormous scale is getting all parties on board to start with the project. Obstacles for getting towards a plan for the North Sea are the national struggles, the Netherlands for example has their national processes and laws. Ideally, this would be passed over with European regulation.

### 6.4.1 Financial aspect

The nomination of the NSWPH as a project of common interested helped bring publicity to the project and to give it status. This also meant for the consortium to go from just thinking conceptually towards more concrete plans. Moreover, the status of PCI gives access towards financial aid with the CEF. Possible financial support from the EU, will likely result in increased support from the national processes also.

However, even with financial support from the EU for anticipatory investments, it is only a certain percentage. Other parties will have to invest. Which also may cause friction between parties as it concerns major investments. This raises the question, what part will be appointed for by the TSO (and if) and what part of the bill by the market.

Another concern for a project of this scale is the possibility of stranded assets. To prevent, or diminish, the chance of stranded assets is to ensure binding agreements between the involved parties. For example, when the Dutch TSO is developing their offshore cable to the hub in their EEZ, and the developer of the Offshore Wind Farm backs out of building the hub, there should be a compensation for the TSO. By providing such clauses in the contracts, the risk of stranded assets can be reduced.

### 6.4.2 North Sea Agreement

At this moment countries work together voluntarily. The idea of an agreement is that there is an organization, or a governance, behind it, which in turn will ensure a definitive coordination on the grid on the North Sea. The agreement is specifically to guarantee the cooperation between the coastal countries.

In the case of multi-modal planning of hubs, the process should adapt to the new insights that are there along the way. The central ordering, good entity coming together and form a new policy that are adapted to each other. And adjust to new possible synergies.

Not centrally organized but coordinated. First coordinate one hub (and not do two different hubs at the same time), and then the other. And anticipate on new possible techniques, but also accept that certain techniques will change. Future cannot be predicted entirely, when you look back at the year 2000, people would have not anticipated upon what the world looks right now. Accept in the process that there is no perfect anticipation possible.

# CHAPTER 7: CONCLUSION & DISCUSSION

This chapter elaborates the main conclusions for this research to provide an answer for the main research questions. First, each sub-question is addressed individually. Thereafter, the main research question of this research is answered. Moreover, recommendations for further research are provided, followed by a reflection on the research process of this thesis.

## 7.1 TOWARDS A MAIN CONCLUSION

The aim of this research is to provide insights into the current existing frameworks for cross-border interconnection of the electricity power grid with possible integration of offshore wind, defining multi-lateral hybrid offshore infrastructure projects. In the first chapter the research problem was established, the lack of existing frameworks to facilitate interconnection projects with integration of offshore wind. Therefore, the main research question is:

> *What are the current rules of the game to build a multi-lateral hybrid offshore infrastructure hub in the North Sea?*

Five sub-questions were formulated to answer the main research question. The first sub-question encompassed the theoretical framework, which formed the basis for the sub-questions that followed. This sub-research question could derive a broad literature regarding institutional design, game theory and multi-level governance. The literature introduced a suitable framework to provide a new lens to analyse the case of the North Sea Wind Power Hub.

The second sub-question discussed the roles and responsibilities of the actors for the development of cross-border project, in particular the role of the European Union. The European Union, or in particular the European Commission, does not have a mandate to enforce the nation states to develop offshore wind parks on the North Sea. However, the European Commission does provide tools to promote cross-border projects for interconnection. In particular the Ten-Year Network Development Plan which provides the opportunity to be nominated a Project of Common Interest. The latter meaning the possibility to gain subsidies from the European Commission for the project. However, those subsidies are for research studies, not the commissioning of the windhubs in the future.

Sub-question 2 was seen from the macro perspective, whereas sub-question 3 delved into the meso perspective. The third sub-question aimed to provide the current state of affairs of the national processes to designate offshore wind farms and the facilitation to increases interconnection. In all three countries no framework is established to facilitate multi-lateral hybrid offshore infrastructure projects. The project promoters of the NSWPH, the TSOs and GasUnie all are quasi-governmental organisations. This may result in a complicated relationship due to them being the project promoters of the project, but also having accountability to the government. A great difference between the countries is that the TSO of Denmark, Energinet, no longer has the mandate for the development of the offshore grid. In the Netherlands, TenneT TSO has the mandate for both the onshore and offshore grid. Therefore, whenever the NSWPH will be commissioned, there is one less party involved for the Netherlands to bring the electricity on shore. However, the Netherlands does have to deal with Gasunie. In Germany, the internal landscape is quite different from the other two countries. First, Germany has multiple TSOs responsible for the onshore grid, of which TenneT GmbH is the responsible TSO for the north-western part. This has implication for the internal power dynamics, as the new possible influx of offshore wind from will put greater pressure on the grid and its capacity load. Currently, their onshore grid network will not support an extra influx of power from the North. The onshore electricity grid must be enforced first, before additional electricity can be added to the grid.

The fourth sub-questions dealt with the power dynamics in the decision-making processes, visualized in the figure 10. The figure presents the interaction (and power) of the various actors and levels. The distribution of

power is not simply either from top-down or bottom-up. The project promoters have a vertical relationship with the European Commission. The European Commission can provide influence to a certain degree with their regulations to facilitate subsidies and offer their support. They do not have the mandate to enforce interconnection with integration of offshore wind. Therefore, the balance of power is not simply from top to bottom. However, the EC does hold power over the nations with their 70% rule of the Clean Energy Package. The dynamics between the national governments and their corresponding TSOs are quite complex, the TSOs are the project promoters, but also have to adhere to the regulations of the national regulations.

Sub-question 5 provided an answer to what barriers exist currently for the cooperation and how they possibly can be overcome to ensure an efficient cooperation. One of the main barriers is the issue of the 70% rule of the Clean Energy Package, requiring to allocate 70% of the available capacity to cross-zonal trade.

## 7.2 Main conclusion

The sub-questions show the complexity of the decision-making processes, not only between the participating countries, but also within those countries. Currently, no established process of how to combine interconnection and offshore wind farms exist in the national development frameworks. Due to each country focusing on their own piece of the land in the North Sea.

In this research a game was played to define the who, the what and how of how to designate multi-lateral hybrid infrastructure projects on the North Sea. The three main players in this game were Denmark, Germany and the Netherlands. The federal governments of these countries were playing on the macro level, whereas the actors within those countries are on meso or even micro level.

Interconnection is a cross-border process, to which there is no specific framework. For offshore wind farms national processes are established. For the NSWPH the aim is to create hubs that are not only connected to one country, but besides generating wind, also can distribute the electricity to multiple countries if the demand requires. In order for the NSWPH to happen, multiple countries need to collaborate successfully. There is no sole winner or loser in this game, a balance must be found between participating parties.

Currently, the priorities between the national governments are not aligned. Mostly in the case of Germany. Germany has an internal issue of the distribution of their load capacity in their national grid. Moreover, their grid is divided to more than just one TSO. This also results in a greater difficulty for cooperation.

In the case of hydrogen, its relevant party Gasunie has a lesser degree of power in the game. The NSWPH is not fully dependent on Gasunie for a successful collaboration. The NSWPH can also be commissioned without the possible conversion of electricity to hydrogen. Even more, the benefits of hydrogen must outweigh the costs in order to make it a feasible option. Therefore, Gasunie is also depending on future technological developments and innovation.

## 7.3 Recommendations and future works

This research focused mainly on three different countries, which were the participants within the consortium of the NSWPH, and the European aspect. This research tried to provide insights of the interactions of the three levels of which the main players could be distinguished. However, this research only touched upon a part of the parties who are indirectly involved. Some of the parties, such as fisheries, were touched upon briefly, in further research those parties could also be included. They may not have a direct influence on the decision-making processes, but they are parties that should be taken into consideration, as they will be directly affected in the case the wind hubs are commissioned on the North Sea.

Moreover, the North Sea is not only surrounded by the three countries discussed in this research. The consortium of the NSWPH has expressed the possibility of including Norway and the United Kingdom in a later stage of the project. Especially, the case of the United Kingdom would be both challenging and interesting to research, due to the case of them leaving the European Union.

## 7.4. Reflection

This paragraph provides a reflection on the research process of this thesis. The aim of this research was to provide insights in the decision-making processes for multi-lateral hybrid offshore infrastructure projects and the power dynamics involved. The approach of this research was to approach it as if it were a game, to simplify interactions between the players and how it can affect the power balances in the decision-making process. The research focused on the three main countries and the European Union. In the theoretical framework of this research three different levels were discussed, the macro, meso and micro level on which the players of this research could be located. The players deemed most relevant in this research were mostly operating on the macro and meso level, the micro level was less represented in the analysis of this research. More representation of the micro-level would have given a more encompassing answer to the research question of this research.

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