CLEARING THE WAY FOR INSTITUTIONAL INVESTORS TO INVEST IN OFFSHORE WIND PROJECTS IN THE NETHERLANDS

An explorative study on the barriers that institutional investors face and on the mitigation strategies that they prefer

MASTER THESIS

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Systems Engineering, Policy Analysis and Management

Section Economics of Infrastructures

Report

Type	Master thesis

University

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Faculty	Technology, Policy and Management
Section	Economics of Infrastructures

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Abstract

In 2013 the Dutch government introduced a highly challenging plan to tender a total amount of 3500MW of offshore wind energy projects over the course of merely five years. From the end of 2015, each year two projects of the size of 350MW will be tendered to the offshore wind industry. Traditionally large energy utilities developed offshore wind projects and by doing so they only needed to use their own financial resources in combination with corporate loans. However this changed drastically since the financial crisis of 2008. Energy companies significantly decreased in size while on the other hand the average size of offshore wind parks kept growing and growing. Furthermore the credit worthiness of the utilities is currently under constant pressure leading to the fact that utilities do not want to attract large amounts of corporate finance with the means to finance their offshore wind projects, because this could affect their credit rating. To reach the offshore wind goals a total estimated amount of €19 billion is needed and it is expected that this amount cannot be raised by utilities alone. Therefore external financing sources are needed. There is a growing expectation that, complementary to traditional financers, institutional investors, with significant liquidity like insurance and pension funds, can play a more important role in the financing and refinancing process of offshore wind parks. Insurance companies and pension funds have significant amounts of capital, they have a long-term perspective and due to the decreasing margins on their traditional investment classes they are in search for new investments that can generate higher yields. There is however one problem, institutional investors are known to be risk-averse and therefore institutional investors are currently underrepresented in the financing market of offshore wind projects. This research tries to find out how the large potential capital source of institutional investors can be utilized, if this is desired, and what effect this can have on the Dutch offshore wind targets. The main research question that will be answered is:

Taking into account a Northwest European context, how can the barriers for institutional investors to invest in Dutch offshore wind projects be mitigated and how would this contribute to reaching the Dutch offshore wind targets?

To answer this research question an explorative study was performed. This explorative study can help policy makers in their decision making process of drafting policies that can stimulate the investment climate of offshore wind projects. Information gathered from an extensive literature review study is used in combination with information from interviews with Dutch institutional investors and project developers. Next to the concrete policy recommendations the deliverables will be a validated causal loop diagram that shows all the relevant relations that have effect on whether institutional investors can invest in offshore wind projects and a theoretical model. This research is the first scientific attempt to create a theory regarding this topic.

The starting point of this research was the scientific model of Wüstenhagen and Menichetti. Via an interim model this scientific model was transformed into the causal loop diagram. This was done by collecting causal relations, including barriers and mitigations strategies, that were found in the literature review study and by integrating these causal relations with the interim model which is a derivative of the already existing theory of Wüstenhagen and Menichetti. The theoretical model is subsequently a consolidated version of the causal loop diagram. First a conceptual causal loop diagram and a conceptual theoretical model was constructed. This was done so the conceptual models could be subsequently validated, adapted and specified with information gathered from 13 interviews with Dutch institutional investors and utilities and with 2 interviews with an investment institute and the Ministry of Economic Affairs. This made it possible to compare the more general data that was found in the literature review study with the specific problems and preferences that Dutch institutional investors mentioned during the interviews. This resulted into validated models that are specified to Dutch institutional investors in relation to Dutch offshore wind projects and this made it possible to see the differences between the current scientific knowledge and the actual problems that Dutch institutional investors face. The interviews with the institutional investors were mainly regarding their investment preferences, their barriers and the associated preferred mitigation strategies and

subsequently the interviews with the energy utilities were generally regarding the perceived need of institutional capital for the development of the offshore wind parks. The other two interviews were subsidiary and conducted with the means to receive additional data.

The results show that one of the main investment problems is that generally institutional investors have little knowledge regarding offshore wind projects. It also appears that there is information asymmetry between institutional investors and the project developers. It was mentioned that it is not a barrier that the risks are by definition too high, but that it is a problem that institutional investors are often not able to assess the propositions due to a lack of expertise, lack of capacity and a lack of transparency of real production data. This has effect on the perceived risks and the expected returns of this asset class. This was also stipulated when the data from the interviews was compared with the data from the literature review study. In general, the specific offshore wind related barriers and mitigation strategies that were found in the literature review study were mentioned less or not at all during the interviews. The barriers and mitigation strategies that were mentioned during the interviews were in general regarding the returns, the investment product or regarding high level project risks (e.g. interviewees stated that the construction is a risk, however they were generally not able to state why they believed that the construction risks are high). Furthermore it was found that disregarding the stated importance of environmental, social and governance (ESG) in the investment portfolio of institutional investors, none of the investors incorporated concrete ESG criteria into their investment decision making process. An increased importance of ESG criteria could lead to a different perception of the risk return relationship of projects.

The results from the utility companies show that currently offshore wind project developers do not have the feeling that a shortage of capital hinders them to develop the projects. The way the risks are mitigated is currently still sufficient for other investor types (and according to the utilities there are currently enough other investors) and therefore utilities have currently no direct need to mitigate extra risks so institutional investors can more easily enter the financial agreements. Utilities see institutional investors as reasonable parties for capital recycling and in some cases also as a useful party for earlier stages of the projects. However utilities will just work together with the parties that best suits the project specifications. Due to the answers that were given during the interviews it is not believed that institutional investors have a crucial role in reaching the Dutch offshore wind targets. The availability of capital is currently not seen as a restriction to build projects. Furthermore due to competition and a low LIBOR rate the cost of capital is currently very low and therefore it is not reasonable to expect that due to a potential increase of institutional capital the cost of capital could significantly drop.

The previous results led to the final theoretical model. This model shows the dynamics between six factors that were found and that together influence the bankability and subsequently the ability of institutional investors to invest in offshore wind projects. The factors that are found are: Ability to assess the risks; Ability to assess the returns; Ability to assess the financial characteristics; Level of ESG criteria in the investment methodology; Transparency and communication and; Energy policy. The theoretical model is accompanied with an extensive list of questions that institutional investors can use to get a complete picture of the aspects that should be taken into account when deciding to invest in offshore wind projects.

Disregarding the previous comments it is still desirable that institutional investors build up experience in this asset class. The minor role of Dutch institutional investors in Dutch offshore wind projects should not be seen as a stringent problem, but as a loss of opportunity. From the perspective of policy makers and Dutch institutional investors, it is undesirable that viable offshore wind projects, that receive a lot of government support, are being financed by foreign companies or companies that do not have the long-term perspective and liabilities that institutional investors have. The future role of institutional capital in offshore wind projects can change due to several external circumstances, therefore it is still desirable that institutional investors incrementally participate in financing offshore wind projects so they can slowly build up knowledge and increase their market share. Therefore several policy recommendations were formulated.

Policy makers should decide on their span of control in the market, either through loose or strict criteria. This report summarizes soft policy recommendations that are mainly regarding a potential role that the government can have regarding knowledge building and knowledge sharing. Furthermore recommendations are discussed that implies a more aggressive role of the government. These are regarding increasing the direct role of the government in developing offshore wind projects.

This study led to several contributions. The potential role of institutional investors is shown and it is shown how their role can be increased and what effect this would have on the Dutch offshore wind targets. Furthermore this research is the first attempt to map all the variables that should be taken into account when institutional investors wants to invest in offshore wind projects. This study can therefore be used by policy makers to draft policy but also by Dutch institutional investors that are new to the market or that have little experience in financing offshore wind projects.

Acknowledgements

This report marks the end of a highly interesting, educational and inspiring time as a master student at the Technical University of Delft. It feels like yesterday when I went with my father to the master event in Delft. I remembered being highly enthusiastic about the university and about the master program Systems Engineering, Policy Analysis and Management. I never regretted that I decided to follow this program and I believe that in the last few years I developed myself in a way that I am ready to enter the market.

There are a couple of people that I want to thank that helped me with writing this master thesis. First of all I want to thank Zenlin Roosenboom-Kwee for her valuable remarks regarding the report and for her commitment to supervise this project. It was pleasant working together and due to the feedback I received from Zenlin I was able to highly improve the quality of this thesis. Second I want to thank the rest of the research team. The meetings and contact with Rolf Künneke and Linda Kamp always provided me with the right amount of feedback. Therefore I always knew what to revise and the feedback gave me the confidence I needed to proceed the work.

Moreover I want to thank my colleagues at PwC. I received a warm welcome and I enjoyed the open atmosphere, the professionalism and the willingness of everyone to help me in this process. It was a highly inspiring and educational period. I especially want to thank Jun Hoo and Rick van Koppen who were my direct supervisors on this project. Furthermore I want to thank Dorine Helmer and Robert Hensgens for joining me to several interviews.

Furthermore this research could not have been executed without the willingness of the interviewees to discuss my interview questions. Therefore I would like to thank all the people I spoke to during this research.

I also want to thank my family and friends for keeping me motivated and for helping me to relativize the importance of this master thesis. Writing a master thesis is an interesting but also sometimes a very challenging assignment. Knowing that I could always, professionally and personally, count on my family and friends made this process a lot easier. I especially want to thank my uncle Eric van de Luytgaarden for reading my thesis and for providing me with valuable feedback regarding the content and the language of the report. Finally I want to thank my girlfriend Veerle for always being there for me when needed.

Sylvian Watts-Jones

June 22nd 2015

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List of abbreviations

Abbreviation	Definition
ABS	Asset-Backed Security
AuM	Assets under Management
CAPM	Capital Asset Pricing Model
CFADS	Cash Flow Available For Debt Service
DSCR	Debt Service Coverage Ratio
ECA	Export Credit Agency
EPCI	Engineering, Procurement, Construction and Installation
EIB	European Investment Bank
ESG	Environmental, Social and Governance
FIT	Feed-in Tariff
FTK	Financieel Toetsingskader
LCOE	Levelized Cost of Energy
LCR	Liquidity Coverate Ratio
LIBOR	London Interbank Offered Rate
NLII	Nederlandse Investeringsinstelling
MRA	Maintenance Reserve Account
O&M	Operation and Maintenance
OEM	Original Equipment Manufacturer
PBCET	Public Bond Credit Enhancement Tool
PBI	Public Bond Initiative
PE	Private equity
PPA	Power Purchase Agreement
SDE+	Subsidie Duurzame Energie +
SPV	Special Purpose Vehicle
TSO	Transmission System Operator
WACC	Weighted Average Cost of Capital

1. Research definition

1.1. Introduction

Currently there is a shift noticeable in the European energy market. European Union member countries committed themselves to the 20-20-20 goals which imply that on a European level in 2020, 20% of the consumed energy should come from renewable resources and compared to 1990 a 20% greenhouse gas emission reduction should be achieved in combination with a decrease in energy use of 20% (EC, 2013). To reach these targets member states have all set targets and implemented policies to stimulate the renewable energy production. According to the European Commission offshore wind should be one of the major contributors to reaching the 2020 targets (EC, 2008). Offshore wind has a large potential and according to the European Environment Agency offshore wind can technically meet European electricity demand seven times over in 2020 (EEA, 2009). Especially in West European countries offshore wind could be an important energy source in the renewable energy mix. To capture the large energy potential different European countries have set ambitious offshore wind targets. It is expected that in 2020 between 25-40 GW of offshore wind will be operational in Europe. This is a substantial increase relating to the 6.6 GW that was operational in December 2013 (NLII, 2014). To facilitate this growth an estimated 60 to 105 billion Euro therefore needs to be spent on offshore wind farms in the years 2013 to 2020. This implies that on average a yearly amount of 3.5 billion equity and 8.2 billion debt is needed (NII, 2014).

To participate in reaching the European 20-20-20 goals the Netherlands set its own targets which are stated in the Energy Agreement for Sustainable Growth (SER, 2013). The Dutch government is aiming to increase the renewable energy share to 14% in 2020 and to 16 % in 2023 (SER, 2013; Kamp H. , 2014). Compared to the other European countries the Netherlands set low renewable energy targets and despite these low targets, the Netherlands is still far from reaching those goals. In 2012 the Netherlands was in the top four of the twenty-eight European Union member states who had the worst renewable energy share of the countries' final energy consumptions (Eurostat newsrelease, 2014). To increase the renewable energy share the Dutch government is also partly focusing on offshore wind energy. The Energy Agreement for Sustainable Growth set two offshore wind targets: an extra 3450 MW of offshore wind should be operational in 2023, this is 7 times the current installed capacity, and this has to be achieved in combination with a total project cost reduction of 40% between 2014 and 2024[1]. To facilitate this growth an estimated €11 billion of market investments are needed (NLII, 2014). There are many uncertainties relating to the feasibility of the cost reductions and the willingness of capital suppliers to allocate money of this significant amount to offshore wind projects.

Traditionally large utilities use corporate finance to finance their offshore wind parks. The offshore wind parks will then be placed on their balance sheets. However changing external conditions stresses the ability for utilities to continue their offshore wind financing path because:

- Over the years the average size of offshore wind parks have increased heavily, which reflect to significant larger investments that need to be made. This leads to the fact that it becomes more desirable to include more stakeholders in the financing process
- Utilities have a limited and declining balance sheets. In 2008 the top 20 European utility companies were worth roughly twice as much as at the end of 2013 (The Economist, 2013). Due to the economic crisis and the falling wholesale prices the utility sector is under great pressure. This resulted that a vast amount of utilities were downgraded (CIEP, 2013;

[1] In the Green Deal the Dutch government together with 50 companies agreed upon a cost price reduction (cost price is yearly costs, including project costs, divided by yearly output) of offshore wind energy of 40% (in ten years from 2010 to 2020) (Dutch government & NWEA, 2011). This reduction is thought to be reached by a cost reduction of 27% and an output increase of 21% (NWEA, sd). In the Energy Agreement for Sustainable growth this cost reduction is postponed and this cost reduction needs to be achieved between 2014 and 2024 (SER, 2013).

Standard & Poor's, 2013), which again makes it more difficult for utilities to obtain financing. According to large survey conducted by Freshfields Bruckhaus Deringer (2014) over 60% of the utility and investor respondents believe that utilities are not capitalized enough to fund the equity investments in their offshore wind projects

- Utilities become more reluctant to bear the construction risks because this could further harm the credit rating.

The far-reaching offshore wind targets require substantial investments which, due to the limited balance sheets and changing market conditions cannot be made merely by power producers that are backed by corporate loans. This leads to the fact that the traditional players (banks which provided financing to utilities and utilities who owned the projects) start taking a different role in the financing process and new sources of capital are being attracted to facilitate the growing need for capital.

A potential new source of capital can be found by increasing the capital share of institutional investors (EWEA, 2013; NLII, 2014; SER, 2013; OECD, 2012; Freshfields Bruckhaus Deringer, 2014). According to EWEA there is a growing expectation that, complementary to traditional financers, institutional investors, with significant liquidity like insurance and pension funds[2], can play a more important role in the financing and refinancing process of offshore wind parks (EWEA, 2014). The current total equity share is still very limited and is estimated to be 6% (EWEA, 2013). But according to a survey performed by Freshfield Bruckhaus Deringer (2014), institutional investors are expected to be the second most active type of investor in offshore wind in 2015 (utilities are expected to be the most active investors).

According to the NLII institutional investors are capital intensive enough to fill the funding gap that could emerge due to the decreasing role of the traditional offshore wind financers (NLII, 2014). The problem however is that the specifications of offshore wind projects often still do not match with the investment requirements of the institutional investors. Furthermore institutional investors also have limited experience in financing offshore wind projects and they often do not have the expertise to assess the risks of the projects. This is hindering institutional investors to enter the market resulting that disregarding the availability of capital, currently relatively little institutional capital is allocated to finance or refinance offshore wind projects.

This research will identify indicators that hinder institutional investments to invest in the offshore wind sector, it will find mitigation strategies by looking at successful national and international projects and by reviewing the literature that has been written concerning mitigation strategies for offshore wind projects. Subsequently the mitigation strategies are tested and supplemented by stakeholder interviews. Finally the effects that the mitigation strategies will have on reaching the Dutch offshore wind targets are identified.

1.2. Current research and knowledge gap

The financing difficulty of renewable energy and offshore wind projects is a topic that has often been discussed in scientific literature. The most common research topics concerning increasing investments in offshore wind projects relate to: the risks (sometimes in relation with the portfolio theory (Markowitz, 1952), and with the capital asset pricing model (CAPM) (Black, Jensen, & Scholes, 1972)); costs (if different energy sources are compared, often the term levelized cost of energy[3] is used) and; stimulating governmental policies. Markowitz's portfolio theory has also been adapted to meet the specifications of wind portfolios. The Mean Variance Portfolio theory was created and this theory can be used to create optimal wind portfolios taking into account the intermittent characteristics of wind farms (Roques, Hiroux, & Saguan, 2010).

A relatively new area of research is to assess the underlying strategic choices for energy investments (Wüstenhagen & Menichetti, 2012). According to Agrawal (2012, p. 9) one of the key challenges in

[2] In this research if I refer to institutional investors I mean pension funds and insurance companies.
[3] For explanation of the levelized cost of energy see Figure 6 or section 4.1.2.

financing renewable energy is: “the perception of renewable energy projects as high-risk”. Even if the capital risks are declining or not higher than the maximum risks that investors want to take, the perception could still be negative leading to an unsatisfying amount of investments. Lowering the perceived risk is essential and it can also translate into lower financing costs because the investor will impose lower risk premiums (Wiser & Pickle, 1998). Financers are unable to obtain all the information that is needed to make completely rational decisions and in 1955 it was already believed that investment decisions are made by human beings who act under bounded rationality (Simon, 1955).

The school of behavioral finance argues that individuals are not fully rational when making investments decisions (Masini & Menichetti, 2012). The idea that investors act under bounded rationality and that behavioral factors may strongly affect the decision making process of actors has gained increasing recognition in different research disciplines, however it has seldom been applied to study investments in renewable energy technologies (Masini & Menichetti, 2012). Masini & Menichetti (2012) take the first steps in examining how cognitive elements and behavioral factors and attitude towards technological risk influence an actor’s willingness to invest in renewable energy projects. They show that this can provide a much more accurate description of the relationship between policies and investments and therefore to the design of better and more effective policy instruments. However this knowledge and this designed framework has never been specified for institutional investors investing in offshore wind projects.

Taking bounded rationality and behavioral factors into account implies that it is not enough to lower the absolute risks by introducing e.g. stimulating policies but it is also necessary to take into account how the perceived risks can be decreased. Bürer and Wüstenhagen (2009) state that disregarding the work of Masini & Menichetti (2012) empirical evidence that show how policies and the relating risks are perceived by renewable energy investors is still limited.

Next to scientific literature some research institutions published papers concerning financing difficulties for offshore wind. EWEA for instance conducted a survey amongst forty capital providers for offshore wind projects (EWEA, 2013). A lot of relevant information is stated in this report however a European wide survey was conducted amongst all different capital providers. Therefore this report is relevant for presenting a market overview, however to find the barriers for Dutch institutional investors a new survey (or in our case interviews) need to be conducted. A Dutch investment institute that focusses on increasing the share of institutional investors in offshore wind project, the NLII, also conducted workshops and interviews with offshore wind stakeholders (NLII, 2014). They present an overview of the offshore wind market and they identify some difficulties. However non-concrete and high-level risks are presented and no real barriers, that directly hinder institutional investors to enter the offshore wind market, are stated in the report. This report is more specified and this report is also from a more academic point of view. Therefore the reports mentioned are concerning the same topic but are furthermore not comparable with this research.

This research suggests that institutional investors, with significant liquidity like insurance and pension funds have the potential to play a more important role in the financing and refinancing process of offshore wind parks. However at this moment institutional investors are still reluctant to allocate their capital to offshore wind projects, this is due to the fact that currently still several investment barriers are present. It is yet to be found what these barriers (and requirements) of institutional investors are. Furthermore it is unknown what the importance of institutional investors are in relation to reaching the Dutch offshore wind targets.

Scientific literature only provides us with very generic information about how offshore wind investment decisions are made and what the underlying motives for the investment decisions are. The current literature shows how portfolios are important for investors, how the cost of capital can be calculated and how this for instance relate to the risks. Furthermore, recently researchers also show that investors act under bounded rationality and that therefore the perceived risks should also be taken into account (Wüstenhagen & Menichetti, 2012). However this knowledge cannot directly be generalized and applied to institutional investors who would like (or don’t want to) invest in offshore wind projects**.**

1.3. Scientific and social relevance

The scientific relevance of this research is twofold. An explorative study is performed and by doing so a comprehensive causal loop diagram is created showing the most important dynamics that have influence on whether institutional investors want or can invest in offshore wind projects. Such a model has not yet been constructed and this model can be used by researchers as a starting point for further research. The current literature about financing renewable energy projects is bundled and specified for specifically institutional investors in relation offshore wind investments. Therefore this research presents the first overview of the dynamics that are important for institutional investors to make offshore wind investment decisions. This increases the knowledge about these financing processes. This explorative study also provides us with empirical evidence of how different policies, or in our case different mitigation strategies, are perceived by institutional investors and how this would lead to an increase of investments. This research also adds value by zooming in on one stakeholder (institutional investors) to show how the amount of capital that they are willing to invest in offshore wind projects can be increased and what effect this could have on reaching the Dutch offshore wind targets. This has not yet done before.

Second there is currently little scientific theory about the decision making process of renewable energy investments, and there is no theory about the decision making process of institutional investors in relation to offshore wind investments. One of the most cited renewable investment theories is used and this research shows how this theory is used to create the causal loop diagram. This is done by first creating an interim model. After the causal loop diagram is created this research shows how the causal loop diagram subsequently will be transformed into a new more comprehensive and validated academic theory, specified for institutional investors investing in offshore wind projects. By creating this new theory this research contributes to the academic world that tries to find out how the financing problem of renewable energy projects (and inter alia offshore wind) can be solved.

The social relevance of this research is that a policy design is created that gives policy makers more insights in understanding the investment barriers of institutional investors, how these barriers can be removed and what effect this will have on reaching the offshore wind targets. To reach the 40% subsidy cut, large cost reductions need to be made for offshore wind projects to still be profitable. According to Fichtner & Prognos (2013) between 22-30% of the total offshore wind cost reduction potential between 2014 and 2024 can be attributed to reducing cost of capital. Because institutional investors are thought to have a low cost of capital (EWEA, 2013) it is important to find out how their investment share can be increased and if this would positively contribute to reaching the Dutch offshore wind targets. Furthermore an absolute increase of capital that will be available for offshore wind projects could increase the competition and also therefore drive down costs. It is therefore important to find out how this potential can be utilized.

1.4. Research objective

Looking at the information mentioned above the following research objective is derived:

Taking into account the limited scientific knowledge but the high potential role of institutional capital in offshore wind finance, it is necessary to assess how the role of institutional capital in offshore wind projects can be increased and what effect this would have on reaching the Dutch offshore wind targets.

1.5. Deliverables

This research will have two different kinds of deliverables; a practical and a theoretical one. The practical deliverable is a policy design for Dutch policy makers giving insights into *how* the role of institutional capital can be increased in the Dutch offshore wind sector and *what* effect this will have on the capacity growth. Currently it is unknown how the amount of institutional capital can be increased, if it is desirable and what the effect will be. Therefore policy makers can use this research to

assess if the estimated benefits are balanced against the actions that need to be taken to remove the investment barriers.

The theoretical deliverables will be a newly developed causal loop diagram and theoretical framework. The theoretical deliverables bundle the current knowledge, and newly obtained knowledge from the interviews, about the decision making process of renewable energy investments and it provides a comprehensive overview of the most important aspects that need to be taken into account when doing research about the reasons why institutional investors are able or unable to invest in offshore wind projects. Such an overview is not yet available and therefore it is scientifically relevant to construct this academic deliverable.

1.6. Demarcation

This research will not merely look at the Dutch situation. The offshore wind industry is a highly international sector. Next to governments and (sometimes) grid operators (TenneT is for example operational in the Netherlands and in Germany) the main players in the offshore wind industry are international players. This means that the capital needs will not be restrained by money merely available within national borders. In the Netherlands there are also only two offshore wind farms that are currently operational[4]. This means that when analyzing the Dutch market it will be too limited to only look at the Dutch stakeholders. Furthermore this research can learn from other countries by identifying the barriers and mitigation strategies that parties in other countries encountered and applying them to the Dutch situation. The level of analysis of this thesis therefore will be twofold. This research will focus on the Netherlands, but by doing so lessons learned from Western European countries will be taken into account.

1.7. Research questions

The previous information leads to the following main research question and sub questions:

Main research question

Taking into account a Northwest European context, how can the barriers for institutional investors to invest in Dutch offshore wind projects be mitigated and how would this contribute to reaching the Dutch offshore wind targets?

Sub questions

1. What are the specific financial, technical and regulatory characteristics for offshore wind and how does this relate to the current and expected future role of institutional capital?

2. What are the theoretical investment barriers for institutional investors in offshore wind and what are the variables that have influence on these barriers?

3. What are the theoretical mitigation strategies that can remove the investment barriers?

4. How do the identified theoretical barriers relate to the Dutch situation?

5. How do the mitigation strategies of offshore wind investments relate to the Dutch situation and how can we learn from experience from Northwest European countries?

[4] Two other wind farms, Gemini and Luchterduinen, are currently being built.

1.8. Research approach

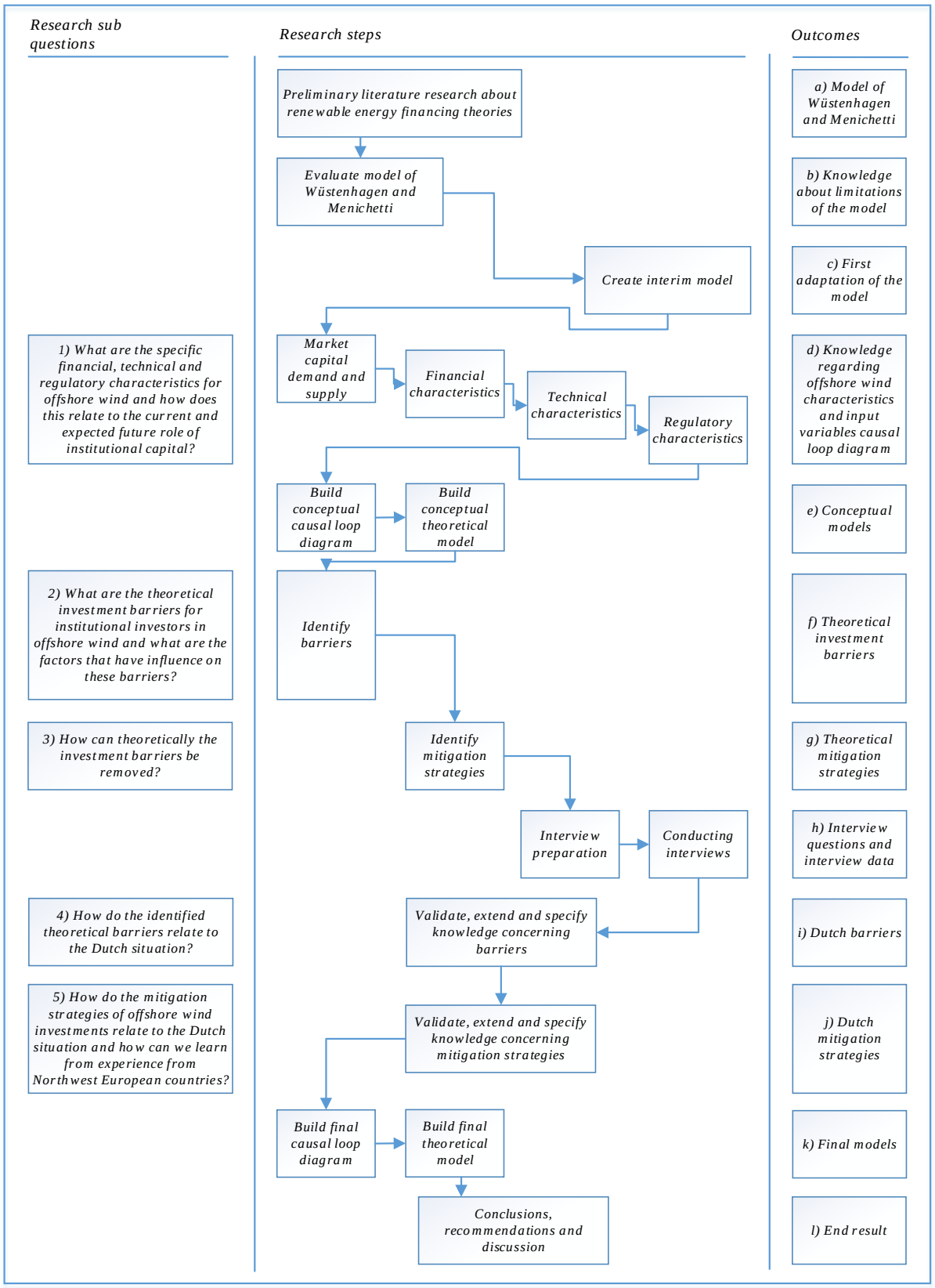

Figure 1 Research approach

Figure 1 shows the research approach that is used for this particular research. The research approach is as follows: First a preliminary research was conducted to find a theoretical model that could be used for this research. The most suitable model that was found was the model of Wüstenhagen and Menichetti (a). This model however needed to be adapted before it could be used for this research (b). The interim model was created (c). Subsequently this new model was used to find relevant data concerning the financial, technical and regulatory characteristics of offshore wind projects. This was general knowledge that was gained from an extensive literature review study and this was used to answer sub question one and to find the relevant variables for the causal loop diagram (d). Subsequently the conceptual causal loop diagram and the conceptual theoretical model was constructed (e). The causal loop diagram presented the theoretical barriers (f) and mitigation strategies (g) and sub question two and three could therefore be answered. The next step was that the interviews were prepared and conducted. This led to the data that was used to validate, extend and specify the knowledge that was gained by the literature review study (h). By doing interviews it was validated whether the barriers that specifically Dutch institutional investors have regarding specifically offshore wind investments coincide with the more general information that was found in the literature review study. The next step was that the interview data was used to identify how the theoretical investment barriers relate to the Dutch situation and this led to the answer of sub question four (i). The same was done regarding the mitigation strategies, this led to the answer of sub question five (j). Finally the causal loop diagram and theoretical model were adapted and finalized (k) and the conclusions, recommendations and discussion was documented (l).

The following table shows where the answers of the research questions can be found.

Table 1 An overview where the different answers of the research questions can be found

Research questions	Where the answer of the research question can be found
Sub question 1	Paragraph 4.4. in Table 7
Sub question 2	Paragraph 5.3. in Table 8
Sub question 3	Paragraph 5.3. in Table 9
Sub question 4	Paragraph 6.10. in Table 16
Sub question 5	Paragraph 6.10. in Table 17
Main research question	Paragraph 8.4.

2. Research method

This section will explain the research method that is created and used for this particular study. Several research steps are performed to restructure a theoretical model into a causal loop diagram and a consolidated theoretical model. First a theoretical model was modified into an interim model. Thereafter the interim model was complemented with data found in the literature review study and the conceptual causal loop diagram and the conceptual theoretical model were created. Subsequently these models were specified, validated and modified with interview data (an overview of the research steps is shown in Figure 2*).*

After the experts are interviewed a clear picture will be present that shows what the investment barriers and the preferred relating mitigation strategies are, and what effect this can have on reaching the offshore wind targets. This well-structured and comprehensive analysis leads to well-validated conclusions.

2.1. Qualitative research within a cross-sectional design

The research that will be performed will be a qualitative research within a cross-sectional design. A cross-sectional design means that the collection of data will come from more than one case, that the data will be collected at (fairly) a single point of time, which is then examined and related to certain variables to detect patterns (Bryman, 2008). The data will come from more than one case but also from more than one stakeholder type. The collected data will come from the following stakeholders: energy utilities, pension funds, insurance companies, an investment institute and the ministry of economic affairs. Bryman states that qualitative research has an “inductive view of the relationships between theory and research, whereby the former is generated out of the latter” (Bryman, 2008, p. 366). This will also be done during this study. A causal loop diagram and a theoretical model will be created out of the knowledge that is gained from the literature review study in combination with the information that is gained from the interviews. Merely qualitative data is used and the research questions are also answered qualitatively. The research methodology is shown in Figure 2. In the next sections these research steps will be explained.

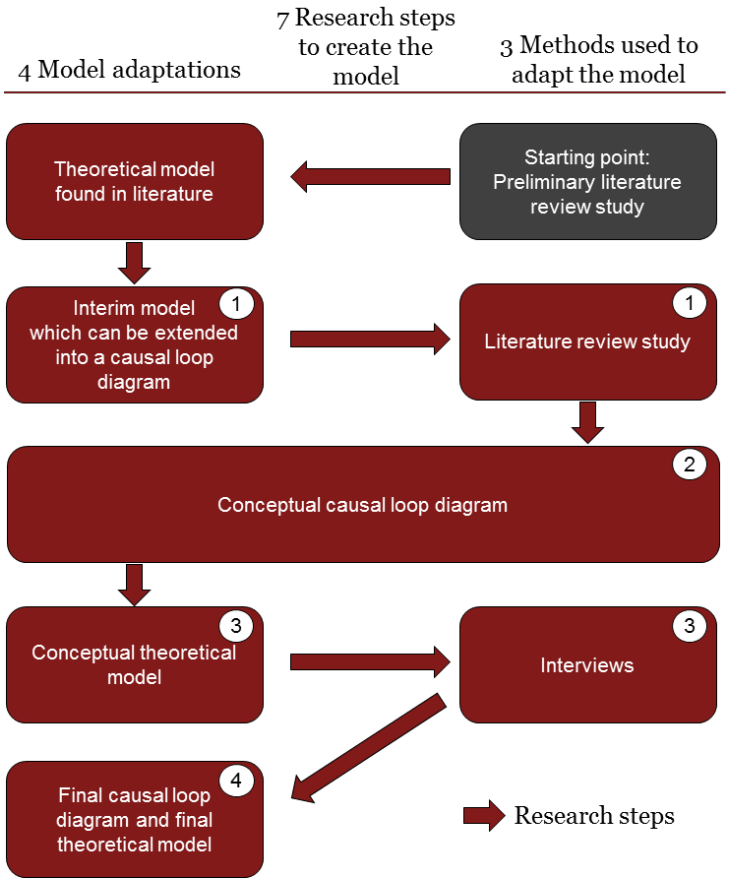

Figure 2 Research methodology[5]

2.2. The interim model

To successfully answer the research questions of this thesis a causal loop diagram will be created (for a further explanation regarding the reasons to create a causal loop diagram see section 2.4). To construct this diagram a theoretical model is needed, which could be supplemented with additional information. Because of the specific characteristics of causal loop diagrams it is ambitious to assume that the most useable and meaningful theoretical model that will be found for this research will be one on one compatible with a causal loop diagram and that it can directly be extended and turned into the model that will be construct in this research. Therefore first an interim model needs to be constructed that makes translation possible. The interim model will be an adjusted existing theoretical model which is presented in the form of a causal loop diagram. Using and extending an existing scientific model will improve the scientific knowledge base of our newly constructed causal loop diagram and subsequently theoretical model.

2.3. Literature review study

In order to identify the variables that will make up the causal loop diagram, the financial, technical and regulatory characteristics concerning offshore wind projects in relation to institutional investors will be identified. This will be done by an extensive literature review study. The data that will be found will be used to answer the first sub question and to identify the variables that would eventually make up the causal loop diagram. Indicators that have influence on whether institutional investors could

[5] The step "causal loop diagram" can be seen as a model modification but also as a method. Therefore this is two times included into Figure 2. This also results into the fact that 9 arrows are presented in the representation while there are only 7 research steps. The arrows that are of a different color are not research steps.

invest in offshore wind projects will be documented and they will be used to create the causal loop diagram.

The information of the literature review study will not be limited to merely Dutch information. International (mainly Western European) information will also be used to create a comprehensive picture about the financial, technical and regulatory characteristics and to create the causal loop diagram. The same accounts for our target group. The information used in the literature review study might sometimes be more general information that is not specified to institutional investors. The specification of merely looking at the Netherlands and at institutional investors will subsequently be done in the interview step (see section 2.6).

The online databases Google, Google scholar, Scopus and the Web of Science will be used for the literature research, different combinations of key words will be used. The key word “offshore wind” will be subsequently complemented with either; “finance”, “financing”, “investing”, “investments”, “capital”, “pension funds”, insurance companies” or “institutional investors”. The criterion for eventually selecting the articles will be the perceived relevance of the topic based on the information stated in the abstracts or summaries. The information needs to directly or indirectly link to the variables of the interim model that will be created in chapter 3 (see Figure 4).

It is believed that this initial search will result in a sufficient amount of data to get a good idea about the knowledge that is available online. The reference lists of the articles that were read for this research will also be used to find additional information. To get a complete picture of the topic which is studied, scientific reports will be used in combination with market and governmental reports. The literature study is an explorative research approach aiming to come up with the variables that are needed to create the causal loop diagram and to answer sub question one, two and three.

2.4. The conceptual and final causal loop diagram

The model that is will be used for this research needs to be able to capture the complexity of the situation under study. We live in a complex and highly interconnected society. Public problems are often complex and therefore they cannot be linearly solved. This makes it difficult for policy makers to draft policy because no policy can guarantee an intended result. Difficult tradeoffs need to be made, not seldom between assumed effectiveness and costs (Patton, Sawicki, & Clark, 2012). Next to the difficulty of many public problems there is also a high variety of different problems. This makes it hard to design one research method that can be used for dealing with all of them. This implies that when doing research on how policies could influence public problems, customized research designs should be created. Complex socio-technical problems are known to be non-linear. A causal loop diagram is a method that is used in system dynamics, which is a discipline that attempts to address these complex, dynamic and long-term policy problems (Barlas, 2007).

There are multiple reasons for using a causal loop diagram. First, a causal loop diagram can help to organize, clarify and unify knowledge. It is a sufficient model to provide insights in what the root cause of the investment problems are and how future stimulation policies can influence, and current policies do influence the investment preferences of institutional investors. The model can give people a more effective view of a system that was puzzling before (Forrester, 1986). From a policy perspective a causal loop diagram is therefore a valid and highly suitable method to find out how the level of institutional investors in offshore wind investments can be increased. Second, there is a practical reason to create a causal loop diagram. The causal loop diagram is a sufficient way to set the boundaries of the research, the so-called problem domain. Variables will only be included into the analysis if they can directly or indirectly be linked to the variables stated in the interim model. Therefore this method can help the research team to focus and to prevent that they get lost in the seemingly unlimited source of information that can be found on the Internet. Third, no theory yet exists about institutional investors investing in offshore wind projects. The causal loop diagram can help to systematically analyze data and therefore to make a first start on drafting such a theory. This is done by consolidating the information from the causal loop diagram into a theoretical model.

Kim (1992, p. 5) states: “creating causal loop diagrams is not an end unto itself, but part of a process of articulating and communicating deeper insights about complex issues”. This is also how the causal loop diagram is used in this research. It is used as a method to perform the explorative study by providing a sufficient way to present the data and to subsequently draft policy, create theory and contribute to the knowledge that is already available regarding offshore wind financing.

The information that will be gathered from the literature review study (in chapter 4) will first be structured and captured into an elaborated Excel file. In the Excel file all the different relations between the variables will be summarized. The sources that indicate the relations between the variables will be added to the Excel file for external verification. Subsequently this long list will be reviewed by the research team and the variables that will not directly or indirectly be relevant for answering the research questions or for constructing the models will be deleted. In the next step all the variables and relations will be mapped in Vensim, which is a simulation software that is also very applicable for making a graphical overview of a causal loop diagram. This will lead to a conceptual causal loop diagram. In the end two causal loop diagrams will be constructed. The conceptual causal loop diagram will be created with the (sometimes still fairly general) information gathered from the literature review study and a final causal loop diagram will be created after the conceptual model is validated and adapted with information gathered from the interviews. The final causal loop diagram will be a validated model that is specified for institutional investors in relation to offshore wind investments.

2.5. The conceptual and final theoretical model

After the variables that were found in the literature review study are incorporated into the conceptual causal loop diagram, the model will be adapted again and consolidated, by taking the core of the causal loop diagram and by clustering the variables, into a more clarifying, well-ordered conceptual theoretical model. This conceptual theoretical model will contain no substantial differences regarding the causal loop diagram, it will merely be a more readable representation. The most important variables of the causal loop diagram will be placed in the conceptual theoretical model (what the most important variables are, and how they are selected is explained in chapter 5.2.). This conceptual theoretical model will be the concept version of the substantive theory that will be created in the conclusion.

The causal loop diagram that will be constructed will be an extensive and detailed model. Therefore this model is not directly suitable to function as a scientific theory. To create a scientific theory the variables of the causal loop diagram need to be clustered. First a conceptual theoretical model will be constructed so it could thereafter be validated and specified by the interviews before the final theoretical model will be created and presented in the conclusion of this research.

Another reason why the conceptual theoretical model is constructed is that it is difficult to validate the entire causal loop diagram due to its level of detail. Due to time restrictions it will not be able to ask the interviewees to validate every variable and link that will be presented in the causal loop diagram. Therefore first a conceptual theoretical model needs to be constructed which contains the most important parts of the causal loop diagram. These most important parts will be validated by the interviews. The conceptual theoretical model therefore will be used to construct the right interview questions.

2.6. The interviews

After the conceptual causal loop diagram and theoretical model are created, they will be validated and possibly modified and supplemented with information gathered from interviews.

2.6.1. Justification of the interviews

There are two reasons why interviews will be conducted. First, the validity of the models will be tested and it will be tested whether the models are also valid when specifically looking at Dutch institutional

investors in relation to offshore wind projects. If errors are found, the models will be adapted. This validity check is needed because the research topic of choice is very specified. This research is focusing on a specific target group (institutional investors), a specific renewable energy technology (offshore wind) and at a specific country (the Netherlands). It is expected that most of the scientific knowledge that is available will describe the risks, difficulties and barriers that investors experience regarding investing in renewable energy, and perhaps to a more limited extent offshore wind, projects. However it is likely that in most scientific sources the investors are seen as one target group and the investments relate to renewable energy projects which are not always specified to offshore wind and to the Netherlands. Therefore it is decided to first use more generic information to get an idea what the barriers and mitigation strategies are and that subsequently this information will be tested by conducting interviews with specifically Dutch institutional investors and Dutch utilities.

Second, interviews are needed to qualitatively assess the importance and the role of institutional investors in the financing process and the development of offshore wind parks in the Netherlands. Without interviews it would be very difficult to answer this part of the main research question.

2.6.2. Interview protocol

In this research semi-structured interviews, that are specified per target group, will be. The advantage of semi-structured interviews is that the topics and questions of the interviews can be made very clear in advance but during the interview there will still be ample room for discussions and to ask further follow-up questions. Therefore it will be possible to link the interview questions to the conceptual models that will be created. The interviews will all be planned at least two months in advance. This will lead to the possibility to schedule all the interviews in a few successive weeks and this will leave room for the possibility to rescheduling appointments when unexpected events occur. Before the interviews will be conducted the interview questions will be sent to the interviewees. This will give the interviewees the possibility to prepare for the interviews what increases the chance that valuable information will be obtained from the interview questions. All the interviews will be recorded. Furthermore after the interviews an interview report will be created and sent back to the interviewees for feedback. By taping the interviews and by sending back an interview report the chance will be minimized that information will be misinterpreted.

2.6.3. Analyzing the interviews

The interviews will be analyzed on a national and interest group level. After the interviews are conducted, first the answers of the institutional investors will be mutually compared and the answers of the utilities will be mutually compared. Second, an overview of the answers per interview question will be presented. This will give the research team an indication of the consistency of the answers per interest group and this will be an indication if there is a possibility that the answers can (partly) be generalized. The answers of the questions will be anonymized and the presentation of the data will be on a company level (categorized per target group, e.g. two utilities mention A or three institutional investors mention B). After the different answers are mapped they will be compared with the conceptual causal loop diagram and theoretical model that are created after the literature review study. The conceptual causal loop diagram and theoretical model will be validated and modified with the newly found information.

2.7. Validity of the method

The validity of a research project relates to: “the integrity of the conclusions that are generated from a piece of research” (Bryman, 2008, p. 32). By combining thorough desk research with interviewing the relevant stakeholders a method is created that could lead to well-substantiated and validated conclusions.

2.7.1. Validating the research sample

For this research the most important Dutch institutional investors[6] will be interviewed. For this research it is only needed to receive information from institutional investors that actually allocate the capital towards projects, so the parties that have the asset management departments. Fortunately most of the assets of pension funds and insurance companies are managed by a few institutional investors. This significantly decreases the amount of institutional investors that are interesting to interview for this research. Because of the limited amount of relevant institutional investors that could be interviewed, it is expected that it will be possible, within the timeframe of this research, to interview the relevant institutional investors. This will increase the validity of this research.

Next to the institutional investors a representative of the Dutch investment institute (the NLII) and a representative of the Dutch ministry of Economic Affairs will be interviewed. The Dutch investment institute is an institute which is owned by the most important institutional investors. One of their goals is to increase the amount of institutional capital in offshore wind projects. Because one of their goals coincide with the goals of this research it is believed that it could be relevant to interview this party. The Ministry of Economic Affairs is largely responsible for the Dutch offshore wind subsidy regime, or in general the Dutch offshore wind regulatory regime, and therefore they are also an interesting party to talk to during this study.

From the demand side it is interesting to find out what the actual need of project developers is to include institutional investors into the financing process and furthermore what the role of project developers is regarding the perceived barriers and mitigation strategies of institutional investors. Therefore also the project developers that are most likely to take part of the first offshore wind tender round at the end of 2015 will be interviewed as well.

In total fifteen interviews will be schedules and conducted. On top of the 15 interviews, project finance departments of banks and Solvency II experts might be consulted when needed to get an even more complete picture of the financing process of offshore wind parks. It is expected that the number of interviews that are conducted with the different type of experts is sufficient to get enough insights for the purpose of this study.

2.7.1. The external validity

The external validity relates to the fact that the conclusions can be generalized. Despite the different regulatory settings in foreign countries and despite the focus of this research on the Netherlands, it is believed that the external validity is reasonably large and that therefore foreign policy makers can use this research to see how they can stimulate institutional investors to invest in offshore wind projects. Due to the international characteristics of this market it is believed that many of the variables that will have effect on whether institutional investors can invest or not are of a cross-national level. Therefore it is believed that the external validity is sufficiently high.

[6] Pension funds and insurance companies.

3. The interim model

In this chapter the interim model will be created. The model of Wüstenhagen and Menichetti was found to be the most suitable model for this research however this model was fairly limited and the model was not one on one compatible with the causal loop diagram will be to created. Therefore this model first needed to be transformed into an interim model that subsequently could be extended into the causal loop diagram. This chapter will present the theoretical background of the original model, the information used to create our own interim model, and the interim model itself. The interim model is subsequently used as a guidance for chapter 4 to find the variables that would together make up the causal loop diagram.

3.1. Theoretical background of the model

At the beginning of this research a preliminary literature review was performed with the means to find relevant scientific information and theories that could be used for this explorative study. After the search it was concluded that no theory exists that could directly be used for the purpose of this study. The most useable model that was found, was the model of Wüstenhagen and Menichetti (2012) (see Figure 3) and therefore this model was used as a starting point to create the causal loop diagram.

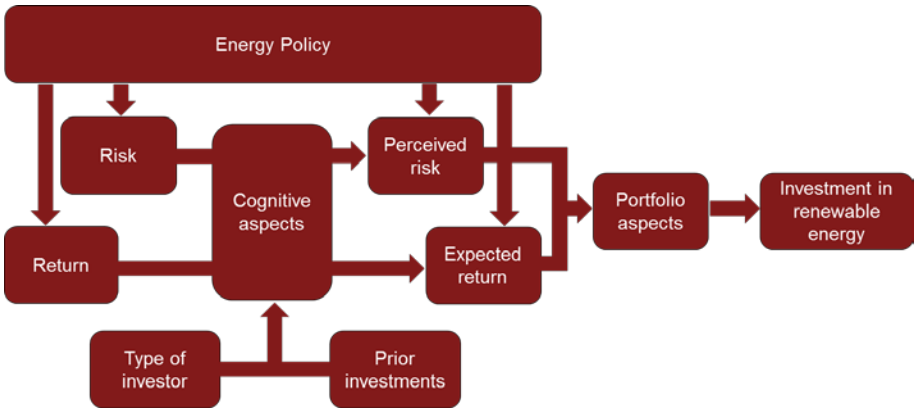

Figure 3 A differentiated model of renewable energy policy and investment (Wüstenhagen & Menichetti, 2012)

The model that in Figure 3 is a relevant model for our research because it shows the dynamic factors of risk and return on renewable energy investments and the basic variables that are important for renewable energy investments are included in this model. Furthermore, Wüstenhagen and Menichetti are amongst the most cited scientists concerning renewable energy financing[7], which can be seen as a validation of their work. A relative new aspect of the model of Wüstenhagen and Menichetti is that instead of "risk" and "return" the new terminology "perceived risk" and "perceived return" is used. This is done because it is expected that investors act under bounded rationality and therefore also non-tangible cognitive factors are expected to have influence on the investment level of investors. For example Wüstenhagen et al. state that an important factor for future energy policies will be regarding managing social acceptance of renewable energy innovation (Wüstenhagen, Wolsink, & Bürer, 2007). This is distinct from the conventional idea of risk and return but it should be taken into account. The model of Wüstenhagen and Menichetti (2012) can therefore, with some modifications, nicely be used as a starting point to create a more specified and comprehensive model regarding institutional investors investing in offshore wind projects. As mentioned before, however first an interim model needed to be created.

[7] In this relative small field of scientific research the article where Wüstenhagen and Menichetti have created their model was cited 77 times. This shows that other researchers validated the work of Wüstenhagen and Menichetti or at least used the article for their own research.

3.2. Reasons for creating the interim model

There are multiple reasons why this interim model needed to be created.

First the model was not one on one compatible with the causal loop diagram that would be created. Therefore first this existing model needed to be modified before it could be properly used as a starting point for creating the causal loop diagram. To do so information concerning causal loop diagrams was studies to find out how the model should be adapted to create the interim model. The information of Barlas (2007), Forrester (1986) and Kim (1992) was used to get a complete picture about causal loop diagrams. Especially Jay Forrester, a former professor of MIT and the founder of system dynamics (causal loop diagrams are part of a wider research area namely system dynamics), is an authority in this research field and by combining his view with information from Barlas (2007) and Kim (1992) a complete picture of the functioning of causal loop diagrams was created.

Second, the model of Wüstenhagen and Menichetti had a low level of specificity and it was too broad and general for our research. During the preliminary research documents were find that could be used to refine this model. One of the documents that was used to refine the original model was the research paper "Recommendations offshore wind" of the Dutch investment institute (NLII, 2014). This research paper was the only research paper that was found that was specifically about the role of Dutch institutional investors in Dutch offshore wind parks. The preliminary research made us realize that the model should also be more refined because this would lead to a more complete interim model that could more easily be used in the literature review study to find the indicators that would make up the causal loop diagram.

3.3. Modifying the model into the interim model

A causal loop diagram has the characteristic that if one variable increases the variable it is linked to should subsequently increase or decrease. These "rules" do not apply to the conventional model (see Figure 3, for an extensive explanation about causal loop diagrams see paragraph 5.1). In this paragraph the modifications of the original model are explained and the interim model is presented.

The first modification of the model concerned the variable "Portfolio aspects". It is impossible to say that if the variable "Perceived risk" increases, this will have a negative or positive effect on the variable "Portfolio aspects". In the conventional model the variables "Perceived risk" and "Expected return" together make up the variable "Portfolio aspects", but it is not a causal relation. Therefore the name of this variable was changed. In a causal loop diagrams the variables should be able to "increase" and therefore the name of the variable "Portfolio aspects" was changed into the "Project diversification". Next to the fact that the name of the variable was changed, the variable was also placed on a different location in the figure. Portfolio aspects are expected to be important for investors but when creating a causal loop diagram the variable should have effect on the perceived risk of the investor (instead of on vice versa). The exact risk of a project can only be assessed in relation to the other assets in the company's portfolio. This was already notified by Markowitz in 1952 (Markowitz, 1952). If the company that is willing to invest in an offshore wind project has a more diversified portfolio, the risks of a single offshore wind project decreases. Therefore in the interim model it is shown that if the level of project diversification increases, this would lead to a decrease of the variable "Perceived risks".

The second adaptation that was made, was that a new variable was included into the interim model. During the preliminary literature review it was found that the bankability of offshore wind projects is an important aspect on whether institutional investors are willing, or able, to invest in offshore wind projects. Therefore the variable "Bankability", and the variables that have direct influence on bankability, were included into the model. According to the European Investment Bank (EIB) the bankability of a project means "whether lenders are willing to finance a project" (EIB, n.d.). According to the NLII (2014) the bankability relies on three aspects:

- The capital costs
- The height of the subsidy

- Cost of capital (NLII, 2014).

These three variables, together with the variable "Bankability" were subsequently included into the interim model. It was believed that the height of the subsidy was indirectly already represented in the model of Wüstenhagen and Menichetti by the variable "Energy policy" and the variable "Expected return". Therefore this variable did not need to be included into the interim model. The information concerning the bankability was combined with information that was provided by Wüstenhagen and Menichetti. Wüstenhagen and Menichetti suggest that whether investors can invest in renewable energy projects relies on whether the relationship between the variables "Perceived risk" and "Expected return" is sufficient. However the NLII documented that investors can invest in offshore wind projects if the projects are bankable. These two ideas were combined by linking the variables "Perceived risk" and "Expected return" to the variable "Bankability". Subsequently the variable "Bankability" was linked to the final variable "Level of institutional capital in offshore wind"[8].

Third, the variable "Cognitive aspects" was removed. This variable was thought to be too broad and vague and in the causal loop diagram this variable therefore needed to be more specified. Therefore this variables was not included in the interim model. In the causal loop diagram this factor would be represented by new variables that will be found in the literature review study and that will be linking to either the variable "Perceived risk" or the variable "Expected return".

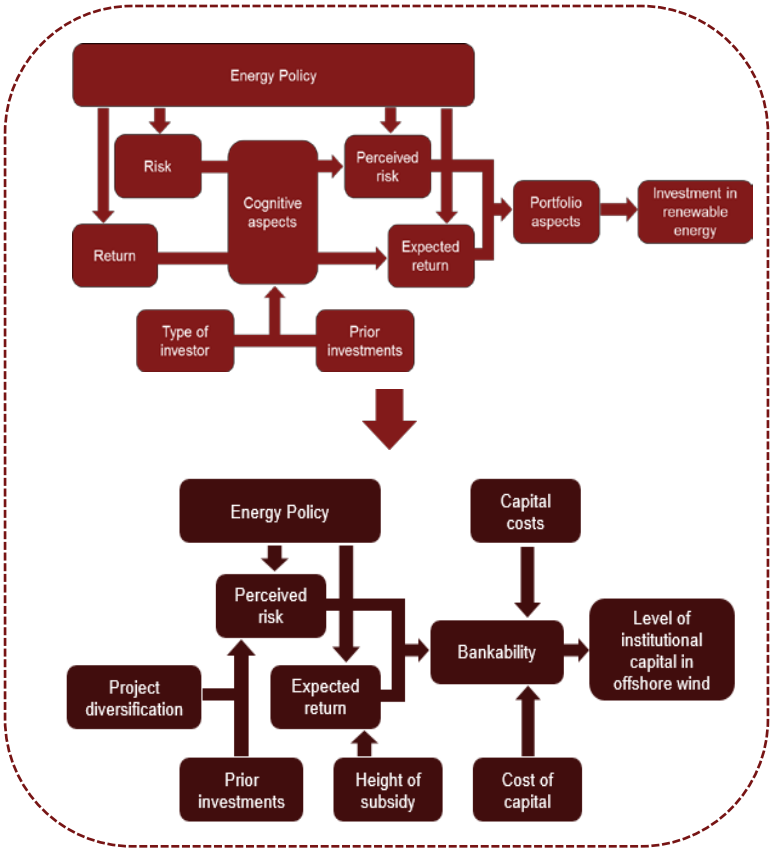

Figure 4 Modifications to the model of Wüstenhagen and Menichetti (2012) into the interim model so it can be used to create the causal loop diagram

Forth the variable "Prior investments" was linked to the variable "Perceived risk". In the original model this variable was linked to the variable "Cognitive aspects" and therefore indirectly to the variables "Perceived risk" and "Expected return". In this research variables were only linked to the variables "Perceived risk" or "Expected return" if there was a direct link. E.g. the variable "Height of the subsidy" has a direct effect on the variable "Expected return" but it has an indirect effect on the variable "Perceived risk" (because you could argue that if the subsidy is not large enough there is a chance that investors do not recover their investments). In this research this variable was however only linked to the variable "Expected return". The same accounts for the variable "Prior investments". If a company has prior experience in investing in offshore wind projects, they have already built up experience and therefore they better understand the risks and they better know what they should and should not do. This experience directly results into a lower perceived risk.

[8] In the original model the final variable was called "Investment in renewable energy" but to optimally meet the purpose of this research this was changed that into "level of institutional capital in offshore wind".

The final modification was that the variable “Type of investor” was removed from the model because this research only focusses on institutional investors.

The changes to the model of Wüstenhagen and Menichetti are shown in Figure 4. The newly created model is suitable to be extended with newly found variables so it could be changed into the causal loop diagram.

The modifications to the model of Wüstenhagen and Menichetti leads to interim model. The next chapter will provide the information needed to find the different variables that could extend this interim model resulting in the causal loop diagram. Furthermore the next chapter presents the most important financial, technical and regulatory characteristics, this will lead to the answer of sub question one.

4. Literature review study

In this chapter the literature review study will be performed and sub question 1 will be answered. The information that is gained in this chapter will subsequently be used to construct the causal loop diagram in chapter 5.
Energy investors are willing to invest in a project when they assume that the investment will generate a profit within the time frame that is agreed upon. The investors must have large enough confidence that their investment will be paid back in the form of profits or principle payments and rent before they will enter the market. The offshore wind market is however not fully developed yet, leading to relative higher investment risks and uncertainties than the mature conventional energy generating market. To get a complete picture of offshore wind the most important characteristics of offshore wind will therefore be identified in this chapter.
First the financial characteristics are presented showing the actual need for capital in the Netherlands. Subsequently the cost of offshore wind projects relating to substitute energy generating technologies, the financing parties and the financing models that are used and the role that institutional investors can play in meeting the financing need is discussed. Second the technical characteristics of offshore wind projects are discussed showing the characteristics of offshore wind that differentiate the technology from other generating technologies. Third the Dutch institutional setting for offshore wind is discussed. European and Dutch information is used to write this chapter. This chapter shows that offshore wind is in many ways different and incomparable with other energy generating technologies.

4.1. Financial characteristics

4.1.1. Overview of market capital demand

According to the Energy Agreement for Sustainable Growth an extra amount of 3,450 MW needs to be installed in the Netherlands between 2013 and 2023[9] (SER, 2013). This means that an estimated amount of around €11 billion of market investments is needed to be invested in offshore wind projects between the years 2013 and 2023 (NLII, 2014). This corresponds to an equity need of €3.3-11 billion and a debt need of €0-7.7 billion[10]. Only in the case of project finance external debt is needed. So the level of equity and debt demand relies on the funding structure used for financing the offshore wind projects.

The total capital that is needed for offshore wind projects also relies on the refinancing need and the amount of capital that will be divested.

The NII estimates that refinancing offshore wind loans lead to an extra capital demand of €8 billion between 2019 and 2025 (see Figure 5). This means that for installing an extra 3,500 MW of offshore wind energy there needs to be €19 billion of capital available (within the years of the Energy Agreement for Sustainable growth (2013-2023) there is a capital demand of €17.9 billion). This is exclusive the divestments. By divesting the equity owner sells off a part of the project to a different investor. Divestment of shares is a method to include other equity providers who are not willing or able to enter the project from the start. Unfortunately there is no data available which estimates the amount that is needed to meet the Dutch offshore wind divestment need. Whether developers have a refinancing need or a divestment need relies on the way the project is financed and structured. If the project is financed with balance sheet finance (e.g. corporate finance) than the developer could have a

[9] According to Kamp & Schultz van Haegen (2014), instead of 3,450 MW an extra 3,500 MW will be tendered.
[10] In the case of project finance the equity debt ratio that was estimated by the EWEA was used. This is 30%/70% between the years 2013 and 2023 (EWEA, 2013).

divestment need. If the project is financed with project finance than there might be institutions who want their loans to be refinanced after a few years. Because it is currently still unknown if project developers will use project finance or balance sheet finance, it is also impossible to state if there will be a refinancing or divestment need[11]. Figure 5 therefore merely presents the investment and refinancing need of Dutch offshore wind projects.

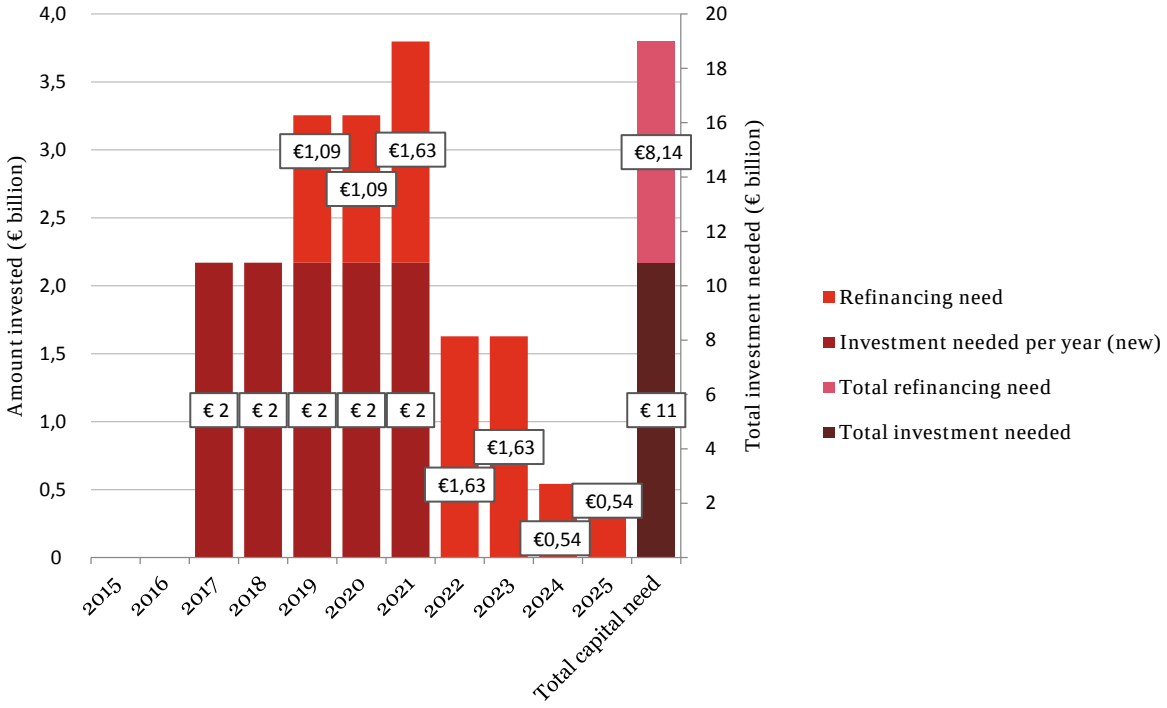

Figure 5 Investment and refinancing need for offshore wind projects in the Netherlands, adopted from NLII (2014) and Kamp & Schultz van Haegen (2014)[12]

4.1.2. Costs of offshore wind parks

High levelized cost of energy

As shown above a significant amount of capital needs to be invested in Dutch offshore wind projects. This is due to the ambitious governmental targets but also because offshore wind parks are amongst the most expensive energy generation technologies that are currently being used. The cost of different generating technologies can be compared by identifying the levelized cost of energy (LCOE). The LCOE is the price that a project must earn per production unit (e.g. MWh) through the total lifecycle to break even (World Energy Council & Bloomberg New Energy Finance, 2013). The method standardizes costs by dividing the discounted total lifecycle costs by the discounted total electricity

11 In the interviews some utilities stated that they have a preference for project finance or balance sheet finance, however this decision has a strategic aspect and therefore the utilities were not willing, or not able, to tell if they were focusing on using corporate finance or project finance when they will develop their next offshore wind project. Therefore it is unknown how the Dutch offshore wind projects will be financed.

12 It is assumed that from 2015-2019, 700 MW is tendered per year. The investments will be made simultaneously 2 years after the tender and the wind turbines are expected to be operational 4 years after granting the tenders. The investment costs will be €3.1/MW (see footnote 13). For the refinancing need the assumptions of the NLII (2014) was used. They assume that 50% of the initial investment costs will be refinanced near the time that the park becomes operational, which should be four years after the tender. Furthermore 25% of the initial investment is refinanced 2 years after being operational (NII, 2014). This figure is qualitative and it is merely an estimation. The refinancing need is highly related with the way the construction is financed. Furthermore the divestment need is not included into this figure.

produced and therefore it is a valuable method to project the cost differences of different generation technologies. Figure 6 shows the LCOE of different newly built generation plants in Germany in 2013, calculated by the Fraunhofer institute. As the figure shows, offshore wind belongs to the most expensive generation technologies. The LCOE of offshore wind is approximately twice as high as the LCOE of onshore wind. However many negative externalities of onshore wind farms like noise, visual pollution, a shortage of space and local opposition are not or to a lesser extent present with offshore wind farms.
The LCOE is a valid instrument to see the cost differences between generation technologies. However LCOE calculations are shown to be different when calculated by different scientists or institutions. The fact that the current LCOE of offshore wind cannot be exactly stated and that it is impossible to estimate the future LCOE developments, makes it difficult to calculate or project the capital that is needed to reach the Dutch offshore wind targets (for a calculation of different LCOE see Appendix C).

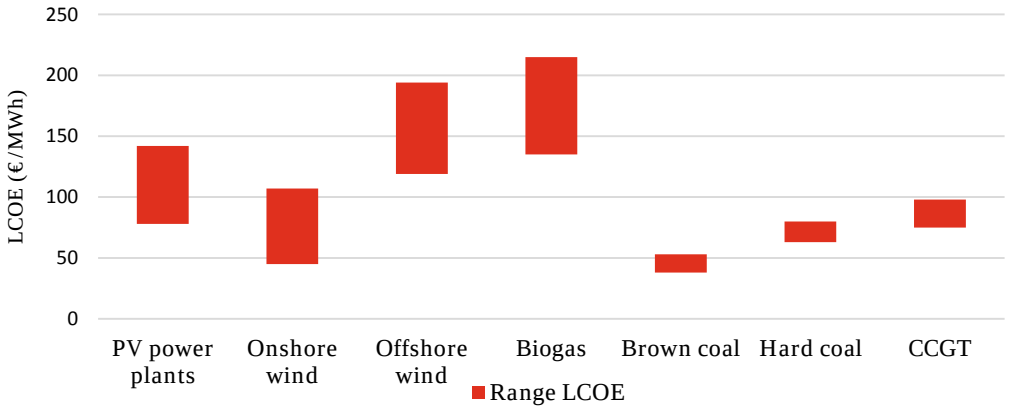

Figure 6 LCOE for different electricity generation technologies, adapted from Fraunhofer ISE (2013)[13]

High and increasing project cost

Over the years the average project size of offshore wind parks increased significantly (see Table *2*). This implies that next to a high LCOE of offshore wind parks, offshore wind parks are usually also of a large size what means that offshore wind parks usually need significant larger investments, on an absolute level, than other renewable energy projects. In 2013 the average project costs of offshore wind parks in Europe were €1.7 billion.

Table 2 Evolution of the average size and project costs of European offshore wind farms, adapted from EWEA key trends and statistics (2009-2014)

Year	2009	2010	2011	2012	2013	2015-2020
Average wind farm size MW	72.1	155.3	200	272	485	700[14]
€ million/MW (investment)	2.60	2.94	2.77	3.42[15]	3.51[12]	3.10[16]

[13] In this figure biogas has the highest LCOE. In this figure however, the heat offtake and therefore the heat credit is not taken into account. If that would be taken into account the LCOE of biogas would slightly drop. But nevertheless biogas installations have high capital costs and fuel (substrate) costs can vary a lot and are high, leading to a high LCOE.
[14] This is based on the parcel decision of the Energy Agreement for Sustainable growth (SER, 2013). Contrary to the other values in this table, this value is based on the Dutch situation.
[15] The total value of the capacity built was presented in a range. The median value of the range was taken to calculate cost per MW.
[16] This value is calculated by EWEA (2013). It is the average between the estimated costs of €2.6-3.6 million/MW between the years 2013-2020. No additional data was found that could be used to calculate the estimated costs between 2015 and 2020. Therefore the estimation of EWEA was used.

Average cost offshore wind farm (€ million)	€187	€457	€554	€931	€1,702	€2,170

Table 2 shows that next to a yearly increase in project size, the average cost per MW also increased heavily between 2009 and 2013. The costs increased due to multiple circumstances:

- Windfarms were being built further away from the coast and in deeper water (SER, 2013)
- The price of raw materials increased
- Turbine manufacturers focused on onshore, which made offshore turbines more expensive and
- Some windfarms experienced technical issues due to the fierce offshore wind environmental conditions (Gernaat, 2014).

Disregarding an expected learning curve the costs of offshore wind in Europe has actually increased with 35% between 2009 and 2013. This trend of increasing costs should be inverted in 2014 to reach a cost reduction of 40% between 2014 and 2024.

4.1.3. Cost of capital

As shown in the previous chapter offshore wind projects are expensive. This is however also due to a high weighted average cost of capital (WACC).

The Weighted Average Cost of Capital

The capital intensity of renewable energy projects – with high upfront investments costs and relative low operational costs – result in renewable energy investments being especially sensitive to financing costs (Waissbein, Glemarec, Bayraktar, & Schmidt, 2013). This means that the cost of capital in offshore wind projects strongly reflects the levelized cost of energy (Prognos AG & The Fichtner Group, 2013). The Crown Estate and the IEA state that one percentage drop of the WACC is equivalent to a reduction in LCOE of around 6% (The Crown Estate, 2012; IEA, 2013). The WACC can be calculated by taking into account the share of equity and debt and multiply that with the required rate of return of the equity and debt.

WACC = Share of equity * Cost of equity + Share of debt * Cost of debt

When projects are being financed with project finance, banks demand a certain debt ratio[17] to make sure enough equity is present so that the owners have a financial obligation and incentive to develop the project according to plan. The cost of debt is usually lower than the cost of equity. Therefore the debt ratio of projects is important for the WACC and therefore also for the LCOE of offshore wind project. According to Prognos AG & The Fitchner Group (2013) lenders demand a debt ratio of approximately 65% or lower, however EWEA (2013) states that a typical debt to equity ration of offshore wind projects is currently 75%:25%.

Figure 7 shows the estimated required return on investments of different equity providers for offshore wind projects. Compared to other equity providers institutional investors have a relatively low required return of investment and therefore for the total project costs it could be beneficial to increase their investment share in offshore wind projects.

The cost of debt is largerly determined by to the perceived ability of the borrower to repay the debt, this therefore strongly related to the risks. To calculate the risk premia, capital providers need to be able to make an estimation about the risks relating to the project (NLII, 2014). According to Freshfields Bruckhaus Deringer (2014) the current cost of debt for offshore wind projects lie between 250 and 350 bps[18] above LIBOR[19]. Refinancing deals have an average cost of between 200-300 bps

[17] This describes the proportion of debt relating to the amount of equity defined as (debt/(debt + equity). The debt ratio is also sometimes called the gearing. However, the term gearing has multiple meanings. In this thesis the term debt ratio is used.

[18] Bps means basis points which is 0.01 %. In the example 250 bps therefore means 2.5%.

[19] On 28 January 2015 the 6-month LIBOR rate was 0.36. This would mean that the average debt cost for offshore wind projects (in the case when the bank used the 6-month LIBOR rate) would have been

above LIBOR. Partly due to the low LIBOR rates, the debt financing costs for offshore wind projects are currently very low. This leads to the fact that institutional investors who want to invest in debt might not be able to compete with the rates that are offered by banks or this could lead to the fact that the risk return relation of offshore wind debt cannot compete anymore with the risk return relation of substitute debt products. A low interest rate might therefore have the result that institutional investors, who want to invest in debt, are unable to provide capital for offshore wind projects or that they might look for possibilities to provide equity instead of debt.

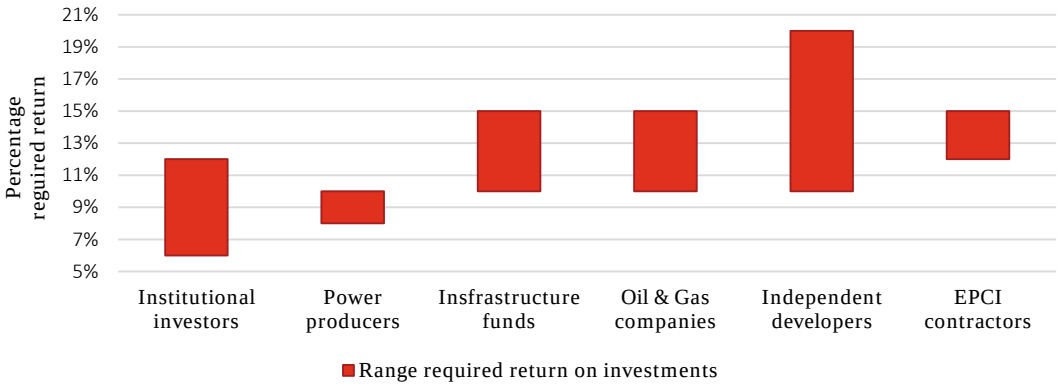

Figure 7 Return on investments different equity providers, adapted from EWEA (2013)

Future cost reduction

In 2013 on behalf of the German Offshore Wind Energy Foundation, Prognos AG & The Fichtner Group (2013) conducted a study to assess the cost reduction potential of German offshore wind farms. Two different scenarios were presented showing a potential cost reduction between 32% and 39%. According to these scenarios the largest cost reduction will be obtained by decreasing financing costs. Financing costs will reduce due to more favorable risk evaluations. Lower project specific risks will result into lower risk premia regarding equity and debt financing. This subsequently leads to lower required market margins (lower return on equity and debt). Furthermore if the industry develops (if e.g. the technology improves, if companies gain more experience in designing, constructing and operating windfarms or if clear long-term agreements between the government and offshore wind developers about their responsibilities and present) more confidence will exists towards offshore wind projects. It is therefore expected that the level of equity that banks demand will lower in the future. Because the cost of debt is generally less than the cost of equity this could also lead to a lower WACC.
It is expected that instituitonal investors can play a role in reducing the financing costs. Therefore in the next part the role that institutional investors can have in the financing process of offshore wind projects will be discussed.

4.1.4. The role of institutional investors

Institutional investors traditionally make long-term, low risk investments, usually in investment grade corporate or government bonds (EWEA, 2013). However due to the financial crisis interest rates of government bonds have fallen drastically and many of the traditional type of investments of institutional investors became less profitable as before. This led to lower yields and a decrease in strong investment products. Therefore institutional investors are increasingly searching for alternative investments that can deliver steady, preferably inflation-linked, income streams which are not, or to a little extent, correlated to other investments or markets (renewable projects are for instance not linked to the oil and gas market and therefore are not vulnerable to oil and gas price fluctuations) (Kaminker & Stewart, 2012). This increased the interest of institutional investors in large infrastructure or e.g. offshore wind projects. According to the EWEA (2013) and Freshfields Bruckhaus Deringer (2014)

between 2.36-3.83% and the average refinancing cost would have been between 2.36-3.36%. The LIBOR rate is often used as the risk free rate. The required return on debt is usually the LIBOR rate + different risk and service charges. The level of these risk and service depend on many factors.

offshore wind projects can be attractive for institutional investors because the projects facilitate large scale, long-term investments with a steady annual return of investment.

Looking at the supply side, Dutch institutional investors have a cumulative investment portfolio of approximately €1,262 billion (€1,002 billion comes from pension funds and €260 billion from insurance companies), of this amount around €400 billion is invested in the Netherlands (NLII, 2014). According to the best estimate calculation of the NLII, pension funds and insurance companies have the ability to allocate respectively €17.6 billion and €3.3 billion of their investment portfolio to long-term higher risk investments like equity or debt investments in offshore wind projects (NLII, 2014).

In the Netherlands the importance of institutional investors was noticed and in the tenth pillar of the Energy Agreement for Sustainable Growth the need is stated to transform bank loans into capital market investments and to find ways to attract more institutional capital for providing equity and debt for offshore wind projects (SER, 2013). To stimulate institutional investors to invest in the Dutch industry and Dutch offshore wind projects the Dutch government initiated together with thirteen large institutional investors the establishment of the Dutch investment institute (the NLII). This shows the growing perception that it is important to stimulate this capital transition and the co-establishment shows that there is commitment among institutional investors to look for ways how their role can be intensified. Institutional investors can provide equity and debt but because of the higher rate of returns institutional investors most often prefer equity investments (Global Capital Finance & Clean Energy Pipeline, 2014).

On a European level institutional investors are already showing an increasing interest in offshore wind projects. Institutional investors have acquired 284MW of effective capacity in 2014, this is more than double the 130MW that has been acquired in 2013 (Freshfields Bruckhaus Deringer, 2014). The current total equity share of institutional investors in offshore wind in Europe is however still limited and is estimated to be 6% (EWEA, 2013). Furthermore no Dutch institutional investor, and merely one international institutional investor (the Danish pension fund DKA) participate in a Dutch offshore wind park (a subordinate loan of €120 million was provided by DKA to the offshore wind park Gemini).

There are still some difficulties and uncertainties concerning the potential role of institutional investors. Institutional investors manage large amounts of capital provided by many individuals. This means that they have a high social and corporate responsibility to manage the assets correctly. To do so institutional investors often have very specific project demands and risk requirements and they are known to be risk averse. Institutional investors are for instance particular reluctant to bear the construction risks. After the construction, the projected return can be estimated more accurate. This lowers the risk and makes it easier to enter for investors. Institutional investors will mainly seek participation alongside other financial stable and strong investors and they might demand firm guarantees to delimit the investment risks.

According to Freshfields Bruckhaus Deringer (2014) the survey respondents think that institional investors are becoming the second most important type of investor and the third most important type of financer in offshore wind projects in 2015. Disregarding the risk averse nature of institutional investors, the large amount of available capital, the long-term focus of institutional investors and the relative low costs of capital make it from a policy perspective very interesting to stimulate the growth of institutional capital in the financing process of offshore wind farms.

Next the different financing stakeholders will be discussed.

4.1.5. Other funding and non-funding stakeholders

The equity providers of Dutch offshore wind parks are shown in Table 3. In the Netherlands the equity providers are: Three power producers, and one EPCI, Oil and Gas company, institutional investor and OEM. To get a clear context about the possible different equity and debt providers of offshore wind

projects a short general introduction about different debt and equity investors that have invested in European offshore wind projects is stated next.

Table 3 Dutch offshore wind projects and their specifications

Project name	Project capacity (MW)	Year	Funding model	Owners	Financers	Project cost (EUR m)
OWEZ	108	2007	Shared ownership	50% Nuon 50% Shell wind energy Ltd. (Noodzeewind JV)	50% Nuon 50% Shell wind energy Ltd. (Noodzeewind JV)	217
Princes Amaliapark	120	2008	Shared ownership	Eneco 50% Mitshubishi 50%	Eneco 50% Mitshubishi 50%, also banks, ECA and EIB	383
Luchterduinen	129	2015	Shared ownership	Eneco 50% Mitshubishi 50%	Eneco 50% Mitshubishi 50%	450
Gemini	600	2017	Project finance	HVC (10%); Van Oord (10%); Siemens (20%); Northland power (60%)	Banks, ECA, EIB	2,800

Equity providers

Power producers are still the largest equity providers in the European offshore wind market. Utilities however have more cash constraints than before, therefore a recent trend is that utilities form more partnerships and joint ventures. Utilities are also increasingly looking at project finance structures because that requires them to commit a smaller sum up-front to fund the construction (Freshfields Bruckhaus Deringer, 2014). A problem with project finance is that utilities are afraid that this will affect their credit rating. This can be prevented by taking a smaller share of equity. The European offshore wind equity share of utilities has dropped from 78% in 2011 to 70% in 2013 (EWEA, 2013).

Engineering, Procurement, Construction and Installation (EPCI) companies are important stakeholders in the offshore wind financing market (e.g. Van Oord in Gimini). Project managers and debt providers like EPCI companies to partly own shares because that increases the EPCI companies' strategic interest in the project. The more EPCI companies can lose during the project, the more dedicated they are expected to be to deliver the needed quality within the projected time frame. EPCI companies are usually asset light meaning that they generally cannot acquire large shares of equity.

Oil and Gas companies seem to be the perfect fit for providing equity because of their knowledge in offshore, large (infrastructure) constructions and their large balance sheet capacity. However they only own 5% of the European offshore wind shares. Shell is only involved in one offshore wind park (OWEZ). Shortly after the OWEZ project Shell however decided to exit the offshore wind energy market because alternative investment opportunities generated higher returns with a lower risk profile (EWEA, 2013).

Cooperative investors, local governments or corporations, can invest in offshore wind projects. The amount these cooperative investors can invest is usually limited (especially taking into account the enormous investments needed for offshore wind projects) but including cooperative investors can increase the public support of the projects. Especially Germany has experience with including cooperative investors into offshore wind projects.

Corporate investors have invested in offshore wind projects for strategic reasons (branding reasons, security of energy supply) or merely as an investment opportunity.

Other equity providers are e.g. *Original Equipment manufacturers* (OEMs) which have the same strategic importance of being involved in offshore wind projects as EPCI companies, e.g. Siemens in Gemini, *Infrastructure funds, Sovereign wealth funds and Independent developers.*

This shows that there are many equity providers and that the demand does not only has to be met by institutional investors.

An overview of the current European distribution of equity providers is shown in Figure 8.

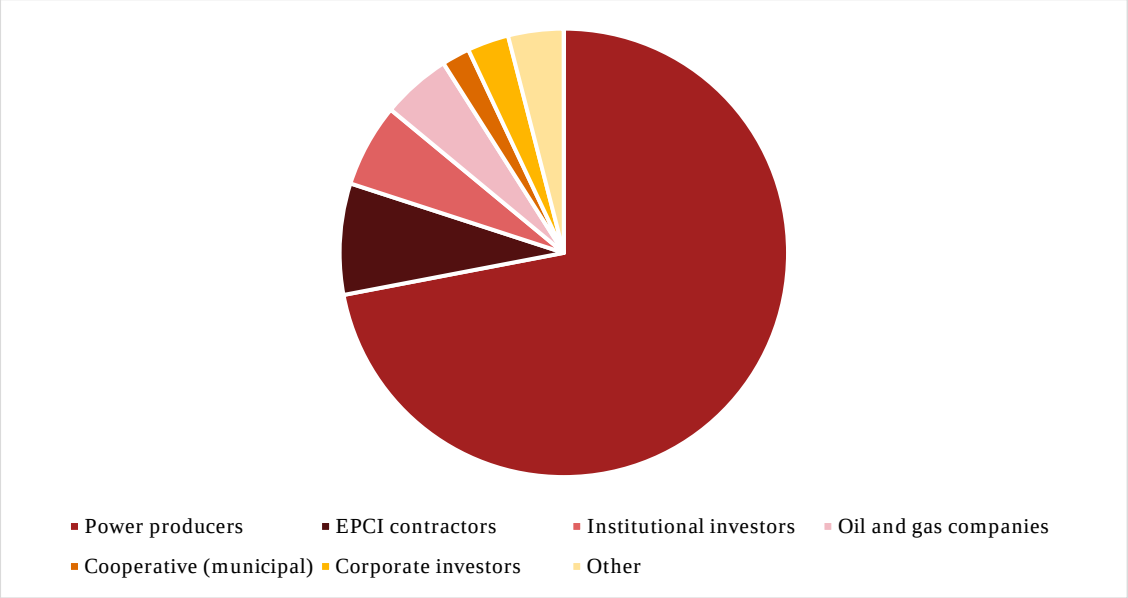

Figure 8 Representation of the equity distribution of European offshore wind farms in 2013, adapted from EWEA (2013)

Debt providers

Next to equity, debt needs to be available. EY performed an analysis for the NLII and they mapped all the banks that provided debt for offshore wind parks between 2003 and 2014. Around 30 banks have financed two or more offshore wind parks. Taking into account the internal requirements and limitations of banks, EY and the NLII therefore expect currently between €2-3 billion of bank loans will be yearly available for European offshore wind parks (NLII, 2014). It can be expected that when project risk decrease this amount will grow.

Next to banks typical other debt providers are: Export Credit Agencies (ECAs), multilaterals, development banks, institutional investors, utilities and (especially in the long-run) the capital market via green bonds.

ECAs and multilateral organizations are especially important for providing the debt and security for offshore wind projects. These organizations can invest significant sums per projects and they can provide guarantees or capital insurances. The evolvement of ECAs and multilateral organizations often lead to a perceived decrease of project risks. The importance becomes clear when noticing that in the last 5 years all the deepwater offshore wind projects that received project finance involved at least some participation of an ECA or a multilateral bank (usually the EIB) (Freshfields Bruckhaus Deringer, 2014). A multilateral bank can offer loans with good financing conditions (e.g. subordinate loans with low interest rates), an ECA can also provide loans but they also can provide credit insurances and guarantees.

According to Freshfields Bruckhaus Deringer, the offshore wind financing stakeholders think that debt finance is readily available for offshore wind projects and that there will be enough capacity to support the growing need in the next five years.

International market

So far Gemini is the only Dutch offshore wind farm that has been financed with debt. The debt part for Gemini was provided by 11 commercial banks, one multilateral bank (the EIB), one utility (Northland

power), one pension fund (PKA) and furthermore 3 export credit agencies. Altogether the debt part was therefore provided by one multilateral and 16 companies from 8 countries located in 3 different continents. Only two Dutch stakeholders were involved in the debt part. This shows the international character of the offshore wind financing market. When identifying the stakeholders it is therefore crucial to look at an international context. The financing of Gemini also shows that banks are getting more comfortable with providing debt to offshore wind projects.
Due to a decreasing role of utilities and an increasing role of project finance more bank loans are needed, especially in the construction phase, to meet the capacity growth. The loans might be supplied under different conditions and in more cooperation with other capital (debt and equity) suppliers. Next, different funding methods will be discussed showing how the different equity and debt providers can work together in financing an offshore wind project.

4.1.6. Overview of the funding models

In this paragraph the different financing models and the most important characteristics that are used by the different stakeholders will be briefly presented.

In the Netherlands the offshore wind projects are financed via two different funding models:

- Shared ownership, usually between a electricity company and a multinational e.g. Shell and Mitsubishi Corporations in respectively the offshore wind parks OWEZ and Luchterduinen (Mitsubishi acquired 50% of the shares of Luchterduinen during the construction phase). Mitsubishi Corporations also took over 50% of the shares from the Princes Amalia wind farm. This farm was financed with balance sheet finance but now it is a shared ownership (which is also balance sheet finance)
- Project finance (e.g. Gemini) (see Table 3).

A third way to finance the parks, which is the most used funding method for offshore wind parks so far, is via balance sheet finance**.** If companies use balance sheet finance, the wind parks will be on the balance sheet of mainly utilities. The projects are sponsored by the companies' capital reserve and/or corporate lending. Sometimes after a few years utilities sell shares to free up the balance sheet.

In 4.1.1 already some first notes were presented regarding *divesting* and *refinancing*. By divesting parties can (partly) recover their investments by disposing their assets during the lifetime of the project. This has the advantage that utilities can develop their projects with balance sheet finance (alone or in a shared ownership structure), because after a few years (instead of the lifetime of the project) they can recover their capital. This has also an advantage for institutional investors because now they can participate in offshore wind in a later stadium, which means that they don't expose themselves to the development risks. This is an important method for a project developer to free up their balance sheet and an important requirement for some investors to enter the offshore wind financing market.

Previously merely operational assets were divested but now utilities increasingly divest pre-operational shares (for investors who have more experience with offshore wind or who can bear more risks) to share the financial burden of the construction of the wind parks (see Table 4).

Table 4 Divestment of pre-operating capacity (in MW), adapted from Freshfields Bruckhaus Deringer (2014)

Year	2010-2012	2013	2014 (up to October)
Divested	430MW	725MW	756MW

The perception that utilities need to own the wind parks is currently slowly changing. The CEO of Delta e.g. stated: "we do not need to own the steal; that is an old-fashion way of thinking. We just want to sell the electricity" (Fd, 2015). This gives room to divestments, shared ownership structures and project finance structures. This could make it easier for institutional investors to enter the offshore wind financing market.

In *shared ownership* finance two or more companies invest in a joint venture and from this entity the project will be executed. Because utilities do not have as much investment potential as before they are more often forced to form partnerships to fund the future growth (Freshfields Bruckhaus Deringer, 2014). In shared ownership constructions, no project debt is provided for the offshore wind park and parties merely invest equity (which might be funded with corporate finance). This structure is therefore only relevant for parties who merely want to provide corporate loans (mostly to a utility so not directly and merely to the project), or equity.

Project finance (non-recourse finance) differs from on balance sheet finance (recourse finance) by the fact that merely the cash flows generated by the project are used as a collateral for the financial obligations of the project instead of the cash flows generated by the company. A special purpose vehicle (SPV) will be created, debt and equity is placed in the SPV and merely income from the SPV will be used to pay back the lenders.

4.1.7. Providing return certainties for capital providers

Before investors are willing to provide capital for offshore wind projects they need to know how their investment will be secured. Providing capital certainties is one of the most important aspects of offshore wind propositions. The most commonly used methods are described below.

Different debt tranches. In project finance often different debt tranches are constructed which contain different levels of risks. The principle and interest payments which are collected from the project cash flows will be paid first to the lender who provided the senior debt, the subordinate loan holder will be paid second and finally the mezzanine debt holder will be paid. This provide different parties with different risk perceptions to invest capital in offshore wind projects. Senior debt holders will receive lower interest rates than mezzanine debt holders. According to Freshfields Bruckhaus Deringer (2014) the security of the capital structure could be increased if the government would be able to provide the sub-ordinated debt or that the government would buy equity shares. If the government would have equity shares, direct via project shares or indirect via utility shares (Dong in partly owned by the Danish government), this could reduce the perceived risk of debt providers that the loans are not being repaid

Debt Service Coverage Ratio (DSCR). In project finance debt providers require a minimum debt service coverage ratio (DSCR). The DSCR is: “The measure of cushion between debt service and cash flow available for debt service (CFADS) in any given period (typically annual, but may be intra-annual especially for projects exposed to seasonality) (Fitch, 2012, p. 27). Or the ratio between the yearly income and the yearly debt obligations. If you are a debt provider you want to make sure that the project is generating enough capital to pay back the principle amount and the associated interest costs. Usually the DSCR should be higher than 1.10 meaning that the project generates 10% more capital than they need generate to pay the debt providers. Because of the DSCR the length of the debt and the amount of debt becomes very important because it determines the amount the wind park needs to generate to pay the principle and interest payments (Wiser & Pickle, 1998).

Maintenance Reserve Account (MRA). This is a contingency buffer which is used in the case extra maintenance costs need to be made. This prevents that the cash flows that are reserved to pay the debt holders need to be used. Furthermore other contingency buffers could be present

Insurances and guarantees. There are multiple parties that are able to provide project or capital insurances and guarantees. O&M contractor can guarantee a minimum availability or the turbine manufacturer can guarantee a minimum lifetime etc. Furthermore there are large insurance companies like Delta Lloyd who can provide tailor made insurances on e.g. the turbines or on certain problem that can occur during the construction phase. Finally there are companies who can insure cash flows. ECAs can insure debt payments, monoliners can insure project bonds[20]. These insurances and guarantees are crucial for reassuring the investors that the cash flows are secured. According to the literature, institutional investors are reluctant to finance the construction phase and according to

[20] These are merely examples and this is a non-exclusive list of examples.

Freshfields Bruckhaus Deringer (2014) institutional investors need to have a full EPC-wrap before they can finance the construction phase. An EPC-wrap is a guarantee of a project developer that the problems that occur during the construction will be paid by the project developer. This creates an opportunity for institutional investors to enter already in the construction phase (without baring the risks).

Feed-in tariff (FIT) and power purchase agreements (PPA). A FIT is a guarantee that a minimum price is paid for the electricity (this will be further explained in 4.3.1) and a PPA is a contract between the electricity generator and a purchaser. A PPA is very important because it secures that the electricity will be bought. Often fixed price agreement can be negotiated which secures the developer that a fixed price will be paid for a certain amount of years. Institutional investors prefer inflation correlated returns, therefore according to the NLII (2014) they would prefer a FIT or PPA with an inflation correction.

There are also soft strategies that can provide return certainties. Extensive wind studies can increase the certainty of production and working with trustworthy and financial stable project parties also increases the chance that when problems occur (and the problems were not contractually mitigated) that the costs are shared pro rata.

4.2. Technical characteristics

Offshore wind projects are technologically different from other (renewable) energy generating technologies. Because of the relative young technology there are still many design choices to be made. One of the characteristics of a relative new technology is that there is still no dominant design. This is also the case with the offshore wind technology. In 2013 offshore wind farms were constructed with different turbine sizes, different foundation heights, blade sizes and different foundation technologies. This indicates that the offshore wind technology has not matured yet, which increases the uncertainty and risks for investors. This part will briefly explain the technological characteristics of offshore wind and it will show why offshore wind is different and in many ways incomparable with onshore wind technologies.

4.2.1. Innovation curve

In 2013 four different support structures were used in European offshore wind parks. The monopile was the most used foundation (79% of the total installed constructions were monopiles). This was followed by the tripod, than the jacket and finally the tripile and gravity foundation (EWEA, 2014). Furthermore scholars and R&D institutes are looking for new ways to construct offshore wind farms in deep water and different deep-water constructions are being discussed. The offshore wind turbines that are used are also diverse and companies keep innovating to increase the generator capacity. In 2009 the average turbine size was 2.9 in 2013 this increased to 4MW (EWEA, 2014). Turbines of up to 10MW are however being anticipated on by Siemens, Vestas and XEMC Darwind and according to UpWind a 20MW turbine is technically feasible (UpWind, 2011). Finally innovative companies have numerous ideas regarding increasing the quality of different windmill components, construction process, or regarding cost reductions.

The fact that there are still many design uncertainties indicates that the offshore wind market is not a mature market yet. According to the literature after a while a dominant design occurs which will be adapted by the entire commercial market and this will make all the other designs obsolete (Utterback, 1996). The fact that this choice is yet to be made increases the risks for investors due to the high possibility that investors invest in a design that is not supported anymore by the rest of the market or that they invest in a suboptimal design.

4.2.2. Technical differences offshore and onshore wind

The basic concepts of offshore wind turbines are the same as for onshore wind turbines. However there are many subtle differences that altogether lead to the fact that offshore wind turbines have substantial different technical characteristics as onshore wind turbines.

Offshore wind turbines are designed for more extreme conditions. The turbines must resist higher wind speeds and the foundations must resist the erosion of the wave impact, the current and the (salty) water. Furthermore the turbine is exposed to forces from wind and wave/current at the same time. The turbine must me designed so it can handle this interplay of (possible) extreme forces.

Because of the visual impact, onshore wind turbines are often restricted in size. This is a non-existing problem for offshore wind turbines resulting into the fact that the size of offshore wind turbines are on average significantly larger than onshore wind turbines (average blade size of 100m offshore versus 50m onshore, and average turbine size of 2.5-3 MW onshore versus 4MW offshore) (EWEA, 2014; EWEA, 2015).

Offshore wind power plants often also have significant higher load factors[21]. Typical load factors for offshore wind are > 35% while a typical load factor for onshore wind is 25-30% (PwC, 2011; RWE , 2014). This means that the offshore wind turbines have on average bigger turbines that also more often run at full capacity.

Furthermore there are many technical differences relating to the construction process of offshore wind parks. The installation of offshore wind turbines is more difficult due to the accessibility of the offshore construction site. Vessels and ports need to be available that can work with constructions of the size of offshore wind turbines. Another technical difference is the grid connection. The offshore wind connection cable needs to be installed underneath the sea bed which could be a difficult and costly task[22]. Because of the specific knowledge that is needed to construct the parks, and because of the high costs per project, project developers want reliable and solid project parties to construct the offshore wind park. Currently only a few developers have experience with building large offshore wind parks. Therefore utilities and independent project developers want these reliable partners, that have experience with the technologies, to build the park and to be responsible for the project management. Project management risks are reduced if one party, which has a solid track record, is responsible for the construction and for managing the sub-contractors.

Finally the operation and maintenance of offshore wind parks is more difficult due to the accessibility of the park. It is more costly to get technicians to the site and because of the swell special boats (or helicopters) are needed to get people on board of the wind turbines. Furthermore due to the weather, technicians are sometimes even unable to get to the wind turbines for the maintenance. Because the accessability is difficult and costly, it is of more importance, compared to onshore wind turbines, that at offshore wind parks issues are prevented and constant monitoring is therefore of more importance necessary.

Altogether this makes offshore wind parks more expensive and the immaturity of the market and the dependency of supporting industries (e.g. availability of vessels) increases the risks for offshore wind investments.

[21] Load factor (or capacity factor) is the ratio of the actual output over a time interval to its potential output if the plant was running 100% of the time interval at its full capacity, so actual production/ (time interval * full capacity).

[22] As of 2015 in the Netherlands the grid connection of offshore wind parks will be managed and executed by the transmission system operator (TSO) TenneT. Who will pay for the grid connection and if (and if so how) the costs are translated into subsidy reductions is unknown.

4.3. Regulatory characteristics

In a report published by the United Nations Development Program it is stated that public derisking instruments could have a positive effect on the perceived risks and the financing costs (Waissbein, Glemarec, Bayraktar, & Schmidt, 2013). To assess how the role of institutional investors can be increased in offshore wind financing it is therefore important to show the current regulatory characteristics and institutional setting that is applicable to Dutch offshore wind projects. First the institutional setting is discussed which show the subsidy scheme applicable in the Netherlands and the most recent decisions of the Dutch government regarding the deployment of offshore wind. Second certain regulations (Basel III, Solvency II and the FTK) will be discussed because these regulations have a direct effect on the investment and financing capabilities of banks and institutional investors.

4.3.1. A changing Dutch institutional offshore wind setting

As stated before offshore wind projects are amongst the most expensive renewable energy technologies and the cost difference with conventional generation technologies is very large. Therefore the exploitation of offshore wind still heavily relies on supporting mechanisms and on the general institutional setting.

In 2013, major changes in the regulatory setting of offshore wind were announced. The Energy Agreement for Sustainable Growth of September 2013 introduced a significant different pathway for offshore wind. From 2015 offshore wind would be left out of the regular SDE+ subsidy scheme (for a brief explanation of the SDE+ scheme see Appendix D). The minister of Economic Affairs Henk Kamp however promised that €18 billion of subsidy would be made available for the development of the offshore wind parks (from 2019 until 2038). In 2015 the newest estimations shows that the expected offshore wind subsidy that is needed will be €12 billion, the maximum amount however stays at €18 billion (Kamp H. , 2015).

Next to the fact that offshore wind will be left out of the national renewable energy subsidy scheme, the minister of Economic Affairs introduced many new aspects (rules, assumptions and promises) in the transition pathway to more offshore wind energy.

In the new subsidy scheme the FIT that an offshore wind generator can receive will differ per offshore wind location (taking into account the different costs and wind projections of the location). Every subsidy that will be granted will be tendered by competitive bidding. This means that the government sets a maximum subsidy level per offshore wind park and that developers are able to bid for a lower subsidy. The developer who has the right criteria and who can deliver for the lowest subsidy wins the tender. Furthermore the average costs of developing an offshore wind is expected to be estimated €124/MWh in 2015 (Kamp H. , 2015) and it is assumed that a yearly cost reduction of €5/MWh can be achieved (SER, 2013). This leads to an estimated cost reduction of 40% between 2014 and 2024. When the new tender regime opens at the end of 2015 it will be known if the subsidy level is sufficiently high enough for the developers to develop the parks. In the past the subsidy floor of the offshore wind SDE+ scheme has often be higher than the electricity price. This implied that the subsidy did not always compensate the costs that were made (see Appendix D). The exact specifications of the subsidy scheme is still unclear so it is currently unknown if this will be an issue or not. In the new onshore wind subsidy regime the government announced that so-called banking will be allowed. A developer can receives the FIT over a certain production amount, the pre-calculated full load hours. If that amount is not reached in one year, the difference can be transferred over to the next year (which might be a good year where the developer might produce more the production amount that can receive the FIT), this is called banking. It is not certain yet if this will also be implemented in the offshore wind subsidy scheme. Another change is that the offshore grid will be developed and financed by TenneT while before 2015 project developers were responsible for building the offshore wind grid (for more information see the Dutch regulation called STROOM).

Regarding the allocation of offshore wind projects the Dutch government decided to take more control. The offshore wind park locations will, from now on, be chosen by the government and they will start a tender procedure where project developers could apply to (it used to be the case that project developers searched and assessed an offshore wind location and that they after they found an appropriate location would apply for a subsidy). Three offshore wind locations are chosen where developers can develop large offshore wind parks. On these area's different locations are indicated where 700MW of capacity can be developed and connected to the grid. In the new letter of the Minister of Economic Affairs to the House of Representatives the Minister announced that instead of one tender of 700MW, two tenders of approximately 350MW will be placed in the market every year between the years 2015 and 2019 (the current offshore wind parks and the allocated locations for future offshore wind parks are shown in Figure 9) (Kamp H. , Kosten winderergie op zee, 2015). Table 5 shows that the amount that will be tendered already changed three times between the publication of the Renewable Energy Agreement for Sustainable Growth in 2013 and now. Even now the tender procedure is not still entirely clear yet. Two locations, which are 2 miles closer to the coast (where in Figure 9 the number 2 is shown) are still being investigated if they are relevant locations for offshore wind farms. It is estimated that if the assessments of the proposed locations, the locations that are closer to the coast, are positive this could lead to a cost reduction of 1.2 billion (Kamp & Schultz van Haegen, 2014). In this case the assigned locations will change again to incorporate the closer offshore wind locations into the tender process. The government will conduct the environmental impact assessment and they will acquire the information regarding wind and water conditions. This will be made publicly available before the tender procedures will start.

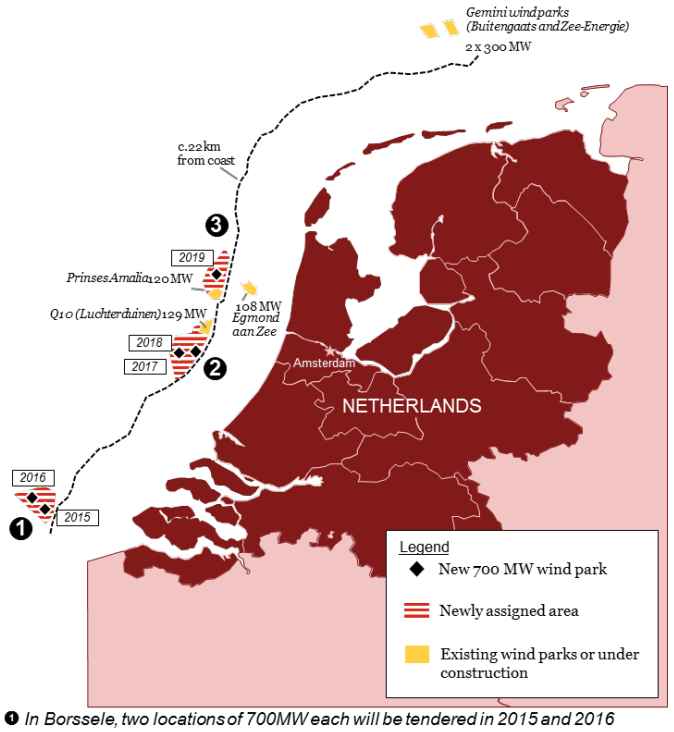

Figure 9 Existing and new Dutch offshore wind parks, adapted from RVO (2014)

Table 5 Tender offshore wind 2015-2019, adapted from Kamp & Schultz van Haegen (2014)

Year	Amount tendered according to Energy Agreement for Sustainable Growth (SER, 2013)	Amount tendered according to amendments (Kamp & Schultz van Haegen, 2014)	Amount tendered according to new amendments (RVO, 2014)	Areas tendered

2015	450 MW	700 MW	2 times 350 MW	Borssele
2016	600 MW	700 MW	2 times 350 MW	Borssele
2017	700 MW	700 MW	2 times 350 MW	Hollandse Kust: Zuid Holland
2018	800 MW	700 MW	2 times 350 MW	Hollandse Kust: Zuid Holland
2019	900 MW	700 MW	2 times 350 MW	Hollandse Kust: Noord Holland

All the previous rules and assumptions are merely applicable to offshore wind. This makes the institutional setting for offshore wind substantially different and incomparable with the institutional setting for onshore wind (which still uses the SDE+ subsidy scheme).

4.3.2. (Inter)national regulations relevant for offshore wind financing stakeholders

A few regulations are relevant when identifying ways to increase the amount of institutional capital in offshore wind. Partly due to Basel III project developers are looking for new capital providers. Therefore first a short introduction about Basel III is presented. Because this thesis concerns institutional investors thereafter two regulations, Solvency II and the FTK, which have effect on the investment possibilities and (perhaps) costs of insurance companies and respectively pension funds are presented.

Basel III

After the financial banking crisis of 2008 European regulatory authorities drafted a new regulation, called Basel III, which contains a set of reform measures with the means to regulate the banking sector in such a way that a new crisis would be prevented. The measures aims to:

- Improve banks to absorb shocks that come from financial and/or economic stress
- Improve risk management and governance
- Strengthen banks' transparency and disclosure (EBA, 2015)

The regulation demand banks to strengthen their capital requirement and liquidity and funding ratios. The increased capital requirements aims to provide a buffer to absorb losses in periods of stress. The minimum capital requirements will rise to 10.5% in 2018, which is a 2,5% rise compared to the 8% which was required in 2011. Furthermore also the quality of the capital needs to be increased because the minimum equity of banks need to rise from 2% to 4.5% in 2015 and 7% in 2019 (Standard & Poor's, 2011). The liquidity ratio, or liquidity coverage ratio (LCR) will be introduced in 2015 with the means to regulate the amount of liquid assets that could be used to meet short-term obligations (e.g. a bank run). Subsequently the funding ratio, or net stable funding ratio, compares the amount of the firm's stable funding to its required stable funding (PwC, 2014). Finally also a minimum leverage ratio (debt-to-equity ratio) was implemented. This ratio measures the rate of high quality capital in relation to a bank's total exposure (Standard & Poor's, 2011).

All these measures are drafted to prevent a future economic crisis. They however also have side effects.

The concern is that Basel III could make it more difficult for banks to enter into long-term loan agreements, like offshore wind investment, and that banks are likely to require higher funding costs (NLII, 2014; Standard & Poor's, 2011). Therefore banks might stimulate sponsors to borrow for shorter terms and they might stimulate them to increasingly accept refinancing risks.

Innovative risk transfer techniques might therefore be developed to diminish e.g. the refinancing risk (Standard & Poor's, 2011). Basel III might also lead to a change in project finance. It is expected that so-called two-phased-financing where e.g. construction financing is funded by bank loans but then taken out trough bonds would become more common (Standard & Poor's, 2011).

Basel III was entered into force on 1 January 2014, parts of the regulation will be phased-in between 2014 and 2019 (EBA, 2015). Partly due to Basel III the Dutch government expects that new capital is needed to meet the capital demand for offshore wind projects and therefore they are looking for ways to include more type of investors, e.g. institutional investors, in the financing process of offshore wind projects.

Solvency II

Next to Basel III, Solvency II will be (most likely) implemented in 2016 (Lloyds, 2015). Solvency II, which some call "the Basel III of the insurance industry", demands for the first time capital requirements on the asset risk of insurance companies (Standard & Poor's, 2011). Insurance companies must hold a certain capital reserve if they invest in debt or equity. The required capital reserve is linked to the level of risk of the portfolio of that particular firm (Lloyds, 2015). This implies that Solvency II, just like Basel III, imposes higher capital charges for lower-credit-quality and longer-dated financial instruments and obligations (Standard & Poor's, 2011).

It is stated before that the required equity return of institutional investors is low compared to other investors. It is however unknown if this will still hold after Solvency II is fully implemented. This will be validated with the interviews.

FTK

Just like banks and insurance companies, pension funds are also subjective to a new regulation. Since 1 January 2015 the FTK (*Financieel Toetsingskader*) is applicable to pension funds (Pensioen Federatie, 2015). Just like insurance companies, this means that pension funds now have legal obligations regarding their capital requirements. The legally required equity also relies on the risk profile of the investments in the portfolio. Due to the different financial obligation of pension funds relating to insurance companies, the capital charges of pension funds are less drastic as the capital charges of insurance companies via Solvency II. Therefore it is expected that the FTK has less effect on the possibility of pension funds to fund offshore wind projects.

The implementation of the new regulations might imply that insurance companies and pension funds might need to demand higher equity (or debt) returns than before.

4.4. Conclusion

Between the years 2017 and 2025 a total estimated amount of €19 billion is needed to support the 3.500MW of offshore wind capacity that will be tendered between 2015 and 2019.

Table 6 shows different capital demand and supply scenarios. It is most likely that institutional investors want to invest in shares that are divested after the construction or in loans that need to be refinanced because in these cases there are no construction risks present. However even in the case that institutional investors are willing to supply all the equity and debt that is needed to reach the targets, the supply that is available by merely institutional capital is sufficient to reach the goals[23].

This indicates that the availability of capital is not an issue and that there is still a large potential to increase the share of institutional investors in the financing process of offshore wind parks.

Table 6 Demand and supply of capital of institutional investors in different scenarios

Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total
Demand and supply in the case that institutional investors are only willing to invest in loans that need to be refinanced after the construction phase										
Refinancing demand (€ million)	X	X	1,085	1,085	1,628	1,628	1,628	543	543	8,140

[23] In the three demand and supply scenarios I did not consider a maximum investment per project or per year. Therefore these tables present a highly simplified overview of the real situation.

Institutional investor supply (€ million)	X	X	2,986	2,986	2,986	2,986	2,986	2,986	2,986	20,902
Demand and supply in the case that institutional investors are willing to invest in pre-construction equity shares or preconstruction loans, and loans that are refinanced after the construction[24]										
Refinancing and pre-construction equity demand (€ million)	651	651	1,736	1,736	2,279	1,628	1,628	543	543	11,395
Institutional investor supply (€ million)	2,322	2,322	2,322	2,322	2,322	2,322	2,322	2,322	2,322	20,902
Demand and supply in the case that institutional investors are willing to invest in pre-construction loans and equity and in post-construction debt and equity										
Divestment and pre-construction equity and debt demand (€ million)	2,170	2,170	3,255	3,255	3,798	1,628	1,628	543	543	18,990
Institutional investor supply (€ million)	2,170	2,170	3,255	3,255	3,798	1,628	1,628	1,499	1,499	20,902

Currently institutional investors are underrepresented in the financing market of offshore wind projects while there are indicators that show that the offshore wind project developers and institutional investors can profit from each other. Institutional investors are looking for new investments that have a long tenure, large nominal value, and a good risk-return profile. Furthermore despite the fact that enough capital is available project developers are constantly looking for investors who are willing to supply sufficient amounts of long-tenor capital for the right pricing.

There are however still some hurdles to overcome. Onshore wind farms use technologies that have been utilized and developed for many years, making the projects relative predictable and safe. The offshore wind market is however not a mature market yet; making it a more risky market to invest in. Since offshore wind is a very expensive energy generating method, subsidies are still a necessity for projects to be developed. Because the projects rely heavily on subsidies and the projects will be operational for many years (usually 20-25 years) regulatory risks are a large issue. In 2015 the offshore wind subsidy scheme has changed completely and it is still unknown what the specifications of the new scheme are (e.g. the subsidy level). These uncertainties confirm the concerns of investors to enter the offshore wind market.

If the risks can be mitigated properly institutional investors can become an important financer for offshore wind projects (in debt, equity, divestments or refinancing). This could potentially lead to lower cost of capital and therefore to lower total project costs and LCOE. Furthermore if institutional investors show more appetite for buying the shares that are divested after the construction, or if they show more appetite to take over the bank loans after a number of years, project developers and banks could also become more willing to invest and finance offshore wind projects. Therefore it is important to find out how the fit between the characteristics of offshore wind projects and the needed demands of institutional investors can be improved.

Due to the new regulations long-term financing becomes increasingly difficult for financing institutions and due to these new regulations banks and institutional investors might therefore demand higher returns or shorter investment tenors. How institutional investors cope with the regulatory changes and under what conditions they prefer to finance offshore wind parks will be identified during the interviews.

[24] Assumption that everything will be financed with project finance and the debt /equity ratio is 70%/30%.

Chapter 4 provides the background to answer the first sub question. The first sub question was:

What are the specific financial, technical and regulatory characteristics for offshore wind and how does this relate to the current and expected future role of institutional capital?

Table 7 provides the answer to sub question 1.

Table 7 Overview of the answer to sub question 1

Characteristic	Relate to current role	Relate to future role
Financial characteristics		
Large capital costs and growing market	In the past the size of offshore wind projects was too small . This made it unattractive for institutional investors to invest in offshore wind projects (NLII, 2014)	Offshore wind is a growing market and also in the Netherlands this would lead to market opportunities. Around 3500MW will be tendered leading to a large capital need. The new Dutch offshore wind projects will be around 350MW per project, this roughly need a capital investment of €1,1 billion (see Table 2). In the new tender regime the stakes will be large enough to be attractive for institutional investors (NLII, 2014)
Low cost of debt	Currently still many institutional investors who want to supply debt believe that the risk-return characteristics of offshore wind projects does not suit their investment portfolio. This is partly due to the low returns debt providers receive for a perceived high risk investment (see 4.1.3)	If the debt margins stay as low as they are currently, the amount of competition and the regulatory regime make it difficult for institutional investors to provide debt. This might lead to the fact that less institutional capital will be available, or this will lead to the fact that debt providers will switch to equity (see 4.1.3)
Many potential financing stakeholders	There are many potential investors (debt and equity) that are able to invest in offshore wind. The difficulty is to create a proposition that meets the demands of the different investors (see 4.1.5)	If many different type of investors remain interested in offshore wind investments, maybe the stakeholders who are the least risk averse will be the most likely parties to invest in offshore wind projects (see 4.1.5)
Possibility to provide debt and equity	In the past institutional investors have invested in debt and in equity (see 4.1.5)	In Solvency II, the required capital reserve is linked to the level of risk of the portfolio. Therefore the capital charge depends on how the regulator will rate the different debt and equity projects. Because institutional investors can provide both equity and debt, they might switch from their preferred investment due to a more favorable capital charge (see 4.3.2)
Trend towards project finance	In the past project developers placed the wind farm on their balance sheet. Institutional investors invested in the underlying companies by providing corporate loans (see 1.1)	The trend is towards more project finance. This means that institutional investors can also more easily provide direct equity or debt towards offshore wind projects. Project financed projects have different risk profiles then balance sheet financed projects. Institutional investors need to have enough

		confidence in the underlying assets to provide the loans or equity (see 4.1.6 and 4.1.4)
Technical characteristics		
Fast changing technology	Institutional investors are risk-averse. Therefore they prefer proven technologies. This is one of the reason why institutional investors are reluctant to invest in offshore wind (see 4.1.4, 4.2.1 and 4.2.2)	The first offshore wind parks are currently operational for a few years. This learning curve can provide confidence for institutional investors. In the future institutional investors might still prefer proven technologies, which might lead to the fact that they do not want the newest unconventional turbines (see Table 3 and 4.2.2)
Regulatory characteristics		
Solvency II	Solvency II is not a main reason why insurance companies have not invested in offshore wind projects yet (see 4.3.2)	The other reasons why insurance companies have not invested in offshore wind are in the future becoming less a restriction (see 4.2.1). Because of high capital charges, insurance companies might be demotivated to invest in offshore wind assets (see 4.2.1)
Basel III	Currently banks (most often) provide corporate finance, however more and more projects are financed with project finance. Due to Basel III project developers are currently exploring different types of financers (see 4.1.6 and 4.3.2)	Basel III will play a role in the transition to a different, project finance way of financing future offshore wind projects. If institutional investors are willing to invest in debt, Basel III might lead to a refinancing need that be met by institutional investors (4.1.1)
FTK	The FTK has just been implemented. Therefore it has not yet been a restriction (see 4.3.2)	Even if pension funds will invest in debt, the capacity charges will probably not have a restraining influence on the reason to invest in offshore wind projects (see 4.3.2)
Subsidy regime	The regulatory regime in the Netherlands has in the past be inferior relating to neighboring countries. Partly due to the subsidy regime, institutional investors have in the past not been interested in investing in offshore wind projects (see 4.3.1).	The new subsidy scheme might provide more certainties for investors who want to invest in offshore wind projects. This could lead to an increasing role for institutional investors in the financing process of offshore wind projects but this could also lead to more competition and therefore to declining margins (see 4.3.1).

5. Conceptual causal loop diagram and conceptual theoretical model

In this chapter the conceptual causal loop diagram and the conceptual theoretical model will be created and sub question two and three will be answered. The most important concepts that were found in the desk research of chapter 4, which will have effect on whether institutional investors might invest in offshore wind projects, were captured in the causal loop diagram. The adapted model of Wüstenhagen and Menichetti (2012), the interim model, was extended with the newly found concepts to create the causal loop diagram. Finally the causal loop diagram was consolidated into a representable and easy interpretable conceptual theoretical model which is a more specified model for this research than the original model of Wüstenhagen and Menichetti.

During the literature review study merely the relations were identified, so the answer of sub question 2 and 3 do not include an explanation of the mutual importance of the barriers and mitigation strategies. After the interview data has been processed, the importance of the different barriers and mitigation strategies will be shown in chapter 6.

5.1. Conceptual causal loop diagram

5.1.1. Explanation of causal loop diagrams

A causal loop diagram is a descriptive model showing how the concepts that have influence on the level of investments of institutional investors interact. A causal loop diagram is a causal chart that shows how interrelated variables affect each other (Aslani, Helo, & Naaranoja, 2014). The diagram exists of variables and their underlying relationships. The relations can be positive, meaning that an increase in variable A leads to an increase in variable B. Or the relations can be negative, meaning that an increase in variable A leads to a decrease in variable B. An arrow shows the direction of the relation (see Figure 10 for a graphical overview of how relations are affecting each other and how that is presented in the model). After the relations are mapped, potential solutions can be found to mitigate the negative factors that form barriers for institutional investors to invest in offshore wind projects.

A causal loop diagram exists of dependent and independent variables. A dependent variable is a variable that is “influences by another variable”. An independent variable is the opposite, a variable that is “not influenced by another variable” or a variable that is “influencing another variable”. The final dependent variable, or the end-variable, is the variable that this research is about. The causal loop diagram can show how the final dependent variable, the variable “Level of institutional capital in offshore wind”, is influenced by the other dependent and independent variables. All the variables that are included into the causal loop diagram have an indirect or a direct effect on this dependent end-variable.

5.1.2. Creating the conceptual causal loop diagram

The interim model was the starting point of the causal loop diagram. All the relevant variables that were found in the literature review were linked, directly or indirectly to a variable of the interim model. After the extensive diagram was constructed it was validated if the variables were mutually exclusive. Sometimes different sources uses different terminologies for the same variables. Therefore some variables needed to be combined and the terminology sometimes needed to be changed.

The terminologies of the variables that have influence on the bankability (which were included in the interim model) were slightly adapted so it would better fit with the variables that were found in the

extensive literature research of chapter 4. The variables that have influence on the bankability were adapted in the following way:

- "Cost of capital" became "The weighted average cost of capital"
- "The height of the subsidy" was changed into the independent variable "FIT", which has a positive effect on the dependent variable "Perceived return capital provider"
- "The capital costs" became "Project costs".

The variable "Bankability" was called "Bankability offshore wind projects for institutional investors" and this became the variable that influences the final dependent variable "Level of institutional capital in offshore wind".

Two more variables were found that have effect on the end-variable "Level of institutional capital in offshore wind". These variables were: "Focus on ESG" and "Substitute projects". This focus on the environmental, social and governance (ESG) was thought to be relevant because if institutional investors take renewable energy or social corporate responsibility more into account when they evaluate projects, this might have effect on their perception of risk and return (Wüstenhagen & Menichetti, 2012). If a company wants renewable energy projects in their portfolio they might accept lower returns or higher risks. Furthermore the latter variable is relevant for this research because it is relevant to see if investors prefer to invest in substitute projects (NLII, 2014). Substitute projects relate to other (energy generating) projects that are, for whatever reason more attractive for investors than Dutch offshore wind projects. A reason could be that e.g. the current regulatory regime in the Netherlands is a barrier for institutional investors to invest and that they therefore prefer project abroad due to the more favorable international regulatory regimes. Another reason could be that solar or wind onshore projects are perceived to be more favorable and that therefore investors are less willing to invest in offshore wind projects. Therefore substitute projects were also taking into account when constructing the causal loop diagram. The variables "Focus on ESG" and "Substitute projects" both also strongly relate to the variables "Perceived risk capital providers" and "Expected return project owner". Because of their interconnectedness with both variables, they cannot be categorized in one of either categories. Therefore it was chosen to not categorize these two variables and to directly link them to the end-variable. This is merely a design choice.

The causal loop diagram is shown in Figure 10[25]. For the overview of the variables that were used to create the causal loop diagram see Appendix E.

5.1.3. Explanation of the categorization of the variables

The variables that are presented in Figure 10 have different colors. These different colors represent different categories. The variables are categorized so it would be more easy to consolidate the causal loop diagram into a more readable and clarifying theoretical model. Furthermore by giving the variables different colors it becomes more easy to see how the conceptual theoretical model is actually constructed out of the causal loop diagram. The variables were clustered into three categories: return related variables, risk related variables and finance related variables. First of all, a significant amount of the variables that are shown in the causal loop diagram directly or indirectly link to the dependent variable "Perceived risk capital providers" and/or to the variable "Expected return capital providers". Therefore all the variables that link to the variable "Perceived risk capital providers" were categorized into the category "Risk related variables" and all the variables that link to the variable "Expected return capital providers" were placed into the category "Return related variables". The risk related

[25] Eventually the relations that are shown in Figure 10 were all distilled from the following scientific and non-scientific literature: Della Croce, Kaminker, & Stewart (2011); EWEA (2013); Freshfields Bruckhaus Deringer (2014); Masini & Menichetti (2012); NLII (2014); PwC (2011); SER (2013); Standard & Poor's (2011); Wiser & Kahn (1996); Wiser & Pickle (1998) and Wüstenhagen and Menichetti (2012).

variables were all colored red and the return related variables received the color orange. Next to these categories many other variables link via the variable “Weighted average cost of capital” or “Project cost” to the variable “Bankability offshore wind projects for institutional investors”. All these variables directly or indirectly relate to the financial structure and cost of the projects. Therefore these variables were clustered into the category called “Finance related variables”. All the finance related variables are colored black. Three variables are not categorized and colored. As it is shown in Figure 10, two of these variables are directly linked to the end-variable and one variable has directly effect on both the risk and return variable. Therefore these variables are not categorized in one of the three categories.

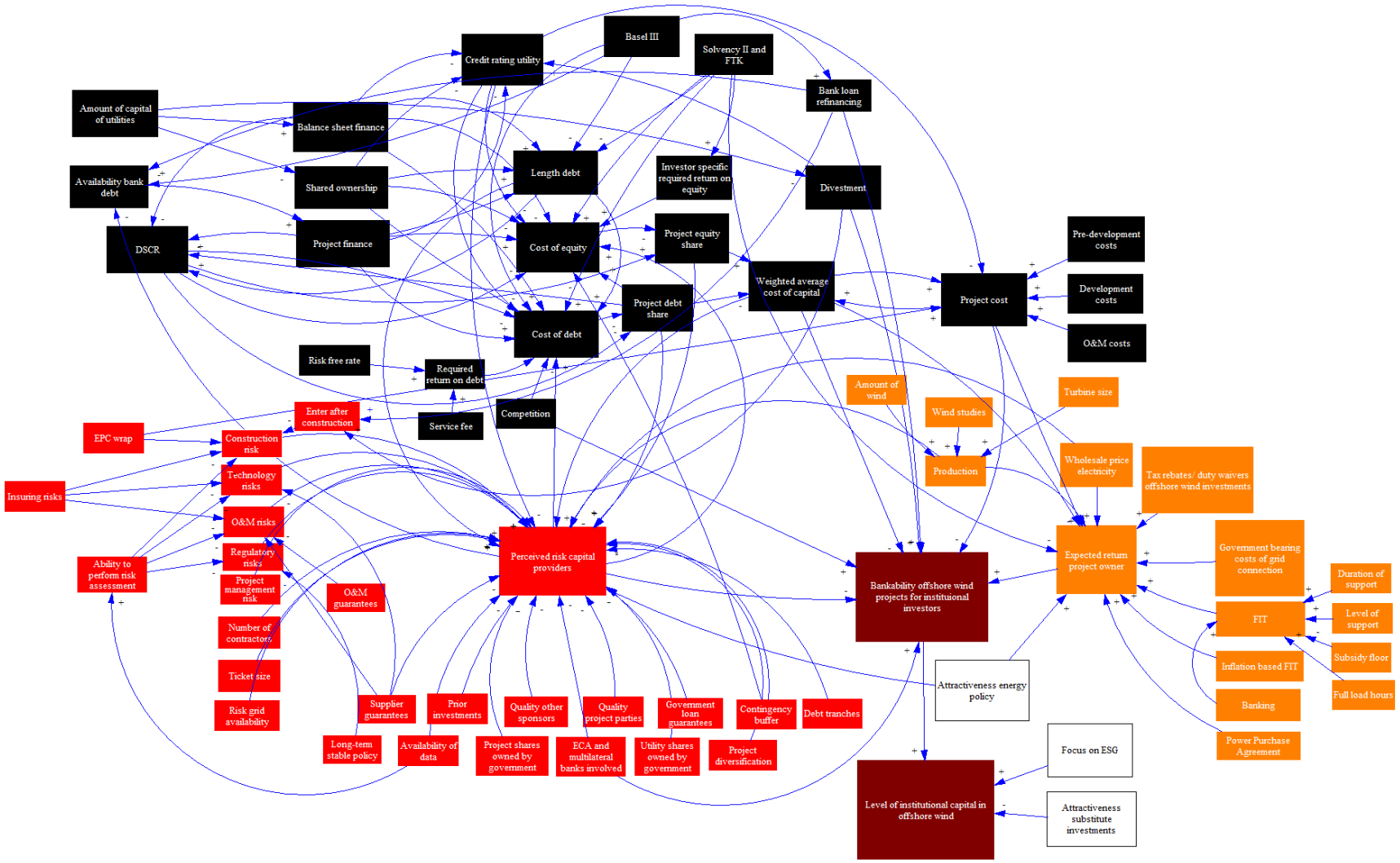

Figure 10 Conceptual causal loop diagram

5.1. Conceptual theoretical model

After the causal loop diagram was constructed the information was consolidated and clustered into a conceptual theoretical model. The conceptual theoretical model is merely a simple and different representation of the causal loop diagram. The most important variables of the causal loop diagram together with the variables of the interim model are placed in the conceptual theoretical model. The most important variables of the causal loop diagram are the dependent variables have effect on the variable "Bankability of offshore wind projects for institutional investors" or the independent variables that have effect on the end-variable "Level of institutional capital in offshore wind"[26]. The independent variables will be removed except the independent variables that were also shown in the interim model and the independent variables that have direct effect on the end-variable. The conceptual theoretical model therefore shows the core of the causal loop diagram (and the causal loop diagram builds on the knowledge that is presented in the interim model). The colors of the variables that are presented in the causal loop diagram coincide with the colors of the categories that are shown in the conceptual theoretical model (see Figure 10 and Figure 11).

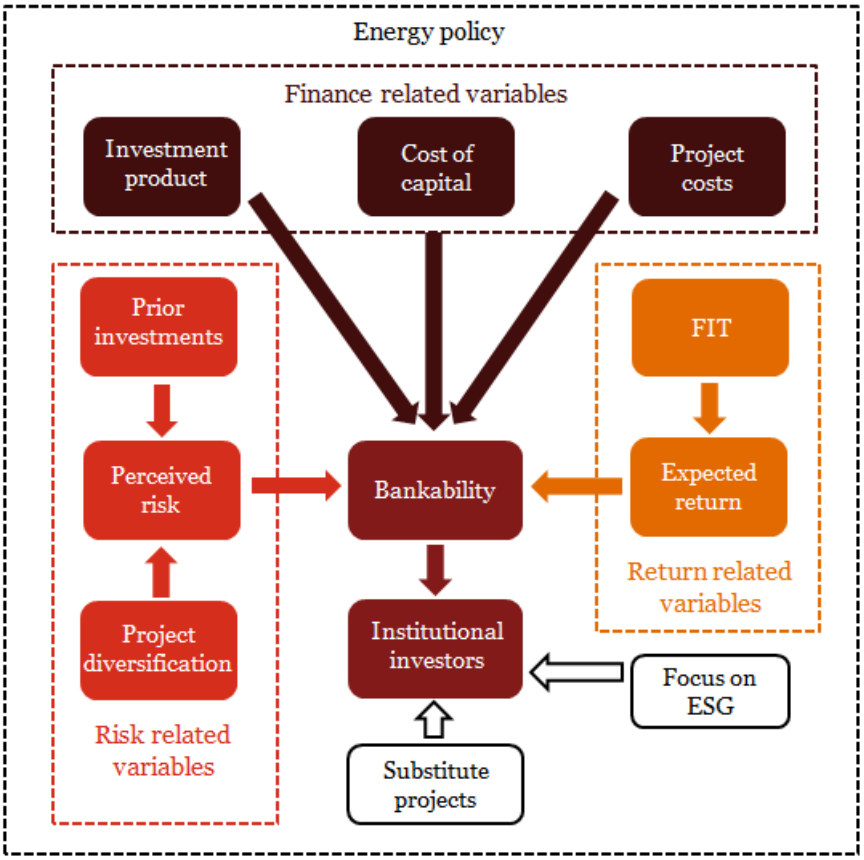

Figure 11 Conceptual theoretical model

As mentioned before the variables of the causal loop diagram are clustered into three categories: risk related variables, return related variables and finance related variables. In the conceptual theoretical model the same classification is used. Furthermore, just like in the causal loop diagram, two variables, "Substitute projects" and "Focus on ESG" are not categorized. In the next section the logic behind including the different variables in this model will be explained. Because the variables closely relate to

[26] The variable "Investment product" was not mentioned in the causal loop diagram, this variable is the only exception. In this chapter it will be explained why this variable was also included into the conceptual theoretical model.

the variables of the causal loop diagram, the causal loop diagram will be used to justify and explain the conceptual theoretical model.

The *finance related variables* include three variables namely: "Investment product", "Cost of capital[27]" and "Project costs" (see Figure 11). The variable "Investment product" has not been directly mentioned in the causal loop diagram. However according to our desk research in chapter 4, institutional investors certainly have a preferences for a particular type of investment product (e.g. senior debt, bonds, direct equity or indirect equity[28]) and also for a particular time when they enter the agreement (in the pre-construction, construction phase or operational phase of the project). These preferences show that it matters for institutional investors how projects are structured and in what kind of investment products they can invest in (institutional investors are used to invest in rated and reliable fixed income products or in equity shares of stable high rated companies). Therefore the variable "Investment product" was included in this figure. The variable "Cost of capital" is a contradicting variable. If this variable increases this would rationally lead to higher overall costs which subsequently will have a negative effect on the variable "Bankability offshore wind projects for institutional investors". This is due to the fact that a higher cost of capital leads to larger financial obligations. If the project owners have large financial obligations the chance of default will increase. However, capital providers want a high return on equity or debt themselves but they do not want other capital providers to have a high return on equity or debt as well. If the variable "Project costs" increases, the total financial obligations increase as well. This lead to a higher chance of default and therefore in the causal loop diagram the variable "Project costs" is negatively related to the variable "Bankability of offshore wind projects for institutional investors". Furthermore bankability relates to the ability to find appropriate amounts of debt and equity for the proposed project. The more expensive a project is, the more capital needs to be found to finance these projects. An increase in the financing burden therefore rimes with an increase of the commitment of financers and therefore it can be stated that if the project costs increase, this will lead to a decrease in the bankability of offshore wind projects.

The *risk related variables* include three variables: "Perceived risk", "Project diversification" and "Prior investments" (see Figure 11). If in the causal loop diagram the variable "Perceived risk capital providers" increases the variable "Bankability offshore wind projects for institutional investors" decreases. This makes sense in the way that if projects have a high perceived risk it becomes more difficult to attract a sufficient amount of capital which lead to a decrease of the bankability of the project. The second variable which is included into the conceptual theoretical model is the variable "Project diversification". It is expected that if the offshore wind investment suits with the current portfolio of the investor, this will decrease the risks and therefore indirectly lead to a higher rate of institutional investors in offshore wind projects. Although it is not directly clear that this variable is one of the most important variables of the causal loop diagram (because it is a not a dependent variable that relies on many independent variables) this variable was included into the conceptual theoretical model. This was done because this variable was presented in the interim model and the interim model relied on the well-validated and reviewed study of Wüstenhagen and Menichetti. The same accounts for the variable "Prior investments". Merely looking at the causal loop diagram it is not directly clear that this variable is one of the most important variables and that therefore this should be included into the conceptual theoretical model. However, this variable was included into the interim model because this variable was also shown in the model of Wüstenhagen and Menichetti. Because the conceptual theoretical model is merely a representation of the theory that is available, and that at this stage of the research no relative importance between the variables can be shown, the previous two

[27] In the causal loop diagram this variable was called "weighted average cost of capital". For the graphical representation this was shortened into "cost of capital" again. These variables do not have a different meaning.

[28] The possible different debt and equity products are not shown in the causal loop diagram. This is also difficult to include because these financial related preferences are company specific and therefore a positive relation between two financial related variables for one company could be a negative relation for another company.

variables were included into the model. After interviews have been performed it should be more clear which variables are really the most important variables for this particular study and which variables therefore should be included into the final theoretical model.

The *return related variables* include two variables: “Expected return” and “FIT”. If the expected return of the project increases this will directly lead to higher returns for institutional investors in the case of equity investments. In the case of debt investments the return of institutional investors relies on the debt rate and not on the offshore wind project return. However an increased project return leads to more liquidity for the project owners so they will be more able to pay the principle and rent payments to the issuer of the loan. Furthermore if the project return is higher, institutional investors might be able to get better financing conditions e.g. a higher debt rate which directly leads to a higher return for institutional investors (in the case they invest in debt). All the variables of the interim model are included into the conceptual theoretical model. Therefore the FIT is included into the conceptual theoretical model. The FIT is important because it represents the level of the guaranteed income of the electricity that will be generated. A higher FIT leads to a higher income of the project, which again lead to more capital that will be available to pay the debt holders and to more profits. This again results into an increase of the bankability of the projects.

Two variables are included into the conceptual theoretical model that are not categorized. These variables are: “Substitute projects” and “Focus on ESG”. The justification of including these variables in the causal loop diagram is presented in section 5.1.1. These variables are also included into the conceptual theoretical model because these are the only variables that, according the references that were used, directly related to the end-variable.

The last thing that needs to be explained is the “energy policy” which is presented in the conceptual theoretical model. In the model of Wüstenhagen and Menichetti (2012) the energy policy has effect on the perceived risk and expected return (see Figure 3). This is also how the policy context was incorporated into the causal loop diagram (see the variable “effectiveness energy policy” in Figure 10). In the causal loop diagram the variable “attractiveness energy policy” has a positive effect on the variable “expected return project owner” and a negative effect on the variable “perceived risk capital provider”. However more energy policy related variables are included in the model which are also linked to the financial, risk and return characteristics. Therefore in the conceptual model the policy variables were all clustered and called “energy policy”. The location of this variable indicates that it has influence on all the different variables.

As has probably been noticed before, the names of the different variables presented in the causal loop diagram are sometimes slightly different than the names in the conceptual model. Mainly for the graphical representation of the conceptual model the names of the variables are shortened. Appendix F presents the terminologies that are used in the causal loop diagram and the conceptual model and that indicate the same variables.

5.2. Conclusion

The literature review study provided information that was needed to create the causal loop diagram. In the causal loop diagram certain barriers, but also mitigation strategies were presented. So based on the causal loop diagram sub question 2 and 3 could be answered.

Sub question 2: *What are the theoretical investment barriers for institutional investors in offshore wind and what are the factors that have influence on these barriers?*

There are different barriers that lead to the fact that institutional investors are reluctant to invest in offshore wind projects. The barriers are the variables that directly or indirectly have a negative effect on the variable “Bankability offshore wind projects for institutional investors” or on the end-variable. The barriers are categorized in the same way as the categorization of the conceptual causal loop diagram and the conceptual theoretical model. The barriers are shown in Table 8.

Table 8 Overview of the answer to sub question 2

Theoretical investment barriers	Which variables have influence on the barriers
Substitute projects	–
Finance related barriers	LIBOR – There is a low risk free rate (e.g. LIBOR) which make debt investments unattractive
Finance related barriers	Competition – Due to competition the debt rates decrease
Finance related barriers	Solvency II – Due to Solvency II insurance companies need to have large capital reserves
Finance related barriers	Investment product – Institutional investors have a preferences for typical investments products, these products need to be available
Return related barriers	FIT – The characteristics of the FIT are not optimal and the specifications are too uncertain
Return related barriers	Full load hours – The full load hours do not stimulate project owners to exceed the production estimations
Return related barriers	Subsidy floor – A subsidy floor leads to profit uncertainties. Due to the low electricity prices this becomes more severe
Return related barriers	Wholesale price electricity – Wholesale electricity price is currently very low
Return related barriers	Production – The production is unpredictable due to the unpredictability of the amount of wind and the contingencies that can occur during the construction and utilization phase
Risk related barriers	Construction risk – Construction risks demotivate institutional investors to invest
Risk related barriers	Technology risk – Technology risks demotivate institutional investors to invest
Risk related barriers	Operation & Maintenance (O&M) risk – O&M risks demotivate institutional investors to invest
Risk related barriers	Regulatory risk – Regulatory risks demotivate institutional investors to invest
Risk related barriers	Project management risk – Project management risks demotivate institutional investors to invest
Risk related barriers	Risk grid availability – It is a risk that the grid is not yet ready at the time the windfarm could be operational
Risk related barriers	Ability to perform risk assessment – The lack of ability to perform risk assessments demotivate institutional investors to invest. This lack of ability could be due to a lack of skills, a lack of people or a lack of availability of relevant data

Subsequently the causal loop diagram can also give answer to sub question 3.

Sub question 3: *How can theoretically the investment barriers be removed?*

There are different ways to mitigation the barriers that institutional investors encounter when they want to invest in offshore wind projects. The mitigation strategies that were found in the literature study and that were included in the causal loop diagram are shown in Table 9.

Table 9 Overview of the answer to sub question 3

Barriers	Mitigation strategies
Risk related barriers and return related barriers	Increase of the focus on ESG criteria
Financial related barriers - Investment product	Restructure the investments into products that institutional investors prefer
Return related barriers - FIT	Increase of the duration or the height of the FIT
Return related barriers - FIT	Introduction of inflation based FIT
Return related barriers – Expected return project owner	Introduction of tax rebates or duty waivers
Return related barriers - Full load hours	Introduction of banking for offshore wind projects

Return related barriers - Production	Increase of focus on wind studies
Return related barriers - Wholesale electricity price	Arrangement of long-term PPA contract and find ways to increase the value or the duration of the PPA
Risk related barriers - Construction risk, technology risks, O&M risks	Insuring construction, technology and/or O&M risks
Risk related barriers - Technology risks, O&M risks	Arrangement of supplier guarantees
Risk related barriers - O&M risks	Arrangement of O&M guarantees
Risk related barriers - O&M risk	Arrangement of long-term O&M contract
Risk related barriers - Regulatory risk	Long-term consistent and predictable regulatory arrangements
Risk related barriers - Construction risk	Possibility to carve out construction risk via e.g. an EPC-wrap or an insurance
Risk related barriers - Construction risk	Entrance of institutional investors after the construction phase. This could be done by refinancing current loans or by buying divestment stakes after the construction phase
Risk related barriers - Perceived risk capital provider	Increase diversification
Risk related barriers - Perceived risk capital provider	Create a contingency buffer. This could be done by creating different loan tranches leading to a debt cushion in the case problems occur (for an increase of security organization like ECAs, multilateral banks or governments could help creating different tranches)
Risk related barriers – Project management risk	Government buys equity share in project
Risk related barriers - Project management risk	Limit the number of contractors during the construction
Risk related barriers - Project management risk	Selecting good rated and stable project parties and other sponsors

6. Characteristics, barriers and preferred mitigation strategies of Dutch stakeholders

In this chapter the information gathered from the interviews will be discussed and sub question 4 and 5 will be answered. The previous chapters provided a clear picture about the offshore wind financing market and the barriers and mitigations strategies that have effect on whether institutional investors will or will not invest in offshore wind project. This chapter presents an overview of the situation that is present in the Netherlands. Paragraph 6.1. and 6.2. are introductory and the rest of this chapter presents the answers of the interview questions. The answers of the different interview questions will be discussed anonymously and on a company level. Subsequently the information will be used to validate, modify and supplement the conceptual causal loop diagram and theoretical model, this will be done in chapter 0.

6.1. Obtaining the information from the interviews

The interview questions were constructed in such a way that the answers could be used to validate the conceptual causal loop diagram and the conceptual theoretical model, and that the information that was obtained from the interviews could be used to answer the research questions. Different questions were asked to the different stakeholders. The interviews with the institutional investors were directly used to validate the models and to help answering the research questions. The interviews with the utilities were conducted to see if there currently is a need for institutional capital and to find out if utilities are aware of the barriers that institutional investors face and the mitigation strategies that they prefer. It is useful for this research to find out if the ideas of utilities and institutional investors regarding the investment problems coincide. The NLII conducted interviews with institutional investors regarding this topic and therefore the NLII was asked, as being one of the experts, to give their opinion about the investment problems and preferred mitigation strategies. The NLII was also asked what they thought their role should be in stimulating institutional investors to invest. The ministry of Economic Affairs was interviewed to provide information about their role and possibilities to mitigate investment uncertainties and to divagate about the new tender procedure and the new role of TenneT in constructing the offshore grid. Table 10 briefly shows the interview structure that was created and the specific reason why the interviews were conducted is also explained in the table. An overview of the interview questions that were asked is shown in Appendix B.

Table 10 Interview questionnaire structure and goals of the different interview target groups

	Institutional investors	**Energy utilities**	**NLII**	**Ministry of Economic Affairs**
Interview structure	Introduction	Introduction	Introduction	Introduction
	Experience in financing offshore wind projects and composition of current portfolio	External financing need from a utility perspective	Estimated external financing need	New tender procedure offshore wind
	Financial investment preferences	Preferences financial structuring of projects	Expected barriers of institutional investors to invest	New subsidy regime offshore wind
	Investment barriers	Expected barriers of institutional investors to invest	Expected preferred mitigation strategies of institutional investors	Role of TenneT
	Mitigation strategies	Expected preferred mitigation strategies of institutional investors and	Effect of institutional investors for reaching the targets	Governmental possibilities to mitigate investment

		the willingness of utilities in helping to mitigating the risks of institutional investors		uncertainties and risks
	Expected effect that institutional can have on reaching the targets	Expected effect of institutional investors for reaching the targets	Potential different roles of the NLII	
	Influence of Solvency II and FTK	Advantage involvement institutional investors in pre-financing phase		
	Effect of substitute projects	Attractiveness of developing abroad instead of in the Netherlands		
	Corporate social responsibility policy	Experience with cooperating with institutional investors		
	Possible policy adaptations and preferred role of NLII	Policy adaptations and preferred role of NLII		
Goal	Obtain information from the perspective of institutional investors with the means to adapt, complement and validate the causal loop diagram and to answer the research questions	Obtain information from the perspective of utilities with the means to adapt, complement and validate the causal loop diagram and to answer the research questions	Obtain expert knowledge with the means to obtain additional information and to adapt, complement and validate the causal loop diagram	Obtain policy information and information from the perspective of the government with the means to adapt, complement and validate the causal loop diagram
Number of interviews	8	5	1	1

6.2. First notification that should be made

As is shown in Table 10, fifteen interviews were performed for this study. After the interviews were conducted it was concluded that some information would be lost if pension fund and insurance companies would not be analyzed independently. In the literature review study also often the umbrella-term institutional investors was used due to the fact that both insurance companies as well as pension funds are traditional investors, with usually a lot of assets under management (AuM) and long-term obligations towards their customers. However when looking at the ability of pension funds and insurance companies regarding offshore wind investments, there are significant differences. The regulatory regime is fairly different (pension funds need to comply with the FTK while insurance companies need to comply with Solvency II), the possible investment capacity is different and the obligations towards their clients are also different. Therefore it was decided that from now on pension funds and insurance companies will be mentioned and analyzed independently where necessary.

6.3. Experience and engagement of institutional investors regarding offshore wind investments

The interviews showed that Dutch pension funds and institutional investors have very limited experience in investing in offshore wind farms. Direct offshore wind investments require knowledgeability. Therefore the few firms that have done offshore wind investments in the past, usually allocated capital to a private equity (PE) investor or they invested in funds that were managed by other parties. This results that regarding the fact that some companies have invested in offshore wind projects, the learning curve is not steep because most of the firms outsourced their investments. Currently some parties are looking to change this policy and to place direct offshore wind investments. Direct investments have the advantage that the investor can have more control over the assets selection and direct investments can lead to higher margins because you cut out the middle man. To do direct investments you however need to have a dedicated team for infrastructure investments (offshore wind investments are usually classified under infrastructure investments) or at least some experts need to be present. Due to scalability this is only profitable for the larger companies that can allocate significant amounts to offshore wind. Figure 12 shows that only one firm has experience in

placing a direct investment in an offshore wind park, this was also merely one investment. Furthermore the majority of institutional investors have not invested in offshore wind projects yet. In general pension funds have more experience in investing in offshore wind projects than insurance companies (see Figure 12). The parties that have experience in allocating capital towards offshore wind projects are in general more positive and open towards these investments. This coincides with the model of Wüstenhagen and Menichetti and this also partly confirms the conceptual causal loop diagram and theoretical model. Not all the previous Dutch offshore wind investments turned out to be good investments. This is remarkable because still these more experienced offshore wind investors are the parties that stated that they are looking for new offshore wind projects to invest in.

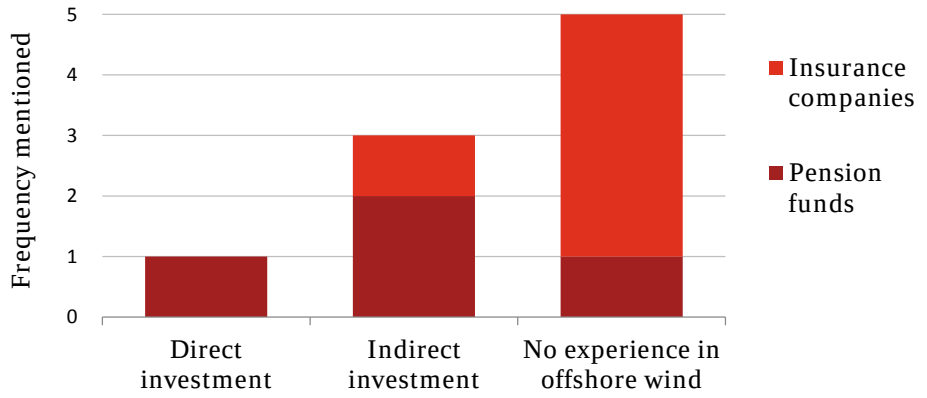

Figure 12 Experience of institutional investors in offshore wind assets

Utilities were also interviewed and they were asked whether they had experience with including Dutch pension funds and insurance companies in the financing process of their offshore wind parks. Only Dong stated that they have had contact with a Dutch pension fund regarding the financing process of offshore wind parks. None of the other utilities that were interviewed had direct contact with Dutch pension funds or insurance companies. Some utilities stated that Dutch institutional investors sometimes publically state that they are interested in financing offshore wind parks, but that they eventually do not want to invest because of the perceived risks. This leads to the fact that there is very limited contact between utilities and Dutch institutional investors and this is not stimulating the learning curve and the experience of Dutch institutional investors regarding offshore wind investments.

Banks are often the financial facilitator. Some institutional investors stated that they have been contacted by banks regarding financing renewable energy projects. However due to the difficulty and specific characteristics of these type of investments, the investor must have large confidence in the counter party. This is limitedly stimulated if institutional investors only have indirect contact with the project developers.

6.4. Financial technical preferences of Dutch institutional investors

Pension funds and insurance companies were asked how their ideally structured investment would look like. First off all they mentioned that this is difficult to state because all the propositions are tailor-made and the preferences are closely linked to the project specifications. Fortunately it was possible to collect some data regarding the financial preferences. The answers to the interview questions regarding the financial technical preferences of the interviewees is presented in this section.

6.4.1. The Dutch preference for equity or debt investments

Most of the companies merely have a mandate to either invest in equity or in debt. This is shown in Figure 13[29]. It is interesting to see that most of the insurance companies prefer debt investments (only one insurance company merely had an equity mandate for renewable energy projects) while two out of three pension funds preferred equity investments. The two pension funds that have the most knowledge regarding offshore wind investments, and that have a dedicated infrastructure team, both prefer to invest in equity. There are currently higher margins on equity investments, however companies need to have more in-debt knowledge to correctly assess these equity investments. Currently only parties who have a mandate to invest in equity have invested in offshore wind projects yet.

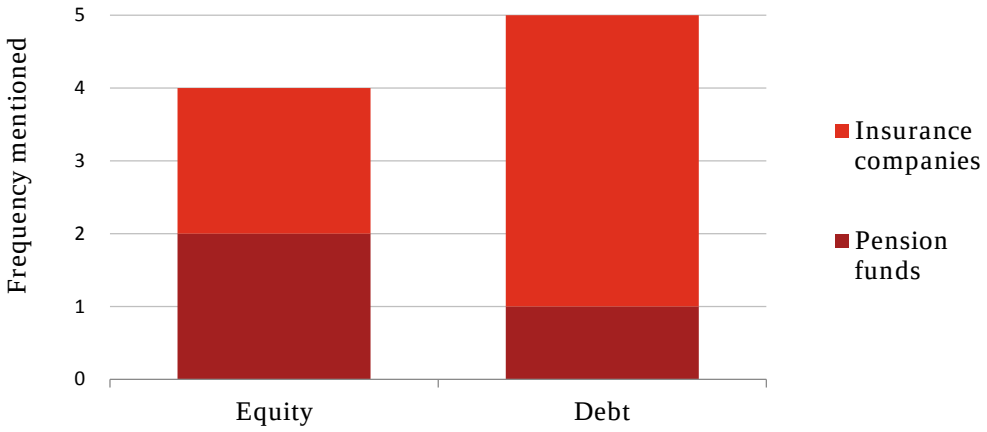

Figure 13 Preferred investment class (equity or debt)

6.4.2. The Dutch preferred ticket size

Most of the companies that were interviewed had a minimum and/or maximum investment size per project. An overview of the answers is presented in Table 11.

Preferred investment size							
		Equity (€ mil.)		Debt (€ mil.)		Unknown	Extra notes
		Min	Max	Min	Max		
Pension funds (PF)	PF 1					X	
	PF 2	150	600				
	PF 3	100	400				
Insurance companies (IC)	IC 1			50	200		
	IC 2			30	150		
	IC 3		5% total project equity	10	50		Dependent on credit rating
	IC 4			20	30		
	IC 5					X	

[29] There was one insurance company that could provide equity and debt.

Table 11 Preferred investment size of institutional investors regarding offshore wind

The amount of capital that pension funds are able to allocate to offshore wind projects are in general significantly larger than the amount that insurance companies can invest (in general pension funds also have more AuM). Furthermore two companies were not able to state their preferred investment size. They mentioned that it completely depends on the characteristics of the proposition. However this also implies that these companies do not yet have a strict policy or mandate regarding offshore wind investments (or these companies did not want to expose their strategy/policy). This can cause investment difficulties or delays at the moment profitable projects occur.

6.4.3. The Dutch preference for balance sheet finance or project finance

During the interviews utilities were asked whether they prefer to develop their offshore wind projects with balance sheet or with project finance. Subsequently institutional investors were asked whether they prefer to invest in a balance sheet financed offshore wind project, or in a project financed offshore wind project. All the utilities mentioned that they have a preference for balance sheet finance because this is generally more cost efficient than project finance (the costs for corporate loans are generally lower than the costs for project loans and third party equity[30]). However four out of five utilities mentioned that they, now or in the near future, also need to use project finance structures to develop their offshore wind projects. They mentioned that the projects are becoming significant larger while their balance sheets are declining and therefore they also need to look at project finance or shared ownership structures. The preferences of the institutional investors are shown in Table 12. One pension fund and one insurance company mentioned that they prefer a project that is financed on the balance sheets of the developer. Their underlying reason was that they want a financial strong partner where they can collect their money in the case contingencies occur. In project finance, there is usually merely a small percentage of equity available (e.g. 30% or 40%), so in the case of contingencies this is the only recourse equity there is where the debt providers can lay a claim to. The investors that mentioned that they prefer project finance structures like this because in project finance structures the liabilities can be more easily registered, and it is easier to build in contingency buffers and certainties. Because in the near future utilities are more willing to develop wind parks with project finance, it is expected that the preference for a particular project structure is not a problem that impedes the cooperation between utilities and institutional investors.

Table 12 Preferred project structure

		Preferred project structure
Pension funds (PF)	PF 1	Balance sheet finance
	PF 2	Project finance or balance sheet finance
	PF 3	Project finance or balance sheet finance
Insurance companies (IC)	IC 1	Project finance
	IC 2	Project finance
	IC 3	Balance sheet finance
	IC 4	Project finance
	IC 5	Unknown

[30] Equity that comes from other parties than the utility (or other company) that develops the projects is called third party equity

6.4.4. The Dutch ability to finance the construction phase

In the literature it is often stated that institutional investors are currently reluctant to finance the construction phase of offshore wind projects (inter alia: Freshfields Bruckhaus Deringer, 2014). The Dutch interviewees were asked whether this is correct or not. Two pension funds and one insurance company stated that, obviously under the right circumstances, financing the construction phase would not be a problem. One pension fund and three insurance companies stated that they indeed currently are not able to finance the construction phase. However, three insurance companies weakened this statement by mentioning that there might be possibilities to finance the construction phase but that they either have not yet looked into the option, or that they currently do not have the knowledge to assess the construction risks. One pension fund mentioned that they are at this moment not willing to finance the construction phase and one insurance company did not know if this would be an option or not. For an overview see Table 13. Table 13 suggests that there are quite a few institutional investors that are actually open to also finance the construction phase. This shows a different picture than was presented in the literature review study. Furthermore the utilities that were interviewed also assumed that institutional investors are not likely parties that want to invest in the construction phase. It therefore seems that on this point there is information asymmetry between institutional investors and utilities

Table 13 The possibility of institutional investors to finance the construction phase

		Finance the construction phase?
Pension funds (PF)	PF 1	No
	PF 2	Yes
	PF 3	Yes
Insurance companies (IC)	IC 1	No, but they are open to assess the possibility
	IC 2	Yes
	IC 3	No, but there might be a possibly to finance a limited part of the construction phase
	IC 4	No, but if they can lift on the experience of others this might be a possibility
	IC 5	Unknown

6.4.5. The Dutch investment horizon

Literature shows that institutional investors are seen as interesting parties to finance offshore wind project, partly due to their long investment horizon (EWEA, 2013). During the interviews the Dutch institutional investors were asked to verify this statement by stating their preference for the preferred length of the loan or equity stake. The two pension funds that have prior experience in investing in offshore wind products, have a concrete policy and a particular mandate for the length of the investments. The other parties stated that they are able to finance the projects for at least the amount of years that are stated in Table 14. The number of years stated in Table 14 roughly coincides with the information that was found in the literature review study. Also the Dutch institutional investors are generally willing to invest for 15 years or more (in the case they decide to invest in offshore wind)[31]. One remark should be made. Solvency II might limit insurance companies to have long-term debt

[31] There is one exception. This exception did not mention why their preferred investment period is less long. It is however known that this company is focusing on investing in certain renewable energy investment products like investment funds and the usual investment periods of these funds is less long. It is assumed that this is the reason why their preferred investment length does not coincide with the preference of the other investors.

loans. Currently for non-rated infrastructure projects, insurance companies must hold a capital charge of 3% per year. If this stays the same they might shorten their investment horizon. But currently the preferred length of the investments are as high as shown in the table below.

Table 14 Preferred length of the debt or equity investments

		Preferred length (in years) debt/equity
Pension funds (PF)	PF 1	Unknown
	PF 2	20
	PF 3	16-20
Insurance companies (IC)	IC 1	15
	IC 2	15
	IC 3	7-10
	IC 4	20
	IC 5	Unknown

6.4.6. The required return on investment for Dutch investors

One interview question was regarding the required return of the projects. This information however was difficult to obtain. The institutional investors stated that this relied too much on all the different variables of the propositions like: the type of investment product, the way the risks are mitigated and the severity of the risks that are still present. The required return is also different for a refinancing deal than for a pre-construction deal. Three interviewees gave concrete answers. They stated: “We need an IRR of 8-10% (equity)”, “we need a return of double digits (equity)” and “we still need decide the required IRR for this asset class”. The three parties that gave concrete answers on this question were all parties that want to invest equity.

6.4.7. The Dutch preferences are diverse

The answers of the interviewees indicated that there is little consistency regarding the financial preferences of institutional investors:

- Some institutional investors only have a mandate to invest in equity, others only in debt and one party can invest in both
- Some institutional investors are only able to invest a small amount while others did not think it is worth investing if the investment size is less than €100 million
- Some institutional investors prefer balance sheet financing, others prefer project financing
- Some institutional investors are willing to invest in the construction phase, other parties stated that they cannot invest in the construction phase
- Some institutional investors stated that they are only willing to invest if they would receive double digit returns, other parties stated that it is impossible to say what their required return should be because the IRR is directly linked to the project specifications.

The only consistency was regarding the investment horizon. There was only one party that stated that they prefer to have an investment horizon of 7 to 10 years, all the others stated that they have long (15 years plus) investment horizons.

Most of the insurance companies and pension funds stated that these financing characteristics are secondary to the project specifications and the contractual specifications. They mentioned that the liabilities of the project partners and the investors should be very clear and that the risks should contractually be clear and mitigated (e.g. via insurances). If the projects are structured correctly and if the project partners are trustworthy partners, then investors will look at the specific financial

technical specifications. Most of the companies said that they are flexible in the financial technical preferences as long as the projects are organized correctly.

6.5. Barriers

During the interviews the institutional investors were asked to state the five most important barriers that hinders them to invest in offshore wind projects. To see if utilities are aware of these barriers, they were also asked to state, what they thought would be, the five most important barriers of institutional investors to invest in offshore wind projects. In the follow-up question the respondents were asked to rank the barriers from important to less important. In the causal loop diagram no information is stated regarding the mutual importance of the barriers that are presented, this additional information could be obtained by asking this follow-up. However none of the institutional investors were able to come up with a ranked list of the five most important barriers. Most of the times only two or three barriers were mentioned. This gave a clear indication of the level of knowledge of most institutional investors regarding offshore wind investments. The type of barriers that were mentioned relied on whether the investors have a mandate to invest in equity or debt and whether they are able to invest in the construction phase or not. This needs to be taken into account because this partly explains why institutional investors mentioned different barriers and also later on different mitigation strategies.

In this chapter the answers of interview question regarding the barriers are summarized. Because not many different barriers were mentioned by the interviewees they all will be presented in this chapter. In total merely nine different barriers were mentioned during the interviews namely:

- Lack of knowledge
- Investment product
- Solvency II
- Construction risk
- Technical risks
- Regulatory risk
- Lead time
- Returns are too low
- Merchant tail

After the barriers were identified they were categorized so they could more easily be analyzed, compared and used to validate the already constructed conceptual causal loop diagram and theoretical model. The categorization of the barriers was done in the same way as the categorization of the variables in the causal loop diagram. Some barriers were already mentioned in the causal loop diagram, these barriers were categorized in the same way as the corresponding variables from the causal loop diagram. Other barriers could be linked to a variable of the causal loop diagram, these barriers were categorized in the category of the variable they were linked to.

The variables of the conceptual causal loop diagram and the theoretical were initially divided into three categories: finance related variables, risk related variables and return related variables. The barriers are clustered into the same categories: finance related barriers, risk related barriers and return related barriers. All the barriers that were mentioned could be grouped into these categories with an exception of the barrier “Lack of knowledge”. As will be mentioned in the next paragraphs, this barrier is severe and therefore it was decided that next to the already established categories a new category, knowledge related barriers, was introduced. In the following paragraphs the different barriers per category will be explained.

Figure 14 presents an overview of the different barriers that were mentioned during the interviews and the number of times the barriers were mentioned by the different interviewees.

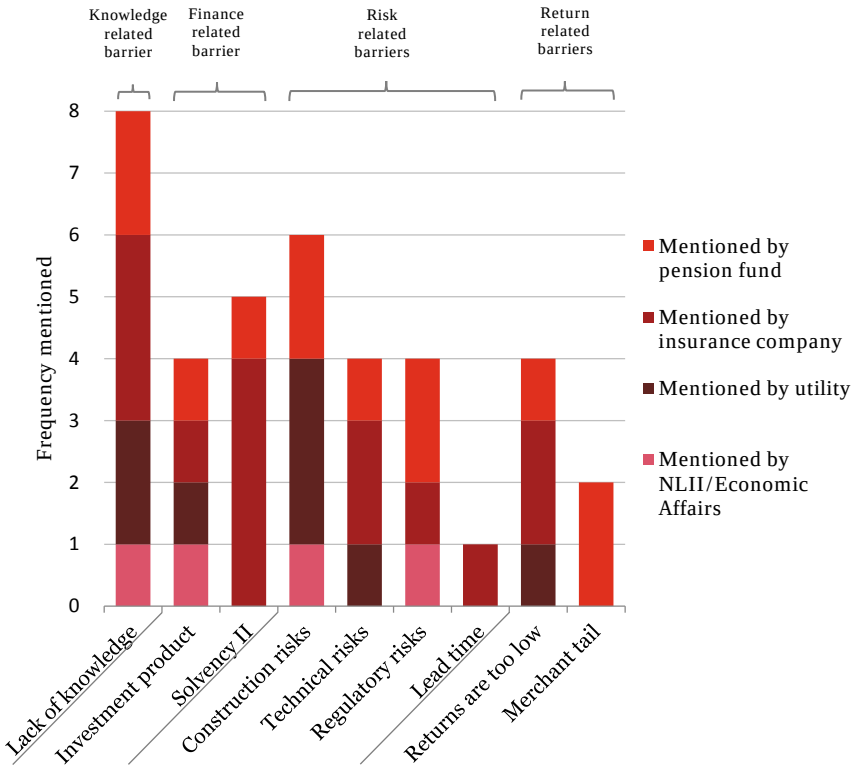

Figure 14 Barriers for institutional investors mentioned by different actors[32]

In the following sections the barriers are explained.

6.5.1. Knowledge related barrier

Figure 15 shows the knowledge related barrier and the frequency that this barriers was mentioned by the different interviewees. The barrier "Lack of knowledge" is the barrier that is most often stated by the different interviewees (see Figure 14). It was often mentioned that institutional investors find it difficult to estimate and calculate the risks due to a lack of specified people (or due to the fact that they do not have enough people with the specified knowledge) and due to a lack of transparency by project developers regarding actual market data. One pension fund stated: "It is not the case that the risk return profile of offshore wind projects are not interesting for institutional investors, the problem is that the projects are too non-transparent which makes it unable to assess whether the projects have a good or bad risk return relation". It is a major problem that institutional investors generally have little knowledge concerning the specifications of offshore wind projects[33].

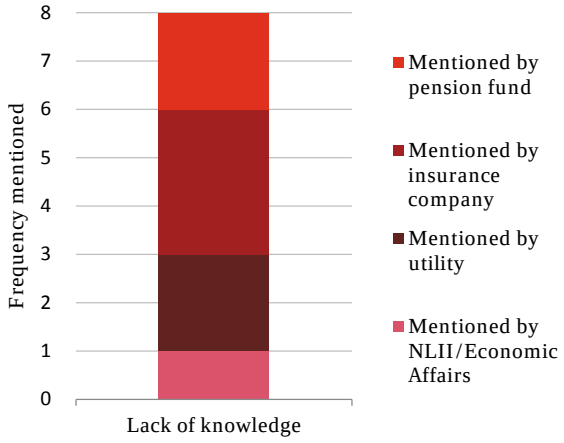

Figure 15 Knowledge barriers for institutional investors mentioned by different actors

[32] This implies that the barriers of utilities are not included in the figure. Utilities were asked what they thought the barriers of institutional investors are. So the utilities in this figure represent the answers of the utilities.

Due to this lack of knowledge some interviewees were also not able to state the reasons why they are reluctant to invest in offshore wind projects.

6.5.2. Finance related barriers

Figure 16 shows the different risk related barriers and the frequency that these barriers were mentioned by the different parties. Institutional investors have a long history of making investments in listed companies and in investment products like e.g. bonds, stocks or securities (see 4.1.4). The administration and the authorization process of these products have been standardized. Institutional investors are however in general unexperienced in making direct investments in infrastructure projects and especially in offshore wind projects. These projects are often unrated which makes the authorization process even more difficult and viscous. The fact that offshore wind investments are not always wrapped up in, for institutional investors, traditional investment products, makes it more difficult for them to make the investments. This is also strongly related to the knowledge barrier. The difficulty of investing in, for institutional investors unconventional investment products, relates to the fact that they are unexperienced and that they have too little knowledge regarding these investment products.

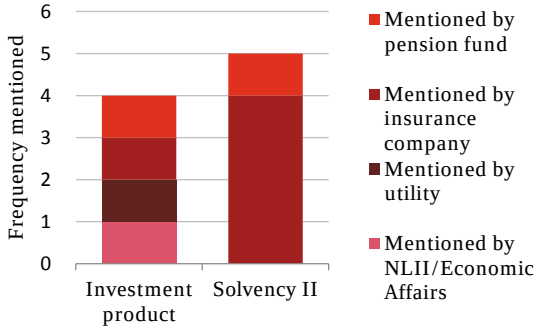

Figure 16 Finance related barriers for institutional investors mentioned by different actors

The second finance related barrier is Solvency II. This barrier is mentioned by four out of five insurance companies. Due to Solvency II, insurance companies are obliged to hold a large capital reserve. As mentioned before, Solvency II links the required capital charge to the risk of the portfolio. There is however not yet a specific (risk) classification for infrastructure projects and therefore companies need to hold the maximum capital charge. For offshore wind projects insurance companies must therefore currently hold a 3% capital charge per year. This implies that if an insurance company would provide a 10 year loan, the company must withhold a capital reserve as large as 30% of the total money that is lend to the project owners. This capital reserve cannot be used to make investments and therefore the offshore wind loan must compensate for the assets that need to be allocated as the capital reserve. Solvency II also requires a capital reserve for equity investments. This capital reserve is around 45-49% of the total investment[34]. Fortunately this capital reserve (and also the debt capital reserve) will be normalized relating to the other assets in the portfolio of the investor, and therefore the actual capital charge is usually around 50% lower, so for the previous example this would be around 23-25%. The Solvency II barrier is strongly related to the return related barriers. The profits of the projects must compensate for the difference in the capital charge between offshore wind projects and substitute projects.

Pension funds need to comply with the FTK. None of the interviewee stated that FTK was a barrier for them to invest in offshore wind products.

6.5.3. Risk related barriers

[33] There are a few exceptions. Some companies have dedicated infrastructure teams with the knowledge and capacity to assess offshore wind projects.
[34] This can change per insurance company. There is a standard Solvency II calculation method an a adjusted Solvency II calculation method. Large insurance companies can adapt the methodology to calculate their specific risks and therefore the capital reserve that they must hold. The Dutch regulator must first approve the newly proposed methodology. But this leads to the fact that different companies (because they have a different portfolio) can have different capital charges.

Figure 17 shows the different risk related barriers and the frequency that these barriers were mentioned by the different parties. The construction risk is perceived to be high. After the barrier "Lack of knowledge", this barrier was mentioned the most (together with the barrier "Solvency II"). Figure 17 imputes that especially pension funds, and the utilities, see the construction phase as a barrier for institutional investors. However it is interesting to notice that the firms that have experience in investing in offshore wind farms, or the firms that are more open in investing in offshore wind farms, also state that they are more likely to invest in the construction phase (as long as the liabilities are clear and the risks are contractually mitigated). This included one pension fund that stated that the construction risk is a barrier. This company mentioned that despite the fact that they believe it is an investment barrier, they are able to invest in the construction phase (see Table 13). The institutional investors that have stated that they are unable to invest in the construction phase were asked the follow-up question why they think other parties are able to do so. A typical answer that was given was: "these companies have already built up experience in this field and therefore these parties are more able to assess the risks". This implies that the construction risks are not per definition too high, but that this is a perceived risk that is again strongly related to the knowledge barrier. Table 13 shows that despite the construction is seen as a barrier, many investors are actually willing and able to invest during the construction phase.

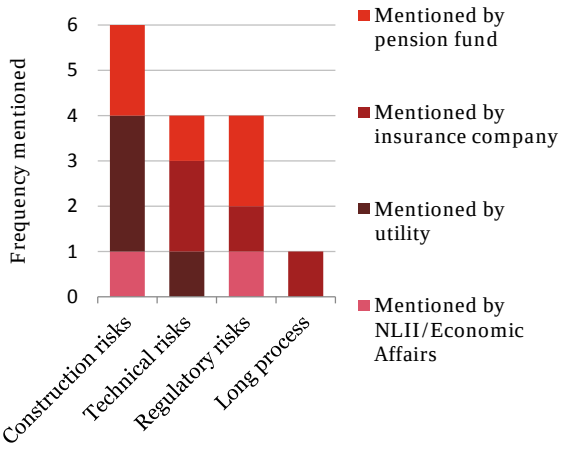

Figure 17 Risk barriers for institutional investors mentioned by different actors

The technology is still under development and this makes it difficult to assess the risks of the technology (even when qualified people are present). Therefore according to one pension fund, two insurance companies and one utility a technical barrier is present. Institutional investors are no venture capitalists and they are by nature risk-averse. Therefore they only want to invest in proven technologies. This leads to the fact that they are reluctant to invest in technologies that are still under development and that do not yet have a proven track record. Whether a technology is a proven technology or not is subjective to the perception of the firms. Institutional investors usually have "rules" regarding investments. One of these rules is that they only have a mandate to invest in proven technologies. Therefore next to the actual risks that come along with a new technology, there is sometimes also an administrative barrier. The institutional investors must first assign offshore wind as a proven technology. Generally the turbines are perceived not to be the main technical problem. But there are different technical risks like e.g. grouting failure, which means that interface problems occur between the different components in the foundation of the wind farm. This problem occurred at the Princes Amalia wind farm in the Netherlands (Telegraaf, 2015). In this situation the wind turbines are not 100% vertical anymore leading to a loss of efficiency and perhaps in extra future maintenance costs. This will drive down the margins of the wind farm owners. Furthermore there is a risk involved with the cable array. It has happened before that a cable was damaged (e.g. by fishing boats) and that therefore a whole set of offshore wind turbines became disconnected to the grid. Furthermore it was also mentioned that it is difficult to get the cable onshore, and that this difficulty is seen as a technical risk. There are different technical risks but especially the fact that the offshore wind technology is still fairly new, is seen as a risk.

Regulatory risks are very important and they are a true concern for investors (see Figure 14). The regulatory framework should be very consistent, thorough and robust. Offshore wind is due to the high capital costs and the low electricity price not yet a technology that can exist without governmental support. Subsidies are therefore still crucial for the existence of offshore wind parks. In Spain the subsidies for offshore wind were withdrawn with retrospective effect. This implied that the

subsidies that were already given to offshore wind park owners, needed to be paid back to the Spanish government. This resulted in a huge loss of confidence among offshore wind stakeholders. Some interviewees for this research also referred to the Spanish situation. The continuity of the offshore wind policy is very important. Investors and project developers referred to these stories and stated that such changes effects the confidence of stakeholders, and that partly due to these earlier international experiences (more countries cancelled the subsidy regimes with retrospective effect) regulatory risks are seen by some investors as a barrier to invest. No utility thought the regulatory risks are a barrier for institutional investors to invest in offshore wind projects. This might be due to the fact that project managers are more effected by regulatory changes than investors and that therefore the utilities did not expect that the regulatory framework is a concern of institutional investors. Regarding the slightly changing regulatory setting, the regulatory risks in the Netherlands are fairly low due to the national offshore wind targets, and due to the well-developed legal system. Institutional investors and project developers believe that the Dutch government is taking the role-out of offshore wind seriously but still it remains unclear what happens if a political shift of power occurs or if the first Dutch tender round at the end of 2015 will not be a success.

Finally a barriers that was stated by one insurance company was that there is a high project lead time. In previous projects, years passed between the proposal and the actual time the money was transferred to the project party. A lot of things can change in these years, which makes it unattractive to enter such a transaction. In the new regulatory regime, the permit is approved together with the FIT. Furthermore in the new regulation, four years after winning the tender, the project should be operational. Because of the change in the regulatory framework, and because this barrier was only mentioned once, it is not believed that this barrier is very severe.

6.5.4. Return related barriers

Figure 18 shows the different return related barriers and the frequency that these barriers were mentioned by the different parties. Two return related barriers were mentioned during the interviews: the returns are too low and the merchant tail is difficult to calculate.

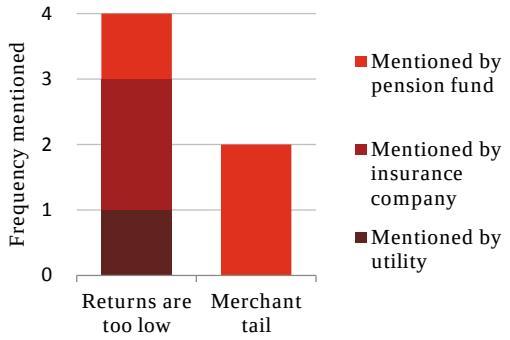

Figure 18 Return barriers for institutional investors mentioned by different actors

According to one pension fund, two insurance companies and one utility, the returns that institutional investors can receive for their offshore wind investments are too low. They mentioned multiple reasons. Due to unanticipated contingencies the production of some previous offshore wind farms lacked behind expectations. This resulted into lower profits than expected and this contributed to the perception that the margins of offshore wind equity investments are too low. Furthermore also debt margins are currently not high. Three finance related variables have effect on the low debt rates. Due to competition many new projects are overbid. Banks are standing in line to provide debt for infrastructure projects. This results into the fact that the margins on debt are currently very low. Second, the LIBOR rate is currently low, this leads to lower debt rates. Third, due to the capital charge of Solvency II, the margins must be high enough to compensate the difference of the capital charge of offshore wind investments and substitute projects. Investors might feel that the returns are too low to compensate for this capital charge[35].

[35] Disregarding the fact that three finance related variables have effect on the barrier "Returns are too low" it is chosen to place this barrier in the category "Return related barriers". A limitation of the categorization is that some variables (e.g. the cost of debt) could be classified into two categories. It is believed that the variable "cost of debt" should be in the category finance related variables because it determines the structuring of the financial product. However in the case institutional investors want

The second barrier that was mentioned was the fact that the investment period is often longer than the subsidy time. Equity providers need to make an estimation about this so-called merchant tail. The merchant tail is: "the period beyond which the project's power sales have been contracted" (US Department of Energy, 2008, p. 14). This is however very difficult to calculate because currently there are still no reference projects that investors or project managers can use to calculate the merchant tail. Both the pension funds that have experience in financing offshore wind projects state that estimating the merchant tail is crucial for estimating the internal rate of return of the project, but it is difficult to make this estimation. This barrier only applies to equity providers.

It is very interesting to notice that no-one mentioned the subsidy floor as a barrier. In the past the subsidy floor of the offshore wind SDE+ scheme has often be higher than the electricity price. This implied that the subsidy did not always compensate the costs that were made (see Appendix D). Either the institutional investors that were interviewed were not aware of this phenomena, or they assumed that they would not enter an investment without a long-term PPA with a fixed price so they do not bear this risk and therefore just did not see this as a barrier.

6.6. Mitigation strategies

During the interviews institutional investors were asked to state the most important mitigation strategies they prefer that could increase their ability to invest in offshore wind. Furthermore also the utilities, and the representatives of the Ministry of Economic Affairs and the NLII were asked to state what they believed the most preferred mitigation strategies were for institutional investors that could make it easier for them to invest.

In this chapter the answers of interview question regarding the mitigation strategies are summarized. During the interviews the following mitigation strategies were mentioned:

- Cooperate with companies with expertise
- Education and knowledge sharing
- Restructure the investments into known and secure products
- Circumvent Solvency II
- Enter after the construction phase
- EPC-wrap
- Insuring risks
- Long-term O&M contract with availability guarantee
- Energy policy should be clear and robust
- Clear arrangements regarding responsibilities offshore grid
- Subsidy year later if grid is connected year later
- Reliable project parties
- Reduce number of contractors
- Large contingency buffer
- ECA, government or monoliner securing debt
- Government provide subordinated debt
- Inflation component on debt structure
- Increase effort on wind studies
- Long-term PPA with fixed price
- Yieldcos

Subsequently the different mitigation strategies were clustered in the same categories as the barriers: Knowledge related mitigation strategies, financial related mitigation strategies, risk related mitigation strategies, return related mitigation strategies. The categorization was done in the same way as the barriers were categorized. The variables in the causal loop diagram where the mitigation strategies

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to invest in debt products the variable "cost of debt" could also be interpreted as the interest rates or margins of the loans (that debt providers receive, so their return).

corresponded with, or where they could be linked to, determined the category they were placed in. By doing so the mitigation strategies were placed in the same category as the barrier they correspond to. Some mitigation strategies mitigate problems and barriers that have not been mentioned during the interviews. Figure 19 shows a representation of the different mitigation strategies that were mentioned, and the categories they are placed in, together with the frequency that the different actors mentioned these mitigation strategies. Table 15 shows the mitigation strategies that were mentioned and the corresponding barriers that were mentioned and which they mitigate.

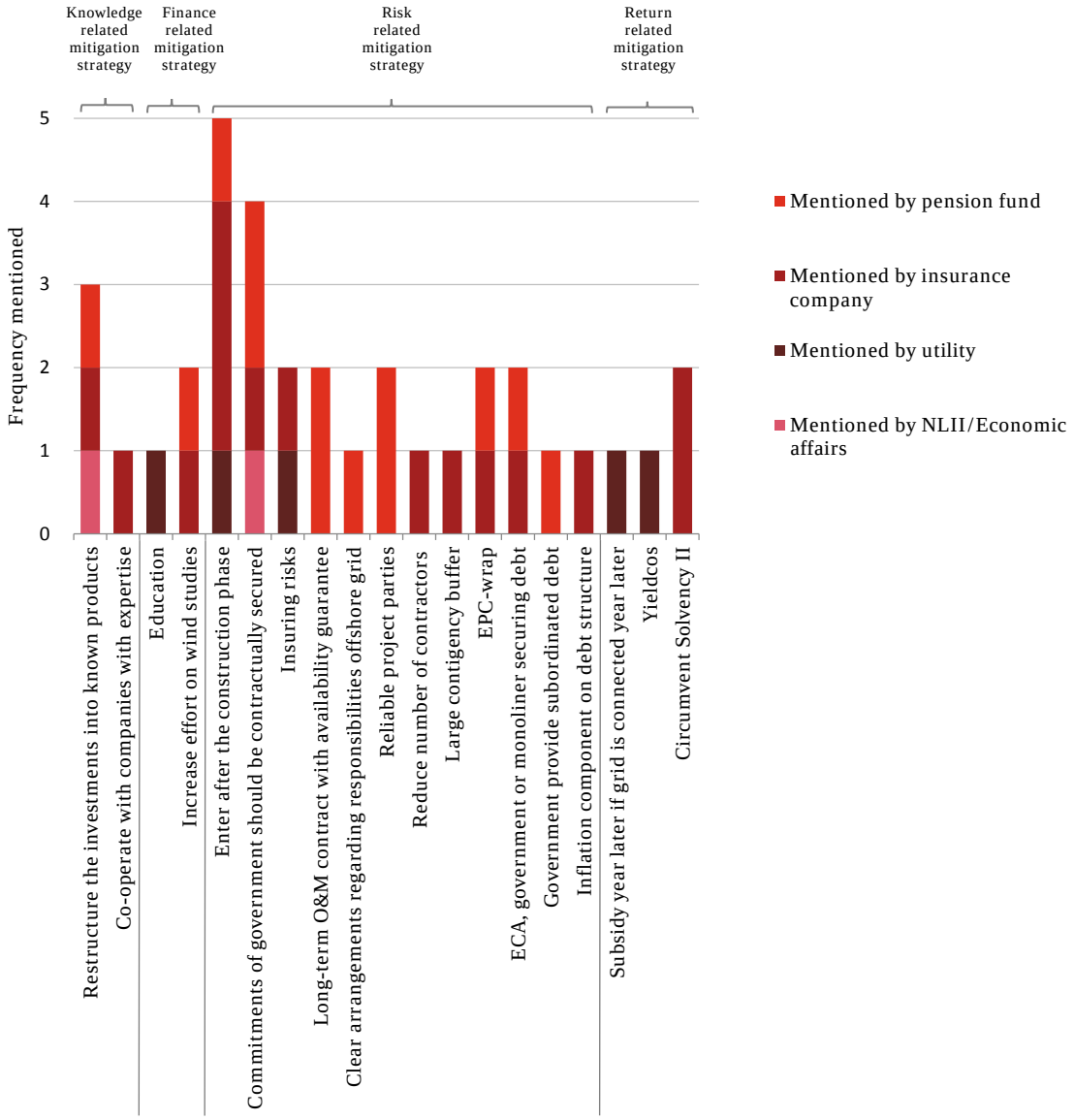

Figure 19 Mitigation strategies for institutional investors mentioned by different actors

Table 15 Barriers and the corresponding mitigation strategies that were mentioned during the interviews

Category	Barrier	Mitigation strategy
Knowledge related barriers and mitigation strategies	Lack of knowledge	Cooperate with companies with expertise
	Lack of knowledge	Education and knowledge sharing

Finance related barriers and mitigation strategies	Investment product	Restructure the investments into known products
	Solvency II	Circumvent Solvency II
Risk related barriers and mitigation strategies	Construction risk	Enter after the construction phase
	Construction risk	EPC-wrap
	Construction risk	Insuring risks
	Technical risk	Insuring risks
	Technical risk	Long-term O&M contract with availability guarantee
	Technical risk	Subsidy year later if grid is connected year later
	Regulatory risk	Subsidy year later if grid is connected year later
	Regulatory risk	Energy policy should be clear and robust
	Regulatory risk	Clear arrangements regarding responsibilities offshore grid
	Regulatory risk	Reliable project parties
	Project management risk*	Reduce number of contractors
	Default risk*	Large contingency buffer
	Default risk*	ECA, government or monoliner securing debt
	Default risk*	Government provide subordinated debt
	Inflation risk*	Inflation component on debt structure
	Lead time	Insuring risks
Return related barriers and mitigation strategies	Returns are too unpredictable*	Increase effort on wind studies
	Returns are too unpredictable*	Long-term PPA with fixed price
	Returns are too low	Yieldcos
	Merchant tail	-

* These barriers were not directly mentioned during the interviews. The fact that the "default risk" was not mentioned could be declared due to the fact that basically all the risks are relating to the default risk, this is the prime concern. It is believed that therefore this risk has not directly been mentioned, disregarding the fact that barrier is present. Some mitigation strategies corresponding the default risk were mentioned.

In the following sections the mitigation strategies that were mentioned by the interviewees are explained.

6.6.1. Knowledge related mitigation strategies

One of the main problems regarding institutional investors and offshore wind investments is the lack of knowledge regarding the specifications of the projects of the asset managers. There are different ways how the knowledge can be increased or how this barriers can be removed. The mitigation strategies that the interviewees mentioned are shown in Figure 20. One insurance company stated that if they want to make offshore wind investments, they need to team-up with another stakeholder because they

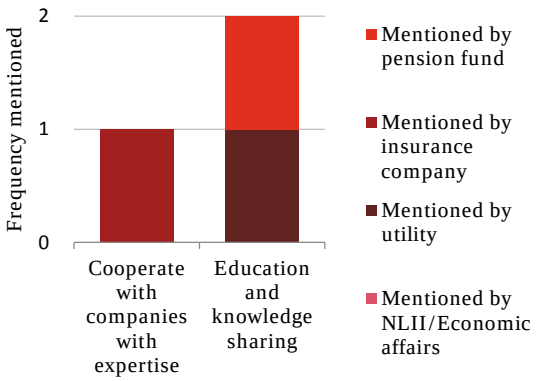

Figure 20 Knowledge related mitigation strategies

are not able to provide a large stake and they do not have the capacity to assess the risks. By cooperating with another stakeholder this party might be able to enter this market. One utility mentioned that the NLII can play a role in providing a platform for educating the institutional investors and for knowledge sharing. Most of the institutional investors mentioned that they do not have the capacity and capability to assess the specifications (especially not if there is not enough structured and reliable information regarding the projects and regarding offshore wind available). Therefore knowledge sharing is needed. The NLII can play a role in collecting the data and in educating their stakeholders (the institutional investors) how to make use of the data.

6.6.2. Financial related mitigation strategies

A difficulty that was mentioned during the interviews was that the investment products of the offshore wind projects are not the investment products that institutional investors are familiar with (e.g. unrated, project finance debt) (see Figure 21). One pension fund mentioned that they might be interested in offshore wind projects if they can invest in an offshore wind investment fund, in green bonds, or in other known products they are familiar with and which they can assess. A project credit rating is therefore preferred.

Currently only parties have invested in offshore wind project who are able to invest in equity. No debt investments have been placed yet. This could be due to the fact that the institutional debt providers products are not familiar with the supplied debt products.

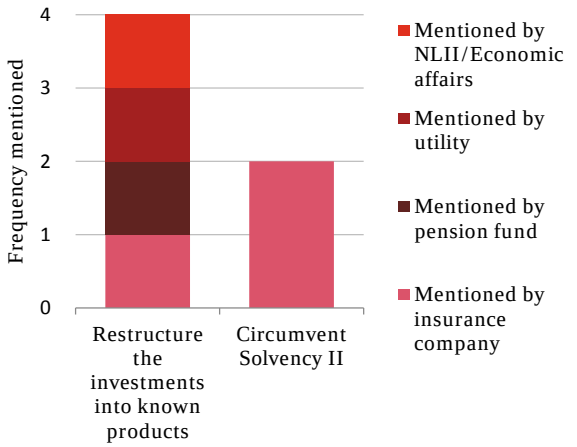

Figure 21 Financial related mitigation strategies mentioned by the interviewees

The investments should be structured in a way institutional investors are familiar with. According to an insurance company there is a problem that in the current propositions, often many amendments are proposed leading to a lot of extra work which some parties do not have the capacity and the skills for. Furthermore this institutional investor mentioned that they want to know when and what the specific drawdown are. A project manager might want to have the possibility to have flexible drawdowns so they can adapt their drawdowns to the progress of the project. Institutional investors however want certainty regarding the drawdowns and therefore they prefers an ex ante agreements, which does not rely on external factors.

The NLII mentioned during the interview that they are currently trying to create an investment product that institutional investors are familiar with and that could make it easier for them to invest. The NLII stated that they are exploring the possibility to use the Public Bond Credit Enhancement Tool (PBCET) of the EIB to secure the debt in offshore wind propositions[36]. In 2012 the EIB started a pilot phase of the so-called Europe 2020 Project Bond Initiative (PBI). This initiative was introduced with the aim to attract institutional investors to finance infrastructure project by enhancing the credit quality of the project bonds that are issues by private companies (EC, 2014). Since the credit crunch in 2008, insurance companies that insured project bonds are more reluctant to participate in infrastructure projects. Therefore it is currently more difficult to find a proper credit enhancement tool that can secure the project bonds. This led to the introduction of the EIB initiative. The initiative works as follows:

[36] This particular method was merely mentioned by the NLII. According to the information gathered from the interviews currently no institutional investors are looking at this option.

The initiative provides a subordinated instrument, a loan, a contingent facility or a guarantee to the project company. This facility will function as a contingency cushion for the senior loans. This facility raises the likelihood of timely principle and interest payments to the bond holders (see Figure 22) (EC, 2014). The PBI will only cover approximately 20% of the bond issuances. With this credit enhancement tool the PBI tries to upgrade the infrastructure project to an A- rating, which is the rating that institutional investors usually require (EY, 2014). This can make it more easy for institutional investors to invest in offshore wind projects due to the fact that:

- The investment has a credit rating of at least A-
- The investment is an investment product that institutional investors are familiar with
- The risks of these projects are lower due to the PBI. This can lead to a lower Solvency II capital charge.

The PBI initiative is introduced for infrastructure projects and this has not yet been used in offshore wind projects. Offshore wind projects are usually not investment graded, so this needs to be done to use this tool and to make institutional investors feel comfortable with this project structure. Furthermore the EIB only provides this facility to projects with stable and predictable cash flows. It is currently still unclear if offshore wind projects comply with the requirements of the EIB.

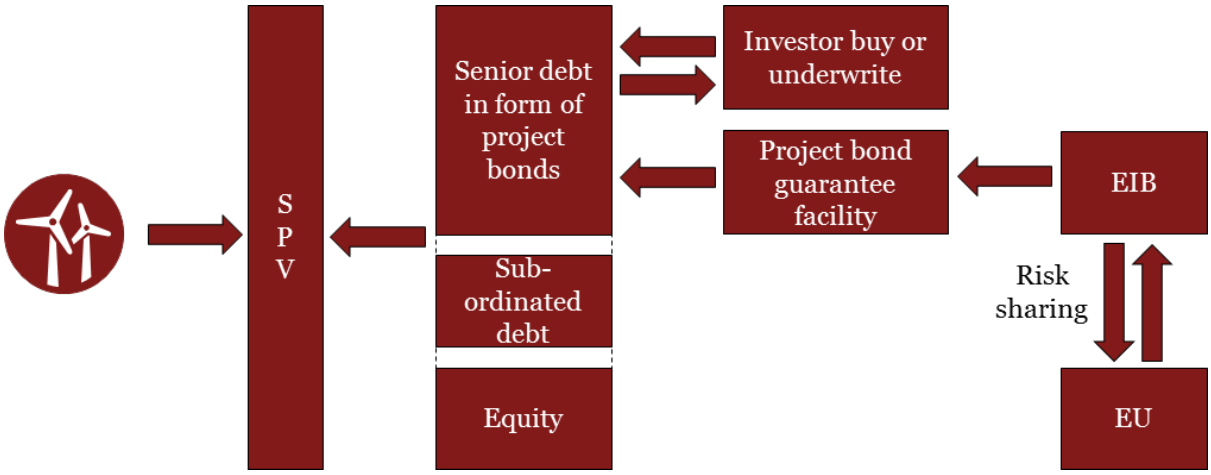

Figure 22 The EIB Project Bond Initiative

This restructuring of the investment product is the mitigation strategy that the NLII is using to make the offshore wind investments more attractive for institutional investors.

In Germany investors are experimenting with a new debt construction that can mitigate the impact of the Solvency II capital charge. The idea is that investors buy asset-backed securities (ABS), which are debt products, from a SPV. This capital that is raised will subsequently be used to buy equity stakes in infrastructure, e.g. offshore wind, projects. The advantage is that the investors can buy a debt product, which corresponds to a Solvency charge that relates to debt investments (this is usually lower, it depends on the tenor of the debt, than the equity capital charge), but that they receive an equity return. By using this method the margins can be increased and such a structure can therefore lead to an increased interest of institutional investors to invest in infrastructure assets. Another advantage is that the institutional investor can buy a more tradition fixed-income asset. Institutional investors have ample experience in these type of products. One of the interviewees is currently exploiting the possibility to use a similar structure to invest in renewable energy projects.

6.6.3. Risk related mitigation strategies

Multiple risk related mitigation strategies were mentioned during the interviews. An overview of the risk related mitigation strategies is shown in Figure 23. As mentioned before, some institutional investors see the construction phase of offshore wind parks as an investment barrier. Fortunately there are multiple ways to mitigate this barrier. There are multiple ways to enter the investment after

the construction phase. Institutional investors can do so by refinance current loans, or by obtaining loans or equity from a SPV where the project will be transferred to after the construction phase. Instead of entering after the construction phase, the risks can also be transferred to another party. Dong for instance is able to provide an EPC-wrap. An EPC-wrap will transfer the construction risks to the issuer of the EPC-wrap. However these companies need to be financially compensated for taking these risks. Therefore such constructions will drive down the returns. Furthermore some of our respondents mentioned that they are able to finance the construction phase as long as the overall financial agreements in the proposal makes them feel comfortable. Currently only Dong was able to provide an EPC-wrap[37], however more utilities mentioned that if necessary, they have enough confidence in the technology and in their own capacities to also provide a full EPC-wrap (these other utilities were not included into the graph because they mentioned that it might be a possibility but that they do not have the need to do so. Therefore at this moment they do not find an EPC-wrap an option). It was interesting to see that despite the perceived risks of the construction phase, and despite the fact that EPC-wraps have been provided in the past, merely two parties said they needed an EPC-wrap. There were also parties who mentioned that they are able finance the construction phase without an EPC-wrap.

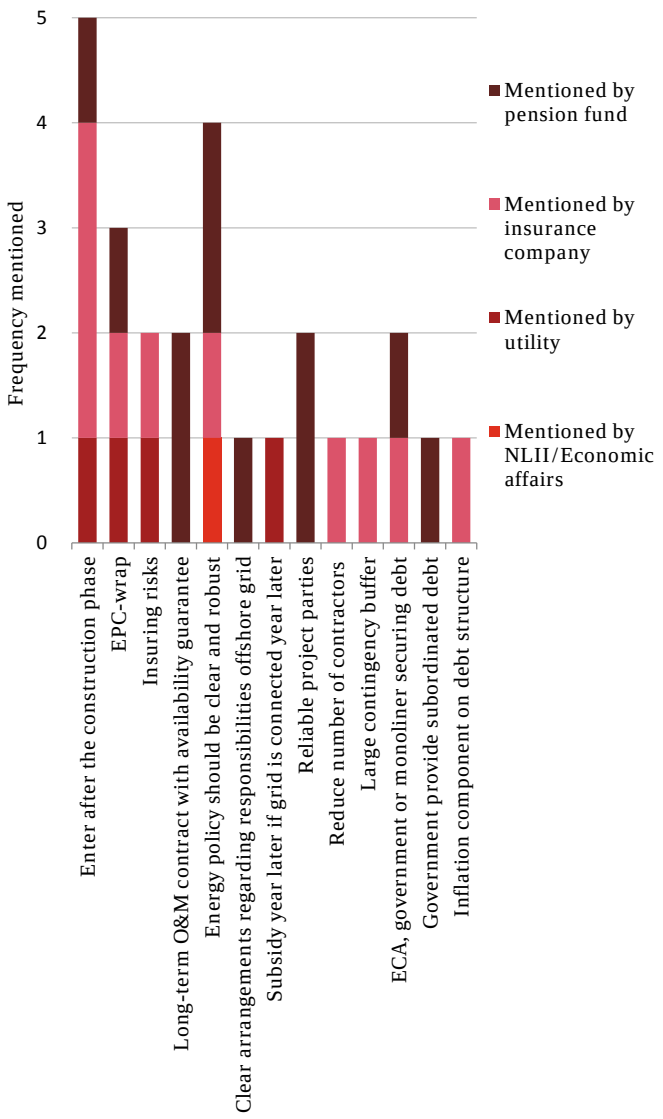

Figure 23 Risk mitigation strategies mentioned by the interviewees

Different type of risks, including the construction risk, can be partly mitigated by buying insurances from companies like Delta Lloyd. Insurances often partly mitigate the risks because only after a numerous amount of days after the problems occur, the insurance companies will compensate the damage (Delta Lloyd starts compensating the damage after 30 days). Next to the physical parts of the wind parks also cash flows and profits can be insured (for an example see 6.6.4). Therefore this mitigation strategy is also strongly related to the category "Return related mitigation strategies".

One stakeholder mentioned that they became interested in investing in offshore wind when they found out that reliable companies are willing to provide an O&M contract for 15 years with a guaranteed availability of 95% (meaning that 95% of the time the wind turbines should be operational

[37] Dong has the advantage that the majority of their stakes are owned by the Danish government, therefore Dong's offshore wind projects with full guarantees can be seen as a Danish government bond. This also significantly decreases the costs of debt and equity.

if there is any wind available). Two pension funds stated that a long-term O&M contract is important for mitigating the O&M risks and for securing the returns.

Because of the long-term investments that are needed for offshore wind projects, a consistent predictable long-term policy is needed. As mentioned before, in 2014 many offshore wind licenses were withdrawn. This had major effect on the confidence of project developers and investors. This created the feeling that the rules of the game could be change any time. It is crucial that project developer and investors have the idea that with the new offshore wind policy, things like this can never happen. The interviewees stated that the Dutch government should create a subsidy regime and regulatory framework that is so rigid, that also in the case of a complete shift of governmental power, the awarded subsidies and permits can under no circumstances be changed. The best way to do this is to legally settle the conditions from the offshore wind policy.

One pension fund mentioned that the risks that are encountered by the fact that TenneT is becoming responsible for the offshore grid should be mitigated. TenneT is becoming responsible for the offshore grid construction but currently they have not accepted the fact that they are also becoming responsible for paying the potential damage that could be present when they are not able to finished the grid on time. This is a major concern for project developers (the concerns/ preferred mitigation strategies of project developers are not summarized in this report) but also for investors. Before the start of the projects the responsibilities regarding the offshore grid and regarding compensation in the case of potential delays should be clear. This barrier and mitigation strategy is only relevant for parties who are willing to provide equity from the construction phase, therefore this was only mentioned by one party. Equity providers will be hit the most if the offshore grid has delays (because of the missed profits and possible fines that need to be paid to contractors).

Another mitigation strategy that was merely mentioned once is that the subsidy scheme should only come into force once the offshore grid is also ready. This is the case in the United Kingdom and this could mitigate the risks that equity holders face due to the fact that the offshore grid is built by an external party (TenneT).

Furthermore two pension funds mentioned that they only want to invest if the project parties are reliable and economically stable. This accounts for the construction parties as well as for the financing parties. They mentioned that if they invest in an offshore wind park, they e.g. want the turbines to come from specific companies who use proven technologies and who are economically stable.

One insurance company mentioned that they prefer to invest in a project with little contractors. They prefer one interface, one party that is responsible for all the sub-contractors. This mitigates the project management risks (which is a barrier that has not been mentioned during any interview). In the case of Gemini, the project has only two major contractors: Siemens is responsible for the turbines and Van Oord for the EPC contract. This gave investors confidence to invest is this project. This barriers is not a bottleneck but project managers should be aware of the nature and the preferences of the project investors. The same accounts for the amount of waivers and amendments that are proposed after the project has been closed. In previous renewable energy projects it was not exceptional that project managers still proposed financial and technical changes after the project had been financially closed. Institutional investors however often do not have the capacity, the knowledge and the time to assess all these post financial close amendments.

Another mitigation strategy, or a way to obtain certainties for debt holders, is to build in a large contingency buffer into the proposition. One insurance company mentioned that a large contingency buffer is desired. It is usual that contingency buffers are built into the propositions. The height of the buffer however can very and the preferences regarding the height of the contingency buffer therefore should be taken into account.

For debt holders there are different ways to secure the principle and interest payments. ECA, monoliners or corporate investor could guarantee senior debt or project bonds. This has multiple advantages. This lowers the perceived risk of debt providers but due the reduced risks the capital charge of Solvency II could also decrease. This would therefore increase the profits. The disadvantage

is that guarantees always come with a price. Therefore such agreements would lower the profitability of the project for the equity parties. One pension fund and the NLII mentioned that this is an interesting mitigation strategy.

Another mitigation strategy that has been mentioned by a pension fund was that the government would provide a subordinated loan. Such a debt cushion would make the other loans more secure because in the case contingencies occur, first the governmental subordinated loans would default, this argument was merely mentioned once by one pension fund.

One insurance company mentioned it would be easier for them to invest if there was an inflation correction on the investments. This was only mentioned once and the inflation risk was also not mentioned as a barrier.

6.6.4. Return related mitigation strategies

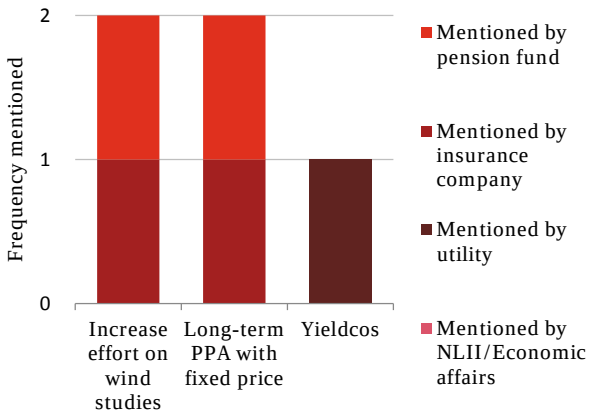

Figure 24 Return related mitigation strategies mentioned by the interviewees

One pension fund and one insurance company mentioned that it is important that reliable (as reliable as possible) information must be produced regarding the estimation of electricity generation data. Therefore proper wind studies are important and the results of these studies must be shared with the institutional investors. If the data from wind studies (together with the historical production data) will be shared, institutional investors can more accurately estimate the production and the corresponding electricity revenues. This will increase the income certainty and this will improve the correctness of the expected returns.

An important way of securing certain profits and mitigating price risks is via PPAs. In a PPA there is usually a period with a fixed price and after that period the parties need to renegotiate again. Due to the various contract periods there will therefore often still be a price risk present.

Another potential strategy that was mentioned during the interviews, and that could unlock the investment potential of institutional investors, is that utilities can develop so-called Yieldcos. A Yieldco is a public company that is created by a parent company to bundle renewable long-term contracted cash generating assets (NREL, 2014). The shareholders receive a yearly or quarterly dividend. The idea is that utilities can establish such subsidiaries where they can allocate their renewable energy projects to that generate predictable cash flows. This means that a current utility, with different assets including non-renewable assets, can establish a company that is totally renewable. Institutional investors can therefore buy corporate bonds, which is a product that they are very familiar with, that will be dedicated to merely renewable energy project. Yieldcos can also be rated meaning that institutional investors can even more easily invest in such companies.

In the previous paragraph it was briefly mentioned that insurances can be used to secure revenue streams. There are insurance companies that can insure the IRR by guaranteeing a minimum return. The possible agreement could be that in the case the internal rate of return would be lower than the floor that is agreed upon, the insurance company will compensate the difference, but on the other hand when the internal rate of return would exceed the ceiling that is agreed upon, this amount would be (next to the insurance fee) an extra profit for the insurance company. Such constructions decreases the profitability of the projects but it will give equity holders a security that they will receive a minimum and predictable internal rate of return from the project. There was one insurance company

who identified this mitigation strategy however they mentioned that their major barrier was the low returns of offshore wind projects (or they perceived that the returns are too low). An insurance on the internal rate of return increases the security but decreases the profitability of the projects. Therefore this company did not take insuring the IRR under consideration and this was the reason why this also was not incorporated as a preferred mitigation strategy (also merely one company mentioned this mitigation strategy).

6.7. Renewable energy targets and substitute projects

Most institutional investors mentioned that they evaluated their project (by somehow) taking into account environmental, social and governance (ESG) criteria. They mentioned that there is a tendency that ESG criteria are becoming more important, and that their customers (who's assets the institutional investors have under management) do start caring more about ESG criteria. However the first criteria currently still remains the relation between risk and return and no institutional investor has concretely incorporated ESG evaluation criteria into their decision making process. Also none of the interviewees had direct renewable energy or offshore wind targets[38]. The level of which ESG criteria are taking into account when making investment decisions is crucial for whether institutional investors are willing to enter offshore wind investments. If ESG criteria are becoming a direct part of the investment decisions, companies might change their view on whether the risks are too high or whether the returns are too low. This has everything to do with perception. If ESG criteria, and preferable renewable energy criteria, will be directly included into the investment decision making process, this could increase the tendency of institutional investors towards investing in offshore wind projects. As Grubb already stated in 1990: "technological advances, and in some cases breakthroughs, are certainly needed: but the revolution required is one of attitudes" (Grubb, 1990). This could be stimulated by including ESG criteria as an evaluation criteria for assessing renewable energy propositions.

Renewable energy investments are categorized under infrastructure projects. Institutional investors usually have a particular mandate to invest in these kind of projects. It was often heard that onshore wind and solar projects are more proven technologies and that therefore these investments are perceived to be less risky. Therefore it is easier for institutional investors to invest in these projects. It can be logically stated that if there are substitute projects that have better risk return profiles investors will less likely look at offshore wind projects. Furthermore investors usually have a mandate to invest a certain amount per asset class. If substitute projects within the same asset class are more favorable this will therefore leave less room for offshore wind investments. Fortunately infrastructure projects are upcoming and (while this was not a direct question during the interviews) multiple investors, especially pension funds, stated that they expect that their infrastructure asset class will significantly grow over the next few years. This means that the total asset class size is currently not a limitation for investors. It is therefore expected that offshore wind projects will be complementary to instead of in competition with other renewable energy projects. And therefore substitute projects are not seen as a factor that deters institutional investors to invest in offshore wind projects.

6.8. The effect of removing the most important barriers that institutional investors face regarding offshore wind investments

Three relating questions were asked to the interviewees regarding the effect of the removal of the barriers. They were asked what effect the removal of the barriers would have on:

- The level of institutional capital that will be invested in offshore wind projects,
- The cost of capital of offshore wind projects and on,

[38] Two weeks before the final deadline of this thesis the Telegraaf and Nu.nl published an article that stated that ABP introduced a target to double their renewable energy investments within two years. This would mean that their renewable energy portfolio would be increased with €1 billion (Telegraaf, 2015; Nu.nl, 2015)

- Reaching the Dutch offshore wind targets.

From the interview data it could be concluded that institutional investors are definitely interested in financing offshore wind projects. Due to the declining returns on conventional investments institutional investors are indeed searching for new assets classes that have the ability to generate higher returns. Therefore the sentiment is that if some barriers will be removed, this could lead to an increase of Dutch institutional capital in Dutch offshore wind projects. However utilities say that it is currently not a problem to find enough capital to meet their development goals. They mentioned that there are plenty of institutions that are eager to finance such projects and that there is currently not yet a need to adapt the development strategy so it would become more easy for institutional investors to invest. This is directly, from the perspective of institutional investors, one of the main problems. Project developers currently have no direct need to take over some risks of institutional investors because there are multiple other type of investors who are willing to invest and e.g. share the risks pro rata. It is expected that the amount of investors who are willing to also bear development risks will only grow when the technology further develops and the experience of project developers further increases. Disregarding the lack of a direct need, it is however favorable for project developers if institutional investors are more willing to invest in offshore wind projects. An increase of institutional capital would lead to an increase of the investment pool, leading to more competition. This could result in lower financing costs. This idea was generally supported during the interviews however this is not the direct effect of institutional capital (so not the effect of the fact that institutional investors often require less return on capital than other investors) but this is due to the fact that the total amount of capital will increase resulting in more competition. Due to the sufficient amount of capital that is available, institutional investors, utilities the NLII and the ministry of economic affairs all did not believe that an increase of institutional capital would have effect on the Dutch offshore wind targets. However it is preferred that Dutch financers are financing the Dutch offshore wind projects because then the subsidies that are paid to these projects, but also the knowledge that is gained from these projects, will remain within the Dutch industry.

6.9. The role of utilities

Five utility companies who have the most experience in offshore wind and who are the most likely companies to enter the tender procedure for developing the new offshore wind projects in the Netherlands were interviewed. The utilities were interviewed with the means to find out if they have a need to include institutional investors in the financing process of the offshore wind parks. The answer was uniform, this was not the case. The utilities mentioned that they currently do not have the need and are therefore also generally not willing to take upon extra risks so institutional investors are able to enter the financing process. Dong was the only exception. Dong mentioned that they have so much experience in building offshore wind parks that they do not mind being responsible for extra risks, due to the fact that they are very capable in calculating all the risks. The utilities mentioned that they generally have no contact with Dutch institutional investors. Next to Dong the contact between utilities and Dutch pension funds and insurance companies has been nihil.

6.10. Conclusion

The main difficulty with financing offshore wind projects is that there are still many uncertainties and barriers. In this paragraph the most important barriers and corresponding mitigation strategies that were mentioned during the interviews will be summarized and sub question 4 and 5 will be answered. The identified theoretical barriers and mitigation strategies that were found in the literature review study were barriers and mitigation strategies that were found in Northwest European literature. In this chapter information specifically regarding the Dutch situation was collected with the means to specify, validate and extend the information that was already gained during the literature review study.

Sub question 4 was: *How do the identified theoretical barriers relate to the Dutch situation*?

In the following table sub question 4 will be answered. This table shows the barriers and it will be described how these barriers relate to the Dutch situation.

Table 16 Overview of the answer to sub question 4

Important barriers for the Dutch situation	Explanation
Lack of knowledge	According to the Dutch interviewees the most severe investment barrier is that institutional investors have too little knowledge regarding offshore wind investments. This barrier was not identified during the literature review study however it was mentioned by almost all the interviewees. Due to this lack of knowledge insurance companies and pension funds are not able to properly assess the offshore wind propositions. The difficulty to assess the propositions is reinforced by the fact that institutional investors state that the Dutch offshore wind market is also very non-transparent and that it is therefore difficult to obtain actual market data and historical data concerning the production and default time. The knowledge barrier is the most important barrier because it was mentioned the most and it has direct influence on almost all the other barriers and mitigation strategies. This barrier is therefore believed to be the main barrier that prevents Dutch institutional investors from investing in Dutch offshore wind projects. During the literature review study the barrier "Ability to perform risk assessment" was identified. This barrier is obviously strongly related to the barrier "Lack of knowledge" however the latter barrier is more general and has a negative impact on far more variables of the causal loop diagram than the barrier "Ability to perform risk assessment"
Solvency II	It was already known that Solvency II had an impact on the offshore wind investment possibilities for insurance companies. It was however not known that the (perceived) impact for Dutch insurance companies was so severe. There was merely one insurance company that stated that Solvency II did not have an effect on the possibility of insurance companies to invest in offshore wind parks. The other companies saw Solvency II as an important and severe barrier to invest. Some mentioned that if the capacity charge of Solvency II would not change, they would see no point in looking at the possibility to provide debt for these parks. It is interesting to see that the insurance company that stated that Solvency II is not a barrier, is also the insurance company with the most experienced and qualified people regarding offshore wind. They weakened the importance of Solvency II by stating: "Solvency II is important, but it is merely one of the considerations that we need to make as an investor". It is difficult to mitigate a regulatory barrier. One company mentioned that they are lobbying for a lower capital charge and another company mentioned that they are looking at a way to circumvent the negative effect of Solvency by implementing a method that has been used by a German companies. This will be discussed in Table 17
Construction risk	The second most mentioned barrier was the construction risk. In the literature it was stated that institutional investors will most likely not be willing to invest in the construction phase, however during the interviews several people mentioned that they are open for looking at ways to finance the construction phase. This might be due to the fact that there are multiple ways to mitigate the construction risks. These strategies will be

	discussed in Table 17
Regulatory risk	The Dutch government withdrew the previous permits at the moment the new subsidy scheme was introduced. This made a significant impact on developers and investors. The feeling that the government can change the "rules of the game" during the subsidy period has a negative impact. However disregarding the fact that many investors mentioned this barrier, it was not believed that this barrier is currently very severe. Most of the investors also mentioned that the Dutch government is currently building a solid regulatory framework and that there are high renewable energy targets. This is in favor of the certainty of the regulatory regime
Investment product	Related to the knowledge barrier, Dutch institutional investors are generally little familiar with the different offshore wind investment products. Most of the investments of institutional investors are in rated bond and they have little experience in investing in unrated products and in doing direct investments
Technological risk	There is a technology risk due to the fact that offshore wind is still a technology that is developing. During the interviews this barrier was mentioned four times however merely one interviewee actually mentioned concrete technological risks. This could be due to the fact that the investors have generally little knowledge about the offshore wind technologies. This barrier seemed to be present but not very severe
Merchant tail	Due to the immaturity of the market there is still too little knowledge about how to properly estimate the production rate and e.g. the merchant tail. Also no mitigation strategy was mentioned that could directly mitigate this barrier. This barrier is also strongly related to the barrier "Lack of knowledge"
Returns are too low	In the literature was found that offshore wind investments are interesting for institutional investors because the margins of other investments are decreasing and offshore wind investments still have relative high returns. However multiple Dutch interviewees actually stated that they are not interested in investing in offshore wind projects because the returns of these investments are also too low (relating to the associated risks). This is especially the case for debt investments. The most heard reasons for this barrier are: strong competition from banks, high capital charge from Solvency II and a low LIBOR rate.

This chapter also contains the knowledge to answer sub question 5. Not all mitigation strategies that were mentioned in paragraph 6.6 are summarized in Table 17, only the most important mitigation strategies that mitigate the most important barriers that were stated before.

Sub question 5: *How do the mitigation strategies of offshore wind investments relate to the Dutch situation and how can we learn from experience from Northwest European countries?*

Table 17 Overview of the answer to sub question 5

Barriers and the relating mitigation strategies for the Dutch situation	**Explanation**

Lack of knowledge - Educating institutional investors, knowledge sharing and cooperating with other parties	Educating institutional investors and knowledge sharing is a newly mentioned mitigation strategy. The barrier "Lack of knowledge" was mentioned as the most important investment barrier and therefore these mitigation strategies are thought to be very important. To mitigate this barrier institutional investors should be able to receive high quality data and have the ability to assess the data to be able to make well-founded investment decisions. It was mentioned during the interviews that the NLII could perhaps play a role in collecting and distributing data and therefore in educating institutional investors to learn them how to assess the propositions. It was also mentioned that institutional investors can cooperate with parties that have the experience that is needed to make the investments
Construction risk - Entrance after construction by refinancing current loans or by buying divestment stakes after construction	The most mentioned mitigation strategy was that there are multiple ways for institutional investors to enter the investment after the construction phase. It is expected that this is the most realistic time for institutional investors to enter the agreement also because less knowledge is needed to enter the agreement after the construction. Disregarding the fact that multiple parties stated that, under the right circumstances they were able to finance the construction phase, an entrance after the construction by refinancing current loans or divestment stakes better suits the preferences and abilities of Dutch institutional investors. Due to the fact that this strategy was often mentioned and it is easy implementable it is seen as one of the most important mitigation strategies
Construction risk & Technological risk - Possibility to carve out construction risk via an EPC-wrap and the construction and technological risk via insurances	Several interviewees talked about the possibility of an EPC-wrap to carve out the construction risks, however only a few mentioned this actually is a necessity. It is interesting to see that the Dutch parties that had previous experience in financing offshore wind all mentioned that they also have the ability to invest during the construction phase and that they do not always require an EPC-wrap. This leads again to the assumption that the risks are not by any means too high, but that the knowledge concerning the risks is too low. On the other hand multiple utilities mentioned that they were able to construct an EPC-wrap, but due to availability of enough capital they do not have the direct need to do so. Utilities mentioned that it is still possible to find investors that are willing to share the risks pro rata. Another way to diminish the construction risks is via insurances. Delta Lloyd is one of the largest offshore wind insurance companies. An insurance policy can give investors the confidence to invest in offshore wind projects. Insurances can also be used to mitigate the technological risk
Regulatory risk – Secure stable and predictable regulatory framework	The mitigation strategy that was mentioned the most after the strategy "Enter after the construction phase" was the strategy "Energy policy should be clear and robust". The level of subsidy and the height of the subsidy should be clear. Furthermore it should be clear what the responsibilities are of the government and governmental organizations and how project owners are compensated in the case calamities occur. There is a sentiment that the regulatory framework is improving and that it is starting to be more clear and robust. The fact that relatively many interviewees mentioned the regulatory risks implies that the regulatory improvements that have been made in the past few years are not known by all institutional investors. This could be better communicated to the investors. Not all institutional investors are aware of how the regime works, while many do know that offshore wind is still relying on the

	subsidies
Investment product - Restructure the projects into known investment products	Institutional investors can more easily invest in offshore wind projects if the investment products are products they are familiar with. A project credit rating would therefore make it for institutional investors more easy to directly invest because this better suits with the internal requirements and this provides a first check whether the project is a good project to invest in or not
International experience	**Explanation**
International experience regarding certainty of returns	There are examples of foreign practices that stimulate the certainty regarding the return: • Subsidy should be postponed when grid is not ready • EIB project bond initiative can be used as a credit enhancement tool
International experience regarding dealing with Solvency and therefore also regarding the low returns	By creating ABS institutional investors can receive equity returns with an accompanying debt capacity charge. This can increase the margins
International experience with creating familiar investment products	It should be find out if it is desirable that Yieldcos with cash generating offshore wind assets will be established. If Yieldcos are established investors can invest in rated corporate bonds. Follow-up research should be done regarding the legal possibilities and regarding the desirability of such constructions. Green bonds can furthermore make it easier for institutional investors to invest. Institutional investors are familiar with investing in bond and if the project company can create green bonds, that allocate the capital towards offshore wind projects, this would be more easy for institutional investors

7. Interpretation of the interview data

In this chapter the model modifications will be described. In chapter 6 the answers that were given during the interviews were stated. The interviews resulted into a sufficient amount of information that could be used to assess whether the information that was gained during the literature review study was also correct for and applicable to the Dutch situation. Most of the barriers and mitigation strategies that were mentioned during the interviews corresponded with the information that was found during the literature review study however also some new information was gained. In this chapters the information gained from the interviews will be compared with the already gained information and this chapter will describe what for implications this will have for the causal loop diagram and for the conceptual model. The causal loop diagram and the conceptual model will subsequently be adapted so it will correspond to specifically institutional investors in relation to Dutch offshore wind projects.

7.1. Comparing the answers of the institutional investors with the knowledge found in the literature review study

7.1.1. Comparing the barriers that were found in the literature review study with the barriers that were mentioned during the interviews

Table 18 shows the barriers that were found in the literature review study and that were also mentioned during the interviews (these are market with a green check mark), the barriers that were found in the literature review study and that were not mentioned during the interviews (these are market with a red cross), and the new barriers that were mentioned during the interviews but that were not yet identified during the literature review study (these barriers were placed in the third column). This table shows that the conceptual causal loop diagram was already fairly complete regarding the barriers. Seven barriers that were found in the literature were not mentioned as a barrier during the interviews, and three new barriers were mentioned. It is not believed that the barriers that were not mentioned are also barriers that are not present or do not play a role. The most heard barrier, which was a barrier that was not found in the literature review, was the fact that institutional investors do not have the required knowledge to make the offshore wind investment decisions.

Table 18 shows that the barriers that were mentioned during the interviews mostly related to finance related characteristics and the actual offshore wind barriers that were mentioned were very generic (e.g. construction risk, technology risk etc.). The barriers that were specifically about offshore wind characteristics were less or not mentioned during the interviews. No institutional investor mentioned that the characteristics of the FIT did not comply with their wishes, and no-one mentioned that the electricity price is currently very low leading to low PPAs or to uncertainties after the PPA contract period. The fact that the more offshore wind specific barriers were not mentioned complies with the newly mentioned barrier “lack of knowledge”.

Three new barriers were mentioned (all merely once): one insurance company mentioned that there is a long period between the time of the first negotiations and the actual transference of the capital (this is the so-called lead time and this is a barrier because in this period a lot of things can change); two pension funds mentioned that they find it difficult to estimate the merchant tail; finally many interviewees mentioned that they have too little knowledge regarding offshore wind investments.

Table 18 Comparison of the barriers that were found in the literature review study and the barriers that were mentioned during the interviews

Theoretical barriers	investment	Mentioned during the interviews	New barriers that were mentioned during the interviews

LIBOR*	✓	
Competition*	✓	
Solvency II	✓	
Investment product	✓	
FIT	✗	
Production	✗	
Wholesale price electricity	✗	
Full load hours	✗	
Construction risk	✓	
Technology risk	✓	
O&M Risk	✗	
Regulatory risk	✓	
Project management risk	✗	
Risk grid availability	✗	
Ability to perform risk assessment	✓	
		Lead time
		Merchant tail
		Lack of knowledge

* These characteristics have effect on the barrier that was called "Returns are too low". During the interviews it was found that LIBOR and competition have a direct effect on the barrier "The returns are too low". In the causal loop diagram these two variables are however categorized in the category "Finance related variables" while during the interviews it was stated that they have effect on the barrier "Returns are too low" in the category "Return related barriers". During the interviews it became clear that the different categories are highly interconnected and that therefore multiple variables can be placed in different categories. This will be further explained in paragraph 7.2.2.

7.1.2. Comparing the mitigation strategies that were found in the literature review study with the mitigation strategies that were mentioned during the interviews

In this section the mitigation strategies that were found in the literature review study are compared with the mitigation strategies that were mentioned during the interviews (see Table 19 for an overview). Ten out of twenty-five mitigation strategies (that were found in the literature review study) were mentioned during the interviews. Merely 3 mitigation strategies were mentioned three times or more. These were:

- Restructure the investments into known products (four times mentioned)
- Enter after the construction phase (five times mentioned)
- Energy policy should be clear and robust (four times mentioned) (see Figure 19).

The previous mentioned mitigation strategies however were all already identified in the literature review study. Furthermore seven new mitigation strategies were identified during the interviews. For an overview of these newly found mitigation strategies see the third column of Table 19 and for and an elaborated explanation see paragraph 6.6.

Table 19 Comparison of the mitigation strategies that were found in the literature review study and the mitigation strategies that were mentioned during the interviews

Mitigation strategies found in the literature review study	Mentioned during the interviews	New mitigation strategies that were mentioned during the interviews
Restructure the investments into known products	✓	
Increase the duration or the height of the FIT	✗	
Introduce inflation based FIT	✗	

Introduce tax rebates or duty waivers	✗	
Banking for offshore wind projects	✗	
Perform high quality wind studies	✓	
Insuring internal rate of return	✓	
Arrange long-term PPA contract and find ways to increase the value or the duration of the PPA	✓	
Insuring construction, technology and/or O&M risks	✓	
Supplier guarantees	✗	
O&M guarantees	✓	
Availability of data	✗	
Loan guarantees (government, ECAs, monoliners, insurance companies)	✓	
Possibility to carve out construction risk via e.g. a EPC-wrap or an insurance	✓	
Enter after the construction phase (e.g. by refinancing current loans or buying divestment stakes after construction)	✓	
Diversification	✗	
Selecting good rated and stable project parties and other sponsors	✓	
Government buys equity share in project	✗	
Limit the number of contractors during the construction	✓	
Create a contingency buffer. This could be done by creating different loan tranches leading to a debt cushion in the case problems occur (for an increase of security organization like ECAs, multilateral banks or governments could help creating different tranches)	✓	
Give the project a credit rating	✓	
Long-term O&M contract	✓	
Energy policy should be clear and robust	✓	
		Cooperate with companies with expertise
		Education and knowledge sharing
		Circumvent Solvency II
		Clear arrangements regarding responsibilities offshore grid
		Subsidy year later if grid is connected year later
		Inflation component on debt structure
		Yieldcos

The mitigation strategies that were not mentioned during the interviews (see Table 19, the mitigation strategies that were identified during the literature review study but were not mentioned during the interviewed are marked with a red cross) were generally mitigation strategies that related to specific offshore wind characteristics (e.g. the FIT, banking and supplier guarantees). It is expected that due to the lack of specific offshore wind knowledge these mitigation strategies were not mentioned during the interviews.

7.2. Implications of the interview data

During the interviews it became clear that the information that was found during the literature review study was in general more complete and comprehensive than the answers that were received during

the interviews. Most of the barriers that were mentioned were only mentioned once or twice by institutional investors and the same accounts for the mitigation strategies (however many mitigation strategies were only mentioned once and also often not even by the institutional investors). Furthermore no barrier or mitigation strategy was mentioned by all the interviewees. Because most of the answers were only mentioned a few times, the interview data needed to be processed with care. Furthermore it was believed that with the variety of answers it was not possible to objectively and correctly state the relative importance of all the different barriers and mitigation strategies. A lack of knowledge was found to be the most important barrier. This notion however directly makes the dataset less reliable and increased the difficulty to state the relative importance of the barriers and mitigation strategies. This was not a large problem because for the explorative purpose of this research and therefore stating the relative importance was fortunately not a strict requirement to perform this research.

Despite the fact that the conceptual causal loop diagram was more elaborated than the answers that were received from most of the institutional investors' asset management teams, there were still some newly mentioned barriers and mitigation strategies. These variables were subsequently incorporated in the final causal loop diagram. In section 7.3 the model will be adapted and the newly found barriers and mitigation strategies (see Table 20) will be included in the figure.

Table 20 New found barriers and mitigation strategies that will be included in the causal loop diagram

Newly found barriers	Effect	Variable
Lead time	+	Perceived risk capital provider
The ability to estimate the merchant tail	+	Expected return project owner
Knowledge concerning offshore wind[39]	+	Bankability offshore wind projects for institutional investor
Newly found mitigation strategies		
Cooperate with companies with expertise	+	Ability to perform risk assessment
Education and knowledge sharing	+	Knowledge concerning offshore wind
Education and knowledge sharing	+	Ability to perform risk assessment
Knowledge concerning offshore wind	+	Ability to perform risk assessment
Clear arrangements regarding responsibilities offshore grid	-	Risk grid availability
Clear arrangements regarding responsibilities offshore grid	-	Perceived risk capital provider
Ability to postpone the subsidy in the case the grid is delayed	-	Risk grid availability
Inflation component on debt structure	-	Perceived risk capital provider
Yieldcos	+	Expected return project owner
Project rating	-	Perceived risk capital provider

During the interviews it was noticed that there is information asymmetry between utilities and institutional investors. This will further be explained in paragraph 7.2.1. Furthermore it was noticed that it is difficult for institutional investors to state the most severe barriers and most needed mitigation strategy because the different variables that affect institutional investors whether they can invest or not are highly interrelated and cannot easily be assessed independently. This will be explained in paragraph 7.2.2.

[39] Lack of knowledge was changed into "knowledge concerning offshore wind".

7.2.1. Information asymmetry

During one of the interviews one interviewee mentioned the following statement: “It is not the case that the risk return profile of offshore wind projects are not interesting for institutional investors, the problem is that the projects are too non-transparent which makes it unable to assess whether the projects have a good or bad risk return relation”. This combined with a lack of qualified people makes it for institutional investors difficult to properly assess the risk and return characteristics of offshore wind projects. It can therefore be stated that there is information asymmetry between project developers and institutional investors. Information asymmetry means that relevant information is known by some parties, in our case utilities or other project developers, but not by all relevant parties (the institutional investors). This is a form of market failure because this leads to the fact that institutional investors are hindered in their capability to assess all the information that is needed to make well-considered investment decisions.

Due to this information asymmetry institutional investors might not be able or willing to invest in offshore wind projects. Therefore information asymmetry might lead to a potential loss of the total capital pool that is available for offshore wind investments. Due to this opportunity loss it is therefore believed that this is of such an importance that it should be incorporated into the model. Information asymmetry can most easily be incorporated into the causal loop diagram by changing the emphasis of some risk-relating variables. According to the interviews, the different risks by itself are not the main problem, the main problem is that it is difficult to estimate the different risks. Table 21 shows how different variables in the causal loop diagram are changed so the notion of information asymmetry is incorporated in the model. Next to the fact that there is information asymmetry, there is also a lack of information due to the immaturity of the offshore wind market. Therefore even when the information asymmetry is removed it is still difficult to obtain reliable information regarding the merchant tail or wind data.

Table 21 Adaptations made to variables from the causal loop diagram

Variables conceptual causal loop diagram	Variables final causal loop diagram	Effect on relations	Reason for adaptation/ explanation
Construction risks	Ability to estimate the construction risks	Positive relation becomes negative relation	Importance of information asymmetry
Technology risks	Ability to estimate the technology risks	Positive relation becomes negative relation	Importance of information asymmetry
O&M risks	Ability to estimate the O&M risks	Positive relation becomes negative relation	Importance of information asymmetry
Regulatory risks	Ability to estimate the regulatory risks	Positive relation becomes negative relation	Importance of information asymmetry
Production	Ability to estimate the production	The relation stays the same	Importance of information asymmetry

7.2.2. Inability to assess risks, return and financial characteristics independently and removal of the categories

The conceptual causal loop diagram shows all the relevant variables that have effect on the ability of institutional investors to invest in offshore wind projects. During the interviews the interviewees were asked to rate the most preferred project structure, the most preferred type of investment product, the most important barriers and the most important or preferred mitigation strategies. The interviewees found this very difficult (actually no one was able to do this exercise) because of two reasons:

1. Many of the interviewees did not have the required knowledge concerning offshore wind investments and,

2. The interviewees stated that the different variables could not easily be assessed independently.

Institutional investors mentioned that whether they are able to invest relies on the complete set of variables. Institutional investors e.g. prefer that a project has an EPC-wrap in the case they invest in the construction phase. However, this might not be necessary if the project parties are very experienced and trustworthy and if there are other certainties, insurances or contingency facilities that provide enough security to the investor. Therefore it is difficult to assess the variables independently. To make it even more complex, next to the fact that all the variables of one proposition are connected, all the projects within the portfolio of the institutional investors are also connected. Therefore there is the possibility that one investor can invest in a product while another investor is not able to invest in that exact same product while their requirements are the same (only due to the fact that they have different other products in their portfolio). This makes it extremely complex to produce one set of requirements that projects must have before institutional investors are willing to enter the investment.

Furthermore during the interviews it was noticed that the categories were not mutually exclusive, and that it would be very difficult (if not impossible) to create mutually exclusive categories. It was notices that some variables that were categorized in one category could also have a direct or indirect effect on a variable from another category. This partly relies on whether you look from the perspective of an equity or debt investor to the model. From the perspective of an equity investor it is e.g. desired that the debt rates are low. However from the perspective of a debt investor the debt rates determine the returns. Therefore in paragraph 6.6.4. the barrier “Returns are too low” is influenced by competition, Solvency II and the LIBOR rate (this was mentioned by debt investors during the interviews). For equity investors the previous however will have a positive instead of negative effect on the returns. Furthermore it could also be substantiated that the barrier “Returns are too low” is a risk and that it therefore should be categorized into the category “Risk related barriers”. Because the interviews alienated that the categories are subjective to interpretation, they were removed in the final causal loop diagram. The categorization was very useful for constructing the conceptual theoretical model (and therefore also for constructing the final theoretical model) but it is believed that the reliability and the usability of the final causal loop diagram is increased if the categories will be removed. Therefore in the final causal loop diagram the colors that indicated the different categories are removed.

The interconnectedness of the different variables are furthermore represented by the fact that they all link to the variable “Bankability of offshore wind projects for institutional investors”. Only the correct combination of perceived risks, perceived returns and financial characteristics, lead to a bankable product. So due to the interviews it became even more clear that the variable “Bankability of offshore wind projects for institutional investors” determines whether institutional investors can invest in offshore wind projects or not. This was already presented correctly in the causal loop diagram.

7.3. Changing the causal loop diagram

In this paragraph the new causal loop diagram will be presented. The newly found variables are added to the already existing causal loop diagram and the proposed changes are implemented. Figure 25 shows the final causal loop diagram.

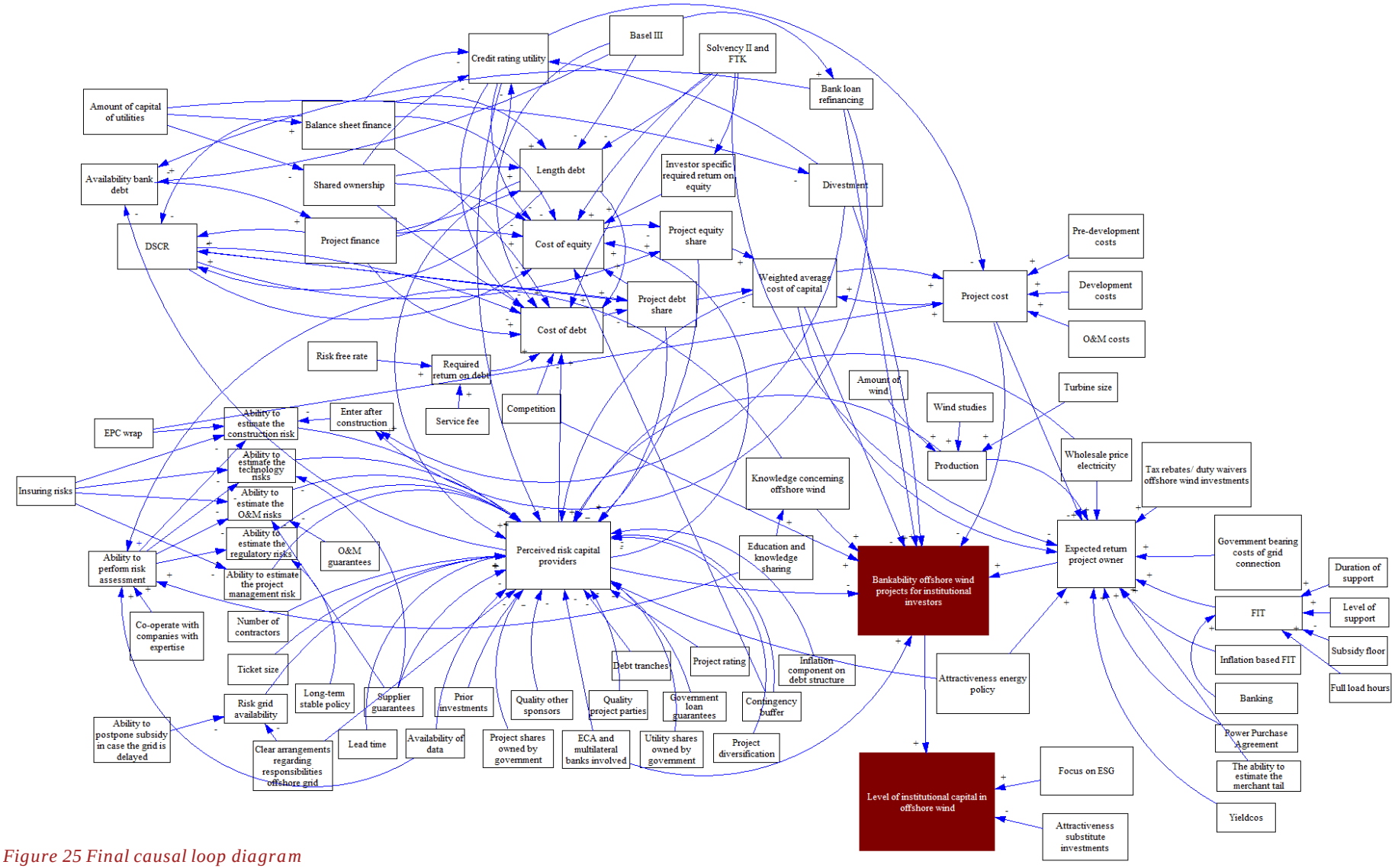

Figure 25 Final causal loop diagram

7.4. Changing the conceptual theoretical model

In this paragraph the conceptual theoretical model will be changed with the newly found insights from the interview data so a comprehensive and concise final theoretical model is created that can be used for further research and by policy makers to draft policies. Due to newly gained insights that was found during the interviews it is believed that the conceptual theoretical model (see Figure 11) needs some important changes. The changes will be described in this chapter.

First of all to create a concise but comprehensive model it is found that the variables that are stated in the three categories of the conceptual model are incomplete or at least not complete in any conceivable situation. Equity investors have different needs than debt investors and insurance companies have different needs than pension funds. The different variables in the categories therefore would not always apply to all institutional investors. Equity providers for instance care a lot about project costs because higher project costs will decline their profits. Debt investors however mainly care about the certainties they have regarding the principle and interest payments. Therefore the first modification that was made was that the variables were removed from the broader categorizations. Therefore merely the following categories were remained: energy policy, finance related variables, risk related variables and return related variables together with the independent variables substitute projects and focus on ESG.

Second during the interviews it was discovered that the absolute risks are not the direct problem, but that the problem is that institutional investors are unable to estimate and assess these risks. The same accounts for the return. If it would become more easy to estimate the risk and return it would become more easy for investors to enter the financial agreement. Therefore the risk, return and finance[40] related factors were changed, in line with the changes in the causal loop diagram, into "the ability to assess" these different factors.

Third, in line with and supportive to the fact that the factors were changed so they would include "ability to assess", it was decided that the information asymmetry as was described in 7.2.1 is of such importance that this should also be included into the model. The ability of institutional investors to assess the projects depend on how well the information needed to assess the projects is shared, and on how transparent the project parties are. In the new model therefore the factor "transparency and communication" was added. To graphically present this, it was chosen to use the same graphical representation as was done with the factor "energy policy" in the conceptual model (see Figure 11 and Figure 26). In the final model therefore two umbrella factors, "transparency and communication" and "energy policy" are present. Both factors influence all the different variables that have influence on the bankability and subsequently the ability of institutional investors to invest in offshore wind project.

Fourth, as mentioned in 7.2.2, it was noticed that the different characteristics that have influence on whether institutional investors can invest or not, cannot be assessed independently. Institutional investors found it difficult to state the different preferences because they just do not have one set of preferences. Institutional investors assess the entire proposition as a whole and this complete set of variables should meet their preferences. This notion led to the decision that all the categories should be linked to each other and this united set of factors should subsequently have influence on the bankability of the projects.

The final change that was made was regarding the variable "Substitute projects". The reason why this variable was included in the conceptual model was that if other projects have a better risk return relation, this could reduce the attractiveness of offshore wind projects. This is theoretically still true but according to the interview data this factors is not very important. Due to the fact that the absolute amount of capital that investors can invest in infrastructure and renewable energy projects is growing, substitute projects are not seen as a factor that hinders institutional investors to invest in offshore

[40] The financial related variables were not changed in the causal loop diagram because all the different financial related variable together, combined with the products that project owners supply (e.g. project bonds, or different loan tranches which are not included into the causal loop diagram) make up the financial structure.

wind projects. It is not the case the due to substitute projects no capital is anymore available for offshore wind projects. It is decided to keep include the variable “Level of ESG criteria in the investment methodology”. Institutional investors currently valuate projects taking into account risk and return criteria. All the investors stated that they have an ESG policy and that they want to do projects with a high ESG score. According to the interviews ESG criteria are however not yet directly part of the methodology of the decision making process. If ESG criteria are incorporated into the decision making process this could diminish the focus on risk and return. Therefore projects could be compared more easily on a level playing field. It is therefore expected that the level of which institutional investors use ESG criteria in their decision making process together with the other variables influences the bankability. Therefore the variable “Level of ESG criteria in the investment methodology” was still included into the theoretical model.

This together resulted in a new theoretical model. This model is composed using the most up to date scientific and non-scientific data that is present in this research area. Furthermore all the large insurance companies and pension funds (the asset management departments) of the Netherlands were interviewed and consulted. This led to the final theoretical model that is presented below (see Figure 26).

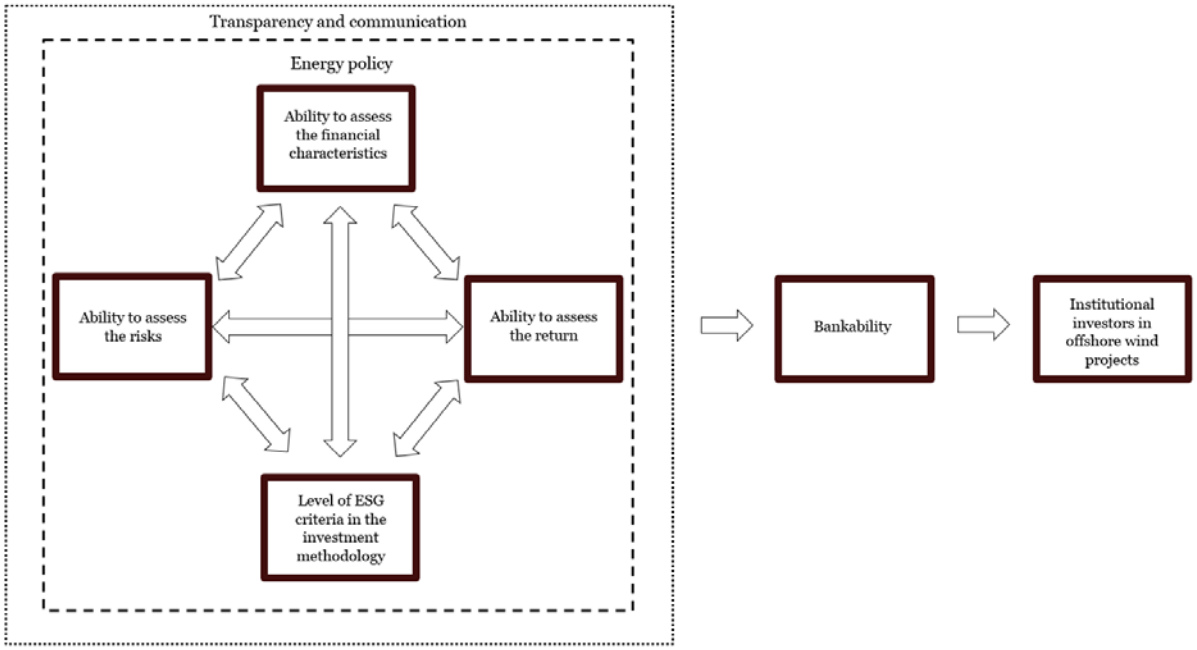

Figure 26 Final theoretical model

7.4.1. Using the final theoretical model

Figure 26 shows the final theoretical model. This model captures the most important factors that have effect on the ability of institutional investors to invest in offshore wind projects. By consolidating the causal loop diagram into a theoretical model the model became more accessible and clarifying, but on the other hand the theoretical model also lost a lot of detail. Therefore Table 22 was constructed. Table 22 shows different questions that people can take into account when using the theoretical model. The questions together determine the ability to assess the risks, financial characteristics and return. These questions can be used as a checklist so investors, researchers and policy makers increase the chance that they take into account as many relevant variables as possible when assessing the possibility of institutional investors to invest in offshore wind projects. The questions in Table 22 are merely a guideline that can be used and they are auxiliary to the theoretical model. Some of the questions stated in Table 22 can also be asked when assessing one of the other factors of Figure 26. The factors and the underlying questions, together with the energy policy and the transparency and communication of the projects owners determine the bankability of offshore wind projects for institutional investors.

Table 22 Matching questions of the different factors stated in the theoretical model

Ability to assess the risks	Ability to assess the financial characteristics	Ability to assess the return	Level of ESG criteria in the investment methodology
What are the construction risks?	What is the credit rating of the utility or other project developer?	What is the average amount of wind on the project location?	How important are ESG criteria in the investment methodology?
Is there an ECP-Wrap?	What is the specific Solvency capital charge?	How reliable is the data from the wind studies?	
Is there a possibility to enter after the construction?	What is the financing structure (balance sheet, project finance or shared ownership)?	What is the turbine size that will be used?	
What are the technology risks?	What is the DSCR?	What is the estimated production?	
What are the O&M risks?	What is the cost of debt (important in the case of equity investments)?	What is the current and estimated future wholesale electricity price?	
What are the regulatory risks?	What is the WACC (important in the case of equity investments)?	Are there tax rebates or duty waivers possible?	
Are there insurances?	What are the project costs (important in the case of equity investments)?	Is the government financially reliable for the grid connection?	
What is the project management risk?	What is the debt rate (important in the case of debt investments)?	What is the height and length of the FIT?	
What is the number of contractors?	What is the ticket size?	Is there a subsidy floor in the FIT?	
What is the ticket size?	What is the length of the investment?	What are the maximum full load hours in the FIT?	
How certain is the grid availability?	What is the project debt share?	Is there an inflation based FIT?	
Is there a possibility to receive the subsidy later if the grid is delayed?	Is the investment about refinance a bank loan?	Is banking possible?	
Is there clarity regarding the responsibilities of the offshore grid?	Is the investment about buying divestment shares	Is a proper PPA available?	
Are there O&M guarantees?	How fierce is the competition?	What will be the estimated merchant tail?	
Are there supplier guarantees?		Is the investment transferred to a yieldco?	
Is it necessary to cooperate with companies that can estimate the risks?			
Do we have the ability to perform risk assessment?			
What is the estimated lead time?			
Were we ever engaged in prior offshore wind investments?			
Is the availability of data sufficient?			

What is the quality of other sponsors?			
Are project shares owned by the government?			
What is the quality of the project parties?			
Are ECAs or multilateral banks involved?			
Are there governmental loan guarantees?			
Do the government own shares of the project developer?			
How does the investment fit in the current portfolio?			
How large is the contingency buffer?			
Is there an inflation component on the investment?			

8. Discussion and conclusion

In this chapter the main research question will be answered. The main research question was: Taking into account a Northwest European context, how can the barriers for institutional investors to invest in Dutch offshore wind projects be mitigated and how would this contribute to reaching the Dutch offshore wind targets?
This chapter will be divided into four parts. First the key findings are stated by summarizing the answers of the sub questions that were presented in chapter four, five and six. Second the scientific and managerial implications of this research are explained. Third the limitations of this study will be discussed and finally the key conclusions will be stated and the main research question will be answered.

8.1. Key findings of the sub questions

This first section will provide the key finding of the sub questions.

> *What are the specific financial, technical and regulatory characteristics for offshore wind and how does this relate to the current and expected future role of institutional capital?*

An extensive literature review was performed to find the specific financial, technical and regulatory characteristics for offshore wind and to find out what the current and expected future role of institutional capital regarding offshore wind would be. The offshore wind market is a fast growing market. This will lead to a large capital need in the Netherlands. Currently institutional investors are underrepresented in the financing market of offshore wind projects. Especially in the Netherlands, because no Dutch institutional investor have yet invested in a Dutch offshore wind park. Institutional investors currently still find it difficult to invest in offshore wind projects due to the very specific financial, technical and regulatory characteristics of these projects. The most important characteristics will be briefly summarized. There are multiple specific financial characteristics. Offshore wind projects have large capital costs and the LCOE of these projects is also significantly higher than substitute renewable energy technologies like onshore wind or solar energy. Due to the low LIBOR rate and the fact that there are many debt providers interested in these particular projects, the debt rates for offshore wind projects are historically low. Institutional investors are able to provide debt and equity for offshore wind projects. There is a trend that more and more offshore wind projects are being financed on a non-recourse basis however institutional investors have generally still little experience in financing project finance projects. There is one main technical characteristic that is important for this research. This is regarding the fact that the technologies used for offshore wind energy are still rapidly developing. Due to the generally long tenor of the loans or the long equity investment period, it is a risk that the technologies used are still under development. The regulatory characteristics of offshore wind relate to both national and international policies. Due to Basel III banks might become more reluctant to invest in long-term products and according to the literature institutional investors are able to fill this gap. However due to Solvency II insurance companies must hold a large capital charge if they provide capital for offshore wind projects and this again might deter insurance companies to invest in these projects. Pension funds need to comply with the FTK. The FTK however seems not to hinder pension funds to invest in offshore wind projects. Due to the high costs, offshore wind is not yet viable without a subsidy. This dependency makes the projects sensitive to regulatory changes.

It is expected that institutional investors are becoming one of the most important financers for offshore wind projects (debt as well as equity). Especially in financing the operational phase it is expected that institutional investors can play a major role.

What are the theoretical investment barriers for institutional investors in offshore wind and what are the variables that have influence on these barriers?

All the theoretical investment barriers that were found in the literature review study were incorporated into the conceptual causal loop diagram that was constructed in chapter 5. The theoretical investment barriers all had a negative effect on the risk, the return or on the bankability of the project. Furthermore one barrier directly had a negative effect on the ability of institutional investors to invest in offshore wind projects, this was the barrier substitute projects. Substitute projects can decrease the interest of institutional investors when there are sufficient amount of other projects with better risk return ratios. Next to substitute projects three types of barriers were identified: finance related barriers, return related barriers and risk related barriers. There are different finance related barriers. It is a barrier that the LIBOR rate is historically low and that the competition is fierce. This drives down the debt margins. For equity providers however it is desired that the debt rates are very low. This barrier therefore relies on whether the investors will invest in debt or in equity. Furthermore it is seen as a barrier that due to Solvency II insurance companies need to have a large capital reserve for offshore wind projects. This decreases the attractiveness of the projects. Furthermore it is a barrier that institutional investors have little experience with investing in the current offshore wind investment products. There are also return related barriers: The characteristics of the FIT are not optimal and the specifications are too uncertain, the full load hours stated in the FIT do not maximally encourage project owners to generate more than the production estimations and the subsidy floor of the FIT leads to profit uncertainties. Furthermore it is a barrier that the wholesale electricity price is currently very low, the production is unpredictable due to the unpredictability of the amount of wind and due to the contingencies that can occur during the construction and utilization phase. These barriers have direct effect on the profitability of the project and therefore on the attractiveness of the projects. Finally there are also risk related barriers: The construction, technology, O&M, regulatory, and project management risks demotivate investors to invest, furthermore it is a barrier that investors do not have the ability to assess the propositions and properly perform the risk assessments and finally it is seen as a barrier that the grid might not yet be ready at the time the wind farm could be operational.

How can theoretically the investment barriers be removed?

There are different ways to mitigate the barriers that institutional investors encounter when they want to invest in offshore wind projects. The mitigation strategies that are discussed in this sub question are the ones that were found during the literature review study. The next two sub questions are about the barriers and mitigation strategies that Dutch institutional investors encounter and prefer.

To mitigate the perception that offshore wind investments have a risk return relation that is suboptimal relating to substitute projects, companies can increase their focus on ESG criteria. If ESG criteria are becoming more important the perception of the suboptimal risk return relation of offshore wind projects might change. No mitigation strategy was found that could mitigate the barrier of the low debt returns. The same accounts for the Solvency II barrier. Institutional investors generally have little experience with offshore wind investment products. To mitigate this problem project developers should be stimulated and educated to restructure the investments into products that institutional investors prefer or at least are familiar with. The projects can be given a credit rating which would make it easier for institutional investors to invest.

Multiple return related mitigation strategies were found. It was found in the literature that investors or project developers could lobby for an increase of the height or length of the FIT, for an inflation based FIT, for tax rebates, duty waivers or banking. This could increase the profitability or the security of returns. Furthermore the certainty of returns could be increase by putting more effort in performing high quality wind assessment studies. No mitigation strategy was found that could increase the low wholesale electricity price, but by arranging long-term PPA contracts the internal rate of return could be secured and be made predictable.

Furthermore the risk barriers can be mitigated by insuring construction, technology and O&M risks and by making arrangements regarding supplier and technology guarantees. Furthermore long-term

O&M contracts could be arranged with built-in availability guarantees. Next to insuring the construction risk an EPC-wrap can also mitigate this risk and furthermore there are also different ways to enter the agreement after the construction phase. The project management risks can be decreased by selecting good rated project parties and by including a limited number of contractors. Loan guarantees from ECAs can secure the principle and interest rate payments and furthermore it is thought that the reliability of the project will increase if the government has project shares (in the case of contingencies the government might be a back-up which increases the chance that the investors will be able to recover the capital that they might have lost due to the contingency). Furthermore a contingency buffer could function as a cushion in the case contingencies occur. The perceived risk of the single project can also be decreased by diversifying the investment portfolio of the investor. Finally the energy policy should be very clear and robust and therefore the project parties must make clear arrangements with the government to secure the subsidies and other agreements.

How do the identified theoretical barriers relate to the Dutch situation?

To answer this sub question the information that was found during the literature review study was compared with the information that was found during the interviews. The main barrier that was mentioned (this was mentioned by most of the utilities, pension funds and insurance companies), was that in general institutional investors do not have the knowledge to correctly assess the projects. The difficulty to assess the projects is increased by the fact that institutional investors mentioned that it is difficult to obtain reliable knowledge because the utilities are non-transparent regarding data sharing. The lack of knowledge has effect on all the different barriers and mitigation strategies. A related barrier, that was mentioned separately, was that institutional investors have little experience in the offshore wind investment products that are offered to the market.

Another severe barrier for Dutch institutional investors to invest is Solvency II. Solvency II has only effect on insurance companies and four out of five of the interviewed insurance companies stated that Solvency II makes it for them less attractive to invest in offshore wind projects. Insurance companies state that the capital charge must decrease or that they need to find ways to circumvent this charge before they will be interested to invest in offshore wind projects. The project margins are currently low (especially for debt investments), therefore a high capital charge is seen as a large problem. The fact that the margins are currently low was also stated by the Dutch institutional investors as an important barrier for them to invest. Especially the debt rates are low and this makes it less attractive for Dutch institutional investors to enter this perceivable high risk market where they have little experience in.

It was found in the literature that institutional investors have a problem with investing in the construction phase. This was partly confirmed and partly disconfirmed during the interviews. Dutch institutional investors indeed see the construction risks as a high risk however there are many ways this risk can be mitigated. Investors can enter after the construction and some Dutch institutional investors even stated that they are comfortable with investing the constructing phase if the risks are properly mitigated (there are examples that the construction risks are properly mitigated so this could be a realistic option).

Furthermore institutional investors have little experience in the regular offshore investment products. They are not used to make direct investments and they are also not used to invest in non-rated products.

The returns on the investment was also perceived to be too low in related to the risks.

The Dutch government has proposed multiple regulatory changes in the past few years. The feeling that the government can change “the rules of the game” during the subsidy period has a high negative impact on the confidence of (mainly utilities) but also on institutional investors. This is mainly a concern for equity providers because they are the one that see their profits decline or vaporize the first.

Another problem mentioned by two pension funds was that it is difficult to estimate the merchant tail. This barrier is only relevant for equity providers. Due to the immaturity of the market there are no

proxies yet that can help indicate the merchant tail. Also no mitigation strategy was mentioned during the interviews to mitigate this barrier.

Finally different stakeholder groups mentioned that the technology is seen as a risk. Due to the relative limited market experience and the fast changing market, this is seen as a barrier to invest. Due to the lack of knowledge of most of the institutional investors they were generally unable to state the exact risks that were high and needed to be mitigated.

> *How do the mitigation strategies of offshore wind investments relate to the Dutch situation and how can we learn from experience from Northwest European countries?*

The most mentioned barrier was the fact that institutional investors have a lack of knowledge regarding offshore wind investments. It could therefore be expected that the most mentioned mitigation strategy would be regarding removing this barrier. However merely one insurance company mentioned that their strategy would be (in the case they would decide to invest in offshore wind), to team up with an experienced partner and furthermore one pension fund and one utility firm mentioned that institutional investors should be "educated" and that the focus should be on knowledge sharing. Disregarding the fact that these mitigation strategies were not often mentioned, it is believed that these strategies are the most important mitigation strategies. Without the correct amount of knowledge it is not possible to assess whether the projects would fit in the portfolio of the asset manager, therefore this mitigation strategy is crucial.

The most often heard mitigation strategy was that institutional investors can enter the financial agreement after the construction phase of the projects. After the construction, equity providers can purchase divestment stakes and debt providers can refinance loans. During the interviews the actors mentioned that this would highly decrease the risks and that this would increase their possibility to invest. This coincides with the information gained in the literature review. However contradicting to the knowledge that was gained in the literature review study, there were still quite a number of Dutch investors that mentioned that they were actually open for investing in the construction phase. The risks should only be sufficiently mitigated. The possibilities to mitigate these risks are via insurances or via an EPC-wrap. This EPC-wrap is not a necessity for every Dutch investor. It was interesting to see that the Dutch parties that had previous experience in financing offshore wind, were more likely to say that they were also able to invest during the construction phase and that they did not always require an EPC-wrap. This results again into the conclusion that the risks are not by any means too high, but that some parties have too little knowledge concerning the risks.

Regarding the regulatory framework it should be entirely clear what the responsibilities are of the government, what the securities are for the subsidies and how the project owners are compensated in the case calamities occur. There is a sentiment that the regulatory framework is improving and that it is starting to be more clear and robust. Disregarding this sentiment, during the interviews the mitigation strategy that clear agreements should be made with the government was still mentioned often. Due to the lack of knowledge however it is believed that not all institutional investors were aware of the (new) arrangements of the regulatory regime. A way to increase the awareness and the certainty of the regulatory framework is to more actively communicate the regulatory arrangements that are made to the investors.

One Dutch pension fund and one Dutch insurance company mentioned that they do not have experience in the investment products that are associated with offshore wind investments. This was also stipulated by a utility and by the NLII. The NLII tries to restructure the propositions in such a way that institutional investors are familiar with the investment products so they can more easily invest.

There are different international examples of how investment barriers can be mitigated. In the UK the subsidy can be postponed if the park is already finished and there have been delays with the offshore grid. Furthermore there is the EIB project bond initiative. This initiative can make the investment products more attractive for institutional investors by securing the payments and by making the investment product a product that is known by institutional investors. Furthermore in other countries

utilities have established Yieldcos. It is expected that it is easier for investors to invest in these Yieldcos than directly in the projects. Finally in Germany SPVs, who own the projects, can be created and issue asset-backed securities. In this way investors can invest in a debt product (with the associated debt Solvency charge) while they receive equity returns (which is usually significantly higher than the debt interest rates). This is a possible way to circumvent the Solvency II capital charge. The strategies that are applied abroad were all mentioned by merely one stakeholder and all during different interviews.

Overall the information that was found during the literature review study coincided with the information gained during the interviews. The main difference is that the preferences are not as black and white as sometimes is described in the literature and furthermore the knowledge that was gained during the literature review study was in general more explicit and extensive than the information gained during the interviews.

8.2. Scientific and managerial implication

8.2.1. Scientific contribution

This research provides a clear overview of the variables that have effect on whether institutional investors can allocate money towards offshore wind projects. No scientific literature exists about institutional investors that want to invest in offshore wind projects. This reports build on the scientific contributions that Wüstenhagen and Menichetti made regarding renewable energy investments and it presents a more comprehensive view and a more specified view of their model. This research show how the fairly general model of Wüstenhagen and Menichetti is extended into a causal loop diagram by firstly creating an interim model. Furthermore this report shows how the interim model is subsequently extended to create the extensive causal loop diagram that represent the variables that influence the decision making process of institutional investors. Next to the causal loop diagram a consolidated and verified theoretical model was created which also can be used by scholars as a scientific base for further research.

Therefore the scientific contribution is twofold. First of all the causal loop diagram and the theoretical model can be used by scientists to do future research in this research area (see Figure 25 and Figure 26). Second a methodology was provided that shows how a current theory can be used and transformed into a new more specified theory and model.

8.2.2. Managerial and policy contribution

This study can contribute to policy makers in various ways. This study can be used as a guideline to see what influences the decision making process of institutional investors regarding offshore wind investments. Policy makers can use this study to find out how changes in the policy setting might affect the willingness of institutional investors to invest in offshore wind projects. To do so Figure 25 can help policy makers with their decision making process. Furthermore this research can help policy makers to build knowledge regarding these investments. The final theoretical framework and the associated questions that are stated in Table 22 can form the basis of the knowledge building of policy makers.

The managerial contribution lays in the fact that this study provides managers with market insights. This study provides managers from utility firms with more insights in the difficulties that institutional investors face and therefore they can more easily change the specifications of the projects or the communication process in such a way that it does not hinder, or even stimulate, institutional investors to enter this market. The managers from utility firms stated that they are not in a direct need for extra capital. This might lead to the fact that utility firms are less willing to change their projects and to become more transparent regarding project sensitive and specific data. However if the need for institutional capital increases this research can help project developers to more easily anticipate on this potential increasing demand.

The managerial contribution for investment managers is that these investors, with the help of this report, can more easily find out what the core of the investment difficulty is. Many institutional investors have not yet seriously looked into the possibility to invest in offshore wind projects and another part of the investors have looked into the projects but they do not know how to assess the projects (a final group has experience with this asset class and they do know how to evaluate the projects). The unexperienced institutional investors might be able to learn from this report and they might be able to see that there are other companies (investors, banks or external due diligence parties) that are able to properly assess the projects. This might lead to more openness of the investors to seriously consider to find ways to invest in offshore wind projects. Furthermore this research provides institutional investors with a theory and associated questions that can be used as a checklist to make sure that they do not forget to assess relevant data.

This report might shed light on the information asymmetry problems that is currently present. Therefore this might lead to the insight that the communication between utilities and institutional investors (perhaps via banks) should be improved. This could bring utilities and institutional investors closer together what hopefully leads to sustainable relationships.

8.2.3. Contribution to PwC

PwC is a company that has a dedicated energy and economics team. This team has many credentials regarding strategic and operational consulting assignments within the energy sector. Offshore wind is a growing sector within the energy sector and therefore there are still many market opportunities. Increasing the understanding of the electricity sector and of offshore wind is therefore always of importance for PwC.

PwC is working on becoming a true specialist on wind energy (on shore and well as offshore) and the explorative study and the specific Dutch market analysis will therefore highly contribute to the knowledge base of PwC. Next to the knowledge contribution there is also a business contribution.

Institutional investors are in general fairly new to the offshore wind energy business and the strategy and economics team of PwC have not yet worked together with institutional investors in this field. During this research I interviewed the most important institutional investors and most of the time a senior manager joined the interviews. Therefore next to the knowledge extension, PwC also gained new contacts within a business area that might soon be interested in offshore wind investments.

When an institutional investor wants to invest in offshore wind farms, they would probably rely on an external party to do a commercial and/or financial due diligence on the business case due to a lack of own industry specialists. PwC has the knowledge and the capability to do such due diligence assignments. Therefore this research may bring some new business for PwC in the future.

8.3. Limitations and future research

8.3.1. Drawback of the method

The causal loop diagram that is used in this research is a sufficient method for the explorative study. It presents a clear picture of all the different relevant variables and it shows how these variables influence each other. A drawback of this method is that by merely looking at a causal loop diagram, it is impossible to see the level of importance of the different variables. Some variables might have a more severe negative or positive effect than other variables. The most important variables were identified during the interviews however for a relative importance of the different variables more research should be done. Another difficulty regarding the causal loop diagram is that it matters from which perspective you look at the causal loop diagram. If you look from the perspective of a debt investor to the model, you want the debt rate to be high, however if you look from the perspective of an equity investor, you want the debt rates to be low so the return on equity will be higher. The model can be more specified if ex ante it is decided who will use the causal loop diagram.

8.3.2. Validity

Despite the fact that the extensive literature review study was validated by the interview data, one of the drawbacks of the chosen research method is that it still is difficult to guarantee the internal validity. The internal validity relates to the issue of causality. Bryman states: “internal validity is concerned with the question of whether a conclusion that incorporates a causal relationship between two or more variables holds water” (Bryman, 2008, p. 32). This research partly uses interviews to collect the data which is used as a fundament for the conclusions. The answers that are provided by the interviewees are collected and validated by mutually comparing them with each other. The internal validity however is difficult to test because of the small interview sample, because of the open interview structure and because of the fact that it is difficult to know whether the interviewees have enough knowledge on the concerned topic or whether they deliberately or not deliberately withhold information.

Eight of the nine large pension funds and insurance companies in the Netherlands that manage assets were interviewed. Therefore the dataset is fairly complete and representable for the market. However due to the limited number of firms the absolute interview group was still limited. Furthermore the answers that were provided on the interview questions were very diverse and limited which makes it difficult to assess the internal validity of the answers. Some interviewees were not able to answer some questions and many interviewees were only able to partly answer the questions. This despite the fact that the interview group all existed out of asset managers or asset management department managers, that were (hypothetically if they did not invest in this asset class) responsible for these type of investments. This led to less data that could be used than initially was anticipated. It was furthermore concluded that, based on the interview group, the knowledge of institutional investors regarding these type of investments is fairly low which directly has an effect on the reliability of the data. Therefore the reliability of the interview data cannot be guaranteed.

Due to time limitations this research did not use the Delphi method. The Delphi method is a method to structurally obtain reliable data by two or more times interviewing a panel of experts. Each interview round the experts receive an anonymous summary that contains all the answers that were given by the interviewees, together with information regarding the reasons why these answers were given. These feedback rounds stimulate the experts to revise their answers. The idea is that after a several number of rounds the range of answers will converge towards the, according to the experts, correct answers. In this research an interview report was sent back to the interviewee and he or she got the opportunity to provide feedback on the report. This also increased the validity. However providing the interviewees an opportunity to get insights into the answers that were given by other interviewees might led to even more validated, complete and concise answers.

Another challenging assignment was to estimate the effect an increasing amount of institutional capital would have on the Dutch offshore wind market. This effect was not modelled and it was only qualitatively assessed. The effect of the removal of the investment barriers on the offshore wind targets therefore cannot be validated and despite the homogeneity of the answer the scientific reliability of this answer is not high.

This study had the aim to merely look at the Dutch market but by doing so it might have been better to also include international stakeholders into the study. As mentioned before, the offshore wind market is a very international market and there are little barriers for international players to participate in the Dutch market. Therefore including international institutional investors would have broaden our view and an incorporation of more data points would have led to a more validated model. The same accounts for the theory that was created. More validation would have led to a more validated theoretical model. Next to a more international interview sample, also more people from one company could have been interviewed to increase the dataset. Due to time limitations it was decided to merely interview the people that are stated in Appendix A.

8.3.3. Further research

A complementary research would be to quantitatively use the causal loop diagram that was created in this thesis. A causal loop diagram can also be used to model and quantitatively calculate different relations. For creating the causal loop diagram the program Vensim was used. In this program every link can also be represented by a formula. It would be highly interesting to find out if it is possible to quantify the different relations (e.g. if you know that a 10% increase of concept A leads to a 20% increases of concept B). This can subsequently be incorporated and programmed into Vensim (or a similar program) leading to a quantitative model that accurately shows how the level of institutional capital increases when one of the concepts is changed. This could improve the effectiveness of the causal loop diagram because it can more accurately show which variables have what kind of effect on the end-variable. When such a model is created it can also be used for different scenario analyses. Different scenarios can be modelled into the causal loop diagram and this would show the effect the different scenarios would have on the level of institutional capital in offshore wind projects. Unfortunately due to time constraints it was not possible to incorporate the previous into this thesis.

The causal loop diagram can also be adapted so it would incorporate other financial stakeholders. This research only focused on institutional investors but as mentioned in chapter 4, there are different type of investors that are willing to invest in offshore wind projects and that are important for the development of this sector.

Furthermore future research could focus more on receiving more in-depth knowledge from the institutional investors. This research was an explorative research. During this research the insurance companies and pension funds were asked open questions regarding the barriers and mitigation strategies. Because of the lack of knowledge and because some of the interviewees had never seriously considered investing in offshore wind project, a very diverse set of answers was obtained from the interviews. For the explorative purpose of this research this was valuable but it was less valuable for the in-depth purpose of this research. When trying to find out what the most stringent barriers and the most wanted mitigation strategies are, an answer sample that is consistent and that is large enough to state certain conclusions is preferable. In future studies researchers can use the answers that were given in this research and ask the same institutional investors to rank the variables. During this research the interviewees were also asked to rank the barriers and mitigation strategy but unfortunately the interviewees were unable to do so. It would therefore be valuable if in further research a survey would be created where the institutional investors can choose between different options (most easily each time two or no more than three options should be given). This again forces institutional investors to think about the aspects that they see as barriers and mitigation strategies and to think about all the barriers and mitigation strategies that other interviewees stated. This will provide the investors with extra knowledge and this could trigger them to learn more about this asset class. A first step in removing the knowledge barrier could be done by doing follow-up research which again actively includes the institutional investors.

Another interesting research would be to more accurately estimate the market capital that is actually needed to reach the Dutch offshore wind targets. The NLII performed an assessment showing the amount of capital that is needed to build the projects and to refinance the projects, however this study is not very complete. The amount of capital that is needed relies on the way the projects are financed and on how often companies will use capital recycling. The NLII included refinancing capital into the capital estimation however the amount that is divested is not included into the calculation. Therefore it is currently still unclear how much capital there is needed to reach the Dutch offshore wind targets, and what kind of capital is needed e.g. equity, debt, construction capital, refinancing capital or divestment capital. The type of capital is important for estimating what type of investors are willing to supply this need.

Finally a more quantitative cost analysis could contribute to the current knowledge base. In this research it was qualitatively researched whether an increase of institutional capital would lead to a decrease of the cost of capital. It would be interesting to more quantitatively assess this question by

decomposing the debt interest rates and by quantitatively assessing the different building blocks. The cost of debt is composed of: the risk free rate + an illiquidity charge + risk charges + perhaps service or administration fees. It would be interesting to find out what the different premiums are for the different type of investors. What determines the level of the illiquidity charge and what determines the level of the risk premiums? It would be interesting to see how the cost of debt is truly calculated and what could lead to a drop of these premiums. A similar research could be done to quantitatively identify how the required return on equity is defined, what the factors are that have influence on the required return on equity and how this can be influenced.

8.4. Key conclusions and recommendations

From the perspective of institutional investors it would make sense to look at the possibility to finance offshore wind projects. The investments are long-term investments which corresponds with their obligations. Furthermore there are many mitigation strategies that can be applied and that have been applied in the past that enhances the reliability of the investments. There are however some concrete barriers that hinder institutional investors to invest. The most severe and present barrier lays in the fact that offshore wind is a relative new asset class for Dutch institutional investors. The investments fall under infrastructure investments and not all asset management teams of Dutch pension funds and insurance companies have (yet) a dedicated infrastructure team and not all infrastructure teams have people that have the right amount of knowledge about offshore wind projects. Therefore institutional investors are in general unexperienced and unequipped to properly assess the offshore wind propositions.

The diverse set of investment abilities that was mentioned during the interviews implies that (when it is assumed that the absolute level of risk that institutional investors can take is mutually not significantly different) the absolute risks of the technology or the projects are not the main problem, but that the ability to assess these risks are the crux of the matter. This was also often mentioned during the interviews. The problem that institutional investors are generally unable to assess the offshore wind propositions is further reinforced by the fact that information between project developers and institutional investors is not shared properly. It can be said that there is information asymmetry between project developers and institutional investors.

A logical reason behind this information asymmetry was given in the interviews with the utility companies. The utility companies were asked whether they believe there was a direct need for institutional investors to enter this market and whether this would contribute to reaching the Dutch targets. The answer to this question was fairly uniform. Currently there is no sentiment that a shortage of capital hinders the project developers to develop offshore wind projects. Utility companies mentioned that there are multiple type of investors that are willing to invest in offshore wind projects. Therefore there is currently, from the perspective of project developers, not a direct need to attract extra sources of capital and to find ways to incorporate institutional investors in the financing process of offshore wind farms. It was stated during the interviews that the way the risks are currently being mitigated is still sufficient for other type of investors and therefore there is currently no need to mitigate extra risks so institutional investors can enter the financial agreements. Utilities see institutional investors as reasonable parties for capital recycling and in some cases also as a useful party for earlier stages of the projects. However during the interviews it became clear that utilities will just work together with the parties that best suit the project specifications and that they do not give preference to institutional investors. This leads to the fact that utilities do not have the need to communicate with institutional investors and to share data with them. This again makes it more difficult for institutional investors to assess the propositions and to enter the financing process.

The problem of information asymmetry and a lack of knowledge can be overcome by extensive knowledge sharing which could be facilitated by an organization like the NLII. The NLII could increase the public knowledge base by collecting the data that is needed to assess the projects and then subsequently prepare the data in such a way that the investors are able to assess it and to make an own judgement regarding the risk return relation of the propositions. The NLII is currently trying

to create propositions where institutional investors can invest in secured, for institutional investors-familiar debt products that have a risk return ratio that is similar to other products they normally invest in. This can make it easier for them to decide to invest in offshore wind projects. Green bonds or Yieldcos could be an outcome. Institutional investors that are interested in investing in offshore wind projects but who don't have the knowledge can also cooperate with institutional investors that do have the knowledge or they can hire external parties that can perform the technical and financial due diligences on the projects. There are companies who are specialized in making infrastructure investments. Therefore not all the institutional investors need to be able to assess the propositions themselves, they could also outsource the assessments. A problem regarding outsourcing is that it will diminish the returns while the returns are currently not perceived to be high. A high or low return however is strongly related to the perception of the investors. Therefore if institutional investors decide that ESG criteria would become more important in the decision-making process by becoming an evaluation criteria together with the risk and return, the risk return relation of offshore wind project might not be perceived to be sub-optimal anymore. For this to happen the governance of the institutional investors must change, as well as the return and ESG demands of their clients.

According to this research at this moment institutional investors do not have a crucial role in reaching the Dutch offshore wind targets. The availability of capital is currently not seen as a restriction to build projects and furthermore the WACC is at this moment already low and therefore it is unreasonable to expect that due to institutional investors these costs will further drop significantly. However if institutional investors will more actively enter this asset class, this will lead to more competition and more competition could lead to a drop of costs. The level of which the costs can still drop and what effect this will have on the total costs of the projects is unclear.

Disregarding the previous comments it is still desirable that institutional investors build up experience in this asset class. It is expected that the amount of capital that is needed to build the offshore wind projects will significantly increase over the next years and it is unknown whether other investors stay interested in financing these projects. Perhaps if in the near future the economy recovers and therefore the debt rates and the expected return on equity increases again the investors that are currently willing to finance offshore wind projects (due to fact that the margins in other investments are historically low) pull back or maybe due to other reasons in the following years a capital need occurs. Furthermore the minor role of Dutch institutional investors in Dutch offshore wind projects should not be seen as a stringent problem, but as a loss of opportunity. From the perspective of policy makers and Dutch institutional investors, it is undesirable that viable offshore wind projects, that receive a lot of government support, are being financed by foreign companies or companies that do not have the long-term perspective and liabilities that institutional investors have. Therefore from an institutional investor and policy perspective it is desirable that institutional investors incrementally participate in financing offshore wind projects so they slowly build up knowledge and increase their market share. Policy makers can play a role in stimulating institutional investors to invest in offshore wind projects. The role of policy makers could be to:

- Secure a stable and predictable subsidy scheme. This is the most important thing that policy makers should do. The development of offshore wind is currently still relying on governmental subsidies. This implies that if the government will cancel or economize the support scheme this could lead to a hold or a reduction of the development pace of the projects. Institutional investors need to invest to build up a knowledge base and they will most likely only do so when they expect future market opportunities in the offshore wind market. Therefore a stable and predictable subsidy scheme is crucial for institutional investors
- Actively stimulate knowledge sharing. They can introduce relevant parties to each other, they can facilitate round tables or they can facilitate the assessment of the offshore wind propositions. By collecting data and publically publishing research reports that can directly be used by investors, the government can help to diminish the knowledge gap of institutional investors and they can facilitate in decreasing the information asymmetry
- Find out if the PBI can be used for offshore wind projects. This could perhaps be done in corporation with the NLII because this organization is currently already exploring this option.

If the PBI cannot currently be used for offshore wind projects, policy makers can play a role in lobbying for this possibility, and to

- Do research about the possibilities, desirability and the possible effect of introducing Yieldcos and green bonds.

There are also some more stringent policies that can be introduced. These suggested policies are no direct recommendations however for the completeness of this report and for inspiring policy makers they will be discussed. If the government wants to have a more severe role in stimulating institutional investors they can:

- Examine the possibility to incorporate tender requirements that will stimulate project developers to include institutional investors in the financing process
- Hire rating agencies to give the projects a project credit rating. This will make it easier for institutional investors to invest in the offshore wind projects
- Offer guarantees. This is especially relevant for debt providers because the government can easily carve out the default risks of the loans by guaranteeing the payments. If the government would be willing to do so, the loans would practically have the same risk profile as Dutch governmental bonds. If this will be the case the risk return ratio will most likely not be a problem anymore and this could stimulate Dutch institutional investors to invest in Dutch offshore wind projects
- Directly participate in offshore wind projects by buying equity stakes or by providing (subordinated) loans. If this option is chosen, the government should be careful not to provide capital that otherwise would have been supplied by the market
- Examine the possibility to demand institutional investors to take ESG criteria into account when evaluating propositions and they can find out if the government is able to introduce renewable energy targets for asset management teams.

The previous list of examples is non-exclusive and depending on the actual willingness of policy makers to interfere in this market, one or multiple of these policies can be introduced.

9. Reflection

During the last six months I started and completed the final test of the Technical University of Delft which was writing a master thesis. It has been a challenging, educational, fun but sometimes also frustrating process, but eventually the result is a well-considered and profound scientific report which I am proud of. The added value of writing a master thesis is more than just the final report. The entire process was very valuable for my development and therefore it is important to reflect back to the past six months to see what I have learned, what the challenges were and what I could have done better if I would have to do the process all over again. This chapter will contain a reflection of the past six months. I hope that students that are about to write a master thesis can benefit from my experiences and that this chapter can help them to circumvent pitfalls and to smoothen their graduation process.

9.1. Choose a topic where teachers can sufficiently guide you

The first hiccup I encountered during the graduation process was that I decided that I wanted to write my thesis about a topic that very interested me but that was not directly linked to the knowledge that was available within the faculty I was studying. I wanted to write a thesis about renewable asset-backed securities and I even completed my research proposal which was also approved by the university. Because of this approval I assumed that my research topic was correct and that I was able to find teachers who had extensive knowledge in this research field. However this was unfortunately not the case. It was difficult to find a research team that was willing to support my research and it was even more difficult to find teachers who had more knowledge regarding this topic than I already gained from writing the proposal. Therefore I started as the expert which made it difficult for my supervisor to guide me into the right direction and to prevent me for potential pitfalls. After a few weeks I was forced to change from supervisor. During the process I spoke to different companies regarding my topic and they all consulted me to change topic because of the difficulty they foresaw I would have in collecting sufficient data and to write a thorough research on this topic. Eventually I therefore decided to change my research topic. Because of my stubborn attitude and my enthusiasm about my first topic I was unable to see that this topic was leading me to a dead-end. It would have saved me a lot of time if I first have consulted the university about the topic I wanted to write my thesis about and if I had first figured out if there were enough teachers who had extensive knowledge about this topic. Eventually I changed my topic in a fairly relating topic however this did cause some delays.

9.2. Planning is the key to a successful thesis

Writing a master thesis is an iterative process that can will cost you a lot of time, and a lot of more time than you expected if the process is not properly planned. For my research I wanted to interview the most important Dutch institutional investors and utilities. To do so I already started planning the interviews approximately two months in advance. This had multiple advantages: I was able to do the interviews in a short period because I was able to plan every day one interview for 3 successive weeks, I incorporated a large time buffer because it will always take you more time than you expect to get into contact with the right people and to actually plan an interview date (some interviews were still confirmed only a few days before the actual interview took place), and finally this gave me a hard deadline to work towards because for the interviews I needed to have finished the first part of the report. I believe setting real deadlines was very important to me. It is difficult to state when your work is sufficient enough and therefore it is easy to keep working until you need to hand in different chapters. For instance, when did you find enough knowledge during the literature review study? It is difficult to set these boundaries. However if you have a deadline in a few weeks, you will just work

towards that specific deadline. Therefore setting deadlines is also a tool for knowing how extensive the different parts of your thesis need to be.

9.3. Be reasonable regarding your expectations

Before I started writing my thesis I was not well-informed about the expectations of the university, about what the university expected regarding the size, the difficulty or e.g. the innovativeness that the thesis needed to have. I wanted to write a world-changing, mind-blowing thesis. I therefore sometimes forgot that I was writing a master thesis and that I was not doing a PhD program. It would have saved me a lot of energy and a lot of uncertain times if I had reasonable expectations regarding the quality and thoroughness of my thesis.

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Appendices

A. Interview list

Party	Company	Interview date
Project developers	Dong	2-4-2015
	Vattenfall/Nuon	25-3-2015
	E.On	19-3-2015
	RWE/Essent	24-3-2015
	Eneco	26-3-2015
Government	Ministry of Economic affairs	1-4-2015
Pension funds	PGGM	23-3-2015
	APG	18-3-2015
	MN	17-3-2015
Insurers	Aegon	20-3-2015
	ASR	1-4-2015
	Delta Lloyd	31-3-2015
	Nationale Nederlanden	8-4-2015
	SNS Reaal	16-3-2015
NLII	NLII	1-4-2015

B. Interview questions

All the interviews that were conducted were with Dutch stakeholders. Therefore the questionnaire was also formulated in Dutch. If necessary, you can contact the author for an explanation or translation of the questions.

B1. Target group: Energy companies

Introductie

Het doel van mijn thesis om te kijken hoe de rol van institutionele investeerders in de financiering van wind op zee projecten vergroot kan worden en wat voor effect dit zal hebben in het behalen van de wind op zee doelstellingen zoals die zijn gemeld in het Energieakkoord. In de interviews met institutionele investeerders zullen, vanuit hun perspectief, de barrières worden geïdentificeerd en de preferenties voor verschillende mitigatiestrategieën in kaart gebracht worden. Vervolgens zal ik hen vragen wat het vermeend effect op de wind op zee doelstellingen zal zijn indien de barrières worden weggehaald.
In de interviews met energiebedrijven wil ik gaan onderzoeken of er vanuit hen vraag is naar een grotere betrokkenheid van institutionele investeerders in de financiering van wind op zee projecten en of energiebedrijven denken dat dit de financieringskosten omlaag kan brengen. Vervolgens wil ik proberen te achterhalen of energiebedrijven bereid zijn om extra risico's te dragen (veelal in de vorm van garanties) wat kan leiden tot meer vertrouwen van institutionele investeerders in de wind op zee projecten. Uiteindelijk zal ik vragen gaan stellen over het geschatte effect dat een grotere rol van justitionele investeerders in het financieringsproces van wind op zee projecten kan hebben in het behalen van de overheidsdoelstellingen.

Vragenlijst

1. Verwacht u dat in de toekomst meer externe financiering betrokken gaat worden bij wind op zee projecten? Zou u uw antwoord kunnen onderbouwen?
2. Acht u het voordelig en gewenst dat institutionele investeerders meer investeren in wind op zee project? Zou u uw antwoord kunnen onderbouwen?
3. Kan het voordelen opleveren om institutionele investeerders vanaf het beginfase van het project te betrekken (waardoor bijvoorbeeld de projectstructuur kan aansluiten bij de eisen van institutionele investeerders, of waardoor er vroegtijdige desinvesteringsafspraken gemaakt kunnen worden)?
4. Heeft het bedrijf waarvoor u werkt ervaring met het betrekken van institutionele investeerders in het financieringsproces voor de wind op zee projecten? Zo ja kunt u uw antwoord toelichten?
5. Heeft u het idee dat het makkelijker en/of winstgevender is om in het buitenland wind op zee parken te bouwen? Is de financierbaarheid van buitenlandse parken hoger? Zou u uw antwoord kunnen toelichten?
6. Wat zijn volgens u de 5 grootste barrières waarom het moeilijk is voor institutionele investeerders om te investeren in wind op zee projecten? Kunt u uw antwoord onderbouwen en ordenen van belangrijk naar minder belangrijk?
7. Welke investeringsrisico's zou u als rol van projectontwikkelaar op u kunnen en willen nemen?
8. Wat voor effect denkt u dat het weghalen van de belangrijkste investeringsbarrières voor institutionele investeerders heeft op:
    - de hoeveelheid institutioneel kapitaal dat geïnvesteerd zal worden in wind op zee projecten?
    - het behalen van de wind op zee capaciteitsdoelstellingen
    - de kapitaalkosten en dus op het behalen van de wind op zee kostenreductie doelstelling

NLII specifiek

9. In het document "Realisatieplan" van de NLII staat pensioenfondsen en verzekeraars respectievelijk 17,6 en 3,3 miljard beleggen in lange-termijn investeringen. Is er ook onderzocht welk percentage hiervan beleggers bereid zijn om in Nederlandse wind op zee investeringen te beleggen?

Indien tijd

10. Hoe kijkt u aan tegen de oprichting van de Nederlandse Investeringsinstelling (NLII)?
11. Wat denkt u dat de rol moet zijn van de NLII?

B2. Target group: Institutional investors

Introductie

In dit interview zal gekeken worden hoe de rol van institutionele investeerders in de financiering van wind op zee projecten vergroot kan worden. Het is de bedoeling dat de barrières worden geïdentificeerd en dat de preferenties voor verschillende mitigatiestrategieën in kaart gebracht worden. Vervolgens zal er gevraagd worden wat het vermeend effect op de wind op zee doelstellingen zal zijn indien de barrières worden weggehaald.

Vragenlijst

1. Hoe ziet de huidige wind op zee portfolio van het bedrijf waarvoor u werkt er uit?
    - Hoe groot is het portfolio (in €)?
    - In welke landen bevinden de projecten zich? En waarom daar?
    - Hoe lang investeert het bedrijf al in wind op zee projecten?

2. Wat zijn de financieringseisen en voorkeuren van institutionele investeerders?

   Wat is:

   - De gewenste grootte van de investering?
   - De gewenste duur van de investering?
   - De gewenste projectstructuur (balansfinanciering, shared ownership, projectfinanciering, etc.)?
   - De gewenste financieringsvorm (eigen vermogen, corporate bonds, project bond, niet-achtergestelde lening, achtergestelde lening, etc.)?
   - De gewenste instapfase (pre-constructie-, bouw- of exploitatiefase) en dan via herfinanciering of desinvestering?
   - De gewenste rentabiliteit van de lening of geïnvesteerd eigen vermogen?
   - Zijn er andere financieringseisen?

3. Wat zijn volgens u, van de bovengenoemde, de belangrijkste vijf financieringseisen of voorkeuren voor wind op zee investeringen? Orden van 1 tot 5 waarbij 1 de belangrijkste financieringseis of voorkeur is.

4. Wat zijn volgens u de 5 grootste barrières waarom het moeilijk is om te investeren in wind op zee projecten? Kunt u uw antwoord onderbouwen en ordenen van belangrijk naar minder belangrijk

5. Welke maatregelen zijn volgens u nodig om deze top-5 belemmeringen weg te nemen dan wel te verminderen?

6. Wat voor effect denkt u dat het weghalen van de belangrijkste barrières heeft op:

   - de hoeveelheid institutioneel kapitaal dat geïnvesteerd zal worden in wind op zee projecten?
   - het behalen van de wind op zee capaciteitsdoelstellingen?
   - de kapitaalkosten en dus op het behalen van de wind op zee kostenreductie doelstelling?

7. Verwacht u dat Solvency II/ FTK invloed heeft op de mogelijkheid van institutionele investeerders om te investeren in wind op zee projecten? En verwacht u dat door Solvency II of FTK institutionele investeerders een hogere rentabiliteit zullen vragen wat leidt tot hogere kapitaalkosten voor projectontwikkelaars?

8. Heeft u het idee dat het makkelijker en/of winstgevender is om in buitenlandse wind op zee projecten te investeren? Zo ja waarom?

9. Heeft het bedrijf waarvoor u werkt een doelstelling om in duurzame energieprojecten of specifiek in wind op zee te investeren?

10. Zijn er andere (duurzame energie) projecten met een betere risico-rendement verhouding waardoor de interesse in wind op zee projecten afneemt?

Indien tijd

11. Hoe kijkt u aan tegen de oprichting van de Nederlandse Investeringsinstelling (NLII)?

12. Wat denkt u dat de rol moet zijn van de NLII?

B3. Target group: Ministry of Economic Affairs and NLII

Introductie

Het doel van mijn thesis om te kijken hoe de rol van institutionele investeerders in de financiering van wind op zee projecten vergroot kan worden en wat voor effect dit zal hebben in het behalen van de wind op zee doelstellingen zoals die zijn gemeld in het Energieakkoord. In de interviews met institutionele investeerders zullen, vanuit hun perspectief, de barrières worden geïdentificeerd en de preferenties voor verschillende mitigatiestrategieën in kaart gebracht worden. Vervolgens zal ik hen vragen wat het vermeend effect op de wind op zee doelstellingen zal zijn indien de barrières worden

weggehaald.
In de interviews met energiebedrijven wil ik gaan onderzoeken of er vanuit hen vraag is naar een grotere betrokkenheid van institutionele investeerders in de financiering van wind op zee projecten en of energiebedrijven denken dat dit de kapitaalkosten omlaag kan brengen. Vervolgens wil ik proberen te achterhalen of energiebedrijven bereid zijn om extra risico's te dragen (veelal in de vorm van garanties) wat kan leiden tot meer vertrouwen van institutionele investeerders in de wind op zee projecten.
Als laatste zal ik EZ en de NLII interviewen. Hier zullen vragen gesteld worden over de mogelijkheden van EZ om risico's weg te nemen en over de invulling van de rol van de NLII. Verder zullen vragen gesteld worden aan beide partijen over wat voor geluiden zij horen omtrent de risico's die institutionele investeerders ervaren en over de bereidheid die zij hebben om te investeren in wind op zee projecten. Uiteindelijk zal ik vragen gaan stellen over het geschatte effect dat een grotere rol van institutionele investeerders in het financieringsproces van wind op zee projecten kan hebben op het behalen van de overheidsdoelstellingen.

Vragenlijst

1. Vanuit een overheidsperspectief, acht u het voordelig en gewenst dat institutionele investeerders meer investeren in wind op zee projecten? Waarom specifiek institutionele investeerders? Zou u uw antwoord kunnen onderbouwen?
2. Kan het voordelen opleveren om institutionele investeerders vanaf de beginfase van het project te betrekken? Zo ja welke?
3. Wat zijn volgens jullie de grootste barrières waarom het moeilijk is voor institutionele investeerders om te investeren in wind op zee projecten? Kunt u uw antwoord onderbouwen en ordenen van belangrijk naar minder belangrijk?
4. Hoe zou de NLII of EZ een rol kunnen spelen in het wegnemen van de bovengenoemde barrières?
5. Wat zijn, met het nieuwe subsidiesysteem, de voor en nadelen van het ontwikkelen van (en investeren in) wind op zee parken in Nederland in vergelijking met onze buurlanden?
6. Wat voor effect denkt u dat het weghalen van de belangrijkste investeringsbarrières voor institutionele investeerders heeft op:
    - de hoeveelheid institutioneel kapitaal dat geïnvesteerd zal worden in wind op zee projecten?
    - het behalen van de wind op zee capaciteitsdoelstellingen?
    - de kapitaalkosten en dus op het behalen van de wind op zee kostenreductie doelstelling?
7. Wat denkt u dat de rol moet zijn van de NLII?
8. In het Wind op Zee rapport van de NLII staat een berekening dat er verwacht wordt dat er een herfinancieringsbehoefte is van ongeveer €8 miljard tussen 2019 en 2025. Is er ook een berekening gemaakt van de hoeveelheid equity dat nodig is omdat projectontwikkelaars willen divesteren?

C. Different LCOE calculations

Figure 6 should be used as a guideline to see the underlying differences but not as a true given. To substantiate this point, Figure 27 shows different LCOE values which are calculated by different institutions. As presented in Figure 27, the offshore wind LCOE varies a lot (especially in the range) therefore the true LCOE of offshore wind cannot be exactly determined (however the estimations are centered around €150/MWh).

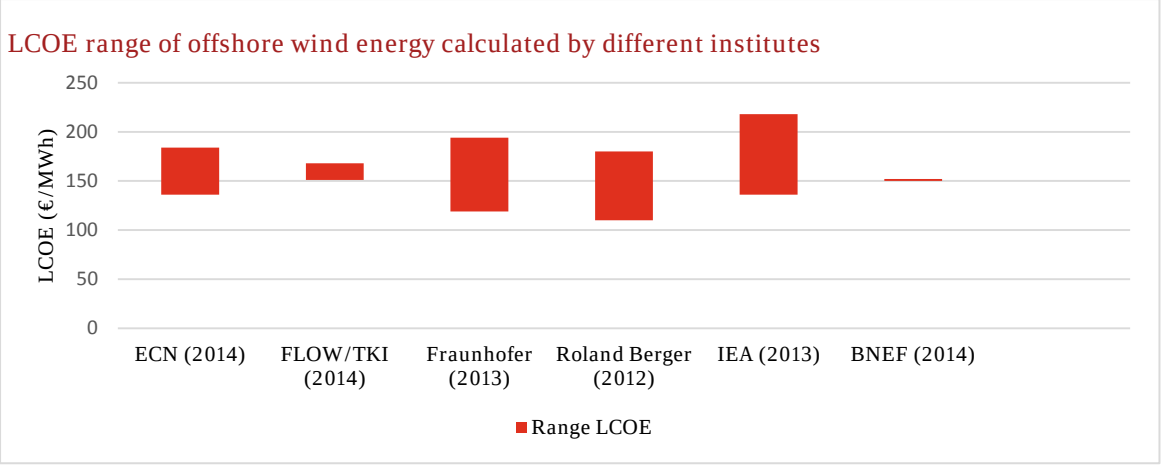

Figure 27 Different offshore wind LCOE estimations, adapted from Fraunhofer ISE (2013), IEA (2013), Roland Berger (2013), ECN & Ecofys (2014), Bloomberg New Energy Finance (2014), Prognos AG & The Fichtner Group (2013)

D. Basic explanation of the SDE+ subsidy scheme

The main subsidy scheme in the Netherlands to remove this unprofitable top of renewable energy projects is the called the SDE+ scheme. Figure 28 shows the SDE+ subsidy scheme for offshore wind in the Netherlands. Every year the correction price (average market electricity price for the particular energy generating technologies) and the cost price (or base price) was calculated. The subsidy that the holder of a SDE+ subsidy receives will be the price difference between the cost price and the electricity price that the generator receives. In the presented situation (Figure 28) the subsidy would have been 157–70= 87 €/MWh. The correction price will function as a subsidy floor, so in the year 2014 the maximum subsidy an offshore wind electricity producer could have received was 157-59 = 98 €/MWh. If the electricity price in the year 2014 would have dropped below 59 €/MWh, the subsidy would still have been 98 €/MWh) (ECN & DNV KEMA, 2013; EZ, 2013). The last years the wholesale electricity price was very low and below the subsidy floor. This means that the LCOE of offshore wind was larger than the sum of the wholesale electricity price and the subsidy (TenneT, 2014).

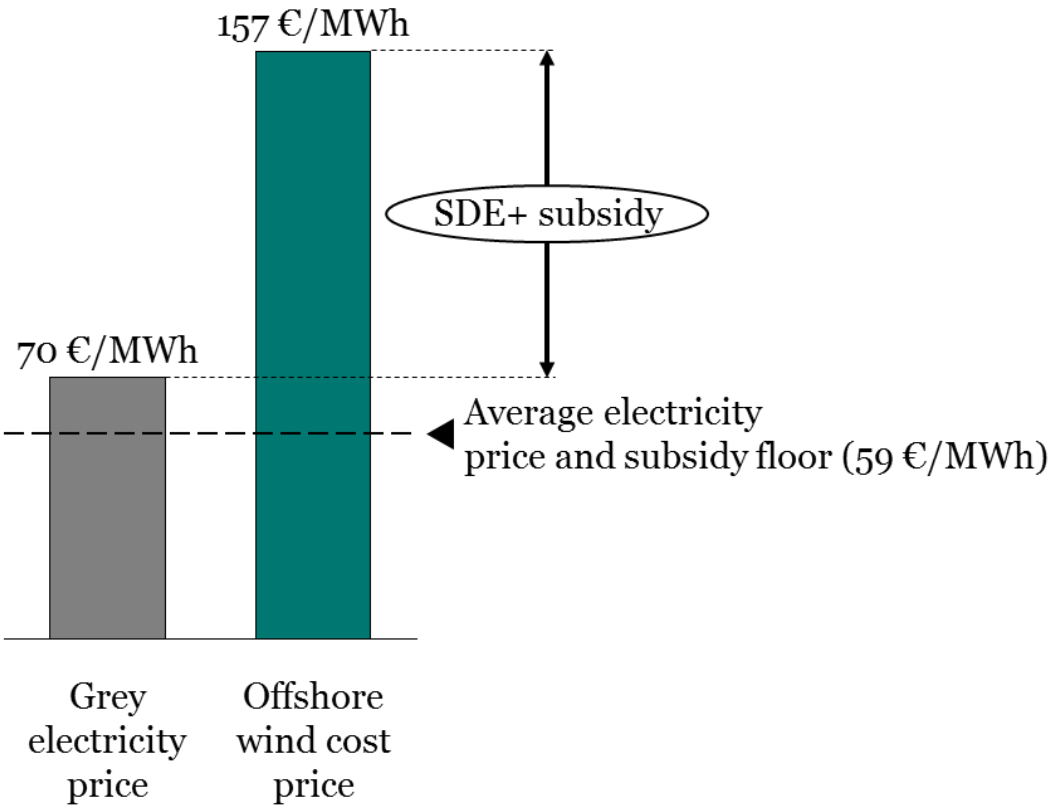

Figure 28 Previous offshore wind base price and average correction price (average electricity market price) in 2014

E. Variables and references conceptual causal loop diagram

Variable	Effect	Variable	Source	Modifications or comment
Project equity share	+	Weighted average cost of capital	(Wiser & Kahn, 1996)	
Project debt share	-	Weighted average cost of capital	(Wiser & Kahn, 1996)	
Balance sheet finance	-	Cost of equity	(Wiser & Kahn, 1996)	
Project finance	+	Cost of equity	(Wiser & Kahn, 1996)	
Balance sheet finance	-	Cost of debt	(Wiser & Kahn, 1996)	
Project finance	+	Cost of debt	(Wiser & Kahn, 1996)	
Balance sheet finance	+	Debt amortization	(Wiser & Kahn, 1996)	
Weighted average cost of capital	+	Project cost	(Wiser & Kahn, 1996)	
Project cost	+	Weighted average cost of capital	(Wiser & Kahn, 1996)	
Technology risk	+	Cost of equity	(Wiser & Kahn, 1996); (PwC, 2011)	This was linked via "Perceived risk capital providers" which is validated by (PwC, 2011) and (Wüstenhagen & Menichetti, 2012)
Technology risk	+	Cost of debt	(Wiser & Kahn, 1996); (PwC, 2011)	This was linked via "Perceived risk capital providers" which is validated by (PwC, 2011) and (Wüstenhagen & Menichetti, 2012)
O&M risk	+	Perceived risk capital provider	Reasoning	
Construction risk	+	Perceived risk capital providers	(Freshfields Bruckhaus Deringer, 2014)	
Debt tranches	-	Perceived risk capital providers	(Wiser & Pickle, 1998)	
Balance sheet finance	-	DSCR	(Wiser & Pickle, 1998)	
Project finance	+	DSCR	(Wiser & Pickle, 1998)	
DSCR	+	Project equity share	(Wiser & Pickle, 1998)	

DSCR	-	Project debt share	(Wiser & Pickle, 1998)	
DSCR	-	Cost of equity	(Wiser & Pickle, 1998)	
DSCR	-	Cost of debt	(Wiser & Pickle, 1998)	
Debt fraction	+	Cost of equity	(Wiser & Kahn, 1996)	
Length debt	+	Cost of debt	(Wiser & Kahn, 1996)	
Length of debt	+	DSCR	(Wiser & Kahn, 1996)	
Project debt share	-	DSCR	(Wiser & Kahn, 1996)	
Cost of debt	-	Project debt share	(Wiser & Kahn, 1996)	
Length debt	+	Cost of debt	(Wiser & Kahn, 1996)	
DSCR	-	Project debt share	(Wiser & Kahn, 1996)	
Investor specific required return on equity	+	Cost of equity	(Wiser & Kahn, 1996)	
Required return on debt	+	Cost of debt	(Wiser & Kahn, 1996)	
Project management risk	+	Perceived risks capital providers	(Freshfields Bruckhaus Deringer, 2014)	
Number of contractors	+	Perceived risks capital providers	(Freshfields Bruckhaus Deringer, 2014)	
Number of contractors	-	Project costs	(Freshfields Bruckhaus Deringer, 2014)	
Wholesale price electricity	+	Perceived return capital provider	(Freshfields Bruckhaus Deringer, 2014)	This was "return capital provider"
Amount of capital of utilities	-	Shared ownership	(Freshfields Bruckhaus Deringer, 2014)	
Amount of capital of utilities	-	Divestment	(Freshfields Bruckhaus Deringer, 2014)	
Amount of capital of utilities	+	Balance sheet finance	(Freshfields Bruckhaus Deringer, 2014)	
EPC-Wrap	+	Project cost	(Freshfields Bruckhaus Deringer, 2014)	
EPC-Wrap	-	Construction risk	(Freshfields Bruckhaus Deringer, 2014)	
Utility shares owned by government	-	Perceived risks capital providers	(Freshfields Bruckhaus Deringer, 2014)	
ECA and multilateral banks involved	-	Perceived risks capital providers	(Freshfields Bruckhaus Deringer, 2014)	
Enter after construction	-	Construction risk	(Freshfields Bruckhaus Deringer, 2014)	
Divestment	+	Credit rating utilities	(Freshfields Bruckhaus Deringer, 2014)	
Divestment	+	Enter after construction	(Freshfields Bruckhaus Deringer, 2014)	
Quality other sponsors	-	cost of debt	(Freshfields Bruckhaus Deringer, 2014)	This was linked via "Perceived risk capital providers"
Project debt share	+	Perceived risks capital providers	(PwC, 2011)	
Project equity share	+	Perceived risks capital providers	(PwC, 2011)	
Regulatory risks	+	Perceived risks capital providers	(PwC, 2011); (NLII, 2014); (EWEA, 2013)	
Long-term stable policy	+	Regulatory risks	(PwC, 2011)	
Tax rebates/ duty waivers offshore wind investments	+	Perceived return capital provider	(PwC, 2011)	
Government bearing cost of grid connection	+	Perceived return capital provider	(PwC, 2011)	
Utility shares owned by government	+	Perceived risk capital provider	(PwC, 2011)	
Insuring risks	-	Construction risk	(PwC, 2011)	This variable was divided into more causal relations. PwC stated that insure construction risk has an effect on the risks of capital providers. In this report this was divided into multiple relations. Insuring risks has an effect on all the risks that are insured
Insuring risks	-	Technology risk	(PwC, 2011)	
Insuring risks	-	O&M risk	(PwC, 2011)	
Insuring risks	-	Project management risk	(PwC, 2011)	
Bankability offshore wind projects for institutional investors	+	Level of institutional capital in offshore wind	(EIB, n.d.)	
FIT	+	Bankability offshore wind projects for institutional investors	(NLII, 2014)	This was linked via "Perceived return project owner"
Perceived return project owner	+	Bankability offshore wind projects for institutional investors	(NLII, 2014)	The source stated that "level of subsidy" or in our case "FIT" was

				positively linked with "Bankability offshore wind projects for institutional investors"
Project costs	-	Bankability offshore wind projects for institutional investors	(NLII, 2014)	
Project costs	-	Expected return project owner	(NLII, 2014)	
Weighted average cost of capital	-	Expected return project owner	(NLII, 2014)	
Weighted average cost of capital	-	Bankability offshore wind projects for institutional investors	(NLII, 2014)	
ECA and multilateral banks involved	+	Bankability offshore wind projects for institutional investors	(NLII, 2014)	Especially the EIB is mentioned a lot
Inflation based FIT	+	Institutional investors in offshore wind	(NLII, 2014)	
Pre-development costs	+	Project costs	(NLII, 2014)	
Development costs	+	Project costs	(NLII, 2014)	
O&M costs	+	Project costs	(NLII, 2014)	
Perceived risk capital providers	+	Cost of debt	(Wüstenhagen & Menichetti, 2012)	
Perceived risk capital providers	+	Cost of equity	(Wüstenhagen & Menichetti, 2012)	
Perceived risk capital provider	-	Bankability offshore wind projects for institutional investors	(Wüstenhagen & Menichetti, 2012)	In the source the variable "Perceived risk" was linked via "Portfolio aspects" to "Investment in renewable energy". It was decided to include the term "Bankability offshore wind projects for institutional investors" which links to the variable "Level of institutional capital in offshore wind". This is partly done by reasoning and partly because of the literature that was read for composing the model
Project diversification	-	Perceived risks capital providers	(Wüstenhagen & Menichetti, 2012)	
Prior investments	-	Perceived risks capital providers	(Wüstenhagen & Menichetti, 2012)	
Prior investments	+	Institutional investors in offshore wind	(Della Croce, Kaminker, & Stewart, 2011)	This was linked via "Perceived risk capital provider"
Appropriate investment vehicles	+	Institutional investors in offshore wind	(Della Croce, Kaminker, & Stewart, 2011)	The variable "Appropriate investment vehicles" is presented via many different variables including the variables: "Balance sheet finance", Shared ownership", "Project finance" and "Divestment"
Availability of data	-	Perceived risks capital provider	(Della Croce, Kaminker, & Stewart, 2011)	
Availability of data	+	Ability to perform risk assessments	(Della Croce, Kaminker, & Stewart, 2011)	
Risk grid availability	+	Perceived risks capital providers	(EWEA, 2013)	
Divestment	+	Bankability offshore wind projects for institutional investors	(EWEA, 2013)	
Competition	+	Bankability offshore wind projects for institutional investors	(EWEA, 2013)	
Competition	-	Cost of debt	(EWEA, 2013); (The Crown Estate, 2012)	
Supplier guarantees	-	Perceived risk capital providers	(EWEA, 2013)	
Supplier guarantees	-	Technology risks	(EWEA, 2013)	
Supplier guarantees	-	O&M risks	(EWEA, 2013)	
O&M guarantees	-	O&M risks	(EWEA, 2013)	
Basel III	-	Length debt amortization	(NLII, 2014); (Standard & Poor's, 2011)	
Basel III	-	Availability of bank debt	(NLII, 2014); (Standard & Poor's, 2011)	
Basel III	+	Cost of debt	(NLII, 2014); (Standard & Poor's, 2011)	
Basel III	+	Bank loan refinancing	(Standard & Poor's, 2011)	
Solvency and FTK	+	Investor specific required return on equity	(NLII, 2014); (Standard & Poor's, 2011)	
Bank loan refinancing	+	Availability bank debt	(Standard & Poor's, 2011)	
Bank loan refinancing	+	Enter after construction	(NLII, 2014)	
Solvency and FTK	-	Length of debt	(NLII, 2014); (Standard & Poor's, 2011)	

Solvency and FTK	+	Cost of debt	(NLII, 2014); (Standard & Poor's, 2011)	
Solvency and FTK	+	Cost of equity	(NLII, 2014); (Standard & Poor's, 2011)	
Ability to perform risk assessments	-	Construction risk	(NLII, 2014)	This variable was divided into multiple causal relations. It is believed that the ability to perform risk assessment has a relation on all the different risks so: construction risk, technical risk, O&M risk and regulatory risk
Ability to perform risk assessments	-	Technology risk	(NLII, 2014)	
Ability to perform risk assessments	-	O&M risk	(NLII, 2014)	
Ability to perform risk assessments	-	Regulatory risk	(NLII, 2014)	
Bank loan refinancing	+	Bankability offshore wind projects for institutional investors	(NLII, 2014)	
Focus on ESG	+	Institutional investors in offshore wind	(Wüstenhagen & Menichetti, 2012)	
Full load hours	+	FIT	(SER, 2013)	
Subsidy floor	-	FIT	(SER, 2013)	
Banking	+	FIT	(SER, 2013)	
Duration of support	+	Perceived return project owner	(Masini & Menichetti, 2012)	This was linked via "FIT"
Level of support	+	FIT	(Wüstenhagen & Menichetti, 2012)	
Availability bank debt	+	Project finance	Reasoning	
Attractiveness substitute investments	-	Institutional investors in offshore wind	Reasoning	
Service fee	+	Required return on debt	Reasoning	
Shared ownership	+	Length debt amortization	Reasoning	
Shared ownership	-	Cost of debt	Reasoning	
Shared ownership	-	Cost of equity	Reasoning	
Project finance	-	Credit rating utilities	Reasoning	Standard & Poor's (2011) state that utilities are reluctant for project finance because they are afraid that this will affect their credit rating. The reasoning is that if the offshore wind projects are underperforming the utility will most likely jump in and spend money to solve the problem or safe the project. This reasoning is copied for Balance sheet finance and shared ownership finance
Balance sheet finance	-	Credit rating utilities	Reasoning	
Shared ownership	-	Credit rating utilities	Reasoning	
Project shares owned by government	-	Perceived risk capital providers	Reasoning	
Quality project parties	-	Perceived risk capital providers	Reasoning	
Production	+	Perceived return project owner	Reasoning	
Production	-	Perceived risk capital providers	Reasoning	
Wholesale price electricity	-	Perceived risk capital providers	Reasoning	
Perceived risk capital providers	-	Availability bank debt	Reasoning	
Amount of wind	+	Production	Reasoning	
Wind studies	+	Production	Reasoning	
Turbine size	+	Production	Reasoning	
Power Purchase Agreement	+	Expected return project owner	Reasoning	
Contingency buffer	-	Perceived risk capital providers	Reasoning	
Credit rating utility	-	Project cost	Reasoning	
Credit rating utility	-	Perceived risk capital provider	Reasoning	
Credit rating utility	-	Cost of equity	Reasoning	
Credit rating utility	-	Cost of debt	Reasoning	

F. Terminology causal loop diagram and conceptual model

Conceptual model	Causal loop diagram
Investment product	This is not represented in the causal loop diagram. With investment products the different debt and equity products were investors can invest in is meant
Cost of capital	Weighted average cost of capital
Project cost	Project cost
Perceived risk	Perceived risk capital providers
Project diversification	Project diversification
Substitute projects	Attractiveness substitute investments
Expected return	Perceived return project owner
Bankability	Bankability offshore wind projects for institutional investors
Institutional investors	Level of institutional capital in offshore wind