The Political Economy of Energy Transitions

"Case studies of natural gas and offshore wind in the Netherlands and the United Kingdom"

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Abbreviations & acronyms

BWEA	British Wind Energy Association
CCGT	Combined Cycle Gas Turbines
CCPI	Climate Change Performance Index
CCS	Carbon Capture and Storage
CDM	Clean Development Mechanism
CE	Crown Estate (UK)
CfD	Contract for Difference
CORE	Centers Of Renewable Engineering
CO_2	Carbon dioxide
CPF	Carbon Price Floor (UK)
DECC	Department of Energy and Climate Change (UK)
DFID	Department for International Development (UK)
EIA	Energie Investerings Aftrek (NL)
EMR	Electricity Market Reform
EU/UK ETS	EU/UK Emission Trading Scheme
E&P	Exploration & Production
FES	Fonds Economische Structuurversterking (NL)
FiT	Feed-in-Tariff
GDP	Gross Domestic Product
GHG	Green House Gasses
GIB	Green Investment Bank (UK)
GIBFS	Green Investment Bank Financial Services Limited
LCOE	Levelised Costs Of Electricity
LDZ	Local Distribution Zone
LNG	Liquefied Natural Gas
MEP	Milieu Electriciteits Productie (NL)
NTS	National Transmission System
NWEA	Netherlands Wind Energie Associatie
ODI	Overseas development Institute
OSW	Offshore Wind
OSWF	Offshore Wind Farm
RET	Renewable Energy Technologies
ROC	Renewable Obligation Certificate
REB	Regulerende Energie Belasting (NL)
TJ	Terajoule
(M)BTU	(Million) British Termal Units
(M)TOE	(Million) Tons of Oil Equivalent

Measures

Table 1. Electrical energy - A measure of power over time	
1 kWh (kilowatt-hour)	1 kW for one hour
1 MWh (megawatt-hour)	1,000 kWh
1 GWh (gigawatt-hour	1,000,000 kWh
1 TWh (terawatt-hour)	1,000,000,000 kWh

1 TOE = 0,04187 Terajoule

1 GWh = 3.6 Terajoules

To: / From: multiply by:	TJ	Mtoe	MBtu	GWh
Terajoule (TJ)	1	2.388×10^{-5}	947.8	0.2778
Mtoe*	4.1868×10^{4}	1	3.968×10^{7}	11630
Million Btu	1.0551×10^{-3}	2.52×10^{-8}	1	2.931×10^{-4}
Gigawatt-hour	3.6	8.6×10^{-5}	3412	1

Prologue

Modern societies face structural problems in several domains. Examples of these problematic domains are the transport domain, the agricultural domain and the energy domain. Problems in the energy domain are related to carbon dioxide [CO_2] emissions, foreign resource dependency (e.g. oil, natural gas), energy reliability and future energy security. These problems are deeply rooted in dominant patterns of production and consumption and cannot easily be solved by simple end-of-pipe solutions. Unsuccessful attempts in the past to deal with these problems suggest that a more fundamental approach is necessary aiming at system innovation rather than system optimisation. In order to overcome the dominant patterns, a transition must take place in order to achieve a true future proof system innovation.

Wind power has been used as long as humans have put sails into the wind. Before fossil fuels, wind was man's major source of power for sailing ships, grinding grain, and pumping water. The beauty of ships and windmills were an endless source of inspiration for painters and photographers. Nowadays, a new momentum has come for wind energy to set sail and contribute to our future energy. Wind energy is a clean, renewable way of producing electricity. Wind turbines are very environmentally efficient and greenhouse gas emissions are not a big concern. As onshore wind has been criticised for its visual impact, noise pollution, and harm to birds (Han et al. 2009), offshore wind [OSW] resources are abundant, stronger, and blow more consistently than land-based wind resources. OSW turbines can be placed right off the coast on concrete platforms but also further out in the sea through the use of floating platforms (connected to the ground with temporary anchors) where wind is even stronger and it takes out the effect on many living sea organisms as the floating wind turbines do not harm the sea bed. Much of the future wind turbine deployment will undoubtedly be offshore. The North-sea is (due to current technologic capabilities) one of the most favourable locations for OSW in the world. With the benefit of shallow seas, strong winds, and population centres near the coast it provides the Netherlands and the UK with OSW resources and a huge potential for OSW energy deployment.

I would like to thank Mr. Rob Raven to give me the opportunity to conduct this research assignment which fits perfectly in my field of interest. Furthermore, I would like to thank Mr. Rob Stroeks and Mr. Paul op den Brouw for giving me the unique opportunity to have an internship abroad at the Netherlands embassy of Tokyo during the 2014 State Visit and obtain the great experience to collaborate with the Embassy, Ministry of Economic affairs and the participating organisations during the economic mission focused on offshore renewable energy. I also would like to thank Ms. Sandra van Thiel and Mr. Johan de Kruijf for their advice and support during my research trajectory.

1. Introduction

1.1 Introduction

In the energy domain, natural gas is a key fuel for many countries. It provides a large part of many countries' energy demand in particular for electricity generation. Both the Netherlands and the United Kingdom have significant natural gas reserves which are mainly used for transportation fuels and electricity generation. Despite of these large natural gas reserves it is estimated that both countries will run out of natural gas in a few decades. The simultaneous depletion of other energy resources (e.g. oil) endangers the future energy security. Furthermore, carbon emissions originating from burning coal and gas as main sources for electricity generation cause many environmental problems such as global warming. Therefore countries are focusing on alternative sources to spare the planet and secure their energy needs.

The development of different types of renewable energy resources is encouraged and promoted by Governments and businesses. In this thesis the role and economic impact of natural gas is studied in both the Netherlands and the United Kingdom or the energy transition towards one particular Renewable Energy Technology [RET], namely Offshore Wind [OSW]. The North-sea is due to current technologic capabilities a favourable location for OSW. With the benefit of shallow seas (most areas 20-50m depth), strong winds, and population centres near the coast, it provides the Netherlands and the United Kingdom with OSW resources and a huge potential for OSW energy deployment. An early study (Gaudiosi, 1994) estimated an OSW resource potential of 48.000km2 for the UK, and 5.600km2 for the Netherlands. In the recent years, the UK has created an effective protective space for OSW development through the enrolling of key political and economic interests (Kern, Smith, Shaw, Raven, Verhees, 2014). It seems that the United Kingdom is on the right path towards managing a sustainable transition in their energy systems while the Netherlands still is way behind. There are expectations that Dutch Government's interrelations with the natural gas system play a role in this reticence. For Great Brittan it is expected that The Crown Estate [CE], a British Governmental owned investment and development vehicle, took up the role as a 'system builder' which was very beneficial for the development of OSW in the UK (Kern, et al, 2014). The CE has played an influencing role in the transition towards Renewable energy systems.

In the past years, Governments have taken different choices for; promoting cleaner energy sources; achieving further energy efficiency or adaptation of Renewable Energy Technologies [RETs]. Many advanced industrialized countries have, in recent years, experienced a significant expansion of electricity production from renewables. Yet not much is known about the dynamics of the underlying policy choices in national promotion of RETs. Bernauer and Schaffer (2014) found that three factors play a particularly important role in pushing countries towards market-based support systems: the characteristics of the existing energy supply system, a federalist structure of the political system, and EU membership. Although so far, not much is known about the role of the political economy in the context of energy transitions. This study aims to open up research focused on this area.

In this thesis, attention is pointed towards natural gas which is used for the purpose of electricity generation, because natural gas as a source for electricity generation could eventually be replaced for electricity generated by OSW. Therefore not only the natural gas industry, but also the electricity industry is involved in the research for this thesis. In order to create the ability to understand the concept and meaning of an energy transition, it cannot be derived from solely the inspection of two energy systems (i.e. natural gas and offshore wind), but has to be regarded in the bigger picture. Other energy sources are just as relevant, just as the overarching eco-system.

1.2 Chapter's structure

The research objective aimed at during this study is twofold; first it analyses the political economy of energy transitions and second, it aims to explain the differences in the rates of diffusion of RETs between the Netherlands and the United Kingdom. The research approach taken will be discussed and give explanation to the chosen research design and the diagnostic framework which will be used through the thesis.

1.3 Problem description

The background to this study is a growing interest among sustainable energy transition researchers on the role of the political economy associated with reforms, in particular sustainable energy transitions. The recent growth in transition research justifies a critical reflection of sustainability transitions research in empirical and conceptual terms. Smith, Voß and Grinc (2010) have already made an important step in this direction, with a focus on the Multi-Level Perspective as one of the established frameworks in transitions research. The aim of this study is to enrich the agenda for future research on sustainability transitions and the role played by the political economy within a country. This study aims to show how both relate to each other with the purpose to come to a broader research agenda in the field of sustainability transitions.

The actual rate of diffusion of new RETs in the energy system varies considerably between countries. This study discloses whether the financial involvement in an energy system can be an explanatory factor for the large difference between the Netherlands and the United Kingdom in terms of deployment of sustainable energy systems, in this case offshore wind [OSW]. On the other hand it attempts to learn more about of the influence of Governmental interests in natural gas systems in relation to renewable energy transitions. This research is concerned with the question whether Government's financial interests in the natural gas sector hampers the development of the wind energy industry. This study investigates the role of political and economic aspects in both two energy systems and in particular the extent to which Governments are financially involved and how this influences policy strategies regarding energy transition. This study will research the underlying dynamics and explanatory mechanisms through a comparative case study between the Netherlands and the United Kingdom. The United Kingdom presents an interesting contrasting case, as it has an Exclusive Economic Zone [EEZ] adjacent to the Dutch one and similarly high ambitions regarding OSW, but has proven far more successful in recent years in terms of deployment, to the extent that it is the current market leader in OSW.

Governmental Renewable Energy [RE] policy interventions are typically designed around a constellation of objectives. That includes helping to develop a policy basis and regulatory framework (e.g. encouraging market entry for RE) as capacity building assistance for a Government agency or department. Moreover, pilot initiatives and information provision for private sector entrepreneurs are essential for assisting energy transitions. The approaches taken by the European Union and its member states assume that economic problems can be best addressed through regulated market-based approaches. Elaboration on the different approaches taken in both countries might provide insights in varying results achieved over the past ten years.

Technical capabilities often limit the possibilities in deployment of RETs. In reality these apparent technical barriers in the RE sector are often highly politicised. Removing fuel subsidies and raising electricity prices are unpopular with consumers with an interest in low energy prices and business with an interest in fossil fuels. They can exploit popular sentiment in order to stifle proposed policy change. Faced with such pressures, Governments and RE pressure groups, struggle to implement RE policy. Therefore the observation of many different stakeholders with varied interests are critical in creating deeper understanding of the barriers and opportunities in possible transition pathways towards RE.

Fossil fuel interests still have a strong economic case when the global impact of carbon emissions is not factored in. Lack of support for RE is not only a matter of unjust projection of vested interests but also because fossil fuels are still cheaper and more flexible sources of energy (e.g. oil, coal and Liquefied Natural Gas [LNG] can easily be transported). The economic case for RE is strengthening but still needs to be built over time. One important side note for natural gas is that the carbon emission argument does not fully hold because it is much less polluting and therefore a much cleaner source of energy compared to other fossil fuels as coal and oil. Still, natural gas is a depleting resource which eventually needs to be substituted within a few decades. Most importantly, arguments for the desire for economic growth and energy security predominates the case of RE, especially in times of economic downturn. Government involvement in promoting economic growth and securing cheap and reliable energy therefore does not automatically correspond with RE interests (Victor, 2013).

A political economy lens can broaden operational considerations beyond technical solutions to include an emphasis on stakeholders, institutions and processes by which policy reform is negotiated and played out in the policy arena. Understanding the relationship between policy-induced changes in incentives and sanctions on the one hand, and changes in behaviour and interests on the other hand, allows sustainable transition researchers and practitioners to engage more effectively in policy reforms and operations by considering stakeholder perspectives in operational design and implementation.

1.4 Research objective

The specific objectives of the study are twofold: first, to unpack the "black box" of political economy and analyse the political economy of energy transitions by applying a social analysis framework to the study of stakeholder interests, incentives, institutions, risks, opportunities, and processes from a social analysis perspective. The second objective is to explain the differences between the Netherlands and the United Kingdom in order to illustrate "what worked, why and how" for a better understanding and management of political economy issues in the design and implementation of sustainable energy transitions.

1.5 Research question

In order to find an answer to the question to what extent hampers a Government's financial interests in the natural gas sector the development of the wind energy industry, the following research question has been formulated:

"How are policy strategies regarding energy transition in the Netherlands and the United Kingdom influenced by the Government's financial involvement with fossil (i.e. natural gas) and Renewable Energy Technologies (i.e. offshore wind energy)?"

Sub-questions:

1. How have energy-policies regarding natural gas developed?
2. What is the country's natural gas ratio to the total energy mix and what is the State's involvement regarding natural gas production and revenues?
3. What renewable energy policies and support mechanisms regarding offshore wind were developed in both countries?
4. What is the State's (financial) involvement and benefits regarding offshore wind?
5. What is the relationship between the financial involvements and policy choices?

Answering all the sub-questions leads to the answer on the main research question.

1.6 Social relevance

When it comes to the social relevance many different perspectives can be taken. In first place, energy security is a critical matter for a nation. Energy resources need to be secured and made available for energy consumption. Access to affordable energy is essential for the functioning of modern economies. By the extraction of fossil fuels accessibility to affordable resources will decrease. Energy plays an important role in the national security of every country as a fuel to power the economic engine. A major concern in today's society is the current unsustainable energy supply. The industrial revolution has led to the wide-scale extraction of our fossil fuels in a very small period of time, and it is only a matter of time when they run out. This mass consumption is not only leaving the fossil fuels all but gone, it also seriously impacts the climate. From this other perspective, our climate is threatened by greenhouse gases [GHG] which cause polluted air and also global warming. The current emission of greenhouse gases needs to be reduced dramatically. Energy supplies must decarbonise by switching to renewable sources and demands must be reduced by means of greater efficiency. The so called "Energy transition" is the shift by several countries to sustainable economies by means of renewable energy [RE], energy efficiency and sustainable development. The main concern in this research topic is that national Governments still are financially entangled with fossil fuels. These fossil resources, when owned by a nation can be a main source of income and fulfil the country's energy demands. RE systems, at the other hand, are new and still underdeveloped in most countries. Outcome of this study may provide insights on which aspects of a nation's political economy influence a nation's ability to move towards a more sustainable energy systems.

1.7 Scientific relevance

The objective of this thesis is identifying and understanding in what manner Governmental financial involvement and economic interests in established energy systems can from a barrier or facilitator towards renewable energy transitions. Questions as, in what matter can Governmental financial involvement in an energy system withholds or stimulates a country to make an energy transition, and in what way can an energy transition be unattractive for Governments, should be answered. In what manner do national gas reserves play a role as a potential barrier towards a renewable energy transition? And on the other hand, how does a Governmental shareholders stake in renewable energy development/deployment plays a role in the transition towards renewable energy systems? Therefore this is an explorative type of research.

1.8 Preview on the theory and methods

The British Overseas Development Institute [ODI] has developed a framework for the analysis of the political economy of sectors (Edelmann, 2009). This framework hand a proper structure for the outline of the analysis and report.

1.9 Report Structure and reading guide

The structure of the report is as follows: Chapter 2 starts with an elaboration on the concepts of political economy and socio-technical transitions. It continues with a literature review on the analysis of the political economy and filters out the relevant theories. Furthermore it summarizes the research objective and approach taken in this work to political economy. The last paragraph discusses the research design by elaboration on the diagnostic framework applied through this thesis. Chapter 3 discusses the methodology and techniques used through this research. Chapter 4 analyses the natural gas sector in both the Netherlands and the United Kingdom. Chapter 5 analyses the political economy of the OSW sector in both countries. Chapter 6 summarizes the findings, the aspects of energy policy reform, and discusses the political economy issues that are particular to both sectors. Furthermore it concludes by pulling out a number of operational implications for energy transition researchers and practitioners in relation to managing political economy risks and opportunities in policy reform, reflects on the research limitations during the study and also elaborates on the research agenda for future research.

2. Theory

2.1 Theory chosen and rationale

In this study theories of political economy analysis serve as the fundamental basis. A political economy lens can help us to better understand the dynamics of policy reform processes. Stakeholders' interests and the power relations between social actors obviously influence their support or opposition to the reform. The sequencing and timing of actions associated with policy reforms can also determine the level of tension and conflict, the duration, and ultimately the success or failure of reforms. This study intends to capture the work in complex political economies. A vital component of understanding the context is, understanding the political dynamics of policy change and sustainable transitions. How are reforms designed, how are they perceived and who will support, oppose or attempt to change the proposals which have been made.

The other fundamental bases drawn upon are theories of energy policy analysis. Historically there have been three approaches evident in the development of proposals for national energy policy: *Supply expansion*; *Demand suppression* and *Cost analysis* (Hamilton, 2013:p3). While all three approaches are critical focus points in energy transitions, this study focuses on mainly on the *Cost analysis* approach. The comparison of costs for each available energy resource has determined, and will continue to determine policy choices about which energy technology will be used in the future. The Cost analysis compares various conventional and renewable energy technologies [RETs] in terms of their respective *Dollar Costs*; *Environmental Costs* and *National energy Security costs* to the nation (Hamilton, 2013:p6). It is evident that analysing or formulating national energy policy is not a merely domestic, internal policy matter, domestic and foreign policies are intertwined and interact in complex ways. Rather than producing a single optimum energy technology choice, the mix of energy technologies with the lowest overall costs in the three above mentioned categories would produce the most viable national energy policy.

2.2 Chapter's structure

To get a proper understanding of the definitions which take centre stage in this thesis, those will be studied and explained in first place. Starting with an elaboration on the definition of political economy, subsequently theories of energy policy will be studied in order to gather understanding how both concepts are related to each other. This will lead to a common understanding of the concept of the political economy of socio-technical transitions, which in this study solely focuses around socio-technical transition of energy. In order to conduct an analysis of its political economy, deeper understanding of the political economy analysis needs to be found. Therefore the following section will elaborate on the academic literature of political economy analysis. Furthermore, relevant policy- and decision making models will be discussed in order to gather thoughts on potential conceptual models which can be applicable on this study.

2.3 Defining the concept of Political Economy

The definition of political economy is subject to multiple understandings. The origin can be found in the work of Adam Smith (Wealth of Nations, 1776), David Ricardo (Principles of Political Economy and Taxation, 1817), Karl Marx (Capital, 1867), John Maynard Keynes (The General Theory of Employment, Interest and Money, 1936) and Milton Friedman (Capitalism and Freedom, 1962). In this body of work, the term referred to the *conditions of production organization in nation-states* or what today is understood as 'economics'.

Due to the lack of a common interdisciplinary understanding and an academic definition of the term 'political economy' political economy approaches are far from representing a homogenous group of approaches. Consequently, these approaches can mean very different things to people with different academic and professional backgrounds. The understanding and scope of political economy vary considerably between the academic disciplines dealing with political economy issues. The understanding of political economy also changed over time, depending on the predominant school of thought. Political scientists, economists and sociologists all understand the term differently. As a result, there is no commonly agreed short definition of political economy.

In political science, political economy is broadly defined as the 'interaction between the economy, the polity and society' (Bealey, & Johnson, 1999). **In economics**, political economy is defined as a synonym for economics. According to this interpretation, political economy is a 'traditional term for the study of economics. More recently it has been referred to as simply "economics"' (Bannock, & Baxter, 2003). **In sociology**, political economy is broadly defined as the 'interdependent workings and interests of political and economic systems'. In this understanding, political economy draws attention to how the State actively 'protects and promotes the interests of those who dominate and benefit most from it' and how the State 'depends on the economic system for its resources' (Johnson, 2000).

In this research the term is defined as the analysis that studies the linkages between politics and economics, drawing on theories of economics, law as well as political and social sciences (Hague and Harrop, 2010). In the analysis in this study the 'political economy' is understood as: *"The study of the interactions between political processes and economic variables".* Now understanding is gathered about the concept of political economy, the following step is to start with information gathering on the analysis of a political economy.

2.4 Analysis of the Political Economy

Sustainable transition development practitioners and researchers need to be aware of the different understandings and scopes of political economy before they take their own stand and develop or refine sector-level political economy approaches. Depending on the understanding of political economy, approaches will focus on very different perspectives, actors and issues.

> *"Political economy approaches could focus on a wider social science perspective or a narrow economics-centred perspective. Moreover, the influence of the political system on the economic system (e.g. economic policy) or the influence of the economic system on the political system (e.g. lobbyism or strikes); the political system's need for the economic system (e.g. public revenues) or the economic system's need for the political system (e.g. trade liberalisation); the nature of political and economic systems (e.g. democracy and social market economy) or the nature of political and economic processes (e.g. democratisation and industrialisation); the role of specific societal actors in development (e.g. middle class or bourgeoisie) or the interaction of these actors (e.g. peasants vs. landlords) or the role of political and economic institutions in shaping incentives and constraints (e.g. rent-seeking or market access)"* (Edelman, 2009).

In recent years, development researchers have started to develop a shared understanding of political economy. Recent publications are using the label "political economy analysis" for a new type of inter- and multidisciplinary approaches in development research and practice (Landell-Mills, Williams, and Duncan, 2006). According to Landell-Mills et al. (2006), 'new political economy approaches', have a broader perspective. They do not only look at the interrelationship of political and economic factors, but also explicitly take into account the social and cultural factors impacting on the policy process.

2.5 Policy- and decision-making models

As starting point for finding an appropriate framework for the analysis of the political economy of energy transitions a look is taken at relevant policy models and decision-making models in order to gather ideas for a framework to analyse decisions which have been made. Analyses of decision-making claim to explain or describe how a decision, or series of decisions came to be made. Decision analysis encompasses a range of academic disciplines and frameworks. For something as complex as decision-making by individuals and groups no one discipline or framework can possibly explain everything. In highlighting one aspect another is ignored or underestimated. Models of decision-making are drawn from a number of social sciences, these include; political science, sociology, organizational theory, economics, psychology and management. In analysing the decision-making process these disciplines can be grouped into five major approaches and categories: 1) *Power approach*; 2) *Rationality approach*; 3) *Public choice approach and its alternatives*; 4) *Institutional approach*; 5) *Informal- and psychological approach* (Parsons, 1995:p247-248).

The most common way of approaching political economy in development work tends to be from either an economic perspective using **rational choice-based models**, or from a political scientific perspective through **power-based models** (World Bank, 2008). The rational choice approach leads economists to investigate the conditions under which rational individuals are willing to cooperate in collective action problems. This implies the analysis of *institutions*, defined here as *formal and informal rules underlying political powers, bureaucratic agencies or social and private organizations*. It also implies giving recommendations to improve institutions to guide individuals' behaviour and exchanges so that they can still maximize their own benefit without harming other individuals and the environment (Moe, 2005).

Critics of the rational choice perspective on political economy raise the question how and especially by whom institutions are built and can be re-built. They question the capacity of this kind of political economy analysis to engage effectively with political dimensions of policy issues and thus to inform decision-making. Following this power-based view of political economy, some political scientists (Bates, 1989; Levi 1988; Moe, 2005; Olson, 1993) have argued that power is a missing perspective in the rational choice approach. They emphasize the potentially destructive nature that power can have and therefore suggest integrating 'power' into the rational choice perspective. The power-based model forms the basis of the political economy of reform approach taken here. It draws upon economic, social and political theory in order to understand how political, economic and social actors, institutions and processes influence each other. The power-based perspective is strongly linked with the economic models and a substantial number of development studies in political economy are built on this perspective. This work is partly based on a power-based approach.

Other relevant policy- and decision-making theories include: Incrementalism (Lindblom, 1959; 1979) and the process of lock-in (Arthur, 1989). Incrementalism refers to the method of change by which many small policy changes are enacted over time in order to create a larger broad based policy change. This view (also called Gradualism) takes a "baby-steps", "Muddling Through" approach to decision-making processes. This was the theoretical policy of rationality developed by Lindblom to be seen as a middle way between the rational actor model and bounded rationality, as both long term goal driven policy rationality and satisficing were not seen as adequate. The concept of lock-in process can be described as followed. Once a (gas fired) power plant has been installed it is likely to be used throughout its lifetime. The same applies to infrastructure (e.g. gas pipelines). Once it is put in place, it may in turn lead to further uptake of the same technology. This is called 'lock-in' effects.

2.6 Cost-price relevant subjects

Energy security

Energy security is the association between national security and the availability of natural resources for energy consumption. Access to affordable energy has become essential to the functioning of modern economies. However, the uneven distribution of energy supplies among countries has led to significant vulnerabilities, also known as "energy insecurity", which is defined as: *"the loss of economic welfare that may occur as a result of a change in the price and availability of energy"* (Bohi, and Toman, 1996). After the 1973 oil embargo, President Richard Nixon was the first who articulated the phrase *"energy independence"*, but up to today the situation is increasingly at odds with reality for the United States. The concept of energy security is interpreted differently by different countries. In most of the developed world the usual definition of energy security is simply the availability of sufficient supplies at affordable prices. In Europe, the major debate centres on how to manage dependence on imported natural gas. Energy-exporting countries focus on maintaining the "security of demand" for their exports, which generate the overwhelming share of their Government revenues. The concern for developing countries is how changes in energy prices affect their balance of payments (Yergin, 2006). Security and reliability of energy supply is a key concern for national Governments. Because of importing and exporting of energy sources, countries are interdependent when it comes to energy security. Gas import is a perfect example of the energy dependency. Due to decreasing natural gas reserves in the UK and uncertainty around the safety of scale gas drilling, the country is relying more and more on imports from Russia. Relying on import fuels for generating electricity can be bad for the security of supply. Increasing demand drives up prices and political instability, such as the current conflict between Russia and Ukraine which can threaten supplies. Nowadays, the growing integration of global energy markets and the rising demand for energy worldwide indicates the need to broaden the definition of energy security. It calls for a global approach for energy security, based on a realistic assessment of differing national interests (Brown, 2003:p169).

Contribution of renewables to energy security

As the resources that have been so crucial to survival in the world to this day start declining in numbers, countries will begin to realize that the need for renewable fuel sources will be as vital as ever. For those countries where growing dependence on imported gas is a significant energy security issue, renewable technologies can provide alternative sources of electric power. The deployment of renewable technologies usually increases the diversity of electricity sources and, through local generation, contributes to the flexibility of the system and its resistance to central shocks. Although, the issue of the variability of renewable electricity production is a major concern for energy security, its significance and reliability depends on a range of factors. Some renewable energy technologies [RETs] such as hydro, wind, Solar Photovoltaic [PV], tidal depend on different natural cycles and are therefore subject to variability on differing timescales. Therefore power supply from renewable technologies does not match demand, whereas traditional sources allow adjustment of supply to demand. This has to be taken into account in considering energy security.

Providing energy from a range of sources to meet society's needs should ideally: 1) *provide secure supplies*; 2) *be affordable* and; 3) *have minimal impact on the environment*. However these three Government goals often compete. "Political discussion of energy tends to revolve around what is often called the "trilemma" of energy policy: how to balance the issues of *energy security*, *climate change* and *affordability*" (Wyman, 2011). RETs have the potential to contribute to energy security as well as environmental objectives on the national, regional and global levels. While, in many cases, the environmental objectives will be uppermost, Governments and industry should also take into account the security benefits of renewables (and occasionally dis-benefits) in framing their policies. In order to bring down costs and achieve market penetration these policies will need to include support funding, incentives to stimulate private investment, Government procurement and buy-down actions, facilitation of international collaboration, and removal of barriers to technology use (IEA, 2007).

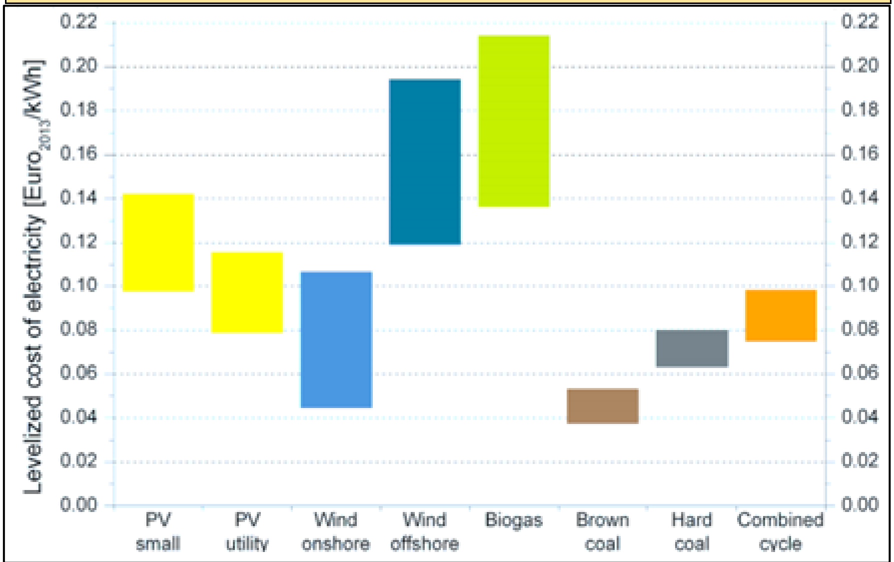
The social costs of energy generation

The successful development and utilization of fossil fuels, which generate carbon dioxide [CO_2], facilitated successive industrial revolutions. But there is a strong causal relationship between world GDP and CO_2-emissions. In order to compare different methods of electricity generation on its costs, the Levelised Cost Of Electricity [LCOE] also known as Levelised Energy Cost [LEC] is a frequently applied measure. It is an economic assessment of the average total cost to build and operate a power-generating asset over its lifetime divided by the total power output of the asset over that lifetime. The LCOE can also be regarded as the cost at which electricity must be generated in order to break-even over the lifetime of the project. Unfortunately, CO_2-emissions are often not taken into account in the LCOE calculation. When this would be done, fossil fuels would be a lot less profitable. A new but still expensive technology allows capturing CO_2-emissions from fossil fuel plants. Carbon Capture and Storage [CCS] is the process of capturing CO_2 waste from fossil fuel power plants, transporting it to a storage site, and depositing it where it will not enter the atmosphere, normally an underground geological formation such as depleted oil and gas fields. The aim is to prevent the release of large quantities of CO_2 into the atmosphere. When CCS is included in the LCOE of gas fired power plants, the eventual costs of gas firing for electricity generation is much higher. Coal is the most carbon-intensive fuel per unit of energy produced, and so is the most sensitive of all the fossil fuels to climate change policy. Although gas firing does not emit the amounts of CO_2 as coal firing does, it still contributes largely to the LCOE of gas firing. In calculating the LCOE of gas firing CCS costs also needs to be included. This would make a better and fairer comparison between de LCOE of natural gas firing and offshore wind. Moreover, the price of electricity generation fuelled by fossil fuels largely depends on the actual fossil fuel prices. It is expected that fossil fuel prices will rise in the forthcoming years, as scarcity grows.

Table 2. Technology specific costs of electricity - 2010	
Technology	**Cost range (£/MWh)**
Natural gas turbine, no CCS [CO_2 capture]	£55 - £110
Natural gas turbines with CCS [CO_2 capture]	£60 – £130
Biomass	£60 – £120
New nuclear	£80 – £105
Onshore wind	£80 – £110
Coal with CO_2 capture	£100 – £155
Solar farms (PV)	£125 – £180
Offshore wind [OSW]	£150 – £210
Tidal power	£155 – £390

(Parsons Brinckerhoff, 2010)

Figure 1. Levelised Costs of Electricity - 2013



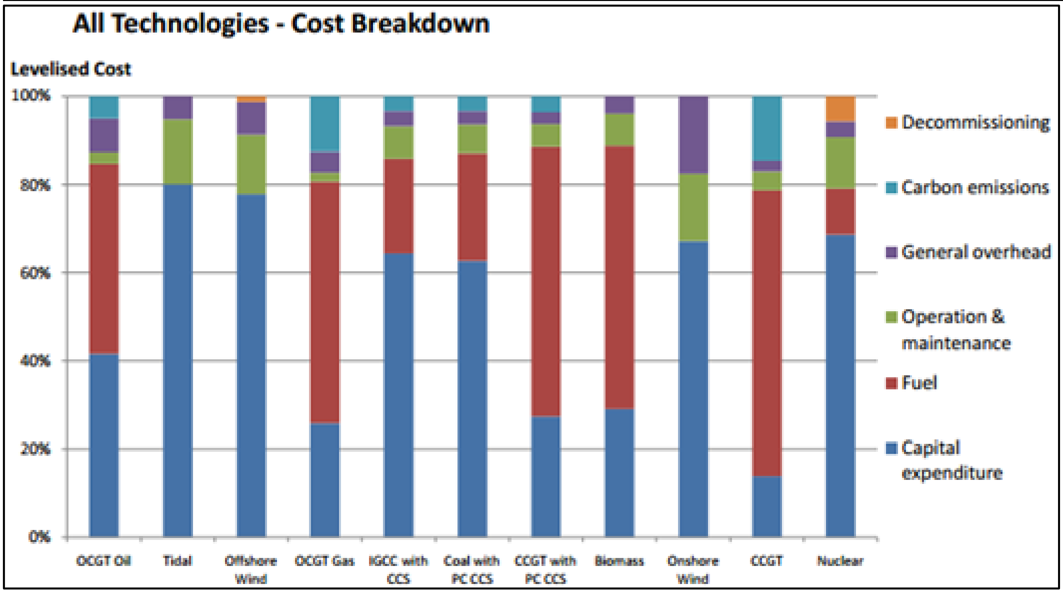
(Fraunhofer, 2013)

As the overview above previews, in 2013 the costs of natural gas firing ("Combined cycle") lays between €75,- and €99,-/MWh. For OSW energy the LCOE lays between €120,- and €195,-/MWh. This study is conducted by German research organization, Fraunhofer.

Cost Breakdown of energy technologies

The cost breakdown graph emphasises the large variations in capital and fuel price contributions among the different plant types. The renewable technologies all have high capital cost contributions whereas the gas and oil burning gas turbine types all have substantial fuel cost components. Nuclear plant is similar to the renewables in having a high capital cost element and only a small fuel cost component. The plant types including carbon capture and storage [CCS] have a significantly higher capital cost contribution, reflecting the high investment cost for these plant types.

Figure 2. All Technologies – Cost Breakdown



(Parsons Brinckerhoff, 2013)

Support systems for renewables

The literature has made some theoretical and empirical comparisons between different forms of support for the production of renewable electricity, especially between Feed-in-Tariffs [FiT] and obligation systems using green certificates. From a theoretical perspective, the obligation system has the main advantage that it is based on the premise of market forces. The probability of "windfall profits" (extra income where no costs come along with) would therefore be smaller than in a system of Feed-in-Tariffs, and cost-efficiency would be higher. Moreover, it would provide more possibilities to steer and achieve the objectives. Feed-in-Tariffs on the other hand offer investors more certainty and would therefore be more effective in stimulating new investments. Moreover, the Feed-in-Tariff system is simpler and cheaper in the implementation.

Empirical comparisons on the other hand are in line with the findings of the European Commission. It shows that the current functioning of obligation systems, combined with green certificates on a national scale have not yet produced the expected and desired goal achievement. In countries with Feed-in-Tariff systems, renewable electricity production grew significantly faster. Also the costs were in the cases studied with obligation systems generally higher than for feed-in systems. The reason for this disappointing performance is noted in the literature on the lack of experience with the obligation system, which investors offered insufficient guarantees. The relatively small scale of national markets for green certificates would also cause that intended market forces do not function optimally (Linden, et al. 2005).

Carbon pricing

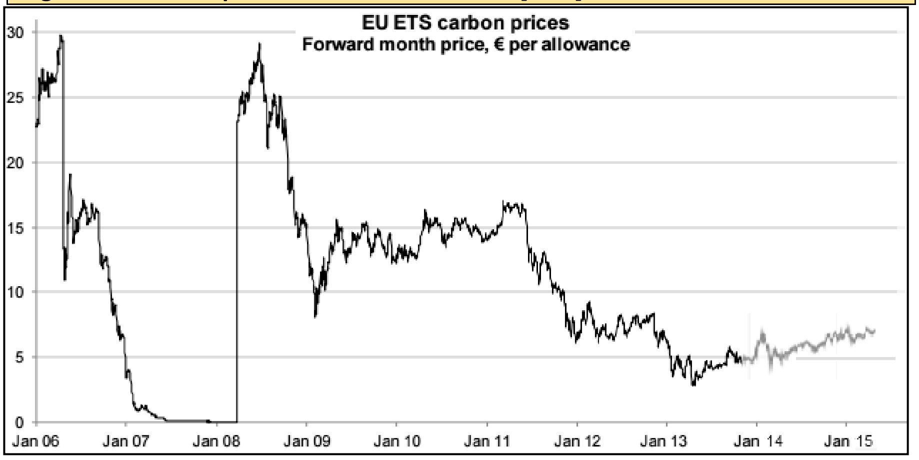
Governments aim to bring down emissions and drive investment into cleaner options. Therefore a price has been put on carbon. There are several paths Governments can take to price carbon. Instead of dictating who should reduce emissions where and how, a carbon price gives an economic signal and polluters decide for themselves whether to discontinue their polluting activity, reduce emissions, or continue polluting and pay for it. The carbon price stimulates clean technology and market innovation, fuelling new, low-carbon drivers of economic growth. There are two main types of carbon pricing: carbon taxes and Emissions Trading Systems [ETS]. A carbon tax directly sets a price on carbon by defining a tax rate on greenhouse gas emissions or, more commonly on the carbon content of fossil fuels. An ETS, sometimes referred to as a cap-and-trade system, is a market-based approach used to control pollution by providing economic incentives for achieving reductions in the emissions of pollutants (Stavins, 2000: 2001).

In 2005 the European Union has introduced the emissions trading system: the EU Emission Trading Scheme [EU-ETS]. With emissions trading, fossil fuels such as coal should become a less competitive fuel than the renewable options. EU-ETS is the cornerstone of the European Union's climate policy and is the key tool for reducing industrial greenhouse gas emissions cost-effectively. This system is the first and still by far the biggest international system for trading greenhouse gas emission allowances (Ellerman and Joskow, 2008). As of 2013, the EU-ETS covers more than 11,000 power stations, industrial plants and installations as metal, chemicals, glass, cement and paper plants and recently also includes the airline industry. EU-ETS includes 31 countries which are all 28 EU-member states plus Iceland, Norway, and Liechtenstein (European Commission, 2013). The first two phases of the EU-ETS (2005-2007 followed up by 2008-2012) resulted in modest emissions reductions. Now that the second phase of the EU ETS has reached its end, the third and final phase (2013-2020) is underway (European Commission, 2013).

The principles of carbon markets were already established in the 1997 Kyoto Protocol, but to date there have been only a few greenhouse gas [GHG] emissions reductions that can be attributed to these measures. The two most important carbon markets so far are the EU-ETS and the United Nations carbon offsetting scheme, Clean Development Mechanism [CDM]. The EU-ETS is the by far the most important part of the European climate policy. All the power plants and other large installations which are included in the scheme are only allowed to emit CO_2 when they hold the required CO_2-Certificates. The EU only makes a limited number of these certificates available each year. This makes the total allowable emissions of the polluting industries predetermined. In each of the following years a fixed declining rate of CO_2-Certificates will be issued. This should bring the total CO_2-emission down over years. Companies that have certificates can sell them. As fewer certificates become available, the price of CO_2-emissions will increase, and with time the green economy must become increasingly competitive (European Commission, 2008).

Meanwhile criticism has grown on the EU-ETS. Besides the disagreement over the emissions targets there is a much more fundamental problem. The emissions trading scheme was meant to put a price on carbon in order to encourage the use of alternative energy sources. But poor policy design such as bad alignment between EU policy and member State level policy, the recent recession and too many exemptions had the subsequent effect that the price not has gone up (Laing, et al., 2013). Since the launch of the ETS in 2005, the carbon price has increased more or less steadily to a peak level in April 2006 of about €30,- per ton CO_2, then dipped on several occasions beneath the expected level and crashed not much later. In the recent years the price stabilized between €4,- and €7,- (www.eex.com).

Figure 3. ECX European Emission Allowances [EUA] Futures



(Quandl, 2015)

As a result of the failing carbon markets many financial institutions have stopped their carbon trading activities, reduced investments in renewable energy funds and due to their assumption that climate change is inevitable, firms are investing in businesses that will profit from global warming. Many big energy companies are getting out of renewables and instead focus on profits from increased extraction of fossil fuels. Newbery (2009) commented that the EU-ETS was not delivering the stable carbon price necessary for long-term, low-carbon investment decisions. He suggested that efforts should be made to stabilize carbon price, e.g., by having a price ceiling and a price floor. Fluctuations in the price of carbon in the form of EU-ETS allowances have resulted in uncertainty for investors in low carbon technologies.

2.7 Research approach

Over the last decade an increasing number of development partners and research institutes have developed a wide range of approaches, frameworks and tools for political economy analysis. So far, only few resources provides development partners and research institutes with an overview of existing sector-level political economy approaches, frameworks and tools for analysing and managing the political dynamics of sector reforms (Edelmann, 2009). This overview can be found in appendix 1.

According to the Organisation for Economic Co-operation and Development [OECD], political economy approaches are *"concerned with the interaction of political and economic processes in a society: the distribution of power and wealth between different groups and individuals, and the processes that create, sustain and transform these relationships over time"* (Collinson, 2003:p3). Following the OECD definition, political economy studies *"recognize that the policy environment is shaped by political, economic, social, cultural and institutional factors*". They analyse all factors influencing the political process (OECD/DAC, 2005).

The power-based model is an important approach in studies on the political economy of reforms. It draws upon economic, social and political theory in order to understand how political, economic and social actors, institutions and processes influence each other. This model in turn facilitates an analysis of how political economy factors constitute risks or opportunities for country-driven and country–owned change through development intervention. The approach will look at how actors use their position to protect or strengthen their political or economic interests. It can reveal the conditions and processes under which political actors or political entrepreneurs manoeuvre within institutional contexts to build coalitions, negotiate, build consensus, and bargain to generate new policies, new legislation, and new institutions. Although some of the aspects in the power-based approach are rather difficult to analyse as well as fully relevant in this study on state's financial involvement. To further elaborate the financial involvements additional financial indicators will be applied in order to disclose whether financial involvement in the natural gas system has been a barrier for offshore wind development.

2.8 Research Design

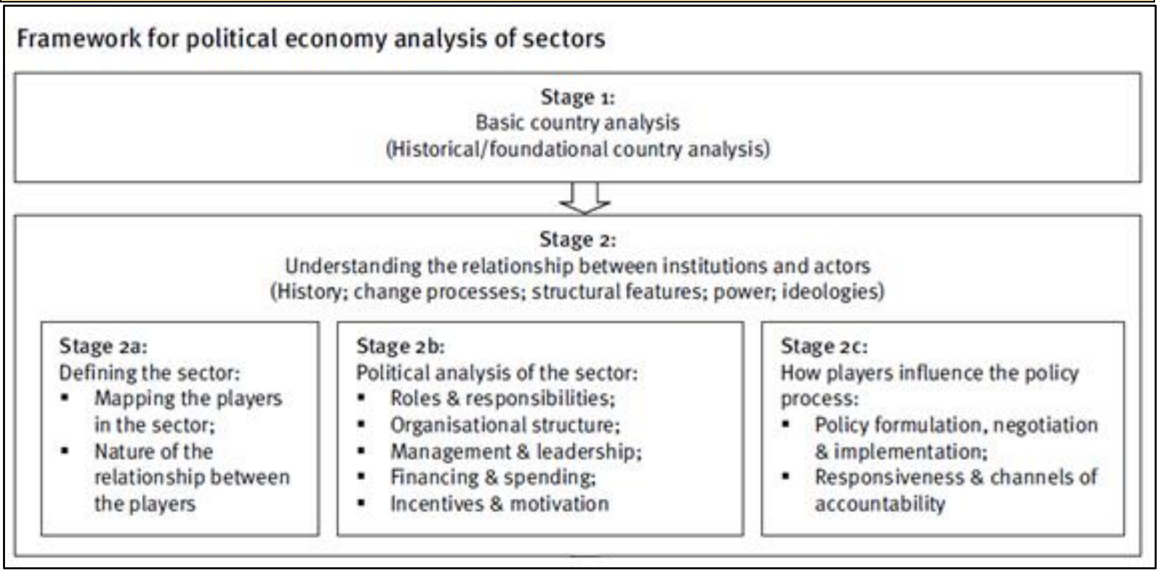
2.8.1. Research model

After an extensive search a model for the analysis of the political economy has been found as the baseline for this work. It is a political economy framework derived from the UK Department for International Development [DFID]: *"An analytical framework for understanding the political economy of sectors and policy arenas"* (Moncrieffe, & Luttrell, 2005). In fact, the DIFD's focus lies on the development of sectors within developing economies. Although the natural gas sector is a mature industry, the OSW sector can be regarded as a developing sector, therefore the model is applicable for this study. The model and framework will be applied in this study since it centrally focuses on sectors. This model will be used to explain both the natural gas sector and the offshore wind [OSW] sector in the United Kingdom and the Netherlands.

2.8.2 Diagnostic framework

The diagnostic framework is presented in three main parts and distinguishes conceptually between different levels. The framework suggests practical guidelines for political analysis, drawing on a range of literature and previous work within and across sectors. As mentioned the framework is divided in three main stages of analysis: The first stage focuses on the broader view and can be seen as a foundational country study. The second section is an incisive investigation of organisations, institutions and actors. The third section discusses the operational implications and some methodological considerations. However, the framework should not be regarded as linear or discrete stages. Analyses like mapping players in the sector or understanding how players influence the policy process are best regarded as continuous activities. Find below an overview of the framework derived from the work by Moncrieffe, & Luttrell, 2005:p5:

Figure 4. Framework for Political economy analysis of sectors



Adapted from Moncrieffe & Luttrell, 2005:p5

<u>Stage 1: Basic country analysis (historical/foundational country analysis)</u>

This first stage analyses the broader historical/political context in which the sector is situated. It concentrates on how historical legacies, changes and structural features (e.g. demographic patterns and dynamics or social identities and allegiances) influence the relations between institutions and actors and, in turn, the policy-making and implementation process (Moncrieffe, & Luttrell, 2005:p6). This analysis also includes the analysis of power and interests to explain the outcomes of policymaking processes as well as the ideologies and values that influence or even determine how individuals and organisations behave.

<u>Stage 2. Understanding the relationship between institutions and actors:</u>

This sub-analysis analyses how institutions and actors interact and how their interactions influence the policymaking and implementation processes. The researcher is expected to 'examine institution-actor relationships through the lens of historical legacies, processes of change, structural factors, power relations and ideologies, values and perceptions' (Moncrieffe, & Luttrell, 2005:p12). The sub-analysis 2a (Defining the sector) sets out to define the boundaries of the sector and to map the players in the sector and the nature of the relationship between these players. The figure in appendix 3 presents a compilation of potential key actors affecting sectoral developments (Moncrieffe, & Luttrell, 2005:p14). The sub-analysis 2b (Political analysis of the sector) seeks to conduct a 'deep' political analysis of the organisations active in the sector. It analyses the roles and responsibilities; the organisational structure; the management and leadership; the financing and spending as well as the incentives and motivation of these players. The framework in appendix 2 provides a matrix for organisational/political analysis (Moncrieffe , & Luttrell, 2005:p17). The sub-analysis 2c (How players influence the policy process) analyses how players influence policy formulation, negotiation and implementation; responsiveness and channels of accountability (Moncrieffe, & Luttrell, 2005:p20). See framework in appendix 4.

3. Methodology

3.1 Introduction

In this chapter the methodological framework will be discussed. First the operationalization indicates what will be actually measured, using the selected research methods. The validity and reliability will also be discussed in this chapter. This research is built on a body of information derived from publicly available internet sources, containing policy documents, evaluations and operational experiences in two energy sectors in two countries. In respect of both natural gas and offshore wind [OSW] deployment, the study looks at policy decisions and actual developments in two detailed case studies in both countries. In respect of the assumed Governmental interests in natural gas, the study examines policy developments/investment projects through case studies. Existing material was used and provided the essential insights into the political economy issues in each of the case studies.

The methodology used is combination of a literature review and document-based case studies. The fundamental method used here is the case study method. The cases are comparable in that the unit of analysis is the national State, respectively the United Kingdom and the Netherlands. The research focuses on the cases of the United Kingdom and the Netherlands. These countries are interesting and relevant for several reasons. According to the Climate Change Performance Index [CCPI], the Netherlands seems to be a laggard in adopting a progressive climate policy and performance (Burck, Hermwille, and Krings, 2012). The Netherlands perform considerably below average and is ranked among the worst European representatives, with 'very poor' climate change performance (Burck et al. 2012:p8).

To answer the research question, two categories of data are required i.e. data derived from policy documents on Governmental decisions on Natural gas policy and OSW energy policy in the period 2003-2013. The other category of data will be collected from statistic data derived from the analysis of financial statements linked to investments and revenues on both energy sources. Data collection has found place over the period 2004-2013. The brief historical analysis for the period before the period of research serves as an introduction to the matter. Moreover, in some cases subjects, such as policy analyses, are also described beyond 2013 to draw a clearer picture of the developments.

3.2 Operationalization

The analysis will be made for both the case of natural gas and the case of OSW on both the Netherlands and the United Kingdom. Not all measures in the above given framework will be analysed in this research. The central focus in this thesis is directed to the State's (financial) involvement and organisations directly related to the state. Moreover, the analysis will focus on policy decisions which have been made in regard to natural gas- and OSW policy. Some elements in Stage 2b and 2c will not be analysed, such as the "roles and responsibilities" and "Management & leadership", while at other elements extra attention is drawn to. Additional focus will lay on the topic "financing & spending" which belongs under stage 2b. In the last stage (stage 3: "Country comparison") a comparison is made on several aspects between both countries. For the case of natural gas, first a comparison will be made on the energy mix for electricity generation. Secondly, the natural gas production, consumption, imports and exports will be compared. And last, there will be a comparison between the State's revenues from gas production. In the following tables, the variables, indicators and methods which will be applied are given. The variables for natural gas and offshore wind are slightly different and presented separately.

Table 3. Variables: Natural gas			
Variable	**Definition**	**Indicators (what)**	**Method (how)**
Stage 1. Basic country analysis:			
1a. Historic analysis	Historical background and situation pré 2004	Event analysis; Policy analysis	Research-,policy documents
1b. Basic analysis	Situation 2004-2013	Event analysis; Policy analysis	Research-,policy documents
Stage 2. Understanding the relationships between institutions and actors			
2a: Defining the sector			
Defining the sector	Industry description	Main elements of the gas industry	Industry analysis
Gas production	Production sector	Actors; Production volume	Actor and ownership analysis
Gas transmission	Transmission sector	Actors	Actor and ownership analysis
Gas distribution	Distribution sector	Actors	Actor and ownership analysis
Gas supply	Supply sector	Actors	Actor and ownership analysis
2b: Government involvement			
Government involvement in gas	Government's role in gas industry	Actors; assets; relations; involvement	Key actors and ownership analysis
		Gas resources	Domestic reserves analysis
		Public ownership of assets in gas	State's ownership
Government taxation on fossils	Gov. Tax income	Types of taxes levied	Tax system analysis
Stage 3. Country comparison			
1. System and regime	Ownership of assets	Financial ownership	Ownership of assets
2. Energy mix	Sources for electricity generation	Total mix for electricity generation	Statistical analysis
		Natural gas for electricity generation	Statistics on gas consumption for electricity generation
3. Production of natural gas	Total domestic production of gas	Annual production, consumption, import, export	Government statistics on oil and gas
		Total oil & gas production	Annual production statistics
4. Revenues		Total revenues from oil & gas	Tax system analysis
		Tax revenues on Natural gas	Tax system analysis
		Revenues per 1 Terajoule	Total production divided by total revenues

Table 4. Variables: Offshore wind			
Variable	**Definition**	**Indicators (what)**	**Method (how)**
Stage 1. Basic country analysis			
1a. Historic analysis	Historical background and situation pré 2004	Important events	Research-,policy documents
1b. Basic analysis	Situation 2004-2013	Important events	Research-,policy documents
Stage 2. Understanding the relationship between institutions and actors			
2a: Defining the sector			
Defining the sector	Companies	sector related companies	Industry analysis
OSW industry		Installed OSW turbines & farms	OSW statistics
		Installed OSW capacity (MW)	OSW statistics
		Available OSW resources	Resource potential (EEZ volume)
		R&D centres of expertise	Academic expertise
		Mapping the sector	Key actors
		Industry structure	Influencing actors and institutions
2b. Government involvement			
Government involvement in OSW		Government assets/ownership	Ownership analysis
		Public investments in OSW	Level of investments by whom
		Public ownership of assets in OSW	State ownership
		Support mechanisms for OSW	OSW subsidies analysis
		Policy developments	Policy document analysis
		Industry development programmes	Gov. initiated program analysis
		Role and influence of actors	Actor analysis
Stage 3. Country comparison			
Subsidy mechanisms	Method of support	Amount of support to OSW	Comparison of subsidy mechanisms

4. Political economy analysis of Natural Gas

4.1 Introduction

Natural gas is a key fuel for both countries. The modern history of natural gas in Europe began in 1959 with the discovery of the Groningen field in the Netherlands, followed a few years later by the first discoveries in the UK sector of the North Sea. This was followed by equally substantial discoveries of gas in the Norwegian sector starting in the 1970s. But while the UK had a huge domestic market, Norway did not, and created a huge export business with a number of pipelines delivering gas to both Continental Europe and the UK (Stern, J., 2003). Natural gas is a major source of electricity generation. Gas provides the Netherlands with almost half of its energy demand, and their own production safeguards supply. Moreover, the production and sales of natural gas is also a powerful pillar in the Dutch economy. The revenues from natural gas make a significant contribution to State income. *"In order to meet the growing demand for energy, natural gas will continue to play an important role as a clean, reliable and affordable fossil fuel"* (EBN, 2014).

Both the Netherlands and the United Kingdom have significant natural gas reserves. On January 1, 2013 The Netherlands was globally ranked on the 24th place with 1,230 billion cubic meters proved reserves of natural gas (although this only accounts for 0,6% of the total world reserves), while the United Kingdom was ranked place 44th with 246 billion cubic meters (which accounts for 0,1% of the total world reserves). Total world natural gas reserves are estimated at 187,300 billion cubic meters where Iran (18%), Russia (17,6%) and Qatar (13,4%) are top three positioned (BP, 2013; CIA, 2014). Even compared with these large amounts of gas, both the Netherland and United Kingdom actually still have significant gas reserves.

4.2 The Netherlands and natural gas

4.2.1 Stage 1a: Historic analysis: pre 2003

In 1959, 56 years ago, one of the largest natural gas reserves in the world was discovered in the Netherlands. Under the soil of Slochteren in Groningen, billions of cubic meters of gas was found. At the time it was the largest gas field in the world discovered so far and is currently still the largest in Western Europe. The extraction started in 1963. Since then, the income from the extraction of natural gas has become an important source of income for the Dutch State. The discovery had and still has been major consequences for the Dutch public finances and has a major influence on the development of the post-war welfare State (Rekenkamer, 2014). After the discovery of the Groningen field the Dutch gas production was almost entirely focused on this huge gas field. Partly in response to the oil crises of the seventies, the realization came that it was important to be careful with the field's reserves and therefore to detect the small fields (i.e. all fields smaller than the Groningen field). Due to the high oil prices in that period, the "small field policy" has been developed. The core of this policy was the obligation for Gasunie Trade & Supply to buy gas from small fields production, and therefore gas extraction would become more flexible and less depending on the Groningen field. The production from small fields has increased significantly since 1976. Starting point of the small field policy was to create substantial gas reserves and the optimal utilization of it. But only since 2006 it was recognized that this position was subject to change because the Dutch gas reserves slowly were decreasing (Min. Ec. Affairs, 2006:p3).

Until 1994, all the natural gas revenues went directly to the general State budget. The budgetary use of strongly growing gas revenues resulted in the 1970s to a resource curse, better known as the "Dutch Disease" (Corden, & Neary, 1982). This term does refer to the high gas revenues and its relation to pressure on the real exchange rate, but it also refers to the potentially negative effects on the economy and public finances. The literature on the symptoms of the "Dutch Disease" often points to the danger that a strong increase in revenues from natural sources can encourage politicians to use this temporary source of income for a permanent increase of the welfare State, to a level that is unsustainable once the natural resources dry up (Ploeg, 2006; Gylfason, 2001).This is indeed what happened in the Netherlands in the 1970s. Minimum wages and social allowances increased substantially. Government spending rose dramatically, from 44% of the GDP in 1970 to 61% in 1983. During the oil crisis and the growth stagnation in Europe, the gas revenues played a crucial role because they hide to which extent the real economy and public finances actually worsened (Wierts, & Schotten, 2008).

On January 29, 1993 the Cabinet Lubbers-3 sent the proposal for the establishment of a Natural Gas Revenues Fund to the House of Representatives (Tweede Kamer, 1993). This fund: *Fonds Economische Structuurversterking* [FES] was created because of the beliefs that natural gas revenues also belong to future generations. Therefore, they should also benefit from these temporary revenues from natural gas. The FES was set up with the intention to isolate the revenues from natural gas extraction from the general State budgeting. Basically, natural gas could also be invested in infrastructure projects through the regular budget system, but in times of budget deficits there is a risk that the proposed investments will be suspended and the revenues will be used to avoid tax increase. To prevent this from happening, the parliament at the time decided to create a separate fund which has a sole purpose of permitted spending in investment projects of national importance. In 1995 the fund was established and was set for the financing of investment projects of national importance to strengthen economic structure. Initially, the investments funded by FES focused on physical "infrastructure" as the Betuwelijn and High-Speed-Line-South [HSL-South].

4.2.2 Stage 1b: Basic analysis: since 2003

Gas plays a key role in the Dutch economy and the lives of Dutch citizens. The Netherlands has the highest gas penetration rate in the EU, as well as the highest share of gas in primary energy consumption and the highest consumption of gas per person. No other country has a higher proportion of electricity generated by gas than the Netherlands. Furthermore, the Netherlands has the highest percentage within the EU of gas consumed by industrial customers for industrial processes. This means that Dutch industry uses gas to make other products, rather than only for energy. The high intensity of gas use by Dutch industry confirms that gas has played a key role in shaping the Dutch industrial sector, by attracting more gas-intensive industries (Bazelon, Dickson, Harris, Humphreys, 2010). In January 2005 an extensive report from the energy council was published (Algemene energieraad, 2005). This report formulated for the first time the importance of a gas hub strategy in which the strategic role of the Netherlands in the gas industry will be strengthened. Under the influence of the cabinet agreements in spring 2005 (Paasakkoord 2005) a shift was made towards investments from the FES in the 'soft' infrastructure e.g. the field of strengthen knowledge and innovation. In the spring of 2006 the Council of Economic Advisors (Raad van Economische Adviseurs, [REA]) advised to abolish the FES in its current form or to reform it and build up a saving and financial investment fund according to Norwegian example (Tweede Kamer, 2006). In 2011, the FES has been abolished and all natural gas revenues went back into the general State budgeting. The financial investment fund was never established.

In October 2009, the Dutch Government has set out its plan of action to develop a gas hub strategy (gasrotondestrategie) and submitted a report outlining its strategy to transform the Netherlands in a north-west European gas hub. The report describes the Netherlands as a 'gas junction' in the international transport of gas and as a distribution centre for gas in north-west Europe. The paper also notes that the gas hub strategy will promote the commercialization of the expertise and experience present in the Dutch gas sector with respect to gas exploration, production, storage, transport, trading and the integration of green gas. The Government report described a successful Dutch gas hub as consisting of a situation in which: *"There would be substantial domestic and foreign investment in the Dutch gas sector. The Netherlands would be a transit route of first choice. The Netherlands will import and then re-export (or uses) large volumes of LNG as a trading hub to the rest of Europe. This, combined with investments in pipelines, should increase security of gas supply. The Netherlands will be an attractive place to develop gas storage projects, which will export seasonal peak gas demand to other countries"* (Bazelon *et al*., 2010). In 2011 the Government has set a cap on the production for the period 2010-2020 of 425 million Nm3[1] plus the remaining production capacity from the previous period (20.7 billion Nm3). This limitation in the production is intended to maximize production from small fields and use the Groningen field as a swing producer (Min. Ec. Affairs, 2012a). Between the start of the natural gas extraction and up to 2012 there is about 2000 billion Nm3 of gas produced.

[1] Normal cubic meter (Nm3) - standard unit in which natural gas is measured (Temperature: 0 °C, Pressure: 1.01325 barA)

In 2011, the Senate has been informed by Min Ec. Affairs about the importance and the potential of the Dutch gas hub strategy. The Netherlands accounts as a major transit country for gas into the UK, and in the future potentially also for other western European countries (Min Ec. Affairs, 2011:p4). The preference for a strategic role in natural gas continues in the subsequent years. In 2014 the Min. of Ec. Affairs (2014:p2), again emphasis on the importance of natural gas in both domestic consumption and businesswise for the Netherlands in the future decades.

4.2.3 Stage 2a: Defining the sector

The Netherlands has an extensive natural gas industry. The Dutch gas sector consists of: 1) Exploration and Production [E&P]; 2) Gas transmission, distribution and storage; 3) Trading and gas supply; 4) LNG terminals and imports; 5) Research and development. Not all countries have the same elements of the gas sector. E&P is also known as the 'upstream' sector of the gas supply chain. Many countries do not have an E&P sector since they have not natural gas or oil reserves. Also the gas trading sector may be very limited. For this thesis, the focus is pointing towards the four main elements of the gas industry: 1) Production; 2) Transmission; 3) Distribution; and 4) Supply (i.e. sales). In addition, the electricity transmission is described, since it is also involved due to transmission of the electricity generated by gas. Appendix 5 provides an overview of the most relevant institutional actors in the natural gas industry in the Netherlands.

1. **Production –** The Nederlandse Aardolie Maatschappij [NAM] with its two shareholders (Shell50% and ExxonMobil50%) executes by far most of the gas production in the Netherlands. Energie Beheer Nederland B.V. [EBN] is a 100% State-owned Company and designates companies to participate production activities. It has a 40% stake in almost every oil and gas project in the Netherlands. Therefore the Dutch Government is highly financially involved in gas production. These entities play a critical role in the Dutch gas production industry and will be fully elaborated in the next paragraph. As of January 2010, the Netherlands had 235 producing gas fields, of which 135 were offshore (NLOG, 2010). These fields contained developed reserves of 1,371 bcm, of which 1,036 bcm are in the giant Groningen gas field in the north of the Netherlands, this is where by far the most of Dutch reserves are allocated.

Table 5. NL – Natural gas production between 2004 and 2013

NL	Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Production of natural gas	*mln m3*	81.459	74.422	73.271	72.013	79.222	74.613	83.902	76.380	75.970	81.479

(CBS, 2015a)

2. **Transmission** – Gas Transport Services B.V. [GTS] is owner of the Dutch national grid and a wholly owned subsidiary of N.V. Nederlandse Gasunie. All shares in N.V. Nederlandse Gasunie are held by the State of the Netherlands. Further elaboration on the State's involvement will follow in the next paragraph.

3. **Distribution** – The regional gas network operator has a monopoly on the energy grid in a particular region. There are nine regional gas network operators in the Netherlands (Cogas; Delta; Endinet; Enexis; Intergas; Liander; Rendo; Stedin; Westland). They operate and maintain the regional networks. The Dutch law stipulates that all network operators (both gas and electricity) must have a majority stake in the network they operate.

4. **Supply** – The gas production from the Groningen field and the other small gas fields is entitled to be sold only to GasTerra. Subsequently the gas is sold to suppliers. GasTerra is 50% owned by the State. Detailed information about Gaterra will follow in paragraph 4.2.4. The largest gas suppliers in the Netherlands (2012) include: Nuon(27%); Essent(20%); Eneco(21%); Oxxio(4%); Greenchoice(2%); Delta(5%); NEM(5%); Energiedirect(3%); E.ON(2%).

Electricity transmission network

Just as the gas transmission infrastructure in the Netherlands, the national electricity transmission system operator (TenneT B.V.) is controlled and 100% owned by the Dutch State. Its sole shareholder is the Dutch Ministry of Finance, making the Dutch high-voltage grid basically completely State owned. In May 2007, TenneT formed a joint venture with British transmission operator National Grid for a 260-kilometre (160 mi) 1,000MW BritNed DC link between the Isle of Grain in Kent and Maasvlakte, near Rotterdam. The installation of the first section of cable link started on September 11, 2009, whilst the entire 260km (160mi) cable was completed in October 2010. The interconnection became operational on April 1, 2011, and by January 2012, electricity flow had mostly been from the Netherlands to the UK. The BritNed interconnection would serve as a vital link for the foreseeable European super grid project.

4.2.4 Stage 2b: Government involvement in the gas sector

Nederlandse Aardolie Maatschappij [NAM] - In 1947 the N.V. Nederlandse Aardolie Maatschappij [NAM] was founded. NAM has two shareholders: Shell (50%) and ExxonMobil (50%). NAM explores and produces oil and natural gas within the Netherlands and the Dutch section of the Continental Shelf. For the exploitation of the Groningen gas field in 1963 the partnership "Maatschap Groningen" has been established between EBN [Energie Beheer Nederland] and the NAM. The shares of Maatschap Groningen are divided between NAM 60% and EBN 40%. The gas production from the Groningen field is entitled to be sold only to GasTerra.

Energie Beheer Nederland B.V. [EBN] - The 100% State-owned company Energie Beheer Nederland B.V. [EBN] is a significant player in the upstream sector. Through the Mining Act, the Ministry of Economic Affairs can designate a company to participate in all production activities. EBN is always the designated company and its interest in the production activity is always 40%. This applies to both onshore and offshore production activities. EBN can also participate in exploration activities but this applies only to offshore exploration and has to be at the request of the exploration company. As well its interests in exploration and production activities, EBN also has interests in five offshore gas-gathering pipelines (Bazelon *et al*., 2010).

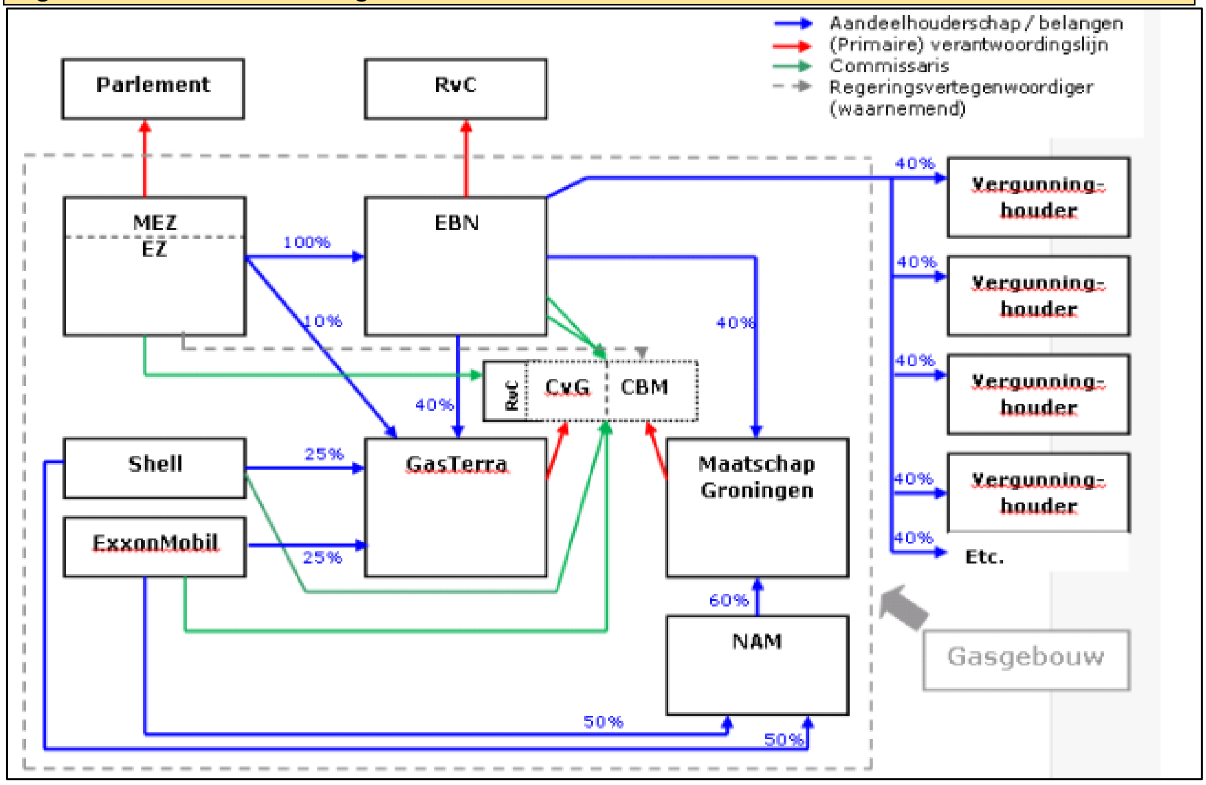
The Government receives revenue from gas activities through the 100% State-owned Company EBN (Energie Beheer Nederland). It plays a key role in oil and gas production in the Netherlands. EBN has a 40% interest the Groningen Maatschap production activities and is a partner in five gas-gathering offshore pipelines. Downstream, EBN participates in four underground gas storage facilities. Furthermore, it has 40% interest in GasTerra. In that context, it has a 40% stake in almost every oil and gas project in the Netherlands. EBN is a 100% State participation with policy influence, i.e. "policy participation". The stock shares are managed by the Ministry of Economic Affairs, this in contrast to conventional State participations whose shares are managed by the Ministry of Finance and policy implementation takes place from another department. These types of State participations do not function as independent businesses, but do include aspects of policy making. This State participation functions as an instrument for the implementation of public policies, in this case EBN is a policy for the benefit of the optimum and cost-effective utilization of the Dutch gas resources.

N.V. Gasunie - Gasunie was founded in 1963 as a public-private partnership of Royal Dutch Shell (25%), ExxonMobil (25%) and the State of the Netherlands (50%) to sell and distribute natural gas from the gas field in Groningen. Due to the liberation of the European gas market, on January 1st 2005 Gasunie was divided into a gas transportation company which kept the name Gasunie and a gas trading company GasTerra. Nowadays all shares in N.V. Nederlandse Gasunie are held by the State of the Netherlands, represented by the Ministry of Finance. Gasunie owns two daughter companies who manage the gas transport network. In Germany this is Gasunie Deutschland and in the Netherlands this the Gas Transport Services B.V. [GTS]. GTS is owner of the national grid and a wholly owned subsidiary of N.V. Nederlandse Gasunie. GTS is the national transmission operator in the Netherlands. GTS is responsible for the management, operation and development of the gas transport system in the Netherlands. Since Gasunie is 100% State owned, all Gasunie's profits are Government revenue. In 2011 Gasunie's revenues increased due to the commissioning of the underground gas storage in Zuidwending, the GATE terminal and the expansion of the Dutch gas transport network. In the same year Gasunie booked a loss of €602mln. This was mainly due to adjustments imposed by regulators to the appreciation of the gas transport network and goodwill. These reductions have resulted in a depreciation of in total €1,300mln. The board has decided not to pay dividends (Gasunie, 2011). Since Gasunie is by far the largest gas suppliers and distributor in the Netherlands, the tax revenues from other gas suppliers and Distribution Network Operators will be much smaller, therefore it is not necessary to look further for the revenues from these companies. Moreover, the BBL Pipeline (Balgzand Bacton Line) is an important natural gas interconnector between the Netherlands and the United Kingdom for gas exports to the UK. The BBL line was developed and operated by the BBL Company. BBL Company was founded on July 9, 2004 and the line became operational on December 9, 2006. The main shareholder of the company is Gasunie with 60% of the shares, and gas companies E.ON Ruhrgas Transport and Fluxys both own 20%.

Gasterra B.V. - GasTerra is engaged in the sales of the Groningen gas and the gas from the small fields. The State owns 10% of the shares of GasTerra and the shares EBN owns in Gasterra (40%). GasTerra is thus a 50% owned by the State and can also be called a "policy participation". Shell and ExxonMobil both possess 25% of the other shares. In Appendix 6 the financial statements of EBN, Gasunie and Gasterra are presented over the period 2004-2013.

Gasgebouw - The so called "Gasgebouw" represents the legal structure in the public-private partnership between the State, EBN, ExxonMobil, Shell and GasTerra for extraction and sales of natural gas. The Gasgebouw got its current structure in 2005. At that time, the gas trade and transport part of the old Gasunie taken apart. In the structure of the Gasgebouw, the State, Shell and ExxonMobil are key players. The State is represented by the Ministry of Economic Affairs and EBN.

Figure 5. Overview of the "Gasgebouw":



(ABDTOP Consult, 2014)

<u>Government revenues in natural gas</u>

The total Government revenues from the Dutch natural gas in the period 1960-2013 amounted to approximately €265bn (Rekenkamer, 2014). Therefore natural gas constitute as a substantial source of revenue for the State for over fifty years. The relative importance of natural gas income for the State has become less significant over the years. As a result of the oil crisis in the 1970s revenues from natural gas were nearly 20% of the income of the Government. Nowadays it is around 5%. Not because the natural gas State revenues are now lower than then, but because other, in particular tax revenues have grown.

Statistics Netherlands [CBS] has been accessed to retrieve the State income from natural gas. CBS indicates that the total revenues natural gas consists of: 1) *"Dividends"*; 2) *"Income out ground and mineral reserves"* and 3) *"Corporate tax"*. Although, several reports conclude that State's gas revenues are much higher than the figures presented by CBS (Bazelon *et al*., 2010:p.30). Over the period 2004-2013 the reports conclude revenues are annually 13-49% higher with an average of 27% higher, which resulted in €14.1bn annual average State's gas revenues and not €11,2bn presented by CBS.

The natural gas revenues from the period 1960-present have flowed into the State treasury and cannot be traced to specific expenditures, except for the part that has flowed into the FES, into the period between 1995 and 2010. A total of €33bn flowed into the FES, of which €26bn came from natural gas. Approximately 80% of this was spent on investment projects in the field of traffic and transportation, such as the Betuwelijn and the High-Speed-Line (Rekenkamer, 2014; Min. Ec. Affairs, 2014).

4.2.5 Stage 2c: Government taxation on fossil fuels extraction

Like all companies in the Netherlands, companies have to pay corporation tax which is currently 25.5%. Gas production companies also have to pay a royalty equal to 50% of their profit net of corporation tax, although the royalty can be based on a profit that is reduced by 10% of costs (Bazelon *et al*., 2010). Production license holders also need to pay an annual area fee which was equal to €679,-/km2 in 2009 and onshore license holders incur a severance tax and a pay a fee to the province in which their gas production is located. Through an agreement that has been in place since 1975, the Government receives additional income from Groningen production, known as "Meeropbrengsten" Groningen. The amount that the Government receives varies with the market price of gas but can range from 80%-90% of net income received by the Groningen producer. The taxes that consumers pay are the regulatory energy tax and VAT. The regulatory energy tax is an environmental tax paid by small consumers with the purpose of reducing CO_2-emissions (Bazelon *et al*., 2010).

Taxes and other Government revenue from exploration and production are the most relevant for this study both because they are likely to be the largest, and because all other taxes would be paid anyway if the same amount of imported gas was consumed. Paragraph 4.4.3 elaborates the revenues earned by the Dutch Government from natural gas exploration and production activities each year during the period 2004 to 2013. Taxes, royalties and EBN's profit are included. Although EBN also participates in downstream activities, the profits of upstream and downstream activities are not separated and therefore show all of EBN's profit. The revenue increases from €6.6bn in 2004 to €15bn in 2013. The exact amount of revenue in a particular year is dependent on the gas price which is linked to oil prices.

<u>Downstream, Government revenues</u>

Downstream, Government revenues come from both corporate income tax revenues and also EBN's participation in downstream activities. Revenues from downstream companies are notably less than E&P revenues and therefore the downstream analysis is limited to the main two downstream companies Gasunie and GasTerra. With these two companies an indication is made regarding the size of Government revenues from downstream companies.

<u>Oil and gas taxation NL</u>

In the Dutch corporation taxes is a distinction is made between a portion that comes from companies in the gas sector and a part coming from companies in non-gas sector. For the corporate income which comes from the gas sector a separate estimate is prepared based on the profit development in that sector, which largely depends on the stock price of TTF gas, oil prices and the dollar exchange rate.

<u>Total Finance & Spending</u>

In total, Government annual revenue from gas activities has recently (in the period 2005-2009) been between around 8%-10% of central Government revenues (Bazelon *et al*., 2010).

2.4.6 Interim conclusion: Natural gas in the Netherlands

The discovery and exploitation of the Groningen gas field had major consequences for the Dutch public finances and the raise of the post-war welfare State. It developed the natural gas sector as an important economic sector which would never have become as large without the discovery of the gas reserves. The success of the growth and development of the Dutch economy is also partly thanks due to this discovery. The State’s participation and ownership in key companies in the natural gas sector underlines the level of involvement. Over time, smaller gas fields have been exploited quickly, but it was not until 2006 that the notion arose that the gas reserves will run out in the foreseeable future. However, the focus continued on the further development of a strong position in the gas market.

In de mid 2000s the hope of the Dutch Government was focused to establish a strong gas industry and a ‘first-mover’ advantage in an area such a green gas or biogas that would allow it to export this knowledge and create a self-sustaining industry. The ironic example of this kind of investment is the Danish wind industry, which was heavily subsidised in between 2000-2005. As a result, Denmark is a world leader in the manufacture of wind turbines and, according to the Danish Wind industry, the sector employs 28.400 people and contributes an annual €5.7bn to the economy.

4.3 The United Kingdom and natural gas

4.3.1 Stage1a: Historic analysis: pre 2003

This chapter highlights the key aspects in the development of the gas industry in Great Britain. The exploration licences provided under the Continental Shelf Act 1964 resulted in the discovery of substantial reserves of gas in the UK portion of the North Sea. These reserves were more than sufficient to meet all existing demand present at the time. This has led to the conversion of existing gas appliances throughout the UK to enable them to burn natural gas. It also led to the construction of gas terminals on the east coast and a high pressure transmission system (O’Neill, 1996). Under the Gas Act 1972, the Gas Council was renamed the British Gas Corporation and received the task to control of the 12 Area Boards. The British Gas Corporation continued to enjoy monopoly rights over gas. Furthermore, it also received monopsony powers (i.e. rights to be the only purchaser of natural gas) with respect to any gas reserves from the UK sector of the North Sea. Gas demand in UK’s commercial, industrial and domestic markets was further fuelled by the strong increase of the oil price in 1973. Meanwhile further gas deposits were discovered in the North Sea and the Irish Sea, and input terminals were added to the transmission network at Barrow and St. Fergus. In 1982, the requirement that all gas be offered for sale to the British Gas Corporation was removed, under the Oil and Gas Enterprise Act. It is clear to see that the discovery of natural gas created a new industry and meet the energy demands for the UK. The central and coordinating role of the Government automatically created dependency on revenues from natural gas.

In 1986 the British natural gas industry started to change. The Gas Act 1986 made provisions for privatising the British Gas Corporation and established a framework to regulate the newly privatised industry (Bartle, G.S.I., 2004:p2).The Office of Gas Supply [Ofgas] (later merged with Office of Electricity Regulation [OFFER] into Ofgem) was set up to fill in a role as industry watchdog. In 1992, the Government introduced new legislation to strengthen the powers of utility regulators (Competition and Services (Utilities) Act 1992). The UK first began to export gas in 1992, when production from the UK’s share of the Markham gas field in the southern North Sea started. This field spans the UK-Netherlands border in the North Sea, and all of the gas produced at this field is sent by direct pipeline to the Netherlands. In 2002, volumes of exports were 2.5 times the volumes of imports, accounting for 12.5% of the UK’s natural gas production.

4.3.2 Stage 1b: Basic analysis: since 2003

UK natural gas production has been declining every year since 2000. The largest concentration of natural gas production in the UK is the Shearwater-Elgin area of the Southern Gas Basin. The area contains five gas fields: Elgin, Franklin, Halley, Scoter, and Shearwater. Most of the leading oil companies in the UK are also the leading natural gas producers, including BP, Shell, and ConocoPhillips. UK's largest share of natural gas production among all fields and gathering systems comes from the Scottish Area Gas Evacuation [SAGE] system, which produced a total of 246 billion cubic feet [Bcf] in 2011. In addition to SAGE, the Shearwater-Elgin Area Line [SEAL] produced more than 200Bcf of natural gas during the year. Practically all of UK's natural gas production comes from offshore production fields from the UKCS, while in the Netherlands most production has come from main land fields.

4.3.3 Stage 2a: Defining the sector

Great Britain has just like the Netherlands as a resource base of natural gas, exploration and production activities and gas trading are also parts of the British gas industry. The economic organization of the British gas industry comprises of: 1) production and processing; 2) transmission and distribution; 3) storage; 4) shipping; 5) supply. Just as in the Dutch sector analysis previously, the focus is pointing towards the four main elements of the gas industry: 1) Production; 2) Transmission; 3) Distribution; and 4) Supply (i.e. sales). In addition, the electricity transmission is described, since it is also involved due to transmission of the electricity generated by gas. Appendix 6 provides an overview of the most relevant institutional actors in the natural gas industry in the UK.

1. **Production and importation** – Gas produced in the UK comes from offshore fields in the North and Irish seas. It is also brought over from Ireland, and imported from Belgium and the Netherlands, via three interconnector pipes and imported in the form of Liquefied Natural Gas [LNG]. A small amount is produced on-shore too. Gas producers, LNG importers and interconnector operators bring the gas on shore to reception terminals and LNG importation terminals. The UK's natural gas production has been on a long-term declining trend, although the country continues to produce sizeable natural gas volumes. Since domestic production of natural gas peaked in 2000, the UK has become increasingly reliant on imports to satisfy its demand. In 2013, domestic natural gas production accounted for just over a third of the UKs natural gas supply, according to DECC.

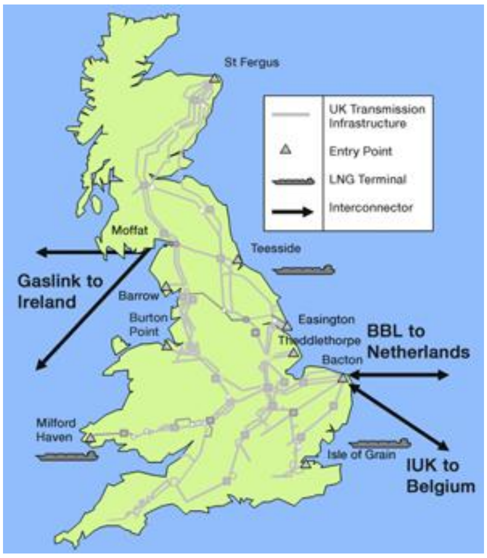


Table 6. UK – Natural gas production between 2004 and 2013											
UK	**Period**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Production of natural gas	*mln m3*	101.592	92.735	83.817	75.839	73.482	62.425	59.707	47.733	41.054	38.475

(Dukes, 2013)

2. **Transmission** – Gas producers supply gas to the *National Transmission System* [NTS] through reception terminals. National Grid plc (an international electricity and gas company based in the UK and north-eastern US) is the sole owner and operator of the gas transmission infrastructure [NTS] in the UK. Gas from the importation terminals is injected into the NTS after quality checks. Gas that has been held in storage can be reintroduced into the system. Since 2000 a number of new gas storage facilities have come operational (Humby Grove, Hole House, Holford/Byley and most recently Aldbrough). The NTS in the UK consists of gas reception terminals, a high pressure pipeline system, compressor stations, and off-takes (pipelines) to 12 Local Distribution Zones [LDZs], (also known as the Local Transmission System [LTS]) and large industrial and power station loads.

3. **Distribution** – *The gas distribution network* (to residences and houses) is not part of the NTS. Companies that own part of the LTS gas network are known officially as Gas Transporters. Gas leaves the NTS at 49 points across the UK. It's odorised for safety then transported in the distribution networks for final delivery to consumers. Gas to this network enters via the NTS through a pressure reduction station to the twelve gas distribution zones in England, Scotland and Wales within eight regional distribution networks in Great Britain, four owned by National Grid plc and four by other companies. The UK gas distribution sector underwent a major change in 2005. National Grid plc sold four of the eight local gas distribution networks to Scotia Gas Networks, Wales and West Utilities, and Northern Gas Networks. Prior to this sale, National Grid plc owned and controlled the complete domestic gas distribution system (EIA.gov). Other assets which belong to National Grid are the LNG "Isle of Grain" import terminal in Kent, which it owns and operates. Moreover, National Grid plc also owns the electricity transmission system in England and Wales. The electricity transmission network will be described later.

4. **Supply** – The last element are the suppliers. Gas is delivered to most through a pipe belonging to the local distribution network, which has been described above. The largest gas supplier in the UK is Centrica, a spin-off of the distribution assets of formally State-owned British Gas. Centrica had a 40% market share in the UK natural gas market in 2013, according to Ofgem. There are five other large suppliers (E.On, NPower, SSE, Scottish Power, and EDF) that each have between 10-16% market share in 2013.

Different from the Netherlands, the UK natural gas sector and all its sub-sectors are fully privatized. National Grid plc obviously has the most assets and a strong position in UK's gas industry. Her shares are publicly traded on the London Stock Exchange [NG/LN]. Also the other companies are privately held, non-Governmental organisations. As far as known, the UK Government is by no means financially involved with the distribution network or aforementioned activities.

<u>The UK electricity transmission network</u>
This is owned and maintained by regional transmission companies, while the system as a whole is operated by a single System Operator [SO]. This role is performed by National Grid Electricity Transmission plc [NGET] - it is responsible for ensuring the stable and secure operation of the whole transmission system. There are currently three Transmission Operators [TOs] permitted to develop, operate and maintain a high voltage system within their own distinct onshore transmission areas. These are National Grid Electricity Transmission plc [NGET] for England and Wales, Scottish Power Transmission Limited for southern Scotland and Scottish Hydro Electric Transmission plc for northern Scotland and the Scottish islands groups.

4.3.4 Stage 2b: Government involvement in the gas sector

In the UK, under the Petroleum Act 1998, 'The Crown' retains all sub-surface rights to hydrocarbons, such as oil, gas and shale gas. In the context of shale gas and as with North Sea oil and gas, the rights of 'The Crown' are managed by the Secretary of State for the Department of Energy and Climate Change who, on behalf of Her Majesty, grants licenses for hydrocarbon extraction. The Crown Estate [CE] does not have a role in shale gas extraction. Moreover, the Crown Estate [CE] is an £8bn asset management business tasked by Parliament with managing a diverse portfolio of assets commercially and paying all profits to the Treasury. This portfolio includes the UK seabed, London's Regent Street and much of St. James's, together with one of the nation's largest rural estates. But it does not include any hydrocarbon rights (Website Crown Estate). Although CE does not own the hydrocarbon rights (e.g. oil, natural gas) it does have great influence in developments on the UK seabed, which does belong under the CE portfolio, when it comes to offshore wind development. This role of CE will be analysed in the offshore wind [OSW] analysis.

4.3.5 Stage 2c: Government taxation on fossil fuels extraction

The UK has several layers of corporate and field taxation on upstream oil and gas activities. The tax regime which applies to exploration and production of oil and gas in the UK and on the UK Continental Shelf [UKCS] currently comprises three elements:

1. Ring Fence Corporation Tax - Ring Fence Corporation Tax [RFCT] is calculated in the same way as the Corporation Tax that applies to all companies, but with the addition of a 'ring fence' which prevents taxable profits from oil and gas extraction in the UK and UK Continental Shelf [UKCS] being reduced by losses from other activities or by excessive interest payments. Such oil extraction activities are treated as a separate trade, distinct from all other activities carried out by the company. The activities are therefore ring fenced from the other activities. The current rate of tax on ring fence profits, which is set separately from the rate of mainstream corporation tax, is 30%.

2. Supplementary Charge - This is an additional charge, currently at a rate of 32% (increased from 20% changed on March 24, 2011), on a company's ring fence profits (but with no deduction for finance costs). A 'field allowance' removes Supplementary Charge [SC] from a slice of production income in qualifying small or technically challenging new fields.

3. Petroleum Revenue Tax - PRT is a field-based tax charged on profits arising from individual oil fields. The tax only applies to fields first given development consent before March 16, 1993. PRT is charged in addition to RFCT and SC, but is a deductible expense for both these corporation tax regimes. Currently only around 20 fields in the UKCS are PRT paying. The current rate of PRT is 50% (Deloitte, 2013). The UK oil and gas sector is a major contributor to the UK economy and the sector represents approximately 5.5% of all UK Government tax revenues. Therefore Oil and gas companies are one of the biggest industry sectors contributing to UK tax revenues. PWC estimates that the Total Tax Contribution for the entire Oil & Gas UK E&P membership, as £30.1bn which amounts to 5.5% of total Government receipts for all taxes in the tax year 2010/2011. These figures clearly show that these companies make a major contribution to the public purse (PwC, 2012).

4.3.6 Interim conclusion: Natural gas in the United Kingdom

Different from the Netherlands, the UK went in an early phase through declining gas production. Domestic production of natural gas in the UK peaked in 2000 and has been declining every year since. The UK has become increasingly reliant on imports to satisfy its demand. UK's gas reserves are nearly all located at sea, which makes it difficult and more expensive to extract than Dutch onshore gas from the Groningen field. Because of the declining production the UK has set its early focus on the import of gas by the construction of LNG terminals. The UK did not benefit as long from its gas reserves than the Netherlands is doing. Due to these circumstances the situation in the UK was much more urgent to rethink their strategy for energy security. Moreover, different from the Netherlands, the UK natural gas sector and all its sub-sectors are fully privatized. In the recent years, shale gas extraction is considered to reduce UK's dependence on natural gas imports. Increased UK gas extraction would represent a positive impact on GDP regardless of whether or not it is used in UK power generation.

4.4 Stage 3: Country comparison: Natural gas

This paragraph contains four sub-analysis in order to disclose the relationship between the level of state involvement in the natural gas industry, the importance of natural gas within the total energy mix for electricity generation in the nation, and the State's financial revenues from the sector. An important outcome of the analysis is gathering insights whether State ownership in the sector results in higher level of revenues for the State.

4.4.1 Comparison State's ownership in natural gas sector

The table below shows the high level of involvement of the Dutch State through the different segments of the natural gas industry, while in the UK there is no State ownership in the natural gas industry. Due to the Dutch State's ownership structures in the natural gas sector, the Dutch State is closely involved with Dutch natural gas production, transmission and supply. The following paragraphs analyse whether the State involvement also results in higher financial involvement of the Dutch State compared to the United Kingdom in terms of financial revenues.

Table 7. Overview: Ownership comparison in the natural gas industry

	Netherlands		**United Kingdom**	
	Company	**State participation**	**Company**	**State participation**
1. Production	NAM (EBN40%; Shell30%; ExxonMobile30%)	NAM 40% EBN 100%	British Petroleum; Perenco; Shell; Chevron; ConocoPhillips; BG Group; Eni; BHP; Total S.A.	0%
2. Transmission (System Operator)	N.V. Nederlandse Gasunie (GTS B.V.)	Gasunie 100% TenneT 100%	National Grid plc; National Grid Electricity Transmission	0%
3. Distribution (local networks)	Cogas; Delta; Endinet; Enexis; Intergas; Liander; Rendo; Stedin; Westland.	0%	National Grid plc; Scotia Gas Networks; Wales and West Utilities; Northern Gas Networks	0%
4. Supply (sales)	Gasterra (50%) Nuon; Essent; Eneco; Oxxio; Greenchoice; Delta; NEM; Energiedirect; E.ON.	Gasterra 50%	Centrica; E.On; NPower; SSE; Scottish Power; EDF.	0%

(Min. Ec. Affairs; EBN; Gasunie; Gasterra; National Grid)

4.4.2 Energy mix for electricity generation

In this thesis natural gas and wind energy are given a central focus, but they do not stand alone in the competition for electricity generation. A nation's energy mix for electricity generation always consists out of a set of different energy sources, i.e. coal, oil, natural gas, nuclear, wind, solar, bio-energy etc. The energy mix is based upon several factors, such as resource availability, lowest costs, historic patterns and Government legislation. Because of the significant natural gas resource base in both the Netherlands and the United Kingdom, it has played an important role for electricity generation. Countries which do not have large amounts of natural gas resources are likely to use less natural gas in their energy mix for electricity generation since they consider other sources of electricity generation such as coal and nuclear energy.

To get understanding about the importance of natural gas in both countries, first the complete energy mix used for electricity generation and the amount of natural gas used for electricity generation will be presented. This analysis focuses only at the energy mix for electricity generation and the amount of natural gas which takes part in the total mix for electricity generation, since natural gas usage for this purpose can be replaced for other types of electricity generation e.g. offshore wind energy. Therefore, for the British case figures are gathered from the UK ministry Department of Energy and Climate Change [DECC], and the Dutch case is built upon figures derived from Statistics Netherlands [CBS]. The figures derived from CBS are the total of central and decentralized produced electricity and heat. Amounts are given in Terajoules [TJ]. By expressing electricity in TJ (Terajoules = 1000 billion joules) it can be compared with other energy sources.

Describing the amount of natural gas used (i.e. as production, input for electricity generation, actual electricity generated, consumption, import or export) by a country can be confusing, since natural gas can be measured in several different ways, and both the United Kingdom as the Netherlands use different measures for energy. Quantities of natural gas are usually measured in cubic feet in the UK and cubic meters in the Netherlands. At the other hand, the energy content of natural gas and other forms of energy (i.e., the potential heat that can be generated from the fuel) is measured in British thermal units [BTU].

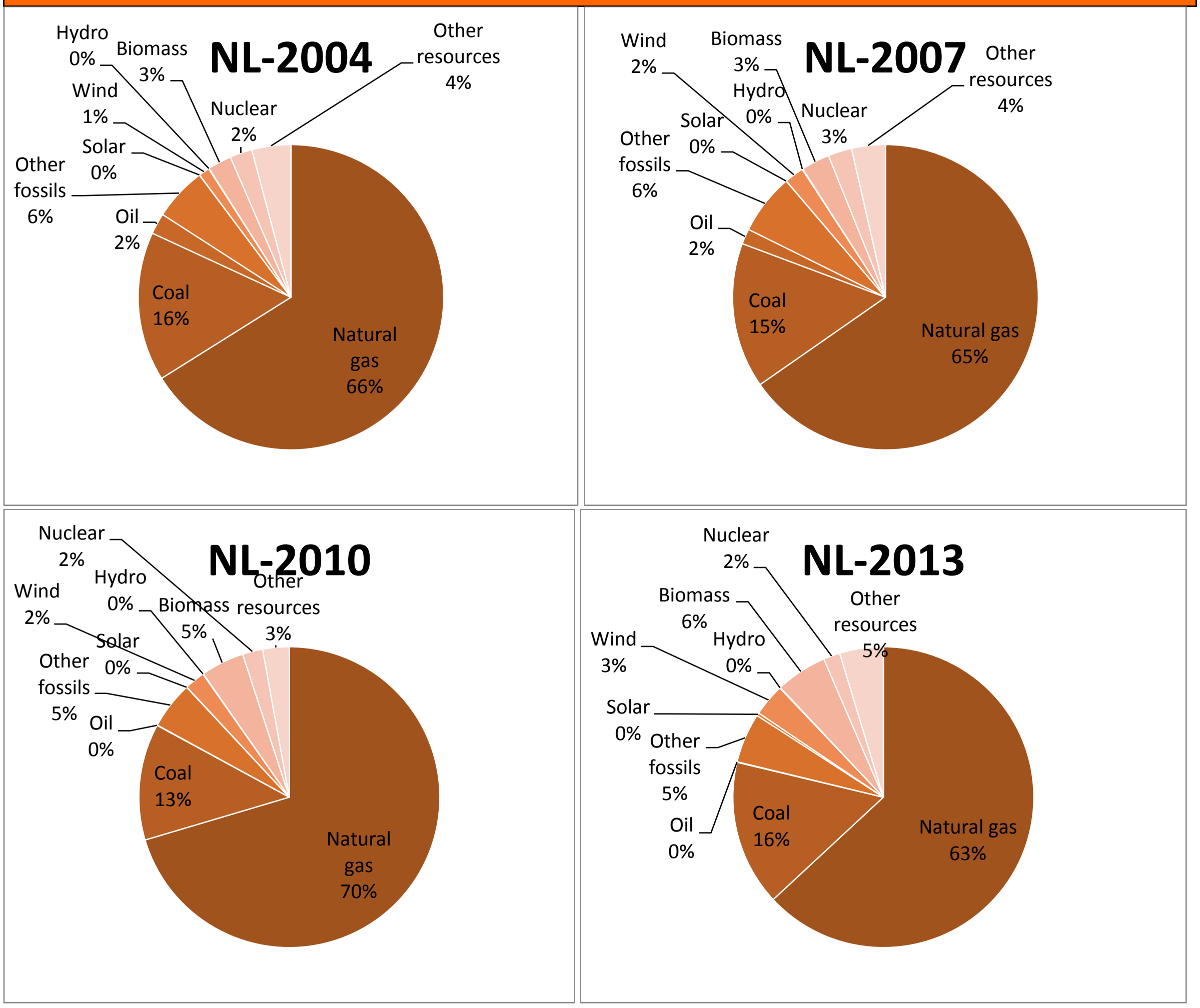
The British DECC presents their figures "UK Fuel input for electricity generation" in the measure Million Tonnes of Oil Equivalent [TOE]. When it comes to production (Electricity generated and supplied), the DECC uses the measure Gigawatt hour [GWh]. The Dutch CBS presents their figures for both input and production in Terajoule [TJ]. In order to allow us to make an appropriate comparison, all energy measures above will be recalculated into the same measure. Since DECC use different measures and CBS constantly uses Terajoule [TJ], it is chosen to use Terajoule as the comparable measure (1 TOE = 0,04187 Terajoules) (1 GWh = 3,6 Terajoules).

Table 8. The Netherlands - Energy mix for electricity generation:

(in TJ)	Natural gas	Coal	Oil	Other fos.	Solar	Wind	Hydro	Biomass	Nuclear	Other	**Total**
2004	385.852	92.308	12.980	33.001	119	6.721	345	14.670	13.759	24.114	**583.869**
2005	381.711	86.913	10.162	38.009	123	7.441	317	22.183	14.391	22.321	**583.571**
2006	377.529	87.276	9.482	33.862	127	9.842	379	22.050	12.490	23.323	**576.359**
2007	393.244	92.686	9.745	38.694	129	12.373	385	18.218	15.121	21.497	**602.092**
2008	426.777	84.796	9.722	35.859	140	15.330	360	21.909	15.008	22.752	**632.654**
2009	428.855	88.304	303	27.191	160	16.500	350	26.537	15.294	21.678	**625.170**
2010	462.535	82.201	279	33.378	214	14.375	375	30.599	14.289	18.715	**656.960**
2011	432.133	77.558	224	35.184	361	18.361	205	31.297	14.907	21.018	**631.248**
2012	376.320	90.346	186	30.170	914	17.935	376	37.593	14.093	26.408	**594.340**
2013	367.666	91.180	340	31.190	1.857	20.258	412	32.212	10.407	27.311	**582.832**

CBS, 2015

Figure 6. Netherlands – Electricity mix pie charts: (2004; 2007; 2010; 2013)



The four pie charts with intervals of three years are presented for the purpose to visualise the fluctuations in the energy mix for electricity generation. The pie charts above show a stable energy mix in the Netherlands. Only a small fluctuation can be found in the year 2010 when Natural gas took over a portion of Coal. In 2013 coal got back its share. Clearly, with an average of 66%, three quarters of the electricity generated in the Netherlands is fuelled by natural gas. This point out the importance of natural gas as a source of electricity supply in the Netherlands. Coal remains an important element in electricity generating over the years, this can partly be explained due to low coal prices which makes it attractive for electricity generation. Nuclear energy has never been a main source of power generation in the Netherlands.

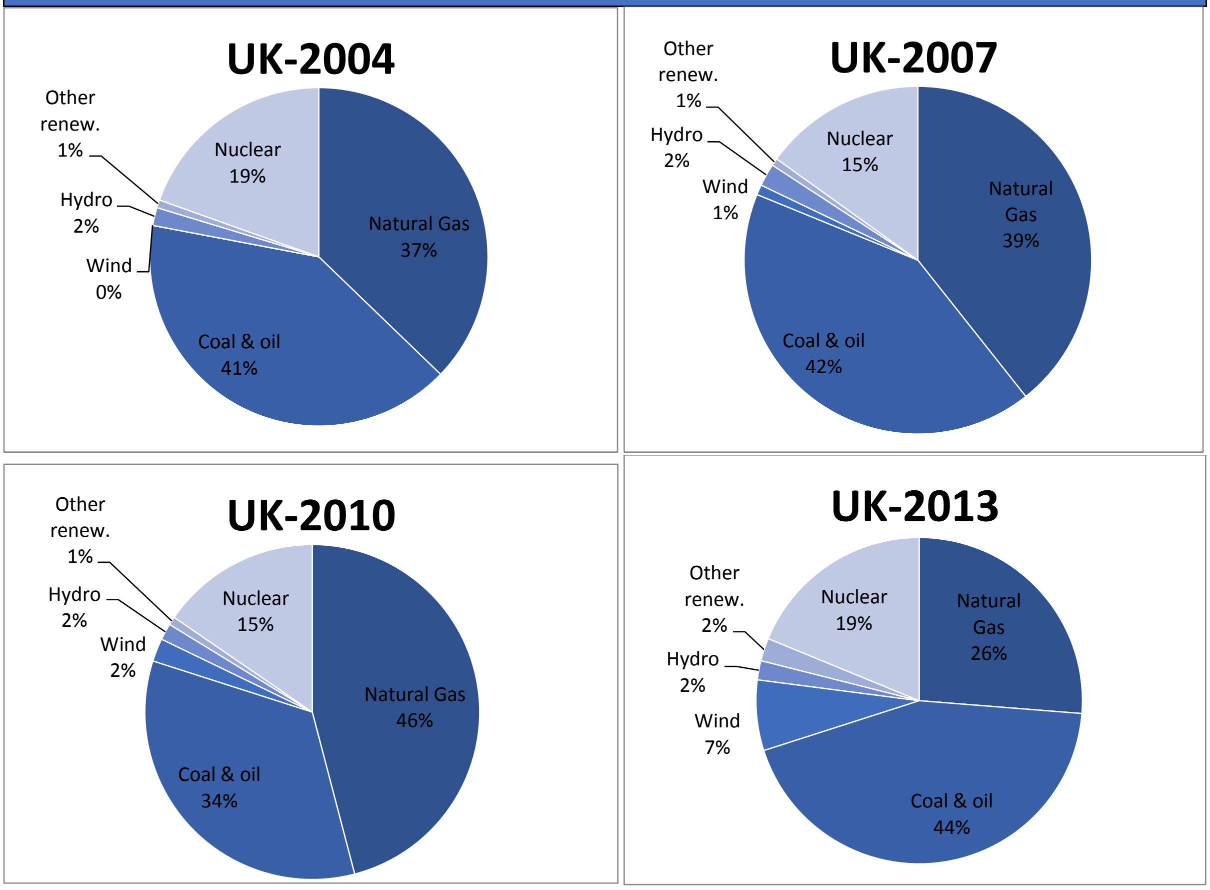
Table 9. The United Kingdom - Energy mix for electricity generation:

(in TJ)	Natural Gas	Coal & oil	Wind	Hydro	Other ren.	Nuclear	**Total**
2004	504.875	553.149	0	23.258	10.291	265.254	**1.356.827**
2005	501.776	559.775	0	23.748	13.830	270.622	**1.369.751**
2006	455.594	613.670	0	26.650	18.436	249.254	**1.363.604**
2007	536.859	570.938	12.848	28.654	9.493	206.096	**1.364.888**
2008	606.111	504.665	19.395	29.822	9.569	171.623	**1.341.185**
2009	572.971	432.191	23.545	28.626	13.262	225.942	**1.296.536**
2010	604.432	447.687	29.308	20.999	10.548	203.190	**1.316.164**
2011	502.926	447.197	45.631	26.904	14.796	225.559	**1.263.013**
2012	337.599	570.601	61.092	25.647	18.504	230.217	**1.243.661**
2013	322.564	538.202	85.788	23.345	27.765	230.881	**1.228.546**

(Dukes, 2014)

In this table "coal & oil" are combined, since the derived statistics did not separate them. Although, oil usage for electricity generation is not common, due to the high price compared to other sources. Other statistics from the DECC showed that oil usage for electricity generation in the UK fluctuates between only 1% and 2% of total. Final energy consumption in the UK has been decreasing since 2005 and has now returned to similar levels observed in the mid-1980s. The decrease was mainly driven by reduction in gas consumption, resulting from a milder winter in 2011 requiring less fuel for heating purposes compared with the cold winter in 2010. It should be noted that an improving long-term trend in energy intensity can be partially explained by improved energy efficiency or fuel switching.

Figure 7. United Kingdom - Electricity mix pie charts: (2004; 2007; 2010; 2013)



From the pie charts above it can be found that UK;'s main energy resouces for electricity generation are natural gas; coal and nuclear energy. Natural gas accounts for a little over a third in avarage of the total electricity generation. Coal fired electricity generation accounts for over 40% of total, while nuclear accounts for a little over a quater of the total electricty mix. Electricity generation by wind energy has strongly increased over the past ten years and replaced part of the share of natural gas. These statistics prove the UK truly has managed to replace a partial share of natural gas for electricity generated by wind energy. In the next chapter, the offshore wind analysis attempts to disclose how the UK has managed this energy transition. An important side note is that the highly polluting coal-fired generation has gone down but strongly increased over the years again, which is at odds with the sustainability of energy supplies. Moreover, different from the Netherlands, nuclear energy always has played a significant role in UK's electricity supply.

4.4.2 Gas and oil production

Netherlands: natural gas production, consumption, import and export

The Netherlands is a major exporter of gas to other EU Member States. In 2008, the Netherlands produced around 36% of all gas produced in the EU (Bazelon *et al.*, 2010). The Netherlands is a net exporter of gas, over the last ten years exports have always been far more than double the size of imports.

Table 10. NL: Natural gas - Production, Consumption, Import & Export (in TJ)

NL *(in Terajoule)*	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Natural gas supply	**1.540.000**	**1.480.000**	**1.435.000**	**1.395.000**	**1.454.000**	**1.466.000**	**1.643.000**	**1.434.000**	**1.373.000**	**1.396.000**
Production	2.579.000	2.357.000	2.320.000	2.281.000	2.511.000	2.363.000	2.657.000	2.419.000	2.406.000	2.587.000
Imports	565.000	688.000	755.000	783.000	794.000	770.000	773.000	690.000	783.000	810.000
Exports	1.606.000	1.565.000	1.640.000	1.670.000	1.852.000	1.669.000	1.786.000	1.676.000	1.812.000	2.007.000
Net. imports	-1.041.000	-877.000	-885.000	-887.000	-1.058.000	-898.000	-1.014.000	-985.000	-1.030.000	-1.197.000
Natural gas consumption	**1.540.000**	**1.480.000**	**1.435.000**	**1.395.000**	**1.454.000**	**1.466.000**	**1.643.000**	**1.434.000**	**1.373.000**	**1.396.000**
Electricity/CHP conversion[2]	581.000	558.000	544.000	575.000	610.000	621.000	664.000	601.000	511.000	497.000
Fuel and heat conversion	28.000	31.000	22.000	16.000	20.000	21.000	23.000	24.000	17.000	20.000
Final energy consumption[3]	840.000	797.000	784.000	714.000	742.000	744.000	862.000	719.000	760.000	798.000
Non-energy use	90.000	94.000	86.000	90.000	82.000	81.000	94.000	90.000	84.000	82.000

(CBS, 2015b)

Table 11. NL – Annual production of natural gas & oil

NL	**Total Gas** *(in mln m3)*	**Total Oil** *(in TOE)*	**Total Gas** *(in TJ)*	**Total Oil** *(in TJ)*	**Total Oil & gas** *(in TJ)*
2004	81.459	2.891.000	2.864.913	121.046	**2.985.959**
2005	74.422	2.269.000	2.617.422	95.003	**2.712.425**
2006	73.271	2.022.000	2.576.941	84.661	**2.661.602**
2007	72.013	2.576.000	2.532.697	107.857	**2.640.554**
2008	79.222	2.163.000	2.786.238	90.565	**2.876.803**
2009	74.613	1.704.000	2.624.139	71.346	**2.695.486**
2010	83.902	1.414.000	2.950.833	59.204	**3.010.038**
2011	76.380	1.464.000	2.686.285	61.298	**2.747.582**
2012	75.970	1.467.000	2.671.865	61.423	**2.733.288**
2013	81.479	1.519.000	2.865.616	63.601	**2.929.217**

(CBS, 2015a)

[2] The input minus the production in the conversion of energy sources in: - only electricity; - Electricity and useful heat used together. (CHP - Combined Heat and Power).

[3] The consumption of energy, hereafter no remaining useful usable energy is left. Examples include the burning of natural gas in a heat boiler, the consumption of electricity by households.

United Kingdom: natural gas production, consumption, import and export

UK's natural gas production strongly decreased over the years, while Net. imports strongly increased. Original figures presented in kWh, for comparison converted into TJ. UK's natural gas production sharply declined over the period 2004-2013, meanwhile imports strongly increased. UK's oil production in the period 2004-2008 was not available in the accessed DECC files, however more recent figures show the large volumes of oil production in the UK which are many times greater than Dutch oil production.

Table 12. UK: Natural gas – Production, Consumption, Import & Export (in TJ)										
UK *(in Terajoule)*	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Natural gas supply	**4.082.055**	**4.253.592**	**4.215.330**	**4.586.216**	**4.954.574**	**4.788.557**	**5.445.000**	**4.728.957**	**4.548.105**	**4.594.321**
Production	4.036.526	3.693.561	3.349.937	3.019.713	2.917.404	2.500.872	2.394.656	1.896.159	1.629.707	1.529.125
Imports	478.918	623.981	878.506	1.216.895	1.465.877	1.646.811	2.133.195	2.118.509	1.978.266	1.926.379
Exports	-410.802	-346.253	-434.127	-443.368	-441.612	-493.559	-635.037	-661.280	-518.483	-394.790
Net. Imports	68.116	277.729	444.379	773.527	1.024.264	1.153.252	1.498.158	1.457.228	1.459.784	1.531.589
Stock change	-22.446	4.756	-23.166	19.728	-11.113	-17.554	54.976	-81.443	-968	2.236
Transfers	-140	-183	-199	-280	-246	-1.265	-947	-216	-201	-218
Statistical difference	2.541	278.128	444.984	774.273	1.026.228	1.138.362	1.500.002	1.454.147	1.451.308	1.530.777
Natural gas demand	**4.079.514**	**3.975.463**	**3.770.346**	**3.811.943**	**3.928.346**	**3.650.196**	**3.944.998**	**3.274.810**	**3.096.798**	**3.063.544**
Transformation	1.305.604	1.274.926	1.200.350	1.366.264	1.448.051	1.375.418	1.430.254	1.188.272	863.026	811.739
Energy industry use	318.484	313.780	294.691	273.690	253.957	254.148	263.589	232.580	206.399	197.544
Losses	29.530	39.471	43.177	43.403	28.184	40.117	46.063	35.735	28.406	26.905
Final consumption	2.389.820	2.318.800	2.203.641	2.091.764	2.168.612	1.955.718	2.175.973	1.796.805	1.978.191	2.007.204
Non-energy use	36.076	28.486	28.486	36.821	29.542	24.794	29.119	21.418	20.775	20.152

(Dukes, 2015)

Table 13. UK – Annual production of natural gas & oil					
UK	**Total Gas** ***(in mln m3)***	**Total Oil** ***(in TOE)***	**Total Gas** ***(in TJ)***	**Total Oil** ***(in TJ)***	**Total Oil & gas** ***(in TJ)***
2004	101.592	n/a	3.572.991	n/a	
2005	92.735	n/a	3.261.490	n/a	
2006	83.817	n/a	2.947.844	n/a	
2007	76.970	n/a	2.707.035	n/a	
2008	73.482	n/a	2.584.362	n/a	
2009	62.425	63.323.306	2.195.487	2.651.347	**4.846.834**
2010	59.707	58.923.587	2.099.895	2.467.131	**4.567.026**
2011	47.733	49.078.489	1.678.770	2.054.916	**3.733.686**
2012	41.054	42.476.679	1.443.869	1.778.499	**3.222.368**
2013	38.475	37.985.299	1.353.166	1.590.444	**2.943.610**

(Dukes, 2013)

4.4.3 Government revenues from fossil fuels extraction

After converting all the figures into Terajoules, the State earnings per 1 unit energy (i.e. 1 Terajoule) are calculated. By taking the total State earnings from natural gas and oil (oil revenues are included, because State revenues from oil and natural gas are presented combined and cannot easily be separated) and divide it through the total Terajoules. This allows the comparison of State revenues per 1 unit energy, in order to find out whether there is a "level playing field" between the Dutch and British Government in oil and natural gas revenues. It will give an indication whether a Government is more or less financially interested in these revenues.

Netherlands: Government revenues

Table 14. NL - Government revenues from oil and gas production

NL	Dividends	Income out ground and mineral reserves	Corporate tax	Total revenues Oil & Gas
2004	€1.538.000.000	€3.203.000.000	€1.940.000.000	**€6.681.000.000**
2005	€1.701.000.000	€4.078.000.000	€1.800.000.000	**€7.579.000.000**
2006	€2.402.000.000	€6.028.000.000	€2.180.000.000	**€10.610.000.000**
2007	€2.371.000.000	€5.579.000.000	€1.812.000.000	**€9.762.000.000**
2008	€3.275.000.000	€9.341.000.000	€2.455.000.000	**€15.071.000.000**
2009	€2.215.000.000	€6.501.000.000	€1.682.000.000	**€10.398.000.000**
2010	€2.080.000.000	€7.075.000.000	€1.515.000.000	**€10.670.000.000**
2011	€2.136.000.000	€8.232.000.000	€1.573.000.000	**€11.941.000.000**
2012	€2.291.000.000	€10.442.000.000	€1.800.000.000	**€14.533.000.000**
2013	€2.230.000.000	€11.120.000.000	€1.714.000.000	**€15.064.000.000**

(CBS, 2015c)

The actual total natural gas revenues are higher than the figures presented above. Formally, the government owns the natural gas, but it outsourced the extraction and exploration to the NAM, EBN, Esso (Exon Mobile), Shell, Gasterra. The difference between the revenues presented above and estimations from TNO (Weterings et. All, 2013:p61) and Brattle group are related to revenues from the ownership structures in Gasterra and Gasunie. This has to do with the ownership of those benefits. The additional revenues cannot be counted fully as natural gas, but also include oil revenues. These reports found the revenues presented above an underestimation of natural gas. VAT on energy consumption is not included in the calculation and the sectors oil and gas are hard to unbundle (GasTerra, EBN) therefore TNO (Weterings et. All, 2013:p61) has decided to count higher amounts. The figures above would, in their opinion would cause an underestimation of the natural gas revenues.

Table 15. NL - Revenues per 1 Terajoule

NL	Total revenues	Total Production (Oil & Gas) in TJ	Revenues per 1 TJ
2004	€6.681.000.000	2.985.959	**€2.237**
2005	€7.579.000.000	2.712.425	**€2.794**
2006	€10.610.000.000	2.661.602	**€3.986**
2007	€9.762.000.000	2.640.554	**€3.697**
2008	€15.071.000.000	2.876.803	**€5.239**
2009	€10.398.000.000	2.695.486	**€3.858**
2010	€10.670.000.000	3.010.038	**€3.545**
2011	€11.941.000.000	2.747.582	**€4.346**
2012	€14.533.000.000	2.733.288	**€5.317**
2013	€15.064.000.000	2.929.217	**€5.143**

(CBS, 20115a; CBS, 2015c)

With an annual average of €11.230.900.000,- Governmental revenues natural gas plays an important role in the Dutch economy. The annual average over the past five years is €4.442,- per Terajoule. Average is calculated of the past five year, since the oil and gas revenues in the United Kingdom cannot be traced back earlier than 2009. For the comparison the same period of time is applied.

United Kingdom: Government revenues

Table 16. UK -Government revenues from UK oil and gas production				
UK	Ring Fence Corporation Tax [RFCT]	Supplementary Charge [SC]	Petroleum Revenue Tax [PRT]	Total
2004	£2.790.000.000	£1.041.000.000	£1.284.000.000	**£5.115.000.000**
2005	£5.210.000.000	£2.097.000.000	£2.016.000.000	**£9.323.000.000**
2006	£4.919.000.000	£1.790.000.000	£2.155.000.000	**£8.864.000.000**
2007	£3.402.000.000	£2.326.000.000	£1.680.000.000	**£7.408.000.000**
2008	£5.716.000.000	£4.110.000.000	£2.567.000.000	**£12.393.000.000**
2009	£2.839.000.000	£2.159.000.000	£923.000.000	**£5.921.000.000**
2010	£3.810.000.000	£3.054.000.000	£1.458.000.000	**£8.322.000.000**
2011	£4.714.000.000	£4.126.000.000	£2.032.000.000	**£10.872.000.000**
2012	£1.908.000.000	£2.485.000.000	£1.737.000.000	**£6.130.000.000**
2013	£1.665.000.000	£1.891.000.000	£1.115.000.000	**£4.671.000.000**

(UK Government, 2014:p7)

Table 17. UK - Revenues per 1 Terajoule			
UK	Total revenues	Total production (Gas & Oil) in TJ	Revenues per 1 TJ
2004	£5.115.000.000		
2005	£9.323.000.000		
2006	£8.864.000.000		
2007	£7.408.000.000		
2008	£12.393.000.000		
2009	£5.921.000.000	4.867.841	**£1.216**
2010	£8.322.000.000	4.565.868	**£1.823**
2011	£10.872.000.000	3.739.940	**£2.907**
2012	£6.130.000.000	3.234.401	**£1.895**
2013	£4.671.000.000	2.930.057	**£1.594**

(UK Government, 2014:p7; Dukes, 2013)

In the UK the average annual income from oil and natural gas is £7.901.900.000,-. This is lower than in the Netherlands. Oil production in the UK is much more significant than in the Netherlands. A five year average of £1.887,- revenues per Terajoule [TJ]. The UK has a much larger oil production, than the Netherlands. Since the oil and gas revenues in the UK are combined and cannot easily be separated, the oil production is also included. UK oil production 2004-2008 cannot be retraced.

4.5 Conclusion: Natural gas comparison

This chapter analysed the first and second sub-question: 1) *"How have energy-policies regarding natural gas developed?"* and 2) *"What is the country's natural gas ratio to the total energy mix and what is the State's involvement regarding natural gas production and revenues?"* It has become clear that Dutch policy, especially after the period of renewed expressed concerns of declining gas production in 2006, focused on strategic deployment by developing a leading trade position on the European gas market through their outlined gas Hub strategy. This would enable the Netherlands to meet future increasing natural gas demand from neighbouring countries, notably the United Kingdom. The British on the other hand, which were confronted on a much earlier stage with a declining gas production, realised action had to be taken to reduce future dependency from natural gas imports. Over the years, the UK shifted electricity supply generated from natural gas towards coal and nuclear generation. Simultaneously generation from renewables expanded.

The Dutch natural gas industry and its production are much larger. At the other hand UK has a much larger oil industry compared to the Netherlands, but oil is not common for electricity generation. In that way the oil industry does not contribute to electricity supply. The statistics on energy mix for elextricity generation prove the UK truly has managed to replace a partial share of natural gas for electricity generated by wind energy over the recent years. Simultaniously coal and nuclear have replaced natural gas as well. Different from the Netherlands, the UK highly relies on natural gas imports. This has created a more urgent need to revise their energy supply and security. It is clear to see the UK has been moving with their energy mix in the recent decade. Moreover, the comparison shows the Netherlands has much higher revenues per 1 TJ than the UK. This indicates there is no level-playing field between both when it comes to natural gas revenues. And therefore the natural gas industry is financially much more important as a source of income for the Dutch State's budgeting. Due to State's ownership in companies in the natural gas sector the Dutch state has larger financial interests in the industry, which results in larger revenues per TJ of produced gas and oil.

The price of natural gas is related to the oil price. Between 2006-2008 the price of crude oil sharply raised to a record high of $140,- a barrel. Due to the financial crises starting in late 2008 the price of crude oil felt back to a low of under $50,-. The high oil and gas prices in the period until 2008 have caused awareness in the UK and renewed interest for development of renewable energy sources. Although, as an exporting country, the Netherlands has generated extra financial benefits from their gas exports due to these high oil prices, while the UK had to pay much higher prices for their gas imports. This can be regarded as an influential factor for the UK to reconsider their electricity supply.

Dutch Gas hub Strategy

Reducing Europe's dependence on Russian gas is, not only recently but always has been a much debated subject in the context of energy security. As well as it can serves as an instrument to increase political pressure on Russia. Europe currently has no alternative to Russia as a gas supplier. Perhaps this is where the strategic excellence of the *Dutch gas hub strategy* comes into play. With high capacity LNG import terminals and high volume LNG imports from anywhere in the world into the Netherlands, a premium interconnected gas grid around Europe (which eventually will be realized with an European super grid project), such as the recently completed BritNet interconnection and further extension of TenneT's high-voltage grid interconnections with neighbouring countries, the Netherlands can become the alternative for Russia as gas provider, and achieve their mission and become Europe's strategic player in the gas industry.

5. Political economy analysis of offshore wind

5.1 Introduction

The UK has been a major growth market for offshore wind [OSW] over the past ten years. As of January 2014 the UK is the world leader in OSW power with an installed capacity of 4.3 Gigawatts [GW] of which 3.8 GW is operational (Crown Estate, 2014b). At the other hand the Dutch Government has been reluctant in the past ten years to support major investments in OSW energy. The Netherlands currently has 0,247GW of installed capacity which only takes up only 4% of the total EU installed capacity, while the UK accounts for 56% of installed capacity (EWEA, 2014). Before 2003 the UK had less than 4MW installed OSW capacity, while the Netherlands already had 19MW of installed capacity. By deploying its first OSW project; Lely 1994, the Netherlands was an early mover. OSW energy was still a brand new technology in 1994. Only two offshore wind farms [OSWFs] had been built: Norgersund in Sweden and Vindeby (1991) in Denmark. The first OSWF was completed in 1991 off the coast of Denmark. This farm consisted of eleven-turbines with each turbine rated at 450kW. In the beginning, OSW turbines were relatively close to shore, and were modelled after onshore turbines. Norgersund in Sweden had a tripod foundation (three pillars), whilst Vindeby in Denmark used a concrete caisson. Lely Wind Farm in the Dutch lake, the IJsselmeer, was the very first to feature a driven monopile foundation (single pillar), which is now the standard in OSW structures in the North Sea. It shows the innovativeness of the Netherlands at that time. The UK was, in the early phase as 2003, clearly not so successful, but somehow they were able to manage a turnaround and moved within ten years to OSW market leader in 2013. Below an overview of annual installed OSW MW capacity at the end of the year (Arántegui, 2014). The data does not include partly-operational wind farms. Intertidal and shoreline (i.e. physically connected to the shore) wind farms are connected to the shore and do not belong in the category OSW.

Table 18. Annual installed OSW capacity (2003-2013)

Country	<2003	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total
Belgium								30	165		185	117	496
China						1.5		65	275	61.1	163		565
Denmark	210	193.2						238	207	3.6	50.4	349	1268
Finland	0.5					15	9		2.3				27
Germany			4.5		2.5		5	60	40	88.3	80	240	520
Ireland			25.2										25
Japan			11.3						14		0.12	18.4	44
Netherlands	19				108		120						247
Norway								2.3					2
Portugal										2			2
South Korea										2	3		5
Sweden	23.25					110		30			4.1	48	216
UK	4	60	60	90	95	95		382	556	667	940	708	3656
Vietnam												16	16
Total	256.5	253	101	90	206	222	134	806	1258	824	1425	1496	7089

(Arántegui, 2014:p25)

In 2011 the UK has the largest amount of installed OSW capacity in the World and it took up over half of the Installed capacity in Europe. Denmark follows with 1.271MW (19%). With 571MW (8,7% of total), Belgium is third, followed by Germany (520MW: 8%), the Netherlands (247MW: 3,8%), Sweden (212MW: 3,22%), Finland (26MW: 0,04%), Ireland (25MW), Norway (2,3MW), Spain (5MW) and Portugal (2MW).

Table 19. Cumulative offshore wind market Europe (Dec. 2013)

Country	BE	DE	DK	ES	FI	IE	NL	NO	PT	SE	UK	Total
No. of farms	5	13	12	1	2	1	4	1	1	6	23	69
No. of turbines	135	116	513	1	9	7	124	1	1	91	1,082	2,080
Capacity installed (MW)	571	520	1,271	5	26	25	247	2	2	212	3,681	6,562

(Corbetta, Pineda, Moccia, Guillet, 2014:p10)

Figure 8. Installed capacity (Dec. 2013) - Cumulative share by country (MW)

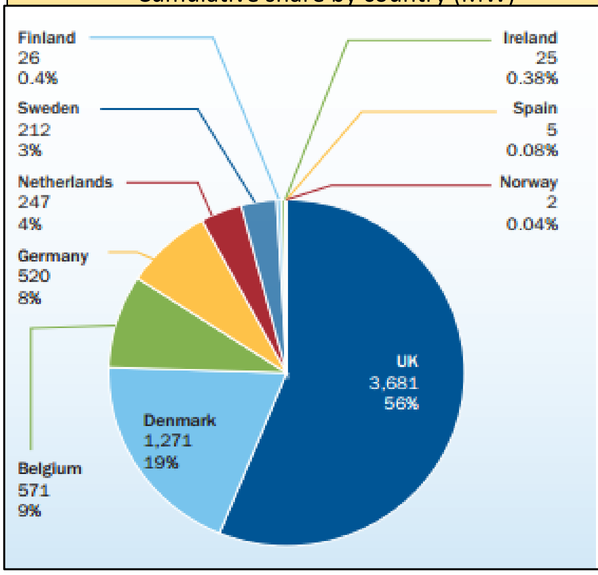
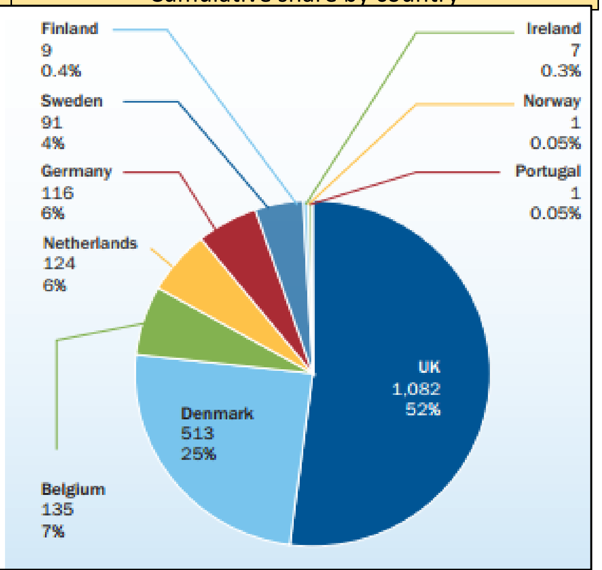
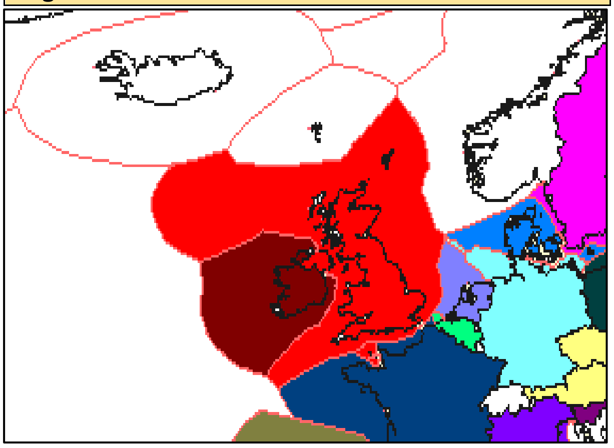


Figure 9. Installed wind turbines (Dec. 2013) - Cumulative share by country



(Corbetta, Pineda, Moccia, Guillet, 2014:p11)

Figure 10. Exclusive Economic Zones – UK & NL



Exclusive Economic Zones

The United Kingdom's Exclusive Economic Zone [EEZ] is the fifth largest in the world at 6,805,586km^2. It comprises the EEZs surrounding the United Kingdom, the Crown Dependencies, and the British Overseas Territories. The EEZ only surrounding the United Kingdom itself is 773,676km^2 (red coloured area), while the Netherlands has 154,011km^2. See Appendix 15 *"Map National Water plan 2009-2015 and EEZ Netherlands"* for a close up of Netherlands EEZ. The United Kingdom has a much larger EEZ and therefore much more resource potential for OSW development.

Turbine capacity, production and efficiency

To get understanding about wind turbine performance, some background information is necessary. Turbine capacity is expressed in Megawatts [MW] of output. A typical turbine build in mid 2000s has a power output between 2MW and 3MW. If a 3MW turbine outputs 3MW every hour of every day of the year, this gives an annual power output of: 3MW (power output) x 24 (hours per day) x 365 (days per year) = 26.280MWh. In the real world, the turbine will never output 26.280MWh in a year, since turbines are never 100% efficient. Moreover, turbines on sea are more efficient due to stronger winds, than turbines on land. A typical wind turbine on land at a reasonable site will operate with around 25% efficiency, while an OSW turbine is estimated at 35% efficiency. Again, this all depends on the specific location. The annual production output for OSW is as follows: 3MW (power output) x 24 (hours per day) x 365 (days per year) x 35% (efficiency) = 9.198MWh. Households in the United Kingdom and Netherlands have an annual average energy consumption of 3.900kWh, where the United Kingdom has a higher average consumption (4.500kWh, 2010) and the Netherlands lower (3.300kWh, 2010). One 3MW turbine with a 35% efficiency rate can power 2385 households annually (9.198.000kWh/3.900kWh). Nowadays, typical turbines placed in a offshore wind farm [OSWF] in the North Sea have a higher power output than 3MW (e.g. 3,6MW, 4MW, 5MW, 6MW). Since October 2013 a demonstrator project (Samsung and 2-B Energy) located in Methil (Scotland) has an incredible 7MW experimental testing turbine. Japan's Mitsubishi Heavy Industries [MHI] is even about to bring a floating 7MW version (June, 2015) to a testing location right of the coast of Fukushima. The next decade will bring stronger turbines to the market even in commercial floating versions.

European Union Legislation (Third energy package)

The Renewables Directive (2009/28/EC) is a European Union directive mandates levels of renewable energy use within the European Union. The directive was published on April, 23 2009. Members States were obliged to notify the European Commission by June 30, 2010 of their National Renewable Energy Action Plan which sets out the road map of the trajectory. The directive requires that 20% of the total energy consumed within the European Union is renewable. This target was pooled among the Member States where the Netherlands has set the goal on 14% and the United Kingdom on 15%.

Subsidy instruments: EU incentive instruments for renewable electricity

In the European Community, different stimulus instruments are used to promote the generation of sustainable electricity. Also the performances achieved in the EU countries with different forms of support are different. This section attempts to make an overall assessment of the results of the schemes, including cost-effectiveness. The European Commission published a report (2005) with the support of electricity from renewable energy sources in the EU. Applied instruments for promotion of electricity from renewable sources in the EU can be broadly divided into four categories:

1. Feed-in tariffs: A Feed-in-Tariff [FiT] system is a subsidy which a producer of renewable electricity will be reimbursed for the electricity supplied. Feed-in systems can be divided into feed-in tariff systems, which the producer sells electricity at a fixed rate to the grid infrastructure company or the supplier, and feed-in premium systems, in which the producer sells the electricity itself on the market and will receive an additional premium to cover the financial gap. Feed-in tariffs is the most commonly used mechanism in the EU countries to promote the generation and use of renewable electricity.

2. Obligations System: Depending on the chosen system, either producers or consumers have the obligation to produce/buy a certain percentage of the production/consumption from renewable sources, or buy non-renewable power purchase certificates from producers of renewable electricity.

3. Public tenders: The Government closes contracts via public tender for the supply of renewable electricity. The additional costs are passed on to the consumer through a levy.

4. Fiscal instruments and subsidies: Producers of renewable electricity are eligible for tax benefits and (investment) grants. This type of stimulation is used only very limited as the main instrument for promoting the production of renewable power. In many countries, it is a complementary instrument.

5.2 The Netherlands and offshore wind

5.2.1 Stage 1a: Historic analysis: pre 2003

The first Dutch study of the potential of OSW was made in 1973 by the Industrial Oceanology Council [IRO]. The IRO had been established in 1971. The IRO felt that wind energy at sea might possibly constitute an interesting future direction for Dutch offshore industry and, as it was its mission to explore such opportunities, it made a study of the economic and technical feasibility of what it referred to as “aero-generators at sea” in late 1973. A “Working Group Wind Energy” was established, consisted out of Fokker, KEMA, engineering agency Marcon, and machine manufacturer VMF, and produced a report entitled *Wind energy plants in the North Sea* (Staveren, 1974) which concluded that OSW could contribute significantly to Dutch energy supply. The Ministry of Economic Affairs [Min. EZ] initiated the first National Research Program Wind Energy [NOW-1] in 1976. Another report confirmed the preference for large scale wind energy on water areas, e.g. the North Sea (Setten, Voogd, 1980). OSW was only a very small part of the NOW-1 program, whose general aim was to determine whether wind energy could significantly contribute to Dutch energy supply (Verbong, Selm, Knoppers, Raven, 2001:p135-172). Only 2% of the program’s 19mln guilders budget went to OSW, compared to 80% of the budget for research into horizontal and vertical axis turbines, 6% for grid connection issues, and 5% for meteorological characterization (Beurskens, H.J.M., 1985) Mr. H.J.M. Beurskens accounts as one of the first and most important contributors to wind energy research in the Netherlands. NOW-1 was followed up by NOW-2 (1981-1984). Again, OSW was not the main focus: it was placed in the ‘miscellaneous’ category and received only 2% of the budget. The Noord-Holland Province Electricity Company [PEN] was the first to make use of subsidies for OSW projects. PEN wanted to gain the necessary knowledge and expertise early on through a demonstration project in the relatively calm and shallow IIsselmeer. The 2MW *Lely* project, some 0.8km from the shore in 5-10 meters of water, was constructed between 1992 and 1994 and became the world’s second offshore, grid-connected wind farm. Half of the parks cost were covered by TWIN and the EU’s CADDET program. A year after the farm’s completion, in 1995 the Ministry of Economic Affairs’ published its Third Energy Memorandum which increased the target for wind energy. Shortly after the Third Energy Memorandum, the TWIN program was followed by TWIN-2 (1996-2000). Novem, the Ministry of Ec. Affairs environmental agency, ordered a feasibility study into a 100MW “Near Shore Park” as part of the program. At this point, it considered offshore locations to be the “most favourable in the long run” (ECN, 1996).

In 1997, the strategy to reach the *Third Energy Memorandum*’s general wind energy targets was laid out in the action programme *Renewable Energy on the March*. In early 1999, Novem presented an ‘offshore wind energy placement plan’ (Plaatsingsplan Windenergie Buitengaats) which contained the results of a number of the aforementioned feasibility study and proposed to go ahead with the construction of the 100MW demonstration park, which it thought could be operational in 2003. One conclusion was that 3250km2 of possible OSW locations was available in water depths less than 20m and factoring in shipping routes, cables, pipelines and offshore resource mining (ECN, 1999), yielding a potential of between 4000MW and 6000MW (Swager, 2006). Later in 1999, the Minister of Economic affairs announced a location 8-15km off the coast of Egmond-aan-Zee. In its Fourth National Environmental plan [NMP-4], the Government recognized the persistent nature of environmental problems, as well as the need for radical innovation and structural changes in the energy as well as the policy regime (VROM, 2001, NMP-4). In 2001 subsidy of €27mln was made available from the Ministry of Economic Affairs’ budget for CO_2-reduction, but in return, proposals would have to include an extensive monitoring program of what came to be known as the Offshore Windpark Egmond aan Zee [OWEZ].

5.2.2 Stage 1b: Basic analysis: since 2003

The period early 2000s - mid-2000s is characterized by contestation in a context of consecutive Governments for whom climate change and renewable energy were not priorities: contestation around the various licenses required for the two consented OSWFs; contestation over the optimal licensing procedure for future ones; and finally, contestation over the legitimacy of Government subsidization of what in this period is increasingly framed as a too expensive option for realizing the Dutch renewable energy targets. One characteristic result of these contestations in this period is increased collaboration among actors in the Dutch OSW energy sector.

Towards the end of the period, the 2001 moratorium was briefly lifted but quickly reinstated, and it concluded with the withdrawal of subsidy for OSW.

The period mid-2000s - late 2000s is characterized by a renewed impulse for OSW. In the context of increased societal attention to climate change, a new (centre-left) cabinet saw OSW as a climate change solution. The moratorium was lifted once again, and while the Government evaluated applications, it announced a subsidy tender for what is now referred to as 'Round-2' of OSW deployment and promised a concession system for the future 'Round-3'. But after the two 'Round-1' farms came online, the subsidy is granted, and the concession system laid down in a new national water policy, the cabinet felt and was replaced by a more center-right one which substantially revised renewable energy subsidy system and eliminated OSW from it.

The period early 2010s-present is characterized by a shift in policy support for OSW from deployment to cost-reduction through innovation in the context of the new cabinet's 'top sector' policy paradigm: stimulating industry-research-policy cooperation by adopting a facilitating role in supporting initiatives by market parties. OSW is named a 'key area' in the 'top sector energy' in part because of its job potential and is supported through the 'green deal' and the 'innovation contract Wind on Sea'. The OSW sector's focus is now significant cost reduction, which was made a prerequisite for (financial) Government support for further deployment in a future 'Round-3'. Round-3 OSW is expected to start in 2017. In September 2014 the Government again updated their OSW spatial planning and changed the reserved locations (Rijksoverheid, 2014).

5.2.3 Stage 2a: Defining the sector

The owner or developer of an OSWF is often an (international) energy company, or a consortium of energy companies. In the Netherlands, the owner of the offshore wind farm at Egmond aan Zee [OWEZ] is the consortium of Vattenfall (Nuon) and Shell. Eneco owns the Princess Amalia offshore wind park and is together with Mitsubishi Corporation the developer of the Eneco Luchterduinen OSWF. The consortium of Typhoon Offshore and HVC is developer of OSWF Gemini. The Dutch OSW industry is characterized by: -Multinational production of foundations and installation tools; -Suppliers of electrical infrastructure; -Suppliers of turbine components for OSW turbines; -Installation of turbines, foundations and electrical infrastructure; -Suppliers of maintenance work; -Other services.

The Netherlands has a number of R&D centres of expertise. The Dutch OSW energy expertise is concentrated at TU Delft, Energieonderzoek Centrum Nederland [ECN] and WMC as far as technology in the widest sense is concerned. At the IMARES institute the ecological effects are studied. The Netherlands was the first to produce an integrated research programme focused on generating the knowledge necessary for applying wind energy at sea on a large scale. Formulated in 2004, the We@Sea program prepared the way for Dutch companies and centres of expertise to work on wind energy in the North Sea. The program ran parallel to the construction of the first two Dutch OSWFs and has particularly contributed to the first practical experiences and the elimination of risks in the field of nature and environment. See appendix 17 for an overview of all development programs. In the Netherlands there are seven port locations that play an important role in the wind industry development. Through the existing port infrastructure, skills and supply chain it enables developing activities in the OSW sector. See appendix 16 for the current overview.

<u>Offshore wind farms in the Netherlands</u>

The first two OSWFs built in the North Sea off the coast of the Netherlands are the Offshore Wind farm Egmond aan Zee [OWEZ] in 2006 and the Princess Amalia Wind Park [PAWP] in 2008. Two others are currently under construction. In appendix 10 an overview and details are given about the operational and OSWFs under construction in the Netherlands. In 2014, the national electricity transport operator TenneT has been appointed by the Government as the network manager for the electricity grid at sea.

1. Offshore wind farm Egmond aan Zee [OWEZ] - Before named OSWF "North Sea Wind" [NSW]. 36 turbines of each 3MW were installed, which makes a total of 108MW generating capacity. The project involved an investment of over €200mln. For the OWEZ farm the Joint Venture NoordzeeWind C.V. was established. The ownership belongs to Shell (50%) and energy supplier Nuon (50%). Both made an investment in the project of over €100mln. The Dutch Government supports the project in three different ways: through the Environmental Quality of Electricity Production (Milieukwaliteit ElektriciteitsProductie - MEP) and an investment subsidy under the Carbon Reduction Plan (Kooldioxide reductieplan) of the Ministry of Economic Affairs. Finally, the fiscal Energy Investment Allowance (Energie Investerings Aftrek - EIA) scheme applies. The first two OSWFs (OWEZ & Prince Amalia) both received an additional a one-time CO_2-reduction grant from the Government. OWEZ received of more than €27mln for the construction. OWEZ financial statement overview of the period 2005-2014 can be found in appendix 11.

2. Princes Amalia Wind Park [PAWP] - This OSWF got its name “Q7” after its geographic location in the North Sea. 60 Turbines of each 2MW were installed, which makes a total of 120MW generating capacity. Later the Q7 wind farm was renamed into Princes Amalia Wind Park. It now is fully owned by the Eneco group, a major Dutch energy supplier. Before, the ownership belonged to Econcern, a new and fast growing holding of five RE companies in the renewable energy industry. On July 25, 2006 Econcern sold 50% of its shares in the Project wind farm Q7 holding to Eneco. In May 2009 Econcern filed for bankruptcy (Wijn & Stael Lawyers, 2013). On October 1, 2011 Eneco acquired the remaining 50% shares in Wind Park Q7 Holding and became 100% owner of the Project Q7.

3. Gemini offshore wind farm - This project is currently being build and consists out of two wind farms “Buitengaats” and “ZeeEnergie” of each 300MW. 150 turbines of each 4MW will be installed, with a total generating capacity of 600MW. Construction has started in 2014 and the wind farm is expected to be fully operational in the summer of 2017. It will be the largest OSWF in the Netherlands (Gemini, 2014). The total construction costs of the Gemini OSWF are estimated at €2.8bn. On May 12, 2010 the Government allocated a total of €4.5bn of SDE (Stimulering Duurzame Energie) subsidies for the OSWF over a period of 15 years.

4. Luchterduinen offshore wind farm - The OSWF Luchterduinen, also known as “Q10” or “Gemini-2” is an initiative by the Eneco group and will be Eneco’s second OSWF. Construction started in October 2013 and operational readiness is scheduled on September 28, 2015 (Rijksoverheid, 2011). The OSWF will consist out of 43 turbines of each 3MW with a total generating capacity of 129MW. The first part of the SDE subsidy budget for OSW was awarded to the Gemini project. The remaining budget of the second round was awarded on November 4, 2011 at Eneco wind farm Luchterduinen. Eneco received in 2011 a grant of up to €989mln for the operation of this wind farm which will be paid over a period of 15 years. The total investments in Luchterduinen are estimated at €400mln to €500mln. Early 2013 Mitsubishi Corporation [MC] took a 50% stake in Eneco Luchterduinen OSWF (Eneco, 2012).

5.2.4 Stage 2b: Government involvement in the offshore wind industry

It is only in the recent past that the Government started to make stronger commitments (besides the subsidizing of sustainably generated electricity) in the development of the OSW industry again. The Far and Large Offshore Wind [FLOW] project was a research program launched in September 2009 by Dutch businesses and knowledge institutes (RWE, Eneco, TenneT, Ballast Nedam, Van Oord, IHC Merwede, 2-B Energy, XEMC Darwind, ECN and Delft University of Technology), which work together on innovation to achieve cost-reduction for OSW. On May 28, 2010 the Ministry of Economic Affairs decided to subsidize the FLOW project with €19.5mln. Moreover, the Government also made investments in long-term research and innovation through the basic funding of ECN and WMC and via the EOS research programs and EOS consortium Innwind, in which in particular, TU Delft, ECN and WMC were active. ECN and WMC received direct funding for research activities by the Ministry of Economic Affairs.

Around 2011 there was a growing consensus there is an important element missing in the Dutch OSW industry, which is present in e.g. Germany and the United Kingdom: a test field at sea. On October 3, 2011, *The Green Deal Offshore Wind* was closed between the Government and Netherlands Wind Energy Association [NWEA] (NWEA; Rijksoverheid, 2011). In The Green Deal the Dutch Government and the sector (50 companies) agreed to achieve a 40% cost reduction in 2020 compared to 2010. In April 2012, the *Innovation Contract Offshore Wind* was signed (Topteam Energie, 2012; Min. Ec. Affairs 2012c). The Innovation Contract aims to amplify and improve the Dutch OSW supply-chain from research to commercial application. Together with the R&D program, the testing field on sea is part of the Green Deal and is an important part of the Innovation Contract. The total cost to carry out the R&D activities and the additional costs of achieving the experimental testing field in the period 2012-2016 is €318,5mln. Of this, €138,5mln is destined for the R&D activities, of which 40% is contributed by the industry and 60% from public sources (NWO, ECN, WMC, and EL&I Innovation). The cost of the experimental testing field is estimated at €180mln, of which 50% will be funded by industry and 50% by the Government. On August 29, 2012 the foundation *Top consortium for Knowledge and Innovation Offshore Wind* [TKI Wind Op Zee] was established as an initiative by FLOW. It is part of the Dutch Top sector Policy, which is a Government policy that targets the further development of successful industry sectors through research and development in cooperation with Universities and Knowledge Institutes. TKI-WOZ facilitates cooperation between companies, research institutions and the Dutch Government in OSW research, innovation and deployment.

Demonstration Park Leeghwater - At the Borssele offshore wind region, next to the planned commercial area for OSW, a small area is made available for the construction of the demonstration park. The demonstration park has space for two large wind turbines. TKI Wind op Zee [TKI-WOZ] will open a tender in 2016/2017 for this innovative wind farm, with unique possibilities for businesses for testing innovations in order to realize intended cost-reductions in OSW. The idea is that as many different innovations are tested and demonstrated together. In May 2013 TKI-WOZ has released its project plan (NWEA; TKI-WOZ, 2013). The demonstration park focuses on innovations that contribute to further cost-reductions to a level of €100,-/MWh by 2020. The current price lays around €150,-/MWh.

At last, Governmental ownership in the Dutch OSW sector is limited. TenneT is the owner and operator of the electricity grid at sea, TenneT is owned by the State, thus the electricity grid at sea is owned by the State.

5.2.5 Stage 2c: Government support mechanisms for offshore wind

Regulerende EnergieBelasting [REB]

In 1996 a tax exemption the REB [Regulerende EnergieBelasting] was established, better known as "eco-tax" for renewable energy sources (REB 36i and REB 36o). Because of EU legislation foreign producers of green electricity could not be excluded from the REB tax exemption. This fiscal stimulus had a significant drawback that Dutch tax money partly encouraged the use of existing production capacity abroad instead of creating new generation capacity. Therefore much tax money leaked abroad. Moreover, the uncertainty about the continuity of this tax incentive caused a brake on the growth of new domestic generating capacity.

Milieukwaliteit Elektriciteitsproductie [MEP]

In 2003 the Netherlands adopted a feed-in-Tariff [FiT] system. The subsidy named MEP (Milieukwaliteit Elektriciteits-Productie) was established on July 1, 2003 and stopped in 2006. It was a ministerial regulation from the Dutch Ministry of Economic Affairs. The MEP took the place of the REB. The MEP scheme was to provide a solution to the shortcomings of the REB tax exemption. Along with the introduction of the MEP subsidy the REB was abolished. The REB exemption was phased out in the period July 1, 2003 to January 1, 2005. The MEP was established to bring investment certainty for a longer term. Therefore the subsidy was given for a maximum period of ten years. This long term subsidy would be encouraging investments in the Netherlands and thus renewable electricity production should be encouraged (Min. Ec. Affairs, 2002). With the MEP most categories of renewable electricity received the investment certainty (exception was large-scale burning of biomass). A project that has been granted once a certain amount of subsidy per kWh will benefit for ten years. The MEP subsidy intended to compensate for unprofitable investments in renewable electricity. The level of investments depends on the chosen production method. Therefore it was chosen to grant different amounts for different types of renewable electricity (Min. Ec. Affairs, 2002). During the preparation and implementation of the policy the categories were further refined several times, especially in the categories of biomass and wind energy (Rekenkamer, 2007).

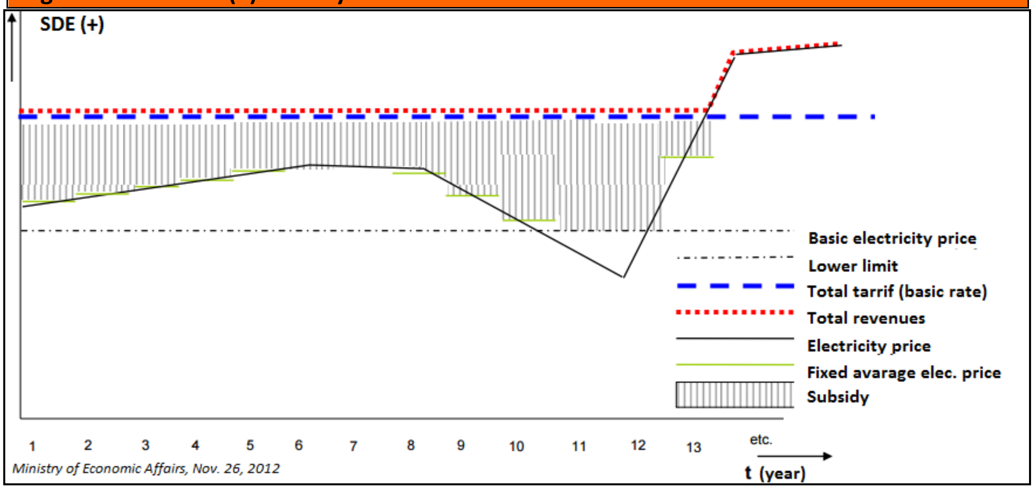
On May 10, 2005 the grant amounts for new applications for the categories scale pure biomass and OSW were put back to €0,- because of the risk that some very large projects could claim a lot of budget. The scheme was successful and therefore became too expensive (Min. Ec. Affairs, 2005b). The announcement of this temporary subsidy stop and reason for this measure were major budget overruns in the MEP due to the already approved projects. Potentially very large biomass and OSW projects would strongly worsen the budgetary issues. Another important reason was especially the high oil and gas prices that changed the circumstances. Granting of MEP funding was therefore for the rest of the year frozen (Min. Ec. Affairs, 2005b). On August 18, 2006, Minister of Economic Affairs put back the MEP Sustainable subsidies for all renewable electricity generation projects to €0,-. Until 2006 producers of renewable electricity could apply for a MEP subsidy of up to €0,07cents/kWh for up to ten years. Existing projects and projects that have been submitted did not suffer. Wind turbine projects have a long lead time. As a result, the figures starting from 2009 showed the effect of the discontinuation of subsidies. In the case of onshore wind, in 2008 416MW of new capacity still was added in the Netherlands, in 2009 it was 110MW and in 2010 it dropped further to 30MW (Rekenkamer,2007). This points out subsidies have great influence on the development of new wind farms. The two first OSWFs in the Netherlands (OWEZ and Amalia) have benefited and still receive MEP subsidy at a rate of €0,97cents/Kwh (€97,-/MWh) for a period of ten years. This is higher than the above mentioned subsidy, due to the technically challenging and expensive development costs.

<u>Subsidieregeling Stimulering Duurzame Energie [SDE]</u>

After the stop of the MEP in 2006, in 2008 it was succeeded by the SDE [Stimuleringsregeling Duurzame Energieproductie]. The SDE is just like the MEP a feed-in-Tariff premium system. The SDE started on January 1, 2008. The SDE was the response to the costly MEP subsidy from 2003 where there was no limit to the granted subsidy. The MEP interest appeared many times greater than the Government expected. Until 2009, the SDE was funded from the State's natural gas revenues and energy taxes. This has been adjusted. Now the funding comes from a surcharge on energy bills for citizens and businesses. Those who use much energy pay more to the SDE. Grants for the wind farm sites were awarded through a dedicated call for tender under the Stimulation of Sustainable Energy Production. Under this scheme, producers receive financial compensation for the electricity they generate for a fixed number of years (15 years for wind farms). The lowest bidder will be awarded. The bid must be equal or lower than the maximum amount (in €/kWh) set for the specific OSWF site. The lowest bidder was rewarded with both the grant and the consent to build and operate a wind farm according to the wind farm site decisions.

The SDE(+) compensates the difference in cost between green and gray energy over a period of 5, 12, or in the case of OSW, 15 years. The price of green energy is expressed in the *basic amount* and the price of conventional power in the *correction amount*. The difference between them is the SDE(+) contribution. In short, SDE(+) contribution = basic amount (price green energy) - correction amount (grey energy price). The price for grey energy (correction amount) varies. The correction amount is therefore provisionally set at the beginning of the calendar year by the Ministry of Economic Affairs. After the end of the calendar year, the corrective amount is revised by reference to the actual price of "grey" energy over the previous year.

Figure 11. NL - SDE(+) subsidy mechanism



(Min. Ec. Affairs, 2012b)

The second round of OSW (Gemini and Luchterduinen) was awarded the SDE subsidy for a period of 15 years. Both projects are still in the construction phase and start receiving SDE subsidy once they become operational and start generating electricity. The subsidy allocated for both projects can go up to a maximum of

€0,1739/KWh (i.e. €173,90/MWh), depending on the market price of "grey" electricity. The subsidy is limited by an annual maximum of "full load hours" of generating electricity. A year has 8760 hours, but generation is subsidized up to a maximum of hours (e.g. 3180 hours in case of Luchterduinen Q10 which will receive SDE subsidy). Generation above the limit is not subsidized. Wind turbines are never 100% productive (one year has 8760 hours). The capacity factor for OWS is estimated on 35% productivity (i.e. 3066 hours). Therefore, 3180 hours of as eligible (i.e. 36% productivity) has been set just above the expected generating capacity.

Subsidieregeling Stimulering Duurzame Energie [SDE+]

In 2011, the subsidy was thoroughly modified and renamed into SDE+. Individual households could not apply anymore and the subsidy now more focused on economic efficiency. In 2011 €1,248mln went to public-private partnerships in the field of green gas projects that create bio-fuel from biomass and €217mln for wind energy. As of 2013, the surcharge fees applied to both citizens and businesses and by 2015 the surcharge became €25,- per year. From 2013 wind differentiation was applied within the framework of SDE+, but only applied to wind on land not for OSW. This means that for windy locations other conditions were applied than sites with less wind. On less windy locations, a wind turbine runs less "full load hours'. For those locations is, therefore, a higher basic subsidy available. The SDE+ will be some tightening implemented in response to the Energy Agreement (Rijksoverheid, 2013). For example, in 2014 it was no longer possible to both apply for the SDE+ subsidy and the EIA (Energie-investeringsaftrek). For 2014, the SDE+ was opened with a total budget of €3.5bn. In 2014 the subsidy for OSW was placed on 15.7 [€ct/kWh], with a total of 3750 full load hours. 2015 again had a total budget of €3.5bn. It is 2015 not possible to request an SDE+ subsidy for wind at sea (RVO, 2015). This category is published a separate tender scheme is expected mid-2015.

Energie-investeringsaftrek [EIA]

The total amount of energy investments which a company can qualify for the EIA (Energie-investeringsaftrek) is at least €2,300,- with a maximum of €118mln per calendar year. 41.5% of the investment for which an EIA statement is received can be subtracted from the taxable profit. Since 2014 it is no longer possible to apply for both the SDE+ subsidy and the EIA.

Table 20. NL - OSWF subsidies

OSWFs	Subsidy	Period	Basic price/MWh	Correction (market price "grey" electricity/MWh)	Max. subsidy/MWh
OWEZ	MEP (10yr)	2007-2016			**€97,-**
Amalia (Q7)	MEP (10yr)	2009-2018			**€97,-**
Gemini	SDE (15yr)	2018-2032	€225,05	€51,15	**€173,90**
Luchterduinen (Q10)	SDE (15yr)	2016-2030	€225,05	€51,15	**€173,90**

(Min. Ec. Affairs, 2010; Nuon, Eneco)

5.2.6 Interim conclusion: Offshore wind in the Netherlands

The fiscal stimulus "Regulering EnergieBelasting" [REB] had significant drawbacks such as the application of existing production capacity abroad instead of creating new generation capacity. Moreover, the uncertainty about the continuity of this tax incentive caused a brake on the growth of new domestic generating capacity. The second scheme, "Milieukwaliteit Elektriciteits-Productie" [MEP], due to many applications and there was no limit to the granted subsidy, therefore became too expensive. In May 2005 the grant amounts for new applications for OSW stopped because of the risk that some very large projects could claim a lot of budget. For a long time, there was no particular focus for OSW stimulation, rather RE technologies in general (in particular solar PV and wind on land). All RE-technologies received the same level of support by the same support mechanisms, thereby those which are easier to realize were more exploited. There are multiple examples of inconsistent policy of the Dutch Government. Also recently this continues to happen. In September 2014 the Government reconsidered the offshore locations in the North Sea for OSWF construction. OSW projects are characterized by large and risky investments and need accurate alignment in collaboration with many actors and institutions. Without solid Government planning and support it is impossible to realize OSWFs on a reasonably pace. Up to the present day, only few OSWF projects in the Netherlands have been developed so far. De processes of planning and development were characterized by disagreement between stakeholders.

5.3 The United Kingdom and offshore wind

5.3.1 Stage 1a: Historic analysis: pre 2003

The oil crisis in the 1970s triggered a search for alternative energy sources in the UK. During the late 1970s and early 1980s exploratory studies on OSW resources and wind farm design were undertaken (Gaudiosi, 1996:p900). The British Wind Energy Association [BWEA] was set up in 1978. A R&D programme was initiated in the early 1980s in partnership with the developer McAlpine. This led to the manufacturing of a vertical axis turbine in 1986. However, commercial and Government support generally was small and the drop of the price of oil led to loss of interest. Efforts subsequently focused on the development of onshore wind. The first onshore wind farm in the UK was constructed in 1990. In 1995 the East of England Development Agency provided ₤3.65mln alongside ₤500,000,- from Renewables East to sponsor a Centre for Offshore to provide office accommodation targeted at SMEs in the offshore renewable sector and giving them access to R&D expertise. The UK's OSW program began in April 2001, when the Crown Estate [CE] awarded 13 Round-1 leases for OSWFs (Toke, 2010:p1). In the same year its first OSWF in Blyth started operating.

5.3.2 Stage 1b: Basic analysis: since 2003

With an approximate coastline of 17.820km and favourable wind circumstances, Europe's greatest potential of OSW energy is to be found in the UK. In 2003 the CE announced Round-2 of licences, focused on larger farms intended to provide 6GW of capacity by 2010 (BWEA, 2003). OSW development was given a further impetus in 2007 when the Government signed up to binding EU targets of 15% of energy to come from renewables by 2020 which acted as a powerful driver for RET policy (Toke, 2010).The most recent period is characterized by a step change in Government involvement in OSWF as well as rapid deployment. During this period, the UK turned from a relative laggard in terms of RE deployment to a frontrunner in terms of OSW installed capacity (Toke, 2010). In 2002, the UK Emissions Trading Scheme [UK-ETS] was the world's first introduced large scale application of emissions trading to greenhouse gases. The new support scheme based on Renewables Obligation Certificates [ROCs] obliges electric utility companies to increase their share of renewable power sources every year. The UK-ETS was significantly predating the development and introduction of the European ETS [EU-ETS] in 2005 (Nye and Owens, 2007).

In 2003 the CE announced round-2 of OSWF construction licenses, focused on larger farms intended to provide 6GW of capacity by 2010 (BWEA, 2003). OSW development was given a further impetus in 2007 when the Government signed up to binding EU targets of 15% of energy to come from renewables by 2020 which acted as a powerful driver for RET policy (Toke, 2010). In round-3 of the CE licensing nine zones were offered with a potential for 25GW. While in Round-1 and Round-2 developers bid for self-proposed sites, the CE now became more strategically involved, identifying zones which had the greatest economic potential. The CE also started to co-invest alongside developers and implemented a new Zone Appraisal and Planning process designed to reduce risks to project delivery and accelerate the programme.

A Renewables Obligation Certificates [ROC] is a ROC regardless of whether the MWh comes from a wind turbine or a solar panel. This leads to increased development in the cheapest technologies, whereas more costly ones are neglected. Therefore the Government introduced in 2009 technology-based 'banding' for ROC to offer greater support to more expensive technologies. Under the banded RO OSW received 1.5ROCs/MWh compared to 1ROC/MWh previously (Woodman, Mitchell, 2011). This was revised to 2ROCs/MWh in 2010 as an 'emergency response' essential to the continued development of OSW (Greenacre et al., 2010).

In search for future energy sources the UK came up with the following concept. The UK is one of the windiest countries in Europe and it obviously doesn't need to import wind. But wind is intermittent so backup generating technologies are also required that can be powered up at short notice. Now, the Government plans to increase the proportion of the UK's electricity supply generated using wind combined with the mix of other renewable sources as backup. The British Government has made clear commitments in its 2011 Renewable Roadmap to increase deployment of renewable energy in particular to OSW and sets out an ambition to achieve 18GW of installed OSW capacity by 2020 (DECC, 2011a). With almost 5,5GW operational and under construction, the UK currently (June 2015) has reached nearly a third of its 2020 ambition. Over 12GW OSW still has to be installed within five years.

5.3.3 Stage 2a: Defining the sector

In the UK, ownership structures of onshore and offshore wind power are similar. Both segments of the market are dominated by large owners, many of which have their origins in the electricity sector. With regard to investors from the oil and gas industry the share of ownership in OSW increased. OSW power is dominated by large investors from electricity supply and the gas and oil sector. In the UK, a large part of the OSWFs are owned by DONG Energy, Scottish and Southern Energy, Centrica Renewable Energy, EIG Partners, RWE, Vattenfall and EON. Other owners and developers are: Talisman Energy, GE Energy, Marubeni Corporation, Statkraft, Statoil ASA, Ampere Equity Fund, Stadtwerke München, Siemens, EDF Energy Renewables, 2-B Energy, Scottish Power Renewables and Masdar. The UK has a reasonable number of installation companies of wind turbines and cables, but a very limited production of turbines, foundations, cables and electrical infrastructure. Therefore, many foreign companies deliver their products and services to the UK OSW project owners.

With 600 ports in total, the UK has plenty of access to the sea. In England there are six locations that have been awarded CORE [Centres for Offshore Renewable Engineering] status by the UK Government. CORE status is awarded through recognising the existing port infrastructure, skills and supply chain to enable rapid growth within the OSW sector. Located in areas identified as having optimum conditions for the OSW industry with the land, infrastructure, skills and supply chain expertise required to take advantage of the world's largest engineering opportunity. This joint working alliance between parties strengthens the complete England offer and highlights it as a connected, credible and exciting place to invest. CORE brings together the relevant expertise from UK central Government and the six major investment hubs in England to support business growth and showcase opportunities for foreign direct investment for the OSW sector. The CORE areas provide: Excellent infrastructure and logistics; Large amounts of available land for development including deep water access; Skilled and available local workforce; Experienced supply chain; Easy access to Round 1, 2 and 3 OSWFs; Extensive business support available; and last: Local Government support providing free location finding services and assistance on skills, premises and grant funding applications. Although CORE acts as a mechanism for attracting foreign direct investment in OSW to England, equally important is its role in supporting existing businesses in England to become more successful in the global market. CORE provides support through the Local Enterprise Partnerships for the six CORE areas, joining up with central Government Departments. An overview of the six CORE areas can be found in appendix 22.

5.3.4 Stage 2b: Government involvement in the offshore wind industry

The UK Government has the ambition to create a low-carbon, climate-resilient and environmentally sustainable and 'green' economy. Several policy measures have been taken by the Government to create a green UK economy. There are many (semi)public organisations with a strategic role in the long-term, sustainable growth of the sector. An overview can be found in appendix 22. Furthermore, the UK has many industry development programmes with public-private partnerships. See appendix 22 for an overview of the programmes.

<u>Green Investment Bank plc</u>

In March 2010, Infrastructure UK [IUK], a division of HM Treasury, which advises on the planning and delivery of infrastructure investment, published a report identifying a lack of finance for large, "complex projects in the low-carbon sector" (HM Treasury, 2010:p59,110). Private companies are often unwilling to invest in unproven or complex projects such as Carbon Capture and Storage [CCS] or offshore wind farms [OSWFs]. To address this, the Government has supported the establishment of a "Green Investment Bank", to be funded by a mix of public and private money. The Green Investment Bank [GIB] was established in 2012 by the UK Government, its sole shareholder, The GIB is one of UK's Government policy measures taken to achieve its ambition. The GIB will complement and strengthen these measures by increasing investor confidence and facilitating access to finance. GIB was capitalised with an initial £3.8bn of public funds from the UK Government. GIBs purpose is to accelerate UK's transition to a greener economy. GIB primarily invests in the OSW, waste- and bio-energy and energy efficiency markets. Since its launch in November 2012, GIB has committed £1.6bn of capital to 38 projects, mobilising a total of £5.2bn. GIB has invested in six OSW projects, Walney, Rhyl Flats, Gwynt y Môr, Westermost Rough, Sheringham Shoal, and the world's largest, London Array. In total, the bank has invested over £860mln in the UK's OSW sector, with a total capacity of over 2.1GW of renewable power. For a complete overview of GIBs OSW investments see appendix 19. GIB invests directly in operational OSWFs and projects in the construction phase, allowing developers to recycle their capital. GIB investments in the sector range from refinancing operating wind-farms to financing construction of new wind farms. GIB also takes part in co-investments with commercial parties in testing and demonstration projects (GIB, 2014b). The Green Investment Bank [GIB] made its first direct equity investment in OSW through the acquisition of a 24.95% stake in a 90MW wind farm located 8km off the coast of North Wales. GIB acquired the stake in Rhyl Flats Wind Farm Limited from companies owned by RWE AG [RWE] for a cash consideration of £57.5mln. Rhyl Flats was an ideal investment for GIB as it will help to develop the market for buying and selling operating OSW assets, allowing the release of capital back to the original developers, which can then be invested in new renewable projects in the UK. At the same time as developing a market, this investment will deliver a commercial return to the bank. This landmark transaction represents a significant step for GIB in supporting one of its core sectors, OSW (GIB, 2012). The GIB has played a key role in providing debt and equity at the construction and operational stages of projects. Also the European Investment Bank [EIB] plays an important role in debt finance at both stages. Pension funds and insurance companies will play an increasing role in the operational of debt and equity finance (Deutsche Bank, 2011).

<u>GIB offshore wind fund</u>
GIB is currently raising £1bn for the world's first OSW fund to encourage new investors to put money into offshore wind farms. Investors are likely to be UK pension funds and sovereign wealth funds looking for long-term, stable returns. GIB is also investing £200mln in the fund. The fund is a new development for GIB because it raises private money up front for investment in a particular industry instead of investing project by project. In April 2015 GIB announced that its subsidiary, UK Green Investment Bank Financial Services Limited [GIBFS], has reached first close on commitments of £463mln. Fundraising continues and GIBFS expects to raise additional funds from other investors to reach the £1bn target. The fund has an expected life of 25 years, allowing a new class of long-term investor to enter the sector.

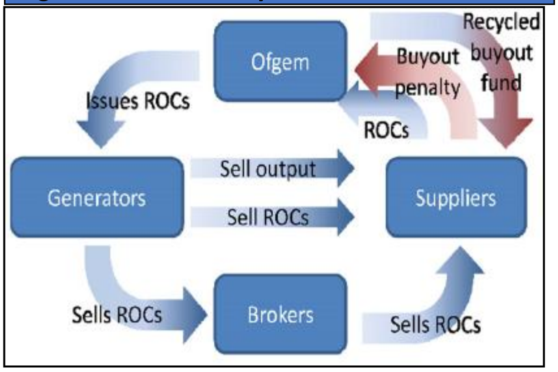
<u>Crown Estate</u>
The Crown Estate [CE] (a statutory corporation) is the owner of the UK's seabed out to the 12 nautical mile limit and has a unique role to play in developing and helping sustain the UK's energy supply and infrastructure by working in partnership with a wide range of organisations. CE manages a highly diverse range of strategic assets, valued at more than £8bn, for the benefit of the UK, with all profits returned to Treasury. The seabed in UK's exclusive economic zone is one of the strategic assets which belong under the control of the CE. Within UK waters, The CE provides leases for energy and infrastructure development through competitive, structured programmes of development attracting huge investment in the design, construction and operation of generation assets. OSWF developers need a license to develop an OSWF and have to pay a fee to the CE. CE has enabled the UK to become the world leader in offshore renewable energy, through granting leases for several commercial and demonstration sites around the UK. The CE has co-invested with development partners in the Round-3 OSWF zones directly and through strategic work stream activities, funding enabling actions designed to catalyse, de-risk and accelerate development throughout the pipeline of UK projects. CE's interests include wind, wave and tidal power, carbon capture and storage, gas storage, marine aggregates and minerals, cables and pipelines (Crown Estate, 2014a). In appendix 20 an illustrated overview is given of CE's growth in revenues by year. Also the revenues by activity are provided. Unfortunately specific revenues from OSW activities cannot be derived.

5.3.5 Stage 2c: Government support mechanisms for offshore wind

<u>Renewable Obligation Certificates</u>
UK's market incentive to develop large scale renewable power projects, the Renewables Obligation Certificate [ROC], has been the main support mechanism for renewable electricity projects in the UK. The ROC succeeded the NFFO which was in place from 1990 to 1998. The ROC requires electricity suppliers to source an increasing portion of their power from renewable generation, or pay into the buy-out fund instead. The RO was legislated in the UK's Utilities Act 2000. The RO came into effect in 2002 in England and Wales, and Scotland, followed by Northern Ireland in 2005. It places an obligation on UK electricity suppliers to source an increasing proportion of the electricity they supply from renewable sources. Through the RO, British electricity suppliers are now required by law to provide a proportion of their sales from renewable sources or pay a penalty fee. The

supplier then receives a Renewables Obligation Certificate [ROC] for each MWh of electricity purchased. ROCs are green certificates issued to operators of accredited renewable generating stations for the eligible renewable electricity they generate. Operators can trade ROCs with other parties. ROCs are ultimately used by suppliers to demonstrate that they have met their obligation. Where suppliers do not present a sufficient number of ROCs to meet their obligation, they must pay an equivalent amount into a buy-out fund. The administration cost of the scheme is recovered from the fund and the rest is distributed back to suppliers in proportion to the number of ROCs they produced in respect of their individual obligation. British electricity suppliers meet their obligation by purchasing ROCs, either from renewable generators or from the ROCs market. The Department of Energy and Climate Change [DECC] sets the RO obligation level each year. This dictates the number of ROCs that suppliers are required to produce for each MWh they supply. In this way the ROC provides an income to OSW generators, which supplements their revenues from the wholesale electricity market. RO has brought forward over 5GW of operating OSW capacity, including wind farms currently being build.

Figure 12. UK - ROC system structure



The RO charge is calculated annually, from April 1, to March 31, (known as the compliance period) from two elements: 1) *Obligation level* – the amount of expected renewable generation as a proportion of overall electricity generation within the compliance period, e.g. 0.158 ROCs per MWh for April 1, 2012 to March 30, 2013. 2) *Buy-out price* - the buy-out price is set by Ofgem and is index linked to the Retail Price Index. The buy-out price for April 1, 2012 to March 30, 2013 was £40.69 per ROC. The charge is calculated as obligation level x buy-out price – e.g. in the above example, 0.158 x £40.69, so the RO charge for April 1, 2012 to March 30, 2013 is 0.643 pence/kWh or £6.43/MWh. The number of ROCs which are issued is based on the amount of MWh is produced by generators of renewable electricity. In the case of OSW, during the winters more MWh's are generated due to stronger winds, thus more ROCs are issued (UK Government, 2011).

Table 21. UK - Renewables Obligation [RO] buy–out price and mutualisation ceiling (2002-2015)

				England, Wales and Scotland			***Northern Ireland***		
Obligation period (Apr.1 – Mar.31)	**Buy-out price (per ROC)**	**# of ROCs for OSW per MWh**	**ROC income per MWh**	**Obligation (ROCs per MWh of electricity supplied)**	**% of Total supply**	**RO charge per MWh**	**Obligation (ROCs per MWh of electricity supplied)**	**% of Total supply**	**RO charge per MWh**
2002-2003	**£30,00**	1	**£30,00**	0,030	3%	**£0,90**	ROCs were introduced in Northern Ireland in 2005		
2003-2004	**£30,51**	1	**£30,51**	0,043	4,3%	**£1,31**			
2004-2005	**£31,39**	1	**£31,39**	0,049	4,9%	**£1,54**			
2005-2006	**£32,33**	1	**£32,33**	0,055	5,5%	**£1,78**	0,025	2,5%	**£0,81**
2006-2007	**£33,24**	1	**£33,24**	0,067	6,7%	**£2,23**	0,026	2,6%	**£0,86**
2007-2008	**£34,30**	1	**£34,30**	0,079	7,9%	**£2,71**	0,028	2,8%	**£0,96**
2008-2009	**£35,76**	1	**£35,76**	0,091	9,1%	**£3,25**	0,030	3%	**£1,07**
2009-2010	**£37,19**	1,5	**£55,79**	0,097	9,7%	**£3,61**	0,035	3,5%	**£1,30**
2010-2011	**£36,99**	2	**£73,98**	0,111	11,1%	**£4,11**	0,043	4,3%	**£1,58**
2011-2012	**£38,69**	2	**£77,38**	0,124	12,4%	**£4,80**	0,055	5.5.%	**£2,13**
2012-2013	**£40,71**	2	**£81,42**	0,158	15,8%	**£6,43**	0,081	8,1%	**£3,30**
2013-2014	**£42,02**	2	**£84,04**	0,206	20,6%	**£8,66**	0,097	9,7%	**£4,08**
2014-2015	**£43,30**	2	**£86,60**	0,244	24,4%	**£10,57**	0,107	10,7%	**£4,63**

(Ofgem, 2013; 2014)

In 2009 the UK Government decided to raise the ROC compensation for OSW from 1 to 1,5 and in 2010 to 2 ROCs in order to further stimulate OSW deployment. Moreover, the total value comprises four elements: the price of electricity, the buyout price, the value of the Levy Exemption Certificate [LEC], and the recycled ROCs premium. Under the Climate Change Levy [CCL] agreements, certain major energy users are able to reduce the normal CCL payment (i.e. 0.43 p/kWh on business customers) to a fifth (i.e. (0.086 p/kWh) if they purchase renewable electricity from eligible power plants or undertake certain energy efficiency measures (agreed with the Energy Savings Trust). This provides a value for Levy Exemption Certificates [LEC] (LEC=1MWh). The major users provide proof of LECs to both Ofgem and to Customs and Excise.

Table 22. UK - Total value of renewable generation eligible for RO in early 2003

	£p./kWh	£p./MWh	€ct./kWh	€ct./MWh
1. Electricity price	1.5–1.8	£15 - £18	2.25–2.7	€22,5 – €27
2. ROC	3.0	£30	4.5	€45
3. LEC	0.086	£0,86	0.129	€1,29
4. Recycled Green Premium	1.5–2.0	£15 – £20	2.25–3.0	€22,5 – €30
Total	**6.1–6.9**	**£61– £69**	**9.15–10.3**	**€91,5 – €103**

(Mitchell, Bauknecht, Connor, 2004:p300)

Furthermore, the increase in wind capacity is in part dependent on the *Production Tax Credit [PTC]*, which enabled wind generators to compete on cost (Lauber, V., 2004). The high rate of OSW deployment in the UK can be attributed to the near-term expiration of the policy, which gave suppliers the incentive to bring projects on line as soon as possible. Both the PTC and the NFFO have been criticised for encouraging stop-go cycles of development (IEA, 2004).

Electricity Market Reform (2013)

The UK Government has recognized there is a need to reform the UK electricity market to attract the investment needed to replace the ageing power plants and meet the required energy infrastructure for the projected future increases in electricity production from renewables. In order to stimulate the generation of energy from renewable sources, the Government had to come up with a market reform which leads to a transition of UK's energy generation. With around a fifth of Great Britain's ageing power plants due to close over the coming decade, and further closures in the 2020s, huge investments are needed for the energy infrastructure Moreover, the UK Governments literally expressed their concerns when it comes to facing rising energy costs due to growing dependence on uncertain supplies of imported fossil fuels (DECC, 2013). This was a major reason move towards a diverse and low-carbon electricity mix.

The Government proposed the Electricity Market Reform [EMR] in July 2011. These identified four basic reforms of the electricity market to attract investment in low-carbon electricity supply and to maintain a secure electricity supply over the long term (DECC, 2011b). The following reforms were introduced: A new Carbon Price Floor [CPF] was introduced in April 2013 to provide a long-term price signal for carbon in power generation. Long-term contracts were introduced for low-carbon generation through a 'Contract for Difference' [CfD] Feed-in-Tariff [FiT] to replace the Renewables Obligation [RO]. An Emissions Performance Standard is set at 450g CO_2/kWh to limit the amount of carbon that coal-fired power stations will be allowed to emit. A capacity mechanism is introduced, involving additional payments to encourage the construction of reserve plants or demand reduction measures.

The Electricity Market Reform [EMR] is an initiative to make sure the UK remains a leading destination for investment in low-carbon electricity. Due to plant closures and the need to replace and upgrade the UK's electricity infrastructure, over the next decade the UK electricity sector will require significant capital investment. The UK electricity market needs reform in order to attract the investment needed to replace the ageing energy infrastructure and meet electricity demand. EMR is a Government initiative to make sure the UK remains a leading destination for investment in low carbon electricity. The UK Energy Act, which gives the Government the power to implement the EMR, was passed on December 18, 2013 (UK GOV 2013).

UK's EMR, came into effect in July 2014, and introduced a level of Government intervention not seen in the country's power market since the early 1990s. The UK electricity sector is undergoing major structural changes, now the Government's long-awaited EMR came into effect. It is the most significant change to the market design in the UK since privatization. As one of the first European countries, the UK was heading towards an energy-capacity crunch because ministers had failed to ensure the construction of new power stations to take over from decommissioned nuclear and coal plants. This case of the UK's EMR is a state of the art and most recent example of the multifaceted complexities Governments have to deal with. The success of EMR depends on the UK Government getting the level of financial support just right. If there is insufficient support, not enough new energy generating capacity will be built. But when there is too much support, EMR could prove unduly costly to consumers and might also fall foul of European Commission [EC] rules on State aid, which usually prohibit selective Government support for industry, except in specific circumstances.

Carbon Price Floor

The UK Government announced its decision in the March 2011 budget to introduce the carbon price floor [CPF] on April 1, 2013 and target a price for carbon of £30,- per tonne of carbon dioxide in 2020. The creation of the CPF covering Great Britain means that businesses using fossil fuels to generate electricity are required to pay CPF rates on those fuels, which adds up to the EU ETS carbon prices. The commodities liable to the CPS rates are: gas supplied by gas utilities, LPG, coal and other solid fossil fuels (petroleum coke, lignite, coke and semi-coke of coal or lignite) (UK Government, 2015).

Feed-in Tariffs with Contract for Difference [FiT CfDs]

The UK Government has proposed wide-ranging reforms with the Electricity Market Reform [EMR] to UK's electricity market which will eventually see Feed-in-Tariffs with Contracts for Difference [CfDs] and replace the Renewables Obligation [RO] as the main renewable generation support mechanism. CfDs were legislated in the UK's Energy Act 2013. Unlike ROCs, CfDs will also be available to generators of nuclear electricity. The first allocation round for Renewable CfDs opened to applications in October 2014, with award of contracts due by March 2015. Subsequent allocations are intended to be on an annual basis. CfDs provides indexed, regulated revenues for generators with insulation from wholesale price risk. The RO will remain open to new generation until March 31, 2017, allowing new renewable generation that comes online between 2014 and 2017 to choose between CfDs and ROCs. After that date, the Government intends to close the RO to new generation and 'vintage' existing ROCs, meaning that levels and length of support for existing participants in the Renewables Obligation will be maintained. Future wind farms can benefit from a newly-adopted mechanism providing a stable framework for financial investors.

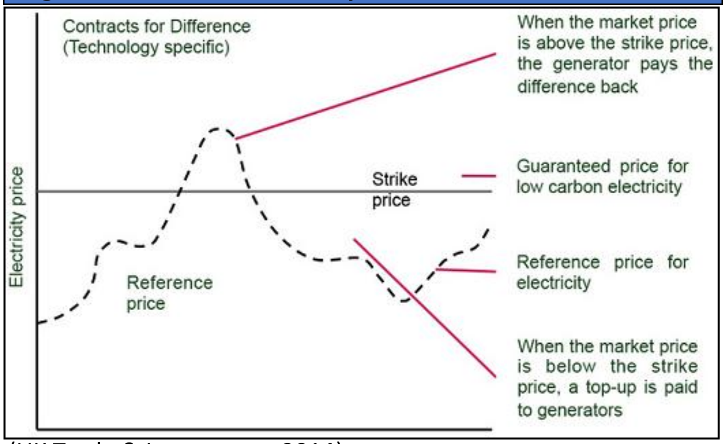
Generators with a Contract for Difference [CfD] will sell their electricity into the market in the normal way, and remain active participants in the wholesale electricity market. The CfD then pays the difference between an estimate of the market price for electricity and an estimate of the long term price needed to bring forward investment in a given technology (the 'strike price'). This means that when a generator sells its power, if the market price is lower than needed to reward investment, the CfD pays a 'top-up'. However, if the market price is higher than needed to reward investment, the contract obliges the generator to pay the difference back. However, when allocation rounds are over-subscribed generators will receive the clearing price from a competitive auction. The administrative strike prices for OSW of the new FiT CfDs mechanism are set out below.

Table 23. UK – FiT CfD - OSW Strike Price (£/MWh)

Period	**Price** *(2012 prices)*
2014/2015	**£155,-**
2015/2016	**£155,-**
2016/2017	**£150,-**
2017/2018	**£140,-**
2018/2019	**£140,-**

(UK Trade & Investment, 2014)

Figure 13. UK - FiT CfD Subsidy mechanism



(UK Trade & Investment, 2014)

5.3.6 Interim conclusion: Offshore wind in the United Kingdom

In the OSW case of the UK the important roles for CE and GIB are underlined. Together with ambitious formulated policies, targets and long-term secured subsidy mechanisms, the British Government strongly supported the OSW industry. Strategic and financial government initiatives have promoted the British OSW industry. Organised with numerous semi-public organisations with a strategic role in long-term sustainable growth of the sector, the UK has created an active offshore wind industry. Another important aspect of the growth of the offshore wind sector is the reliance upon port and manufacturing facilities.

Government involvement

UK's aging power plants and overall energy infrastructure triggered the Government to take action. The establishment of the Governmental owned Green Investment Bank [GIB] can be seen as the evidence of the Government's commitment to the environment. Its capitalisation with £3.8bn of public funds from the UK Government points out the financial involvement of the Government, not in particular with OSW, but more with the overall RE industry. But with close to £1bn (£862,8mln) of investment ongoing OSW projects GIB is clearly opening pathways in the establishment to grow their new infant industry.

Type of investments by GIB

GIB has largely contributed to private investors' confidence and increased attractiveness for private funds in the financing of the private sector's investments related to environmental preservation and improvement. GIB investments in the sector range from financing development and construction of new OSWFs, refinancing operating wind-farms and also co-investments on commercial terms in testing and demonstration projects.

Long-term lock-in

The substantial investment the UK has made into OSW locks the UK into a low carbon trajectory. By contrast, continued reliance on natural gas would give more exposure of the UK economy to potentially volatile international gas prices.

Urgent concerns which have contributed to the need for change

With around a fifth of Great Britain's ageing power plants due to close over the coming decade, and further closures in the 2020s, huge investments are needed for the energy infrastructure Moreover, the UK Governments literally expressed their concerns when it comes to facing rising energy costs due to growing dependence on uncertain supplies of imported fossil fuels.

Moving treats to opportunities

UK's critical need to renew the country's electricity market was turned into an opportunity for growth and jobs. With the Electricity Market Reform [EMR] designed to unlock up to £110bn investment in the electricity infrastructure and support up to 250,000 jobs during this decade alone, the Government has launched an ambitious program to tackle energy insecurity, support for developing RE industries and gives a boost to labour markets. The electricity sector is one of the biggest areas in the UK economy for investment over this decade and the Government is planning to support industry to maximise this potential. The Government has brought forward key announcements that it will give industry the early certainty it needs on EMR to begin planning major capital investments in the UK and its supply chain.

5.4 Stage 3: Country comparison: Offshore wind

5.4.1 Comparison: Subsidy mechanisms

The effects of the regulations in the various countries show great differences. Where in some countries no certainty about the time period that Feed-in-Tariffs are provided, other countries guarantee for long periods of time, i.e. in Germany for twenty years. Country-specific factors are relevant and need to be involved in the assessment. There are large differences between countries in the type and extent of natural resources for the generation of renewable electricity. In England and Ireland wind turbines deliver demonstrably higher return than on continental Europe because of a higher capacity factor due to stronger winds on the North Sea. The Netherlands and the UK have followed very different paths in support of renewable energy development.

The Netherlands: Subsidy mechanisms

In the Netherlands OSWFs were awarded subsidies on a project bounded base, where different subsidies were admitted to different OSWFs. Subsidies were not continuous, several times support systems were put stop and eventually replaced by a new system. Moreover, the subsidies for new applications for the categories scale pure biomass and OSW were stopped because of the risk that some very large projects could claim a lot of budget. This has encouraged stop-go cycles of development. Moreover, another relevant factor is the European carbon emission trading [EU ETS], which can be considered as ineffective, and did not encourage the development of renewables as envisaged. When it comes to the height of the subsidy amounts, OSW compensation in the Netherlands was not necessarily too low compared to British compensations. The first two Dutch OSWFs (OWEZ and Amalia [Q7]) received a compensation of €97,-/MWh, which is in line with British OSW compensation of €91,5 – €103,- (prices 2003). But the latest two OSWFs (Luchterduinen [Q10] and Gemini) received €173,90/MWh which is a rather high compensation.

United Kingdom: Subsidy mechanisms

UK's ROC obligation system has been put in place in 2002 with stability and was continuing until 2015. In contract to the Netherlands, the stabile support mechanism has created confidence among investors. Only recently, the UK has reformed their support mechanism system for renewables from an obligation system towards the more common European support system with Feed-In-Tariffs [FiT], which is an interesting change, since UK's OSW industry has been flourishing in the years starting this analysis. An unanswered question remains why they have changed. The possible answer would relate to cost-efficiency which provides the FiT system.

5.4.2 Comparison: Government involvement in OSW

More important than the subsidy mechanisms being put in place, overall governmental support for industry development seems to have played the crucial role. By literally expressing its OSW ambition and vision the British government has developed a communal vision, which has increased cooperation between government and businesses. Supplemented with coordination by the Crown Estate and financial incentives e.g. by the newly established Green Investment Bank [GIB] and its offshore wind investment fund, the British are well on its way to elevate the OSW industry to its newest key industry for both obtaining domestic energy security as creating an export industry.

5.5 Conclusion: Offshore wind comparison

This chapter has analysed the Dutch and British offshore wind [OSW] industry over the period 2004-2013, and attempted to answer the third and fourth sub-question: 3) "*What renewable energy policies and support mechanisms regarding offshore wind were developed in both countries?" and* 4) "*What is the State's (financial) involvement and benefits regarding offshore wind?*".

The main difference between both countries goes back to its core nation's energy strategy where OSW in the United Kingdom became a promising and cherished industry that would have the potential to become able to provide energy security to the nation in its coming decades and get rid of its raising foreign gas demands, while Dutch policy did not recognise the potential of OSW for its nation's future energy supply. With Dutch gas reserves with at least one more decade of secure supply, the urgent need of an energy transition has not been recognized. Combined with its strategic geological position in Europe, further investments in its already strong position on the European gas market was a prospect with at least similar development potential. It should not be underestimated that gas will continue to play a critical role in the European and global energy supply for the rest of this full century, and probably will continue until all worlds' gas deposits have been depleted. It is a different, non-renewable strategy, but cannot be considered as a better or worse strategy than the British have taken when it comes to energy strategies.

In terms of renewable energy strategy taken, i.e. OSW, the British are far up ahead of the Dutch, by creating an advanced renewable industry, which will bring them a knowledge advantage and export product to coastal countries. Although, the Danish were the first who created a first-mover advantage by pointing attention towards the wind industry by turbine manufacturing in the 1970s, the British, only starting around 2003, still benefit from the advantage, being an early mover into the industry. Creating a new renewable energy industry by deployment of OSWFs was for the British not only about finding domestic energy security, it also in terms of creating jobs and advancing the economy, but maybe even more important, creating a competitive advantage in an upcoming, fast growing industry. By obtaining the technologic capacities and know-how to develop OSWFs brings great potential for the British economy to create an export-industry. This potential has been recognised in the UK, followed by the strong preference for OSW and high ambitions for MW capacity expressed by the British government, together with large financial investments by the Green Investment Bank [GIB] and the coordinating role of the Crown Estate clearly demonstrates their determination to grow the OSW sector in a British key industry for the coming decades.

It seems the Netherlands had more difficulties than the British with geological planning of OSWFs in the North Sea. In the Dutch Round-2 OSW development, developers were allowed to choose a location their self. This has led to extensive planning procedures. For round-3 OSW development the government has appointed locations where OSWFs were allowed to be constructed, which is the same approach the British Crown Estate already applied since 2003 when they started their round-2 OSW development. In 2013 the Dutch energy policy (Energie akkoord 2013) released the OSW areas appointed for construction. Not much later in September 2014 the OSW locations were revised again due to targeted cost-efficiencies. Planning difficulties for Dutch OSW are related to the smaller available space for OSW development on the North Sea within the Dutch EEZ. Most of the Dutch North Sea area is already being used as shipping transport routes and its one of the world's busiest with many port connections in only a small coastal area e.g. Rotterdam, Antwerpen, Zeebrugge, Amsterdam, Eemshaven/Delfzijl. Furthermore, a number of protected nature reserves are excluded for commercial development, while other areas are reserved for military training purposes, fishing, and others contain oil and gas drilling platforms.

Although the Netherlands has provided long OSW subsidies (two times 10 years and two times 15 years) to the few OSWFs who were awarded with the grants, the support mechanisms their self were not stable by far. Subsidy applications were only open for short periods of time, and closed at times when application threatened great financial implications for the State budget. Dutch OWS policy has been recognized as unstable, which has led to an insecure outlook for prospect OSW investors in the Netherlands. While the UK's Crown Estate has been awarding many coastal area sites for OSWFs, in the Netherlands there have been more difficulties when it comes to awarding offshore sites for wind development. The large British coastline compared to the much smaller Dutch EEZ and available area for OSW deployment gives an unequal opportunity to develop OSWFs. The need for replacement and innovation in their energy supply, combined with its large OSWF deployment potential, have been among the most important factors for UK's decision to choose for the offshore wind industry.

6. Findings and conclusions

This study aimed to open up research focused on the role of the political economy in the context of energy transitions. Central attention was pointed towards State involvement in two energy systems: natural gas (used for the purpose of electricity generation) and offshore wind energy. The specific objective of the study was twofold: first, to unpack the “black box” of political economy and analyse the political economy of energy transitions, and second, it aimed to explain the differences in the rates of diffusion of RETs (i.e. OSW) between the Netherlands and the United Kingdom in order to illustrate "what worked, why and how" for a better understanding and management of political economy issues in the design and implementation of sustainable energy transitions. The central research question was formulated as followed: *“How are policy strategies regarding energy transition in the Netherlands and the United Kingdom influenced by the Government’s financial involvement with fossil (i.e. natural gas) and Renewable Energy Technologies (i.e. offshore wind energy)?”*

The theoretical chapter has made clear there are many different understandings and scopes of the definition “political economy” [PE]. The analysis of the PE takes inter- and multidisciplinary approaches. This study took an economic PE approach with focus on economic and financial indicators. Moreover, aspects of energy politics such as energy security, climate change, support of renewables and cost aspects all play a crucial role in the study on the PE of energy transitions.

As a starting point, the main difference between the two industries (i.e. natural gas industry and the OSW industry) is the gas industry is a fully developed and mature industry. The OSW industry on the other hand, compared to the gas industry is still an infant industry in both the Netherlands and the United Kingdom. Although gas-fired generation emits less carbon than the current electricity mix in both countries (with still plenty of coal-fired electricity generation) additional gas power plants can contribute to cleaner energy supply, but will lead to resource dependency due to required gas imports in the future. Moreover, gas cannot be considered sufficiently clean to achieve the medium to long-term ambitions for decarbonisation. Without support mechanisms, fossil fuels still have a stronger economic case than renewables, therefore well-coordinated support policies remain important in the coming decade to encourage further development of OSW and other RET’s.

Through the 100% State-owned Company Energie Beheer Nederland B.V. [EBN] the Dutch State is strongly involved in natural gas revenues. EBN is always involved in all production both onshore and offshore and its interest in the production is always 40%. Natural gas revenues has largely contributed to the revenue for the State since the discovery of the Groningen gas field, and still does over the past ten years. With an annual average of more than €11,2bn Government gas revenues period 2004-2013 as presented by CBS, natural gas plays an important role in the Dutch economy. Some research reports estimate the revenues even higher, up to an annual average of €14,1bn. The exact revenues remain unclear.

By having more resources it easily leads to higher revenues from production, therefore a comparison was made based on State earnings per 1 energy quantity, in this case 1 Terajoule. Total State’s revenues divided through the total oil and natural gas produced. Calculated over the period 2009-2013, for the Netherlands this was an annual average of €4.442,- per Terajoule (based on CBS statistics), while in Great Britain an annual average of £1.887,- revenues per Terajoule. This point out the Netherlands has much higher level over revenues compared to Great Brittan. Assuming gas revenues in the Netherlands are even higher than CBS presents, means the differences between revenues per 1 Terajoule grows even further. By having such high revenues shows the great interest the Dutch State has with natural gas. The British State receives income from oil and gas production from additional taxes (i.e. Ring Fence Corporation Tax and Petroleum Revenue Tax), while State ownership structures in the Dutch gas industry are the reason for the higher revenues in the Netherlands.

By choosing the gas Hub strategy, Dutch energy policy has been formulated for a fairly large extent. This has certainly had an impact on the attention pointed towards deployment of renewables. It potentially has harmed the development of OSW and other electricity generating renewables in the Netherlands.

State ownership, a kind of which can be found in the natural gas industry in the Netherlands, is not found in the Dutch OSW industry. In fact, there is (besides the electricity grid in the North Sea) no State ownership in this sector. On the other hand, the British State is financially involved by investments in OWS by its Green Investment Bank. Moreover, together with the capital investments, the centrally coordinated leadership role for OSW development shown by the Crown Estate [CE] has been absent in the Netherlands. As owner of the seabed, CE awarded and coordinated the leasing rounds. In Netherlands there has been much debate and disagreement about the potential locations of OSW which often has resulted in delays.

Considerations for natural gas or offshore wind

The increase of OSW in the energy mix for electricity generation will lead to lower carbon emissions, although this would be the same in case of a further increase of natural gas to replace coal fired generation. Both natural gas and OSW have their pros and cons. An increase in gas capacity will require the construction of new gas plants. These are cheap to build so have relatively low up-front cost and can provide reasonably low cost electricity under current gas and carbon market conditions. However, they leave the economy reliant on gas imports, vulnerable to volatility and increases in international gas prices. Moreover, they are too carbon-intensive to meet medium to long-term decarbonisation targets. Renewables, in particular OSW energy have a higher up-front cost and, at least for now, produce more expensive electricity. However, they do not produce emissions and have security of supply benefits. Once in operation, they do not rely on fossil fuels for electricity production. Studies (CE, 2012) (DECC, 2012) also show that considerable reductions in future OSW generation costs are possible. The development of OSW capacity has stimulated construction and manufacturing demand in the UK and will continue to do over the period until 2030. In the longer term, it prevents the UK from locking into future natural gas usage and imports. The lock-in into OSW would support decarbonisation consistent with the UK's legally binding emissions target for 2050 and encourage the development of the UK as an OSW technology leader. At the sectoral level the differences are also modest. Large-scale development of OSW is likely to benefit engineering, manufacturing and construction firms, and also possibly insurance and project financing companies. In contrast, utilities (including gas distribution) would benefit from increases in gas-fired generation.

OSW costs are expected to fall considerably as OSW capacity is deployed, but it is not clear by how much. At present still a large proportion of the lifetime OSWF costs go to imports, as OSW turbine manufacturing has so far remained largely outside the UK. However, in a scenario with high OSW deployment, there would be the opportunity to attract investment into the UK supply chain, increasing the proportion of wind turbines that are designed and manufactured domestically. If significant OSW capacity is deployed, it is possible that a substantial domestic supply chain will be developed. In that case the import content of the capital required for an OSW project will fall. The combination of falling capital costs for wind turbines and rising natural gas import prices could mean that OSW is only slightly more expensive than Combined Cycle Gas Turbines [CCGTs]. This, compared to possible variation in relative prices caused by other factors such as changes in gas prices, OSW will bring a more certain future stability. The construction work for large-scale investment in OSW boosts GDP and creates jobs. The prospective cost structures of gas and OSW power generation and compared the levelised costs for projects initiated between 2012 and 2030, with a range of assumptions and at varying discount rates. The findings draw on prior analysis and show that gas-fired generation is currently cheaper, for each unit of electricity generated over the lifetime of the plant, than OSW. However, as the gas and carbon prices are expected to increase in the future and the unit costs of OSWFs are expected to decrease, the difference between gas-fired and OSW power generation will become smaller. There is considerable scope for OSW costs (both capital and operating) to fall over time, as economies of scale and learning effects drive costs down. In addition, as OSW projects become established, the risk premium associated with the borrowing cost for OSW will be reduced; this is currently a major cost of OSW relative to new gas projects.

On the other hand, there will always be a need for natural gas both for electricity generation and for heating. Gas-fired power provides a reliable backup when there is insufficient wind or electricity from other renewables to meet power demand. As long as the global natural gas reserves are not depleted, gas will continue play an essential role in energy supply, but with absence of domestic natural gas reserves, countries will be exposed to insecurity of supply and fluctuating prices for natural gas imports.

A number of important factors are relevant to include in the comparisons and trade-offs that are made in the two countries, these are as follows. In the Netherlands there have been more natural gas reserves and easier to extract gas reserves, while the UK has gone through a declining trend since the 2000s. On the other hand, UK has bigger Exclusive Economic Zone [EEZ], and wind locations with potentially higher wind speeds. The UK's EEZ is much larger than the Netherlands has. Therefore the UK has more resources for OSW. The Netherlands has deliberately chosen for the gas Hub strategy. Both the factors resource abundance and path dependency have played an important role in the development of the natural gas industry in the Netherlands. UK has had by relying on natural gas imports and the aging power plants, a more critical need to adjust their energy supply. These factors together triggered a great need for change in the UK. In the Netherlands this need has been present in much lesser extent. But that could now change, because "the wind is changing" in the Netherlands. Recently, there is a great concern about earthquakes caused by the Groningen gas production. Subsequently the gas production has been reversed and the need for other energy supplies is growing. Pressured by the binding EU legislative 2020 targets, the Netherlands will have to hurry to achieve their renewable targets.

<u>Research limitations</u>
The exact natural gas revenues by the Dutch State remain unclear. Several reports (Bazelon *et al*., 2010; Weterings et al., 2013:p61) estimate the Dutch State's natural gas revenues much higher than CBS's estimations. Dutch and British natural gas figures and other energy statistics were mostly presented in different measuring units, therefore conversion of values (MWh to BTU) and sometimes complicated comparison. Comparison of the Dutch FiT system and UK's ROC obligation system has brought some complications as well. In order to fully analyse both mechanism's effects on the support of OSW it requires a more extensive analysis. The comparison of both support mechanisms is only a passage in this study, therefore the study did not fully elaborate on the complete impact of both mechanisms.

<u>Research agenda</u>
This study focused merely on government's financial involvement. Besides financial involvement other factors play a part as barriers or facilitators for the development of renewables. Painuly, (2000) has developed a framework to identify the barriers to renewable energy penetration and to suggest measures to overcome them. Some barriers may be specific to a technology, while some may be specific to a country or a region. In many recent RE projects the barriers have typically been seen as technical (i.e. the technology is not yet viable), economic (fossil fuels are still cheaper), and policy-based (Governments do not have the right policy framework in place). Assuming that Governments operate rationally and efficiently, it is to be expected that improved capacity and technical knowhow will help tackle barriers. This framework can provide further assistance in future research on replacing fossil energy systems for renewables.

Appendix 1: Overview of different political economy approaches, frameworks and studies

Approach	Analysis of country-level context for sector reform	Analysis of sector characteristics, performance and challenges	Analysis of policy content, consequences and political viability of policy change	Analysis of domestic policy making and implementation process	Analysis of key actors, interests and relationships between actors	Policy management and operational implications
SECTOR-LEVEL political economy approaches, frameworks and studies:						
Poverty and Social Impact Analysis [PSIA] (World Bank)	•	•	•		•	•
An analytical framework for understanding the political economy of sectors and policy arenas (ODI) --- DFID	•	•		•	•	•
Rethinking governance in the water sector (ODI)	•	•			•	
The political economy of policy reform (World Bank)	•	•			•	•
The sector governance analysis framework (European Commission)	•	•			•	•
The policy engagement framework (ODI)	•	•	•	•	•	
The political economy and political risks of institutional reform in the water sector (World Bank)	•	•	•		•	•
Water pricing in Honduras: A political economy analysis (Strand)		•			•	
Drivers for change in Zambian agriculture (ODI)	•	•		•	•	
COUNTRY-LEVEL and politics-centred political economy approaches with interesting lessons for sector-level political economy approaches:						
Drivers of Change approach [DoC] (DFID)	•		•		•	•
Power Analysis (Sida)	•		•		•	•
The capability, accountability, responsiveness framework (DFID)				•	•	
The context, evidence, links framework (ODI)	•		•	•	•	•
The politics of policies approach (IADB)			•	•	•	•
From drivers of change to politics of development (DFID)	•			•	•	

(Edelmann, D., 2009)

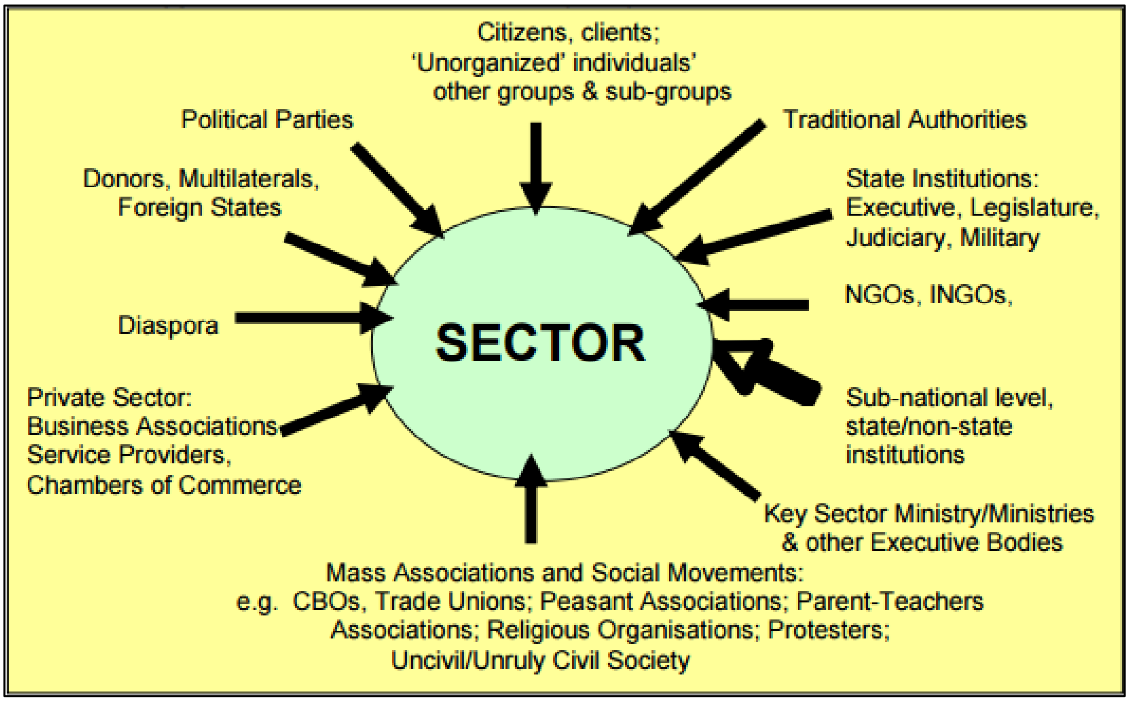
Appendix 2: Political analysis of the sector

Matrix 1: Political analysis of the sector

	Roles, Mandates, Responsibilities	**Organisational Structure**	**Management, Leadership, Composition**	**Financing and Spending**	**Incentives and Motivation**	**Capacity**
Basic Questions	Official and unofficial roles/mandate of the organization	Structure: central to local and horizontally; Power of different levels	Key actors (prominent and hidden) Basis for membership in different parts of organization	Local/central financial balance; Degree of self-financing	Career progression opportunities; Level and distribution of remuneration	Variations in skills and resources; Adequacy of information base.
Historical Legacies	Effect of history on function and role	Basis for organizational structure that exists	Historical basis for management and leadership structure that exists; Implications for change	Influence of past priorities and financial and spending patterns	Legacy of past entry and career progression procedures	Historical reasons and implications of variations in capacity
Structural Factors	Effect of structural factors on power relations, ideologies and policy priorities	Can organization respond to different demands and contexts?	The main factions (political, ethnic etc) and policy implications; How structural factors affect composition and power balances.	Effect of structural factors on financing and spending patterns	Effect of structural factors on incentives; Prospects for change?	Effect of structural factors on capacity and skills levels and implications for policy and change
Change Processes	Changes in roles, responsibilities and political discourse; Opportunities and blocks these present.	Changes in organizational structure; Opportunities and blocks these present	Changes in management and composition of the organisation; Opportunities and blocks these present	Changes in sources of finance and spending; Opportunities s and blocks these present	Changes in incentives and association of these changes with broader processes	Changes in capacity and prospects for the future
Power Relations	Relationship between the mandate of the organization and power dynamics	Balance of power across the organisation; Pockets of resistance and support	Degree to which power is vested in certain individuals or quarters; Inclusion/exclusion of different groups	Effect of funding source on policy; How do different constituencies s seek to influence policy	Benefits and losses from changes in the incentive structure	Power of the organisation n to define and implement policy
Ideologies, Values, Perceptions	Predominant values, ideologies, perceptions re key sector issues and degree to which these affect policy	Variations in ideology across the sector and effect on organisational structure	Values of key individuals (prominent and less visible) and effect on support or resistance to policy	Effect of values on spending priorities	Degree of transparency of Recruitment. Main groups who benefit from the incentive system	Relationship between values and emphasis on capacity building; Implications for change

(Moncrieffe & Luttrell 2005:p17)

Appendix 3: Map of potential key actors in a sector



(Moncrieffe & Luttrell 2005:p14)

Appendix 4: How players influence the policy process

Matrix 2. How players influence the policy process:		
	Policymaking; formulation, negotiation and implementation	**Responsiveness and channels of accountability**
Basic questions	The formal and informal rules for policy making and implementation.	Formal accountability mechanisms; methods for communicating policy; level of freedom of expression within the organization.
Historical legacies	Historical basis for rules that exist and their implications.	Understandings of expectations of the State and accountability.
Structural factors	The way in which the policy process is affected by structural factors.	The effect of structural factors on ability of citizens to make demands or consultations to be carried out.
Change processes	Trends in policymaking and reasons; the role of crises.	Reactions to policy change; flexibility of the policy process to adapt to change.
Power relations	The effect of power relations on the policy process; the distortion of policy in implementation.	The accessibility of accountability mechanisms.
Ideologies, values, perceptions	Conflicts and correspondence in ideologies and values; the (mis)match between rhetoric and policy outcomes.	Nature of State-society relations; how actors express their views.

(Moncrieffe & Luttrell 2005:p20)

Appendix 5: NL - Institutional Actors – Gas industry

NL - Public actors – Gas industry		
Authority for Consumers and Markets – Energy Department	ACM looks specifically at the energy, telecommunication, transport and postal services industries, and, more in general, at competition and consumer protection law. https://www.acm.nl/en/	Authority for Consumers & Markets
State Supervision of Mines (SSM)	Ensuring that mining activities and the transport of natural gas are performed in a socially responsible manner. https://www.sodm.nl/	State Supervision of Mines Ministry of Economic Affairs
Energie Beheer Nederland [EBN]		ebn
Gasunie	100% owned by the State.	gasunie
TenneT	Controlled and owned by the Dutch Government, it is responsible for overseeing the operation of the 380 and 220 kV high-voltage grid throughout the Netherlands and its interconnections with neighbouring countries. The sole shareholder is the Dutch Ministry of Finance.	TenneT Taking power further

NL - Membership organisations – Gas industry		
Netherlands Oil and Gas Exploration and Production Association [NOGEPA]	NOGEPA represents the interests of businesses with licences to explore for or produce oil and gas in the Netherlands. Their aim is to produce oil and gas in the Netherlands, onshore and offshore, efficiently, safely and with respect for the environment, but also to achieve a positive relationship between the industry and society. http://www.nogepa.nl/en-us/nogepa/organisation/	NOGEPA
TKI-GAS	In 2011 the Dutch Government has decided to strengthen the Dutch economy by distinguishing its leading sectors. One of these so called "top sectors" includes Energy: a sector where the Netherlands possesses a lot of knowledge in, and is potentially interesting as an export product. This Top Sector Energy is again divided into 7 Top consortia for Knowledge and Innovation (TKI). TKI Gas is one of them. TKI offshore wind is one of the other Top consortia (Top consortia Energy, 2015). http://www.tki-gas.nl/	TOPSECTOR ENERGIE Empowering the new economy TKIgas
Netbeheer Nederland	The association in the energy sector representing the interests of national and regional electricity and gas network operators in the Netherlands. http://www.netbeheernederland.nl/english/	netbeheer nederland energie in beweging

NL – Public-private partnerships and Joint Ventures – Gas industry		
Maatschap Groningen	The Partnership was formed to manage the production of the Groningen gas. In this partnership, the NAM (a joint venture of Shell and Esso) a 60% interest and the State has the remaining 40% shares.	
Gasterra	Active in the worldwide trade and supply of natural gas. It is owned by Royal Dutch Shell (25%), ExxonMobil (25%) and the Dutch Government (50%).Its history dates back to 2005, when the company was created after a split-up of the Gasunie .	GasTerra

NL - Private actors – Gas industry		
Shell		
Exxon Mobile		ExxonMobil
Nederlandse Aardolie Maatschappij [NAM]	A joint venture of Shell and Esso (ExxonMobil) with 60% interest and the State has the remaining 40% shares http://www.nam.nl/en.html	

Appendix 6: UK - Institutional Actors – Gas industry

UK - Public actors – Gas industry		
Office for Gas and Electricity Markets [Ofgem]	Established in 1990. A non-ministerial Government department and an independent National Regulatory Authority. https://www.ofgem.gov.uk/	ofgem
Oil and Gas Authority [OGA]	A newly created Executive Agency of DECC. Works with Government and industry to make sure that the UK gets the maximum economic benefit from its oil and gas reserves. On 1st April 2015 certain functions passed from DECC to the OGA.	Oil & Gas Authority
Oil & Gas PILOT	PILOT (formerly the Oil and Gas Taskforce) A joint programme involving the Government and the UK oil and and gas industry which aims to secure the long-term future of the UK continental shelf (UKCS) and ensure full economic recovery of hydrocarbon resources. It is chaired by the Secretary of State for Energy & Climate Change and comprises operators, major contractors, small and medium sized enterprises and trade unions. https://www.gov.uk/government/groups/105	

UK - Membership organisations – Gas industry		
Oil & Gas UK	The leading representative body for the UK offshore oil and gas industry. It is a not-for-profit organisation, established in April 2007 but with a pedigree stretching back over 40 years. http://www.oilandgasuk.co.uk/	Oil & Gas UK the voice of the offshore industry

UK - Private actors – Gas industry		
National Grid	The sole owner and operator of the national gas transmission infrastructure in the UK.	nationalgrid

Appendix 7: NL - Revenues from State participation in natural gas industry

EBN B.V.			
	Turnover	**Net result**	**State revenues via EBN**
2004	€4.223.000.000	€1.534.000.000	€3.367.000.000
2005	€4.883.000.000	€3.791.000.000	€7.326.000.000
2006	€6.264.000.000	€2.378.000.000	€5.350.000.000
2007	€6.090.000.000	€2.367.000.000	€4.975.000.000
2008	€8.698.000.000	€3.269.000.000	€7.516.000.000
2009	€6.387.000.000	€2.211.000.000	€5.188.000.000
2010	€6.486.000.000	€2.076.000.000	€5.339.000.000
2011	€7.103.000.000	€2.131.000.000	€5.788.000.000
2012	€8.528.000.000	€2.360.000.000	€6.932.000.000
2013	€8.738.000.000	€2.327.000.000	€7.187.000.000
2014	€6.598.000.000	€1.614.000.000	€4.900.000.000

(EBN, 2004-2014)

N.V. Nederlandse Gasunie				
	Turnover	**Corporate income tax**	**Net profit**	**Dividend paid to the State (sole shareholder)**
2004	€1.418.400.000	€239.300.000	€447.400.000	n/a
2005	€1.277.300.000	€197.100.000	€432.300.000	n/a
2006	€1.250.900.000	€161.200.000	€382.800.000	n/a
2007	€1.318.500.000	€153.400.000	€435.200.000	€248.400.000
2008	€1.506.100.000	€127.500.000	€394.100.000	€295.600.000
2009	€1.668.700.000	€38.700.000	€121.800.000	€415.900.000
2010	€1.523.000.000	€140.400.000	€453.700.000	€181.500.000
2011	€1.725.800.000	€2.900.000	-€602.000.000	€0
2012	€1.506.100.000	€111.000.000	€358.700.000	n/a
2013	€1.670.000.000	€182.000.000	€551.000.000	€325.000.000
2014	€1.651.000.000	€202.000.000	€603.000.000	€362.000.000

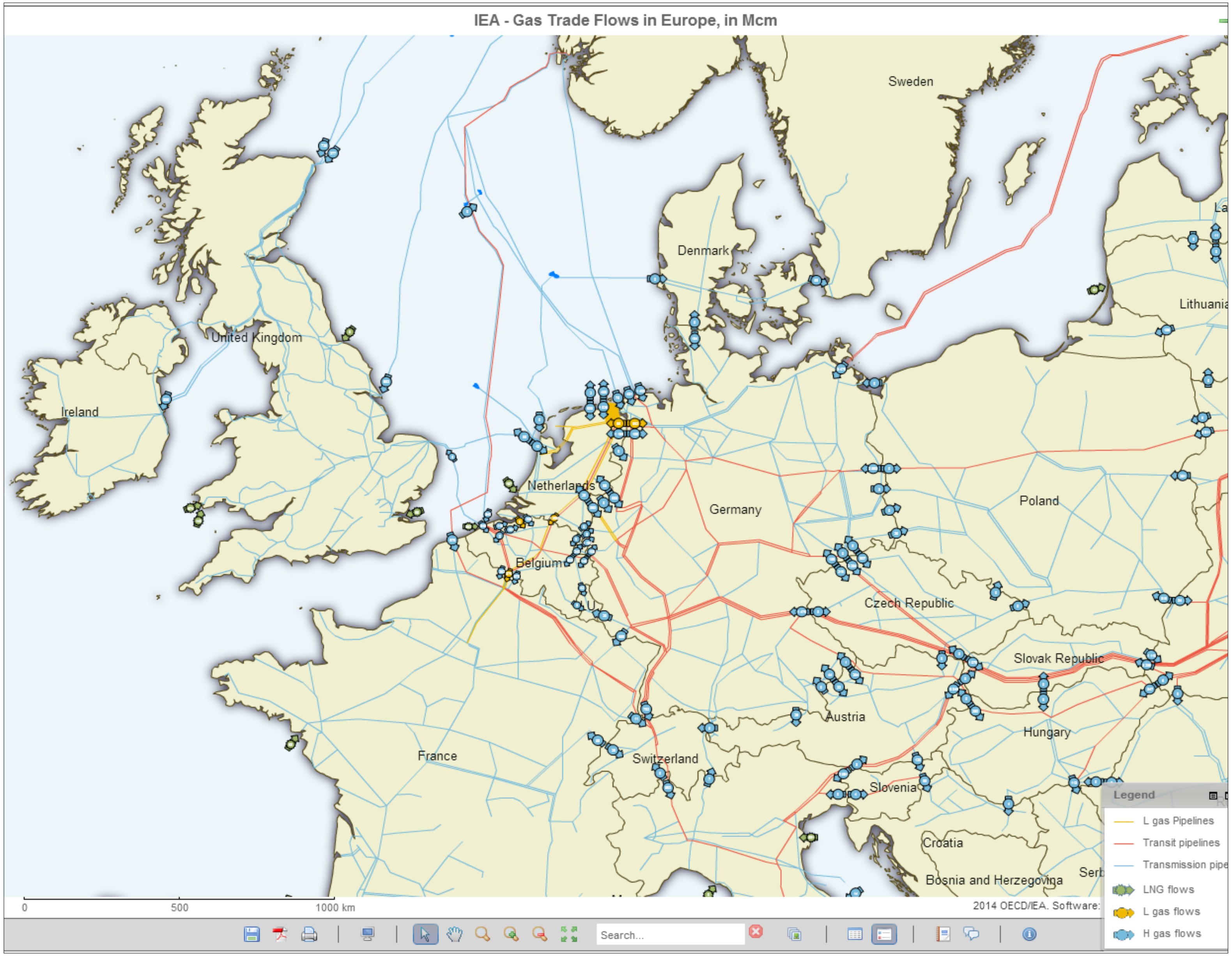
(Gasunie, 2004-2014)

Gasterra B.V.				
	Turnover	**Purchase**	**Net profit**	**State revenues via Gasterra (50%)**
2004	Founded on July 1st 2005			
2005	n/a	n/a	n/a	n/a
2006	n/a	n/a	n/a	n/a
2007	n/a	n/a	n/a	n/a
2008	€23.953.000.000	€22.956.000.000	€36.000.000	€18.000.000
2009	€18.310.000.000	€17.343.000.000	€36.000.000	€18.000.000
2010	€18.357.000.000	€17.458.000.000	€36.000.000	€18.000.000
2011	€21.095.000.000	€20.283.000.000	€36.000.000	€18.000.000
2012	€23.381.400.000	€23.366.400.000	€36.000.000	€18.000.000
2013	€24.292.800.000	€24.219.600.000	€36.000.000	€18.000.000
2014	€19.500.800.000	€19.388.400.000	€36.000.000	€18.000.000

(Gasterra, 2009-2014)

Appendix 8: NL & UK – Natural gas trade flows

The map on the side shows the gas trade flows in Europe. It clearly points out the Netherlands has many cross-bordering trading flows (with Belgium, Denmark, Germany, United Kingdom) (IEA, 2015).



Appendix 9: NL - Additional information natural gas industry

1. Exploration & Production

Information on the E&P sector is described in the chapter on natural gas.

2. Gas transmission, distribution and storage

The State owned firm Gasunie owns and operates the high-pressure transmission network. The transmission network consists of 11,500km of pipeline, and gas is supplied to the grid from 52 entry points, 35 of which feed in gas from Dutch fields and 17 deliver gas from networks from neighbouring countries. The gas is delivered to Dutch customers via almost 1,100 delivery stations, and to foreign customers through 23 border stations. Gas distribution takes place at lower pressure via 12 Distribution Network Operators ("DNOs"). The Dutch gas network has high capacity onshore interconnections with Germany and Belgium. The network is also connected to the UK via the Bacton to Balgzand [BBL] pipeline, which can currently transport up to 16bcm/year from the Netherlands to the UK. Gas from Norway lands via the Norpipe just over the Dutch-German border in Emden (source: the economic impact of the Dutch gas hub strategy). The Netherlands currently has three underground gas storage facilities with a total working volume of about 5bcm, as well as a peak shaving unit operated by Gasunie at Maasvlakte. The Abu-Dhabi National Energy Company (TAQA) bought the Alkmaar storage facility in 2007 from BP, and NAM operates the other two storage facilities – Norg and Grijpskerk. Nuon also has a gas storage facility in Epe, Germany. The Epe facility uses a former salt cavern and has a working volume of 80mcm. Essent/RWE also has a storage facility in Germany. The State-owned company EBN currently participates in all three of the underground gas storage facilities in the Netherlands. Through the Maatschap Groningen, EBN's interest in the two NAM-operated storages – Norg and Grijpskerk – is 40%. In addition, EBN will have a 40% interest in the Bergemeer storage facility that is currently being developed.

Three new storage projects are currently under development in the Netherlands: two at Zuidwending, and one at Bergermeer. These projects have a combined working volume of 4.58 bcm. At Zuidwending, Gasunie and Nuon plan to make use of depleted salt caverns to provide a flexible response to peaks in demand. Gasunie plans to use five caverns with a total working volume of 300mcm and will store Groningen gas at the storage facility. Nuon plans to use four salt caverns to store gas and the caverns will have a total storage capacity. The Bergermeer Gas Storage Consortium plans to invest €800mln in the Bergemeer storage facility which is expected to be built between 2009 and 2013. The consortium has four partners: TAQA, EBN, Petro Canada and Dyas. Two of the consortium parties are foreign (TAQA and Petro Canada) and these two parties have a share of 48% between them. In effect, the foreign investment in Bergermeer will be around €380mln. This figure excludes the value associated with the large amount of cushion gas which will be provided by Gazprom export. In addition to these new facilities in the Netherlands, Eneco has started construction of gas storage facilities at Epe in Germany that will be connected to the Dutch network. Like the Nuon storage at Epe, the Eneco facilities will make use of former salt caverns. The sites are expected to be completed by 2013 and will have a working volume of around 100 mcm. Eneco has reported that the storage facilities will allow it to better respond to developments in the Dutch market. (the economic impact of the Dutch gas hub strategy).

3. Gas trading and supply

Trading of gas in the Netherlands takes place via the TTF. The TTF is currently the most active trading hub in continental Europe, in terms of both the volume traded and the volume physically delivered. GasTerra is also very active as an exporter on the European gas market, and has import contracts with suppliers from Russia and Norway. GasTerra purchases the vast majority of its supplies from Groningen and the Dutch small fields, but supplements the Dutch gas through these Russian and Norwegian contracts and purchases on the spot market.

4. LNG terminals and imports

In 2011 the LNG terminal GATE (Gas Access To Europe) has been opened in Rotterdam and is the first LNG import terminal in the Netherlands. It has a capacity of 12bcm per year. Foreign companies i.e. Dong Energy, OMV Gas International, Essent and E.On Ruhrgas have each a 5% share in the terminal. In 2013 Dong Energy has sold her 5% share to Gasunie and VOPAK. The two other plans for the construction of LNG terminals in the Netherlands have been cancelled. This was a plan for a LNG-terminal in the Groningen Eemshaven. In 2010 the initiators of the project Essent, Vopak and Gasunie announced not to construct the terminal. The other LNG terminal plan, initiated by the British company 4Gas decided in 2010 not to continue with their plans to build a second LNG terminal in Rotterdam.

5. Research and development

However, according to the PwC report (Monitoring publiek gefinancierd Energieonderzoek 2007), Government funded R&D in oil and gas E&P was only about €6.5mln, so almost all R&D is privately funded and can be counted as contributing toward the value of the gas hub.

Appendix 10: NL - Offshore wind farms

NL - Existing offshore wind farms							
Wind farm	**Operational**	**Developer**	**MW per turbine**	**# of turbines**	**Type turbines**	**Total Capacity (MW)**	**Subtotal (MW)**
OWEZ	2007	NUON en Shell	3 MW (2,75 MW)	36	Neg Micon 92	108 MW	
Princes Amalia (Q7)	1 July 2008	ENECO	2 MW	60	Vestas V80-2MW	120 MW	**228 MW**
NL - Offshore wind farms under construction							
Wind farm	**Operational**	**Developer**	**MW per turbine**	**# of turbines**	**Type turbines**	**Total Capacity (MW)**	**Subtotal (MW)**
Gemini (ZeeEnergie & Buitengaats)	Summer 2017	Typhoon Offshore	4 MW	150	Siemens SWT-3.6	(2x 300MW) 600 MW	
Luchterduinen (Q10)	28 sept 2015	ENECO	3 MW	43	Vestas V112	129 MW	**729 MW**
							Total: 957 MW

(NWEA, 2014)

Including the OSWFs in construction, the Netherlands currently has four offshore wind farms with a total generating capacity of almost 1GW.

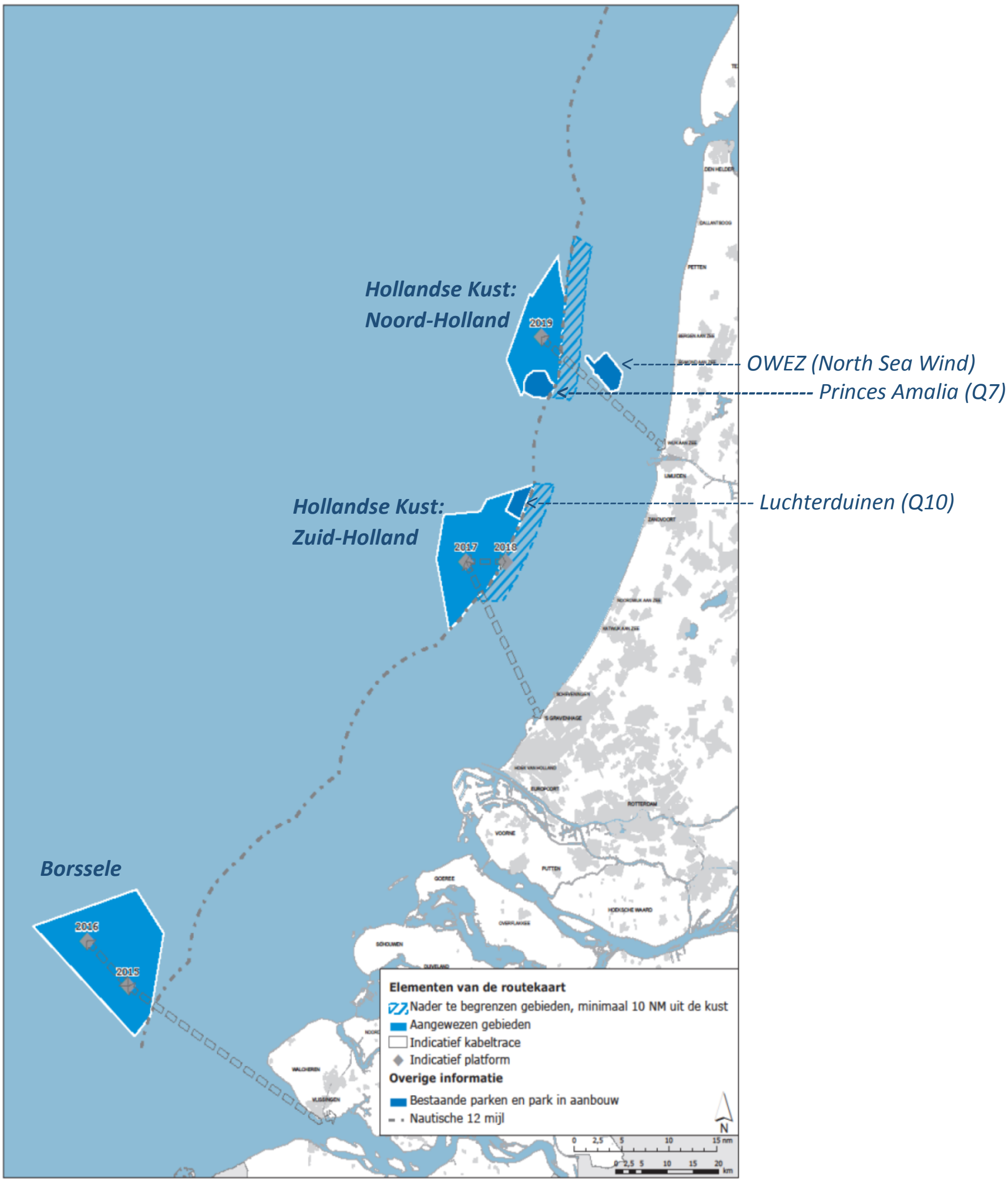
Appendix 11: NL - OWEZ - Financial Statement (2005-2014)

OWEZ - Financial statement 2005-2014 (NoordzeeWind C.V. 's-Gravenhage, Netherlands)									**Joint venture: Nuon (50%) Shell (50%)*
Dec. 31st	**Non-current Assets**	**Current Assets & Cash (equivalents)**	**Long-term liabilities**	**Short-term liabilities**	**Turnover**	**Costs**	**Profit/Loss**	**% interest***	**Bookvalue**
2005	€76.000.000	€6.000.000	€0	€1.000.000	€0	€1.000.000	-€1.000.000	50%	€39.000.000
2006	€202.000.000	€86.000.000	€20.000.000	€69.000.000	€9.000.000	€2.000.000	€7.000.000	50%	€99.000.000
2007	€202.000.000	€35.000.000	€0	€30.000.000	€51.000.000	€18.000.000	€33.000.000	50%	€84.000.000
2008	€192.000.000	€29.000.000	€30.000.000	€4.000.000	€64.000.000	€46.000.000	€18.000.000	50%	€93.000.000
2009	€181.000.000	€13.000.000	€29.000.000	€1.000.000	€46.000.000	€15.000.000	€31.000.000	50%	€82.000.000
2010	€170.000.000	€10.000.000	€28.000.000	€3.000.000	€42.000.000	€15.000.000	€27.000.000	50%	€74.000.000
2011	€160.000.000	€19.000.000	€20.000.000	€1.000.000	€55.000.000	€15.000.000	€39.000.000	50%	€75.000.000
2012	€149.000.000	€19.000.000	€17.000.000	€2.000.000	€50.000.000	€19.000.000	€31.000.000	50%	€71.000.000
2013	€121.000.000	€25.000.000	€8.000.000	€23.000.000	€47.000.000	€42.000.000	€5.000.000	50%	€58.000.000
2014	€111.000.000	€19.000.000	€8.000.000	€0	€44.000.000	€18.000.000	€26.000.000	50%	€61.000.000

(Nuon, 2006-2014)

Appendix 12: NL – Offshore wind locations map 1

As indicated in the most recent State's structure vision offshore wind energy, the offshore wind objective can be cost effectively implemented in three areas: *Borssele* (1,400MW), *Hollandse Kust Zuid-Holland* (1,400MW) and *Hollandse Kust Noord-Holland* (700MW), located in narrow strip between the 10-12 miles zone. The Dutch Coast areas that are not adjacent to the 12-mile zone and the areas in *IJmuiden Ver* and Far North of the *Waddeneilanden.* Due to their location costs increase and these locations possibly only will be classified for offshore wind construction after 2020.

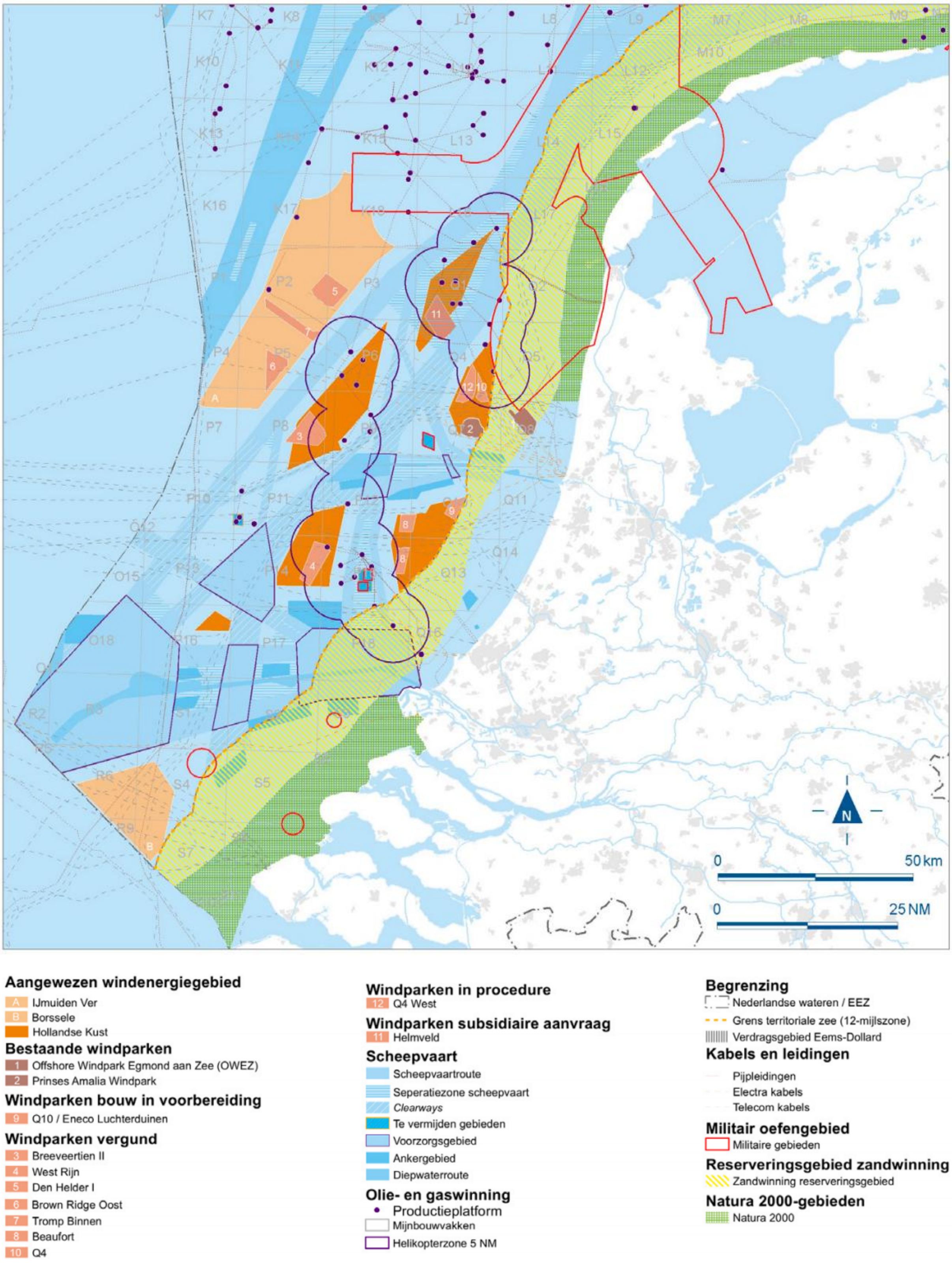


NL - Latest planning: "Structuurvisie Wind op Zee" (26 sept. 2014)								
Start project	**Operational**	**Location**	**Developer**	**MW per turbine**	**# turbines**	**Type turbines**	**Capacity (MW)**	**Previous agreement (Energieakkoord2013)**
2015	2019	Borssele	TBD	TBD	TBD	TBD	700MW	450MW
2016	2020	Borssele	TBD	TBD	TBD	TBD	700MW	600MW
2017	2021	Hollandse Kust: Zuid Holland	TBD	TBD	TBD	TBD	700MW	700MW
2018	2022	Hollandse Kust: Zuid Holland	TBD	TBD	TBD	TBD	700MW	800MW
2019	2023	Hollandse Kust: Noord Holland	TBD	TBD	TBD	TBD	700MW	900MW
							3500MW	**3450MW**

(Rijksoverheid, 2014)

Appendix 13: NL – Offshore wind locations map 2

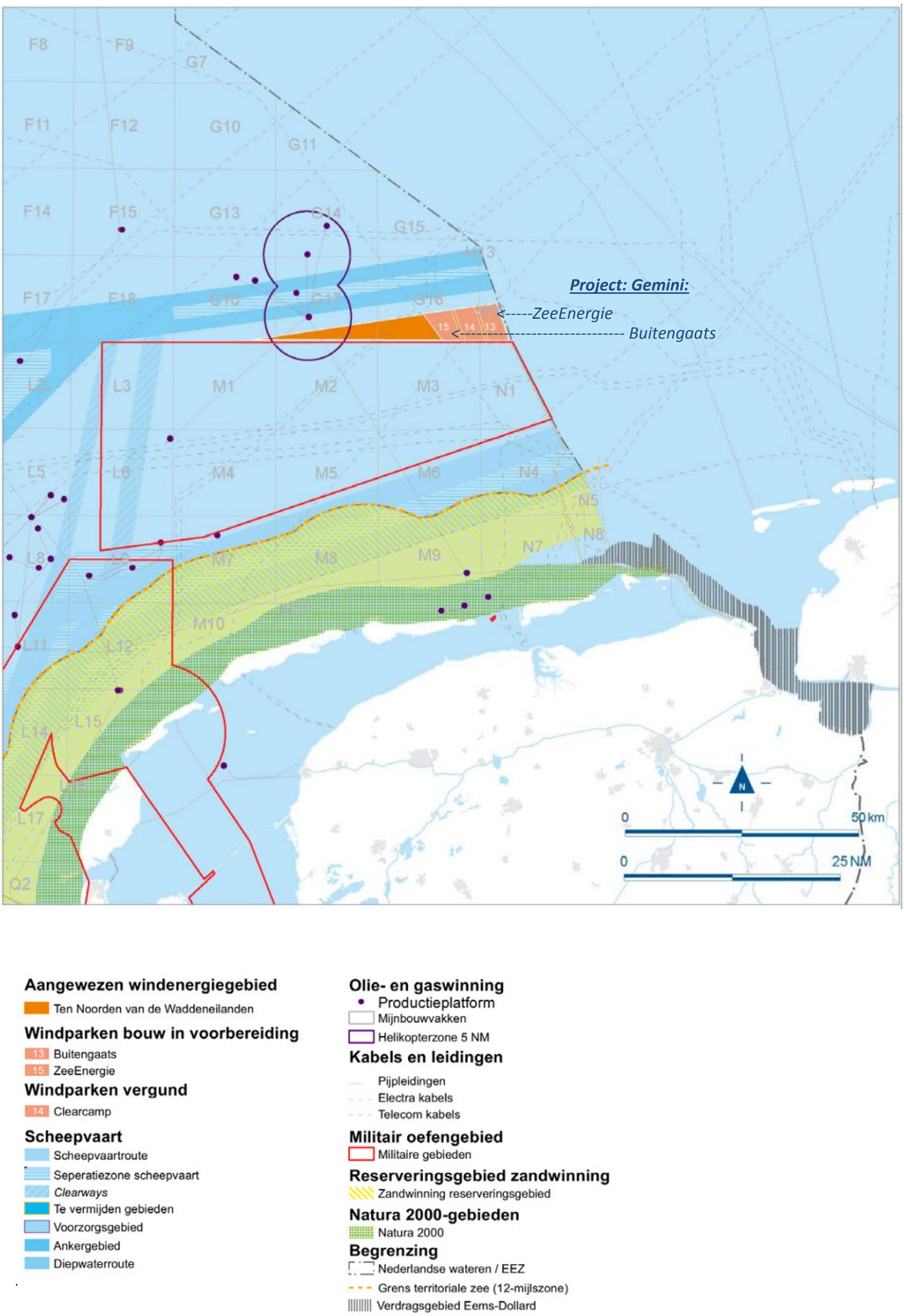
Area Map: Hollandse Kust



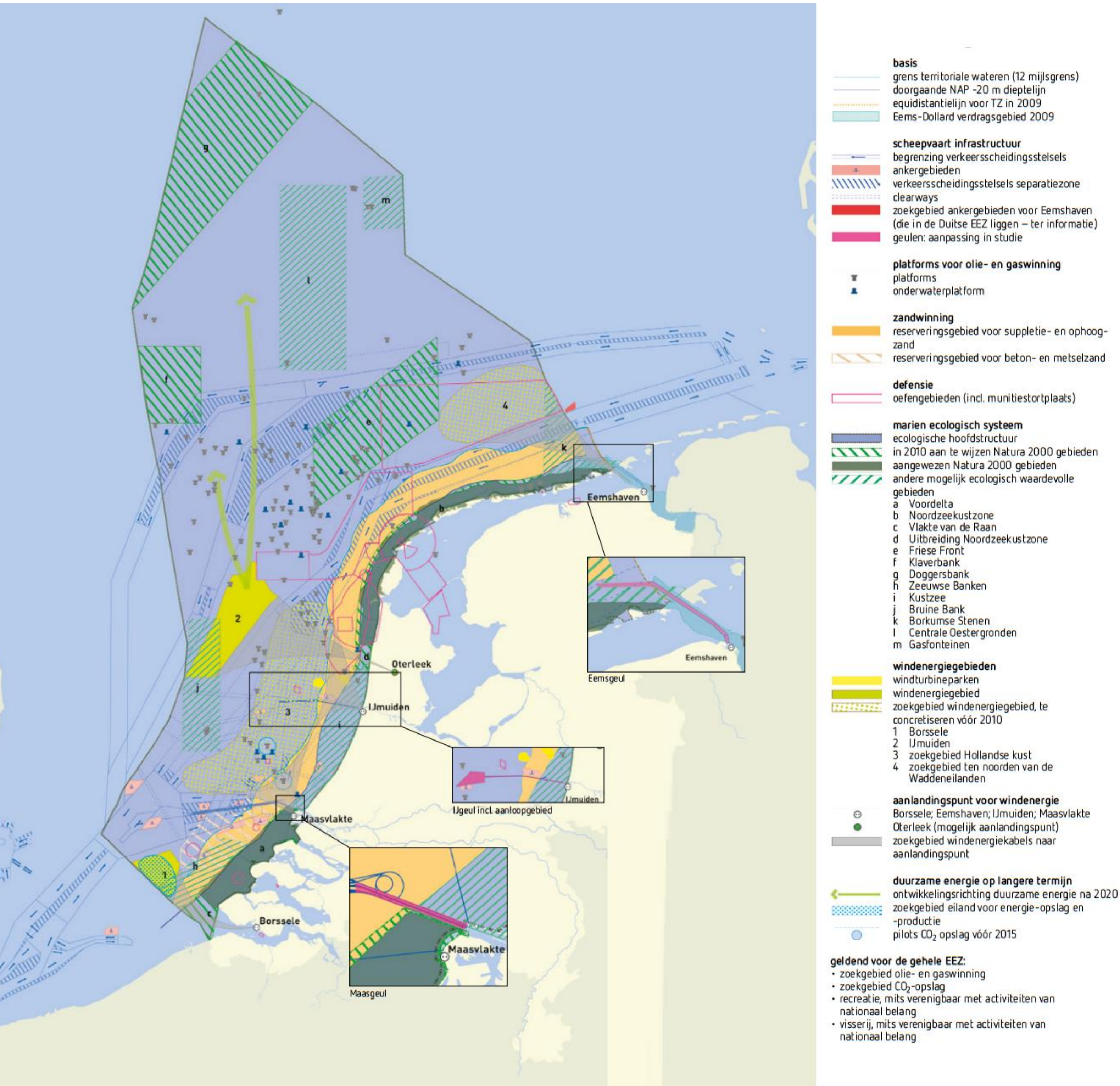
(Min. Infrastructure and Environment, 2013)

Appendix 14: NL – Offshore wind locations map 3

Area Map: North of the Waddeneilanden



Appendix 15: NL - Map National Water plan 2009-2015 and EEZ



Appendix 16: NL – Firms and business associations in the OSW sector

NL - Firms and business associations in the OSW sector		
Energy generation / supply		
NUON Duurzame energie N.V. (Vattenval)	Develop, build and operate wind farms under own management.	
Eneco	Generating and supplying energy. Project management and project development offshore wind farms.	
TenneT	Electricity net operator in the Netherlands. 100% State owned.	
Wind turbine manufacturing		
XEMC Darwind	XEMC Darwind BV, established in 2009, is a Dutch supplier of direct drive wind turbines in the multi-megawatt range.	
Royal IHC Group	• IHC Handling Systems (equipment for installation) • IHC Hydrohammer (piling equipment) • IHC Offshore Systems: (equipment for wind turbines)	
2-B Energy	Developing and marketing offshore wind turbines.	
Consultancy / project management		
MECAL	Wind energy consultancy and engineering with specialization: design and engineering, certification and project certification, turbine towers design and realization (ATS), due diligence, O&M modelling, inspection, contracts, tenders, design, logistics.	
Pondera Consult	Location research, environmental impact assessments and administrative-legal advice.	
Wind Minds	Wind Minds provides services covering the entire value chain of a wind energy project, such as feasibility studies, planning and development support, ecological research, strategic and environmental impact assessments, yield optimization, asset management, O&M strategy and due diligence services.	
Typhoon Offshore	Advice on tendering, recruit financiers.	
Witteveen + Bos	Consultancy with regard to regulations and permits for wind farms; Model calculations yield wind farms; sound calculations; nautical aspects and ice load of structures; electric connections; foundation consulting; hydro-dynamics and morphology of submarine cables, and others.	
Engineering and construction		
Van Oord	Realization of foundations and electricity supply for wind turbines, EPC contracts (Balance of Plant), Construction services.	
Gusto MSC	GustoMSC sells design of installation vessels for offshore wind turbines and deliver it to special mechanical equipment (cranes, lifting and handling tools)	
Other		
Damen shipyards	Marine vessels and equipment for OSW installation.	
Fugro	Soil testing and services for offshore wind farms (foundations). Obtain and interpret geo-data for waves, soil, wind analyses.	
Vryhof Anchors	Engineering and production of mooring systems for the offshore industry, and anchoring systems for floating wind turbines.	

(Min Ec. Affairs, 2011a)

Appendix 17: NL – Institutional actors – Wind industry

NL – R&D centres of expertise – Wind industry	
TU-Delft (DUWind)	DUWind is the wind energy research organization of the Delft University of Technology. Its research program covers almost all aspects of modern wind turbine technology. DUWind was established in August 1999 as a new interfaculty research organization, specifically for wind energy. The focus of the DUWind program is on the development of all turbine aspects from rotor to foundation techniques as-well as wind farm technology, ranging from basic research through technology development to design support for the industry.
ECN – *Wind Energy*	ECN's department *ECN Wind Energy* is part of the Energy Research Centre of the Netherlands (ECN); an independent market oriented knowledge centre for energy research and development. The Unit holds a strategic position between universities and industry covering all relevant wind energy disciplines.
WMC	Knowledge Centre WMC (Wind turbine, Materials and Constructions) is a research institute for heavily loaded materials, components and structures.
IMARES Wageningen	IMARES, Institute for Marine Resources & Ecosystem Studies, is a leading, independent research institute that concentrates on research into strategic and applied marine ecology. The institute was established mid-2006, based on various institutes working in the same research fields. IMARES' products and services include field research, experiments on a real-life scale, exploratory studies on a laboratory scale, data management and modelling. The field of work entitled 'Ecology' includes all research involving plants, aquatic animals, fish, birds and marine mammals.
TNO	Applied research and development, corrosion management, radar signature, subsea noise, operation and maintenance planning.
Delatares	Soil analysis and research on ecological effects wind farms. https://www.deltares.nl/en/
MARIN	The Maritime Research Institute Netherlands [MARIN], is one of the leading institutes in the world for hydrodynamic research and maritime technology. The services incorporate a unique combination of simulation, model testing, full-scale measurements and training programmes. MARIN provides services to the shipbuilding and offshore industry and governments.

NL - Strategic port locations – Wind industry	
Port of Amsterdam	Port of Amsterdam region has a convenient location and plenty of room for the delivery, storage and assembly of wind turbines for the wind farms.
Port of Den Helder	http://www.portofdenhelder.eu/nl
Groningen Seaports	Groningen Seaports is the port authority for the port of Delfzijl, Eemshaven and the adjoining industrial sites. http://www.groningen-seaports.com/
Port of Harlingen	The port of Harlingen is the most important port in the province of Friesland. www.harlingenseaport.nl
Port of Rotterdam	The Port of Rotterdam is the largest port in Europe. http://www.portofrotterdam.com/en/Pages/default.aspx
Zeeland seaports	Zeeland Seaports encompasses two ports: the port of Vlissingen and the port of Terneuzen. Together, they make up a port area which is strategically located in North-West Europe. http://www.zeelandseaports.nl/en/home.htm
Port of IJmuiden	Zeehaven IJmuiden NV has experience in facilitating and accommodating the construction of wind farms in the North Sea The North Sea wind farm of the coast of Egmond aan Zee and the Princes Amalia wind farm off the coast of IJmuiden were both constructed from the Port of IJmuiden. http://www.zeehaven.nl/?lang=en

NL - Membership organisations – Wind industry	
NNOW	NNOW, Dutch Offshore Wind Cluster, aims to improve the cooperation between companies, mainly SMEs, in the offshore wind sector. The network does this by stimulating process and product innovation, human resources and promotions. The aim is to analyse and enhance the northern Netherlands supply chain for (international) business. www.nnow.nl
Energy Valley	The foundation Energy Valley stimulates, activates, facilitates and connects organizations to bring market opportunities in the field of clean and innovative energy to realization. North of the Netherlands has a strong energy position, with a lot of knowledge and activities. Energy Valley brings parties together to strengthen their position and to lead the transition to a sustainable energy economy.www.energyvalley.nl
Netherlands Wind Energy Association [NWEA]	The Dutch Wind Energy Association represents the interests of wind energy in the Netherlands. NWEA attempts to move government and industry to put more effort into wind energy. NWEA also wants to increase the positive involvement of the public in wind energy. http://www.nwea.nl/

Holland Home of Wind Energy [HHWE]	Holland Home of Wind Energy (HHWE) is an independent exporters association representing the interests of the Dutch wind energy companies and knowledge institutes abroad. The goal of Holland Home of Wind Energy (HHWE) is to promote the Dutch wind energy sector on existing and new emerging wind energy markets i.e. China, Japan, Korea, India, Brazil and USA.	
Energie-Nederland	Energie-Nederland is the new advocate for almost all the energy companies active in the Dutch market. It arose from the merger of EnergieNed and the Dutch Association for Competition in Energy [VME]. http://www.energie-nederland.nl/	

NL – Industry development programmes / initiatives – Wind industry		
We@Sea	In 2003, around 30 parties in the Netherlands had formed a consortium called 'We@Sea', and in 2004 they received funding for a research project aimed at applying experiences with the OWEZ to future wind farms. The following parties participated from the energy sector (e.g. Nuon, Eneco, Delta, Tennet), from the offshore industry (e.g. Ballast Nedam, Fugro), wind farm developers (e.g. Shell, Siemens) research institutes (e.g ECN, TU Delft), and NGO's (e.g. including Greenpeace, Stichting De Noordzee). www.we-at-sea.org	
Topsector energie: TKI-WoZ	TKI Wind op Zee (Top consortium for Knowledge and Innovation Offshore Wind) is part of Topsector energie and facilitates cooperation between companies, research institutions and the Dutch Government in offshore wind research, innovation and deployment. TKI-WoZ is part of the Dutch Top sector Policy: a Government policy that targets the further development of successful industry sectors through research and development in cooperation with Universities and Knowledge Institutes. The precursor of the TKI Wind Op Zee is known as FLOW.www.tki-windopzee.eu http://topsectorenergie.nl/english/	
Green Deal	In The Green Deal the Dutch Government and the sector (50 companies) agreed to achieve a 40% cost reduction in 2020 compared to 2010. In April 2012, the Innovation Contract Offshore Wind was signed. The Innovation Contract aims to amplify and improve the Dutch OSW supply-chain from research to commercial application.	

Appendix 18: UK – Offshore wind farms

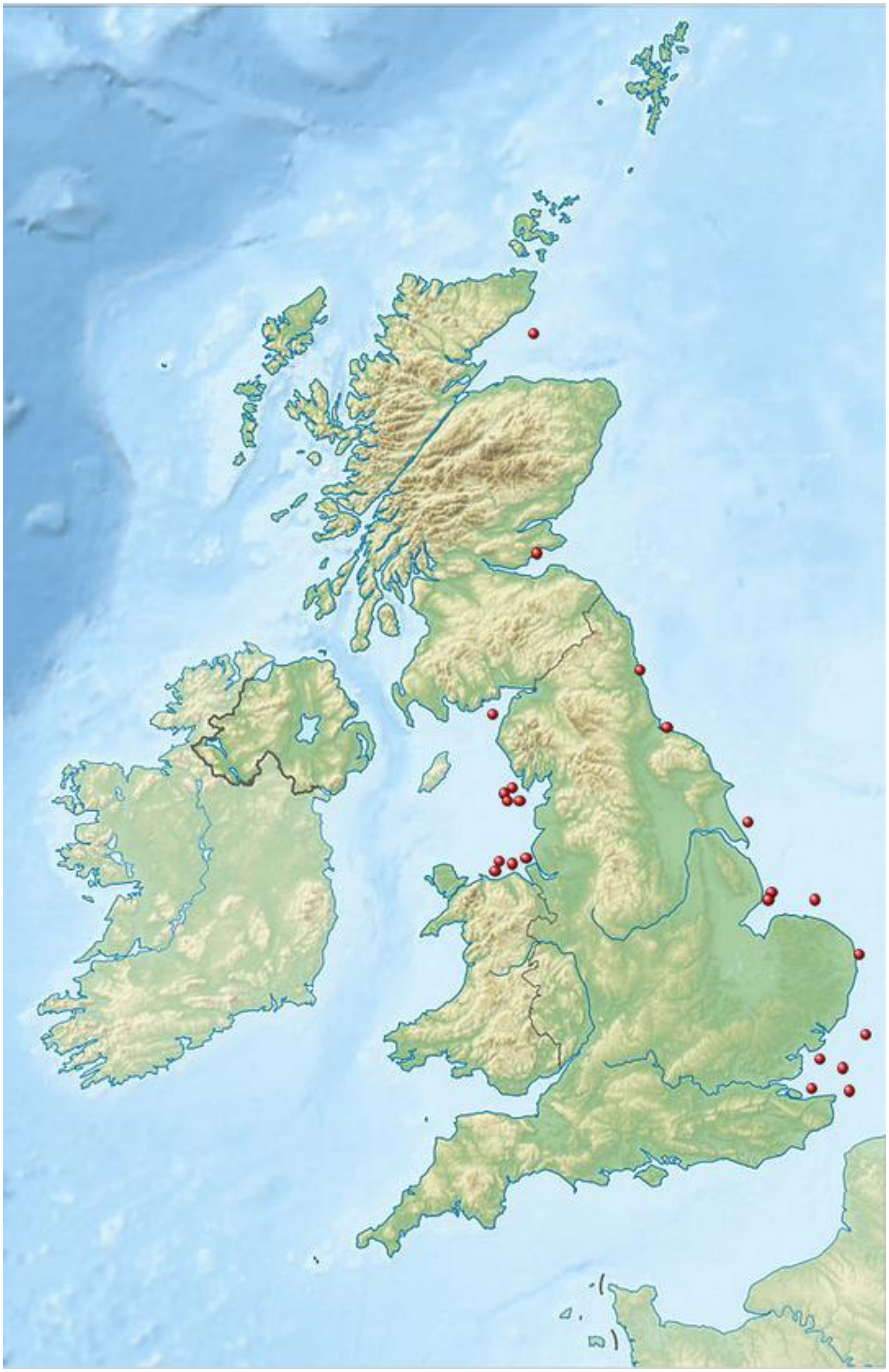
UK - Existing offshore wind farms

	Wind farm	Operational	Owner	MW per Turbine	# of turbines	Type turbines	Total capacity (MW)	Build Cost	Depth range (m)	Km to shore
1	Blyth Offshore	Dec. 2000	E.ON	2 MW	2	Vestas V66-2MW	4	£4.000.000	6–11	1.6
2	North Hoyle	Dec. 2003	Npower (UK)(RWE)	2 MW	30	Vestas V80-2MW	60	£80.000.000	5–12	7
3	Scroby Sands	Mar. 2004	E.ON	2 MW	30	Vestas V80-2MW	60	£75.500.000	0–8	2.5
4	Kentish Flats	Oct. 2005	Vattenfall	3 MW	30	VestasV90-3.0MW	90	£121.500.000	3–5	10
5	Barrow	Jul. 2006	DONG	3 MW	30	Vestas V90-3.0MW	90	£123.000.000	15–20	7
6	Beatrice	Jul. 2007	SSE and Talisman Energy	5 MW	2	REpower 5M	10	£35.000.000	45	23
7	Burbo Bank	Sept. 2007	DONG	3,6 MW	25	Siemens SWP 3.6–107	90	£90.000.000	0–6	7
8	Lynn and Inner Dowsing	Mar. 2009	Centrica (50%) TCW (50%)	3,6 MW	54	Siemens SWP-3.6–107	194	£300.000.000	6–11	5
9	Rhyl Flats	Dec. 2009	Npower (UK)(RWE) GIB	3,6 MW	25	Siemens SWP 3.6–107	90	£198.000.000	4–15	8
10	Walney	Feb. 2010	DONG, SSE, OPW	3,6 MW	102	Siemens SWP 3.6–107	367	£1.200.000.000	19–30	14
11	Gunfleet Sands 1 & 2	Apr. 2010	DONG	3,6 MW	48	Siemens SWP-3.6–107	172	£300.000.000	2–15	7
12	Robin Rigg	Apr. 2010	E.ON	3 MW	60	VestasV90-3.0MW	180	£396.000.000	0–12	11
13	Thanet	Sept. 2010	Vattenfall	3 MW	100	VestasV90-3.0MW	300	£900.000.000	20–25	11
14	Ormonde	Aug. 2012	Vattenfall	5 MW	30	REpower5MW	150	£552.000.000	17–22	9.5
15	Greater Gabbard	Sept. 2012	SSE Renewables	3,6 MW	140	Siemens SWT-3.6–107	504	£1.500.000.000	20–32	23
16	Sheringham Shoal (SSO)	Sept. 2012	Statoil (50%) Statkraft (50%)	3,6 MW	88	Siemens SWT-3.6–107	317	£1.100.000.000	12–24	17
17	Gunfleet Sands 3	Apr. 2013	DONG	6 MW	2	Siemens SWT-6.0 120	12	£51.000.000	5–12	8
18	London Array	Apr. 2013	DONG, E.ON, UK Renewables, Masdar	3,6 MW	175	Siemens SWT-3.6	630	£1.800.000.000	0–25	20
19	Teesside	Aug. 2013	EDF-EN	2,3 MW	27	Siemens SWT-2.3	62	£200.000.000	7–15	1.5
20	Lincs	Sept. 2013	Centrica,Siemens,DONG	3,6 MW	75	Siemens SWT-3.6–120	270	£1.000.000.000	10–15	8
21	Methil	Oct. 2013	Samsung, 2-B Energy	7 MW	1	Samsung 7 MW	7	n/a	5	0.05
22	West of Duddon Sands	Oct. 2014	DONG, SSE	3,6 MW	108	Siemens SWP 3.6–120	389	£1.600.000.000	17–24	15
23	Westermost Rough	May 2015	DONG, Marubeni, GIB	6 MW	35	Siemens SWT-6.0-154	210	£370.000.000	15	10
	TOTAL				**1219**		**4258**	**£11.996.000.000**		

UK - wind farms under construction

Gwynt y Môr	2015	GIB	3,6 MW	160	Siemens SWT-3.6-107	576			
Humber Gateway	2015		3 MW	73	Vestas V112-3 MW	219			
Dudgeon	2017		6 MW	67	Siemens SWT-6.0-154	402			
TOTAL				**300**		**1197**			

Appendix 19: UK - Offshore wind farms in the United Kingdom



The UK currently has 23 operational offshore wind farms, with a total generating capacity of over 4GW.

Appendix 20: UK – Green Investment Bank – OSW investments

GIB investments in OSW									
	Investments in OSWF	**Date**	**Type of financing**	**GIB commitment (£)**	**Other capital**	**Total transaction (GIB + 3rd parties) (£)**	**Total capacity (MW)**	**GIB %**	**Other parties**
1	**Walney**	Dec '12	Debt	£46.000.000	£178.000.000	£224.000.000	367	GIB (24.8%)	DONG (50.1%), SSE (25.1%)
2	**Rhyl Flats**	Mar '13	Equity	£57.500.000	£57.500.000	£115.000.000	90	GIB (24.95%)	Greencoat UK Wind PLC (24.95%)
3	**London Array**	Oct'13	Debt	£58.600.000	£207.400.000	£266.000.000	630	GIB (20%)	Bank of Tokyo-Mitsubishi UFJ, KfW IPEX-Bank, Siemens Bank, Sumitomo Mitsui Banking Corporation
4	**Gwynt y Môr**	Mar'14	Equity	£220.000.000	£220.000.000	£440.000.000	576	GIB (10%)	
5	**Westermost Rough**	Mar'14	Equity	£240.800.000	£647.600.000	£888.400.000	210	GIB (50%)	Marubeni Corporation (50%)
6	**Sheringham Shoal [SSO]**	2014-2015		£240.000.000	£240.000.000	£480.000.000	317		Joint-venture: Scira Offshore Energy Limited (Statoil, GIB, Statkraft)
	TOTAL			**£862.900.000**	**£1.550.500.000**	**£2.413.400.000**	**2190**		

(GIB, 2014a)

Appendix 21: UK - Crown Estate – Revenues 2005-2014

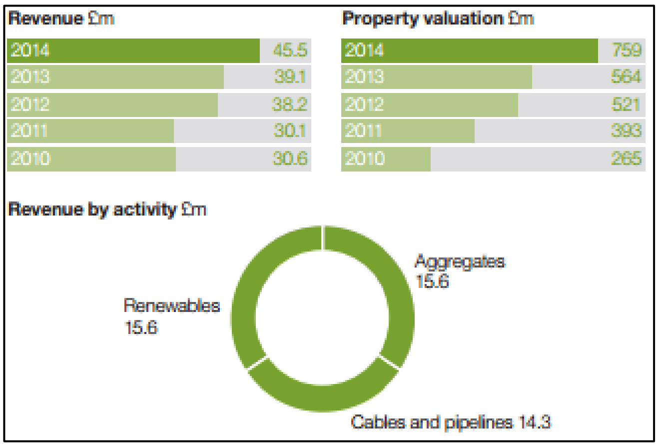
Crown Estate – Revenues & profit

Based on the Financial Statements for the years ended 31 March:

	2005 £m	2006 £m	2007 £m	2008 Restated £m	2009 £m	2010 £m	2011 £m	2012 £m	2013 £m	**2014 £m**
Income account										
Revenue (excluding service charge income)	245.4	252.3	262.1	231.9	285.8	299.7	306.8	314.2	332.2	**350.8**
Direct operating costs (including net service charge expense)	(31.9)	(31.6)	(38.7)	(40.2)	(42.6)	(52.9)	(42.5)	(41.8)	(49.0)	**(45.9)**
Gross surplus	213.5	220.7	223.4	191.7	243.2	246.8	264.3	272.4	283.2	**304.9**
Administrative expenses	(11.7)	(12.3)	(13.3)	(15.5)	(17.0)	(18.5)	(17.1)	(18.4)	(19.8)	**(20.0)**
Indirect operating expenses	(2.0)	(1.0)	(0.8)	(0.7)	–	–	–	–	–	**–**
Net revenue account profit	**184.8**	**190.8**	**200.1**	**213.4**	**226.5**	**210.7**	**230.9**	**240.2**	**252.6**	**267.1**
Consolidated Fund payment	185.7	188.0	200.0	211.0	230.0	210.0	231.0	240.2	251.8	**266.2**

(Crown Estate, 2014b)

Crown Estate - Revenues related to "Energy and Infrastructure"



(Crown Estate, 2014c)

Appendix 22: UK – Firms and business associations in the OSW sector

UK - Firms and business associations in the OSW sector		
	Energy generation / supply	
National Grid – EMR Delivery Body	Coordinating the implementation of the CM and FiT CfD mechanisms.	
E.ON	Invested since 2000s.	
Centrica	One of the largest suppliers of electricity, operating under the trading names Scottish Gas in Scotland and British Gas in the rest of the UK. Invested since 2000s.	
Scottish Power	Interested since early 2010s; trying to develop several UK OSWFs.	
Scottish and Southern Energy [SSE]	Invested since 2000s.	
Vattenfall	Vattenfall is a Swedish power company, wholly owned by the Swedish Government. Also generates power in the Netherlands and the United Kingdom. Invested since 2000s.	
RWE	German electricity supplier. Invested since 2000s.	
Danish Oil and Natural Gas [DONG]	Invested since 2000s.	
Statoil	Norwegian Oil & Gas company. Invested since 2000s. In 2009 Statoil launched the world's first operational deep-water floating large-capacity wind turbine; "The Hywind".	
	Wind turbine manufacturing	
Alstom	Acquired existing Spanish wind turbine manufacturer in 2007; started developing dedicated OSW turbines in late 2000s.	
Areva Wind	Interest in establishing manufacturing presence in UK since late 2000s; signed an agreement with Scottish Enterprise to site a new nacelle and blade manufacturing facility in Scotland in 2012. In 2007, Areva purchased 51% of offshore wind turbine manufacturer Multibrid. In June 2010, Areva purchased the remaining 49% and formed Areva Wind.	
Gamesa	Wind turbine manufacturer. Interest in establishing manufacturing presence in UK since late 2000s; singed memorandum of understanding in 2012 to build manufacturing plant in Scotland.	
Vestas	Provided turbine since early 2000s.	
Siemens	Provided turbines since late 2000s; received planning permission for turbine manufacturing plant in 2012.	
	Consultancy / project management	
AMEC	Active in consultancy/project management. AMEC took over Borderwind which was active from the mid-1990s; involved in Blyth wind farm in 2001	
Renewable Energy Systems [RES]	UK-based renewable energy project developer. Active since the 2000s.	
Garrad Hassan	Garrad Hassan is a leading provider of technical and engineering services, software products and training, not only for onshore and offshore wind, but also for the rapidly developing wave, tidal and solar sectors. Garrad Hassan & Partners Ltd. is a member of the Germanischer Lloyd SE (GL) group which merged (2013) with DNV and became GL-DNV.	
	Engineering and construction	
McAlpine	Engineering and construction in energy industries. Active in the 1980s.	
	Other	
Balfour Beatty	Electrical infrastructure and offshore transmission. Active since late 2000s.	
Central Electricity Generating Board [CEGB]	Explored OSW in the 1980s; abolished in 1990.	
Wind Energy Group	Active since the 1980s; taken over by Vestas.	

Appendix 23: UK – Institutional actors - Wind industry

UK - R&D centres of expertise – Wind industry		
The National Renewable Energy Centre [Narec]	Established in 2002 and active in OSW since late 2000s.Has invested over £150m of UK Government, private sector and European Union funding to create a unique, integrated portfolio of industry accredited testing and research facilities for offshore renewables. Narec plays an important role in supporting delivery of the Government's policy objectives and in attracting and anchoring internationally mobile investment in the UK. http://www.narecde.co.uk/	
UK Energy Research Centre [UKERC]	The focal point for UK research on sustainable energy. UKERC was established in April 2004. he Centre was set up to address key controversies in the energy field through comprehensive assessments of the current state of knowledge. http://www.ukerc.ac.uk/	
Offshore Renewable Energy Catapult	Catapult is a big push to revitalise our economy by stimulating innovation and accelerating growth for the UK. Catapults are a rapidly growing network of seven technology and innovation centres, established and overseen by the Technology Strategy Board with over £200m of Government investment. Scientists, engineers and business innovators will be able to pool expertise, intelligence and experience on a nationwide scale and make a significant contribution to our economy.https://catapult.innovateuk.org/offshore-renewable-energy	

UK – Strategic port locations ("CORE areas") – Wind industry		
The Humber CORE	The Humber is the closest to all three of the UK's largest planned offshore wind farms. Centrica, RES and Siemens have already established an operations and maintenance base here to serve Rounds 1 and 2 offshore wind farms. Is the largest Enterprise Zone in the country offering OEMs and their supply chains the opportunity to co-locate to make cost reductions on a major scale. Around 25,000 people employed in advanced and marine engineering andoffer fabrication and assembly, port and portside services, turbine maintenance, vessel operation and maintenance, turbine access and safety, and logistics. www.humberlep.orghttp://thehumber.com/	
The Liverpool City Region CORE	Liverpool City Region – only CORE areaon the West Coast. Close proximity to the Irish Sea Round 3offshore wind sites.www.liverpoollep.org	
The Kent CORE	A strategic location ideallypositioned for rapid access to offshore wind opportunities in theNorth Sea, English Channel andwider European markets. http://www.locateinkent.com/offshorewindenergywww.locateinkent.com	
North Eastern CORE	This is an important hub for worldwide trade and investment, central to the UK's economic growth for hundreds of years. The North Eastern CORE offers three Ports: Port of Blyth; Port of Tyne; Port of Sunderland. The National Renewable Energy Centre, Narec, is also located in Blyth. Has a Supply Chain with over 250 North Eastern companies with existing commitment or potential to diversify into offshore wind supply.www.nelep.co.uk	NORTH EAST LEP
Great Yarmouth and Lowestoft CORE	Great Yarmouth and Lowestoft together form the primary focus of the East of England Energy Zone – one of the world's largest and most diverse clusters of energy businesses.http://www.theenergyzone.co.uk/http://www.newanglia.co.uk/	
The Tees Valley CORE	Tees Valley's main strengths are in its prime land availability and existing supply chain. Tees Valley has the world's largest cluster of subsea cabling and trenching capabilities, plus expert offshore fabrication facilities and also prime port sites ideally located for three of the world's largest offshore wind projects.www.teesvalleyunlimited.gov.ukwww.teesvalleyunlimited.gov.uk	

UK - Public actors – Wind industry		
Carbon Trust [CT]	Established in 2001; initially focused on small-scale technologies but supported OSW since late 2000s	
Committee on Climate Change [CCC]	Exists since 2008. The independent body to advice the UK Government.	
Crown Estate [CE]	Actively promoted OSW since 2000. Is an independent commercial business created by an Act of Parliament. The Crown Estate manages the UK seabed effectively and sustainably, balancing differing interests and delivering best value over the long-term. 100% of their annual revenue profits are returned to HM Treasury for the benefit of public finances.	
Green Investment Bank [GIB]	The Green Investment Bank's purpose is to accelerate the UK's transition to a greener economy. GIB was created by the UK Government, its sole shareholder, and capitalised with an initial £3.8bn of public funds. GIB uses this finance to back green projects, on commercial terms, across the UK and to mobilise other private sector capital into the UK's green economy.	

Department for Energy and Climate Change [DECC]	Established in 2009	Department of Energy & Climate Change
Department of Business, Innovation and Skills [BIS]	Has taken an interest in OSW since late 2000s when Low Carbon Industrial Strategy came out.	Department for Business Innovation & Skills
Offshore Wind Investment Organisation [OWIO]	The Offshore Wind Investment Organisation [OWIO] has been established within the Government department UK Trade & Invest [UKTI] in order to boost the capacity of the UK offshore wind supply chain as the industry continues to grow. UKTI's OWIO offers dedicated support to potential investors in the UK supply chain, supports UK based suppliers to grow and export, and works with developers of UK offshore wind farms to deliver on their local supply chain strategies. The organisation works closely with the other two departments mentioned above (DECC and BIS).	UK Trade & Investment
Infrastructure UK [IUK]	A division of HM Treasury that advises Government on the long-term infrastructure needs of the UK and provides commercial expertise to support major projects and programmes.	HM Treasury
Energy Technologies Institute [ETI]	Launched dedicated OSW programme in 2009 and is a public-private partnership between global energy and engineering companies – BP, Caterpillar, EDF, E.ON, Rolls-Royce and Shell – and the UK Government. In early 2014 ETI has announced investment of more than £60m on knowledge building and technology development projects in offshore wind. http://www.eti.co.uk/	energy technologies institute
Engineering and Physical Sciences Research Council [EPSRC]	Provided limited funding for wind research since the1980s.	EPSRC Pioneering research and skills
Innovate UK	Established in 2007; active in OSW since late 2000s Private public bodies/networks. Innovate UK is the new name for the Technology Strategy Board [TSB]. Innovate UK is an executive non-departmental public body, sponsored by the Department for Business, Innovation & Skills. https://www.gov.uk/government/organisations/innovate-uk	Innovate UK Technology Strategy Board Technology Strategy Board Driving Innovation
Offshore Wind Cost Reduction Taskforce	Established in 2011 to set out a path and action plan to reduce the costs of offshore wind to £100/MWh by 2020.	
Offshore Wind Programme Board [OWPB]	A joint Government / industry body responsible for driving cost reduction in offshore wind. Has been established following the recommendations in the Offshore Wind Cost Reduction Task Force report. It brings together senior representatives from industry (including developers and supply chain), Government, The Crown Estate and Statutory Nature Conservation advisors and is based on successful models used in other sectors such as the Oil and Gas PILOT group. It steers a collaborative, long-term programme of work that aims to deliver cost reduction and enable growth of a competitive UK-based supply chain as the offshore wind industry grows and matures. The Board was established by the Secretary of State for Energy and Climate Change in November 2012 and has a membership drawn from across the industry and Government. Their objective is to set out an action plan for reducing the levelised cost of offshore wind to £100 per MW/h by 2020.	Offshore Wind Programme Board
International Clean Energy Sustainability & Network [ICESN]	Setup in 2010, ICESN is an international network of renewable energy stakeholders who regularly exchange information about technological innovation and changes. Annually it organises a conference: the Offshore Wind Developers Forum [OSWDF].	ICESN
Offshore Wind Industry Council [OWIC]	(OWIC is a senior Government and industry forum established in May 2013 to drive the development of the world-leading offshore wind sector in the UK. The OWIC is responsible for overseeing implementation of the Offshore Wind Industrial Strategy, and is the sponsoring body of the OWPB.	

UK – Industry development programmes / initiatives – Wind industry		
DECC/TSB Offshore Wind Components Technologies Scheme	To help companies developing and demonstrating component technologies that can cut the costs of offshore wind energy in the run up to 2020 and in the subsequent decade. This £15m Scheme (not presently open for applications) is now supporting 19 innovation projects aimed at cost reduction, including projects addressing: wind turbine generators and drive trains; concrete, steel and floating foundations; foundation fabrication techniques; offshore access; subsea cabling and turbine testing and maintenance techniques. https://www.gov.uk/innovation-funding-for-low-carbon-technologiesopportunities-for-bidders	
Offshore Wind Structural Lifecycle Industry Collaboration [SLIC] project	A collaborative joint industry project established by a group of ten offshore wind operators undertaking research into the specific behaviour of wind turbine structures in the offshore environment.	
Carbon Trust Offshore Wind Accelerator [OWA]	A joint public-private sector innovation programme involving more than three-quarters of the UK's offshore wind developers and managed by the Carbon Trust. The OWA supports the development and commercialisation of novel foundations, electrical systems, cable installation methods, O&M access systems and wake effects models to reduce cost of energy by at least 10% in time for Round 3. www.carbontrust.com/offshorewind	
EUROGIA-UK	A collaboration between DECC, Eurogia+ and the Technology Strategy Board to encourage UK companies to participate in transnational collaborations to develop innovative industrial research, development and demonstration projects for low carbon energy technologies. DECC considers funding applications from collaborative projects receiving the Eurogia+ quality label. There are four application windows each year, held on a rolling basis. Consortium partners from other EUREKA countries will be eligible for funding in their own countries within the usual EUREKA/Eurogia+ framework. https://www.gov.uk/government/publications/guidance-notes-for-eurogia-ukfunding-applications-2013 https://www.gov.uk/innovation-funding-for-low-carbon-technologiesopportunities-for-bidders	
Offshore Renewables Joint Industry Programme [ORJIP]	ORJIP is a joint industry project involving the Carbon Trust, the Department of Energy and Climate Change, Marine Scotland, The Crown Estate and offshore wind developers. ORJIP aims to reduce the risks around gaining consent for OSWFs and accelerate development. Over the next three years, £3m of public and private sector funding will be provided for research, of which ORJIP is providing £400,000,-. Through the Offshore Wind Programme Board it has also commissioned an update to the 2012 report on cost reduction to aid the sector.http://www.carbontrust.com/client-services/technology/innovation/offshore-renewables-joint-industry-programme-orjip	

UK - Membership organisations – Wind industry		
Renewable UK	Renewable UK (before named the British Wind Energy Association) is UK's leading renewable energy trade association, with over 580 corporate members active in the wind, wave and tidal energy sectors. A not- for- profit organisation, Renewable UK is the sector's central point of information and a united representative voice for their members. It develops and promote the wind and marine energy industries, protect members' interests, facilitate business networking, and organise events. Expertise ranges from delivering research projects, conferences and exhibitions, one-day networking and business development opportunities, to promoting the benefits of wind and marine renewables to Governments, related industries, the media and the public.www.RenewableUK.com	
Energi Coast	The representative group for the North East of England's offshore renewables sector; promoting the extensive offshore renewable energy sector expertise from the region.www.EnergiCoast.co.uk	
EEEGR	A non-profit, business-led group committed to the sustained development of the energy sector in the East of England. www.EEEGR.com	
Offshore wind England	A coalition of organisations working together to provide supply chain expertise to wind farm developers, turbine manufacturers, top tier suppliers and English based supply chain companies.www.offshorewindengland.co.uk	
NOF Energy	A highly proactive business development organisation working on behalf of companies within the oil, gas, nuclear and offshore renewables sectors.www.nofenergy.co.uk	
Energy Industries Council (EIC)	The leading trade association providing dedicated services to help members understand, identify and pursue business opportunities worldwide.www.The-EIC.com	

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