Financing offshore wind

A study commissioned by Invest-NL

August 2020

pwc

About this report

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In April 2020, PricewaterhouseCoopers Advisory N.V. (PwC) was asked by Invest-NL (Client) to conduct a study into the financing of future Dutch offshore wind farms in a zero-subsidy environment. The Report has been prepared for the sole benefit and use of the Client and not for the interests or priorities of any third party. Please refer to Appendix D of this report for further information about this report and all applicable disclaimers.

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Management summary

- Facilitating the development of offshore wind farms is one of the pillars of the Dutch climate policy. The Climate Agreement has established a target of 11.5GW of installed capacity in 2030. Parties that are subject to the Climate Agreement have queried whether this target is achievable, as we move towards a zero-subsidy regime. Invest-NL was asked to investigate this query.

- In this context, PwC has been commissioned by Invest-NL to examine the following research questions: (i) how does the transition to a zero-subsidy industry affect the availability and cost of capital for offshore wind and (ii) how can the availability of capital be further improved? Our analysis is based on desk research and a market consultation amongst 15 developers and project finance providers active in the global offshore wind industry.[1]

- We believe that sufficient funding is generally available for Dutch offshore wind projects. Most investors are of the opinion that offshore wind offers an attractive risk/reward ratio. The carbon-free nature, and potential to deploy large amounts of capital, add to the sector's attractiveness. Over time, the spreads associated with the asset class have decreased, and partly reflect the decrease in construction-related risks.

- The risk profile of offshore wind projects will increase as we move from support under the SDE+ scheme to a zero-subsidy environment. Investors will be exposed to the risk of varying electricity prices ("merchant price risk"). In general, this will increase the cost of capital for offshore wind projects. This may in turn have an impact on the availability of capital for offshore wind projects if the higher risk profile no longer matches the risk appetite of certain financiers, like debt providers in a project financing environment.

- An increase in the cost of capital is not a problem as such. The financial markets tend to put a price on uncertainty, which ensures the efficient allocation of capital. Investors and financiers also indicated that they are, in principle, open to varying levels of merchant price risk. Some are in fact already exposed. The concern, however, is that there might be too little appetite to take on many more Dutch offshore wind projects with full exposure to merchant price risk, given the limited possibilities to hedge such risk.

- Government intervention can help facilitate the transition towards a market without subsidies and with exposure to electricity prices. Increased demand for long-term green PPAs, and a more liquid PPA market, could help developers hedge merchant price risk. However, demand for green electricity PPAs is currently lagging behind supply, due to a shortage of concrete policies to electrify and decarbonize the industry (i.e. market failure). The government can unlock demand for green PPAs by coordinating new supply chains, solving infrastructural constraints, effectively pricing carbon and offering access to support schemes.

- More than half of the capacity required to reach the 2030 target will be tendered in the years up to 2025. There is a risk that zero-subsidy tenders will fail to produce a sufficient number of bids. Whilst we believe government policy should primarily focus on facilitating a zero-subsidy environment, a temporary back-stop policy instrument may still be needed to support the 2030 offshore wind target. We recommend investigating what such a back-stop should look like and anchoring the details in the offshore wind law ('Wet windenergie op zee').

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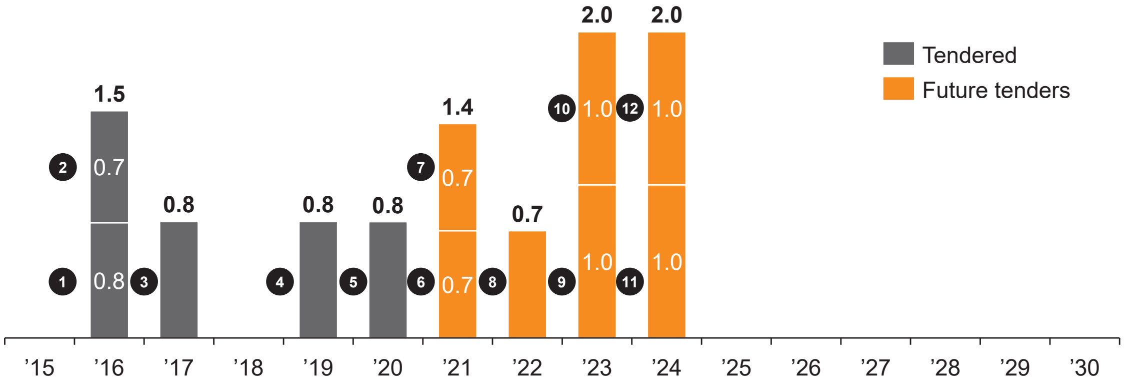
1. We are grateful to Amsterdam Capital Partners (AMSCAP) for offering valuable expertise in the preparation of this white paper.

1. Introduction

In the Climate Agreement of 28 June 2019, the Dutch government identified its target of reducing CO2 emissions by 49% by 2030 compared to 1990. Agreements were made across five sectors: urban environments, mobility, industry, agriculture and land use and electricity.

Offshore wind will play a key role in reaching the goal for electricity production.[2] Approximately 11.5 GW of offshore wind capacity is planned by 2030 ("the Roadmap 2030")[3], of which only 1 GW is currently operational. When this report was written, 6.1 GW still had to be tendered in the years up to 2025 – see Figure 1.

Figure 1: as per the Roadmap 2030, 6.1 GW of offshore wind capacity still has to be tendered
(figures in GW, capacity adjusted for tender results)



1: Borssele I & II
2: Borssele III & IV
3: Hollandse Kust Zuid I & II
4: Hollandse Kust Zuid III & IV
5: Hollandse Kust Noord V
6: Hollandse Kust West VI
7: Hollandse Kust West VII
8: Ten noorden van de Waddeneilanden
9: IJmuiden Ver I
10: IJmuiden Ver II
11: IJmuiden Ver III
12: IJmuiden Ver IV

Source: PwC analysis based on RVO (2020)

Offshore wind is a capital-intensive industry. The upcoming tenders therefore require a vast amount of investment. Based on PBL figures, more than €11 billion in capital[4] is required to realize the Roadmap 2030 (excluding offshore grid connection). The recently published AFRY report indicates that approximately €17 billion in capital is required for the coming 10 years of wind, onshore wind and solar PV development.[5]

In 2015, a new system for allocating offshore wind sites was introduced in the Netherlands. Tenders are being organized where wind farm developers are competing for permitted sites. In the first two tenders under the new system, developers competed for a site which included a subsidy (SDE+). The tender was awarded to the developer (or developers, in case of a consortium) that expected to produce offshore wind power at the lowest fixed amount per MWh (strike price or 'basisbedrag').

2. 49 TWh of the 84 TWh required renewable energy production will be generated by offshore wind
3. Wiebes E.D. (2019)
4. Analysis based on Lensink, S., & Pisca, I. (2019, February). Multiplying expected investment costs with the planned capacity for all wind farms that are not yet tendered
5. AFRY (2020)

As the offshore wind sector matured, significant cost reductions and improved economics were achieved due to larger turbines and better construction know-how. Additionally, the decline in commodity prices (most notably steel), as well as low interest rates and low offshore services pricing (due to low oil and gas prices), further triggered cost reduction.[6] As a result, tender bids dropped significantly. Borssele I & II was awarded an SDE+ of €72.7 per MWh and Borssele III & IV an SDE+ of €54.5 per MWh.

More recent tenders (since Hollandse Kust Zuid I & II) are based on a zero-subsidy regime. In this procedure, the winner is selected based on a 'beauty contest': a set of criteria (e.g., knowledge and experience, quality of design, wind farm capacity, social costs, risk analysis and measures to ensure cost-efficiency) is used to determine which bid will be awarded the permit.[7]

In this context, zero-subsidy means that the winner will not receive a direct financial subsidy. The project's revenues are thus fully exposed to market prices. Nonetheless, some offshore wind developers still receive indirect subsidies (as of the current offshore wind regime, i.e. all wind farms shown in Figure 1). These developers do not bear the costs for connecting to the offshore grid, which is developed and operated by the offshore transmission system operator (TSO). Furthermore, site selection and research are conducted by the government.

The Dutch government intends to continue this trend towards zero subsidies. Parties subject to the Climate Agreement have raised the question if this intention is compatible with the ambitious offshore wind target. In this context, AFRY conducted a study on the viability of the business case for the upcoming Dutch offshore wind tenders.[8] Additionally, Invest-NL was asked to investigate the financing of future offshore wind farms. PwC has been commissioned by Invest-NL to examine the following research question:[9]

"How does the transition to a zero-subsidy industry affect the availability and cost of capital for offshore wind and how can the availability of capital be further improved?"

The remainder of this report is structured as follows. Chapter 2 addresses the current availability of capital for offshore wind and the characteristics of the market. Chapter 3 considers the impact of zero-subsidy on the availability of capital and its costs. Furthermore, we discuss the challenges for mitigating merchant price risk and explore the potential impact on the Roadmap 2030. In Chapter 4 we summarize our recommendations to the government for improving the availability of funding.

6. PwC (2018)
7. These are the ranking criteria from the Hollandse kust V tender (Ministerie van Economische Zaken, 2019)
8. Commissioned by the Ministry of Economic Affairs and Climate Policy
9. The Climate Agreement (p. 161) mentions the following: "There will be a further review of the business case for the generation of renewable electricity, regarding offshore wind energy in particular. In addition, effective and early insight into the assessment of funding parties is crucial; this also applies to the way in which risks (e.g. no support from the SDE+ beyond 2025) are weighed and possibly priced, and the possible impact thereof on funding options. It is also important to establish whether there are increasing financing costs and whether, if possible, those can be mitigated, for example through the use of funding instruments, such as guarantees, national or European co-funding or other options. Invest-NL will be requested to carry out a review of this matter and to gain better insight into the risks and funding options, to identify promising opportunities and to report these issues by the end of 2019." The footnote corresponding to this text adds: "Once the results of this review are published, consideration will take place of whether similar insights would be required in relation to potential financing risks for Renewable Energy on Land (HOL) and small -scale solar-PV"

2. Availability of capital for offshore wind

This chapter covers the current availability of capital for offshore wind. In the first section, we argue that - in a well-functioning capital market - capital is provided to projects that have a viable business case. Capital can be raised from equity investors and debt providers, both of whom have a different perspective when it comes to investment decisions. The second section argues that capital providers generally perceive offshore wind as an attractive asset class. Different providers of capital with different risk appetites are willing to invest in all stages of the offshore wind cycle. Based on our market consultation, we can conclude that there is currently no scarcity: developers with a good business case can pick the best offers from a large pool of capital.

2.1 Financing offshore wind

Offshore wind is capital-intensive (e.g. roll-out of the remaining 6.1GW is expected to require more than €11 billion in investments). To finance an offshore wind project, developers may either choose (i) balance sheet finance or (ii) a combination of equity and non-recourse debt (project finance).

In balance sheet finance, projects are funded by the developer. Capital (debt and equity) is raised at company level through e.g., corporate loans, bonds and share issues. Debt providers assess whether developers at company level are able to repay their loans, including interest payments. Similarly, equity providers assess whether developers make enough profit to provide the required rate of return.

Developers consider if the project's internal rate of return (IRR) is higher than the weighted average cost of its capital (WACC). If the expected IRR exceeds the WACC, a project is deemed financially viable. If it does not, the project will not create any value and, hence, is not worth pursuing.

In project finance, projects are financed as a stand-alone entity. The developer provides equity to this entity and attracts equity investors, banks and other lenders.[10] Unlike balance sheet finance, equity and debt providers are repaid via cashflows from the project. Developers will try to optimize the capital structure of the project by considering characteristics of the various types of capital (as described below).

Equity providers are paid dividends as compensation for their investment in the project.[11] The expected return on their equity investment is measured via the equity IRR. They compare this equity IRR with their required return on equity investments, also called the hurdle rate. This hurdle rate is primarily a reflection of the perceived risk of a project. It increases if an investment is perceived to be higher risk. See Figure 2.

External debt providers provide debt financing and receive debt services payments[12] from the project. Debt providers are mainly interested in the borrowers' ability to repay loans and interest. In a project finance setting, lenders will only have recourse to project assets in case of default. The cost of providing debt depends on various factors, such as funding costs, operational costs and expected loss (costs due to the risk if debtor default). A common measure for determining the debt capacity of project is the debt service coverage ratio (DSCR), which is equal to the net operating profit (EBITDA) divided by debt service (interest and principal payments). A higher ratio means more operating surplus to cover debt service payments, which is less risky for lenders. When operating on the basis of perceived risk, lenders require a certain credit spread above the base rate (e.g., LIBOR) to cover expected losses (i.e. costs due to the risk of default) and other costs. See Figure 3.

10. In this section, we describe the perspectives of equity and debt providers. In practice, the difference between the two is not always as clear. For example, it is also possible for equity providers to provide debt.

11. In some offshore wind projects, equity providers might also anticipate capital gains from selling part of their equity later in the lifecycle (as is discussed in section 2.2).

12. Principal plus interest

Figure 2.

Equity investors

When to invent

Equity internal rate of return (IRR) > Hurdle rate

The equity IRR is the internal rate of return on equity investment based on projected/actual cash flows during the project lifetime. If the business case for an investment improves (lower costs or higher revenues) the IRR increases.

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Figure 3.

Debt providers

When to provide debt

Interest rate > Expected costs of providing a loan

The cost of providing a loan depends on various factors, such as funding costs, operational costs and the expected loss (the probability that borrowers are unable to repay their debt, multiplied by the exposure upon default). The interest rate must be high enough to cover these costs.

In a well-functioning capital market, capital is provided to projects that have a viable business case. Developers and other capital providers make the above-mentioned considerations when assessing whether or not to deploy their capital. Most developers and capital providers take a supra-national or regional perspective: they actively scan for projects in a variety of countries to identify promising investment opportunities.

2.2 Development of the asset class offshore wind

Capital providers generally find offshore wind an attractive asset class to invest in

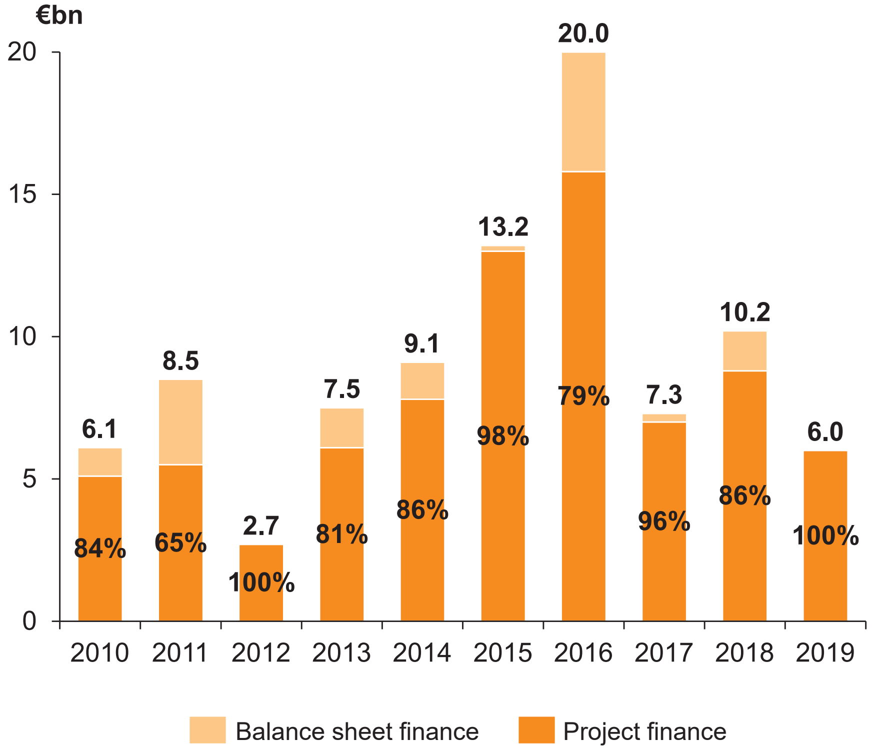
From our market consultation it follows that capital providers generally view offshore wind as an attractive asset class, primarily because of its risk/reward profile. In addition, offshore wind has high strategic value in a decarbonizing economy and the huge capital requirement for offshore wind projects enables efficient capital deployment.

There are several signs that the perceived risk of offshore wind as an asset class has decreased in the past decade, which has added to its attractiveness.

Firstly, project financing has increased over the past decade – as shown in Figure 4. Due to its non-recourse nature, project financing requires banks to be relatively more familiar with projects when providing debt. The first offshore wind projects were balance sheet financed, and were reserved for parties with a strong balance sheet and high liquidity (i.e. good credit rating). As understanding about construction and technology risks increased, project financing developed and has become the prominent financing structure in recent years.

Figure 4: over the past decade, the incidence project financing has increased in Europe

Financing structures for new offshore wind assets (in €bn) in Europe between 2010-2019



Source: PwC analysis based on WindEurope (2020)

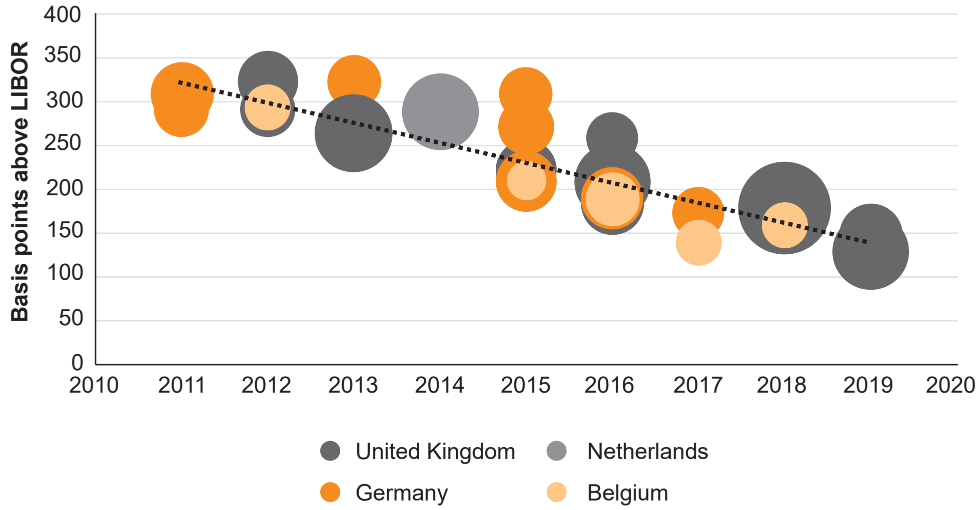
Secondly, the level of leverage (the percentage of debt financing) in project finance has increased from 60% to 75% in recent years, thus lowering capital costs (as debt is generally cheaper than equity).[13] As explained in 2.1, the amount of debt in a project is linked to the DSCR covenant and applicable spreads. An increase in leverage is thus a sign of increasing confidence in the asset class.

Thirdly, and most notably, spreads relating to debt financing for offshore wind have decreased over the past decade. Figure 5 shows the difference between the base rate (LIBOR) and interest rates for offshore projects. The spread offers an indication of the perceived risk of debt, where a higher spread represents higher perceived risk. Figure 5 shows that the spread has decreased significantly since 2011, which is a sign that perceived risk has decreased over time. In 2011, spreads were still roughly 325 bps above LIBOR and moved below 150 bps in 2019 – as shown in Figure 5.

13. Figures from Green Giraffe (2019)

Figure 5: spreads for offshore wind projects decreased from 325 to below 150 bps over the past decade

Spreads (in bps above LIBOR) for offshore wind projects between 2011-2019, bubble size represents wind farm capacity



Source: PwC analysis based on WindEurope (2020)

Various parties have the appetite to provide funding in all stages of the offshore wind cycle

An offshore wind farm goes through several stages during its lifetime (Figure 4). The supply of capital in each stage of the lifecycle is associated with different levels of risk, which attracts specific investors and financiers (Table 1).

Early development involves everything up to acquiring permits, and includes site selection and research. Utilities, IPPs and other developers are usually involved in this stage. The need for capital is relatively low, but project risk is at its highest because project realization is still in a preliminary phase.

Once permits have been received, supply and installation contracts are drawn up and financing is secured for the huge capital requirement in the construction stage. In this stage, value chain investors typically step in to secure construction contracts (and generally sell their equity stake once construction is completed).

The construction stage starts after the final investment decision. The construction of offshore wind farms requires huge amounts of capital. Due to the sheer size of capital requirements, developers that opt for project finance usually involve banks and other lenders at this point, lowering the capital costs of the project (as discussed in 2.1), The level of risk reduces significantly once a wind farm becomes operational. This makes it possible to refinance loans under better terms and to sell equity stakes to parties that have an appetite for post-construction offshore wind (for example, pension funds). The latter frees up capital for developers to pursue new projects.

Figure 6: the offshore wind lifecycle is characterized by several stages, with the majority of costs occurring during construction

Stage of lifecycle	Duration	% of LCOE	Level of risk
1 **Early development** *Site selection and research*	Multiple years	3%	
2 **Late development** *Contracting and financing*	0.5 – 1.5 years		
3 **Construction** *Manufacturing and installation*	1 – 2 years	67%	
4 **Operation** *Operating and maintenance*	20+ years	28%	

Source: PwC analysis, LCOE figures based on BVG Associates (2019). The LCEO percentages in the figure do not add up to 100% as we do not show the decommissioning stage (~2% of the LCOE).

Table 1: the current financial landscape for offshore wind contains a wide range of investors and financiers with different preferences[14]

Type of capital provider	Debt / equity	Risk appetite	Preferred capital structure	Examples (based on interview list)[15]
Utilities	Equity	Early development	Balance sheet finance / project finance	Vattenfall, Eneco, Ørsted
IPPs	Equity	Early development	Project finance	Northland Power
Value chain investors	Equity / debt	Late development	Project finance	Siemens, DEME
Financials	Equity / debt	Ranging from early development to operation	Project finance	Macquarie, Green Investment Group, Partners Group, apg
Banks	Debt	Construction	Project finance	Rabobank, ABN·AMRO, SMBC
Other lenders	Debt	Construction	Project finance	NN investment partners, Atradius, European Investment Bank

14. This is a broad overview, preferences can differ for each party
15. Please refer to Appendix B

Based on our market consultation, we understand that all financiers are willing to provide capital as long as returns in the business case match their risk profile. Capital providers generally find offshore wind an attractive asset class to invest in due to its characteristics (e.g., efficient capital deployment, risk/reward profile). The European (Dutch) offshore wind market is sufficiently mature and attractive to investors and financiers who are willing to invest in a decarbonized renewable portfolio. Moreover, the market is entered at various stages of the life cycle by a range of investors and financiers, who are increasingly more willing to expose themselves to merchant price risk (as explained in the next chapter). it thus comes as no surprise that projects with a viable business case are able to (easily) attract capital, because there is no scarcity. In fact, it is quite the opposite: developers with a good business case can pick the best offers from a large pool of capital.

The availability of capital is, of course, influenced by general changes in economic conditions as result of COVID-19. Financiers have already become more cautious and selective, which can be observed by slightly higher risk premia. In the long-term, capital may be more restricted if COVID-19 further depresses economic conditions, for example as result of a financial crisis.

3. Impact of zero-subsidy on the availability and cost of capital

This chapter describes the expected impact of a zero-subsidy environment for offshore wind on the availability and cost of capital. The first section describes the conceptual impact of zero-subsidy. The second section covers the expected impact in practice. The third section discusses whether offshore wind farms can reduce their exposure to market prices through PPAs. The fourth and final section addresses the question whether there is a risk of capital availability decreasing to such an extent that not all tendered capacity up to 2030 can be financed.

3.1 Conceptual impact

This section assesses what impact zero-subsidy will have on the availability and cost of capital for future offshore wind farms. In order to understand the impact of a zero-subsidy environment , it is important to first understand how current subsidy schemes work.

Many renewable support schemes reduce merchant price risk

There are various schemes for supporting the development of renewable energy, with each authority providing subsidies in a slightly different manner, which has an impact on the extent to which varying electricity prices (merchant price risk) are reduced in the business case (see Table 2). In a feed-in tariff scheme, power producers receive a fixed payment for each unit of electricity that is generated, irrespective of the electricity market price. As such, there is no exposure to varying electricity prices. At the other end of the spectrum, there are green certificates and fixed feed-in premiums which, to a great extent, expose the business case to merchant price risk. Under a certificate (or quota) scheme, power producers are exposed to price changes on both the electricity market and the green certificate market. Moreover, with a fixed feed-in premium, there is a fixed top-up on the market price, which means that revenue fluctuates with movements in the market price.

The most popular support scheme for offshore wind in Europe is the sliding feed-in premium. With a sliding feed-in premium, providers of capital are not, or only to a limited extent, exposed to the risk of varying electricity prices. This is due to the structure of the support scheme, where the level of received subsidy is linked to evolutions in the electricity price.

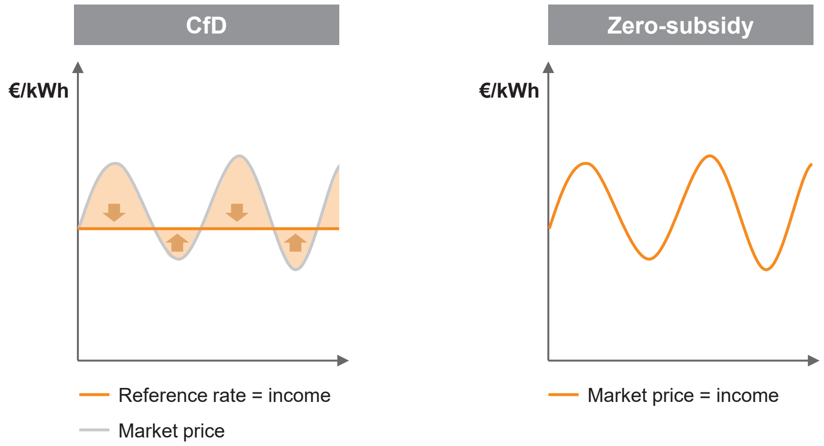
Table 2: there are various subsidy schemes, with varying merchant price risk reductions

Support	Short description	Merchant price risk exposure
Feed-in tariff	Tariff for every MWh produced over a given period. Example: EEG	No exposure
Sliding feed-in premium	Difference between market prices over a certain period of time and a predefined reference level or strike price. Example: CfD and SDE+	Limited exposure
Fixed feed-in premium	Fixed premium on top of the market price for every MWh produced over the given period.	Exposure to varying electricity prices (plus fixed subsidy amount)
Green certificates	Obligation for the power producer to either produce a certain volume of green energy or to buy a certain quota of green certificates on top of the market price. Green certificates are traded on a separate market. Power producers are therefore exposed to both the electricity market and green certificate market price	Exposure to varying electricity prices (plus fixed subsidy amount)
Zero-subsidy	No (direct) financial subsidy is received	Exposure to varying electricity prices

Source: PwC analysis based on WindEurope & Swiss RE Corporate Solutions. (2017)

The Contract for Difference (CfD) is an example of a sliding feed-in premium scheme. Such a support scheme (used in the UK and France)eliminates exposure to merchant risk. If the market price for electricity is lower than the reference rate in the CfD, the government pays the difference to the offshore wind producer. Similarly, if the market price is higher than the reference rate in the CfD, the offshore wind producer must reimburse the difference. Under this contract, offshore wind developers effectively receive a fixed price for produced electricity and are not subject to merchant price risk. Figure 7 shows how the principle of a CfD works.

Figure 7: In a CfD scheme market price exposure is limited, in contrast to a zero-subsidy environment in which the producer is fully exposed to the market price



The Dutch SDE+ scheme can also be described as a sliding feed-in premium structure, which takes away most, but not all, exposure to merchant price risk. A price floor is embedded into the SDE+ regime, which means the subsidy is capped at a maximum amount per MWh. Therefore, wind farm developers do not receive additional compensation if the market price falls below the floor price. Nevertheless, the SDE+ regime significantly limits exposure to market prices, making the revenues from offshore wind production more predictable and stable (compared to zero-subsidy), as illustrated in Figure 7.

Zero-subsidy increases risk profile of offshore wind projects

Moving away from support schemes like the SDE+ increases risk for capital providers. Evolutions in future electricity prices are uncertain, which means revenues from offshore wind production will be less predictable and less stable in a zero-subsidy environment.

For equity investors, this increased risk translates into a higher required rate of return (a higher hurdle rate). Effectively, the cost of capital increases, which worsens the business case for offshore wind. Some business cases that were viable under a support scheme will no longer be considered as such, which means these projects will no longer be able to attract the required capital.

Moreover, the increased risk of the investment may no longer match the risk appetite of relatively risk-adverse equity investors. In this case, the availability of capital from certain types of equity investors is reduced. This may even be the case if the expected revenues from the offshore wind project are high enough to cover the higher need for return on equity (or return on capital in general).

For debt providers, exposure to merchant price risk increases the risk associated with providing loans. Fluctuations on the revenue side increase the risk of borrowers not being able to meet their obligations (i.e. meet interest and principal payments). At the very least, this increases the interest rate that debt providers will require.

Moreover, debt providers generally have a low risk appetite, which means that they usually provide debt with a low risk/return profile. The increased risk profile for offshore wind can become problematic in this context. It might not be enough to simply increase the interest rate in line with increased risks. It is likely that debt providers will require extra certainties to limit the level of risk they are exposed to. They can, for example, demand a higher DSCR ratio, require cash sweeps, reduce tenor and hereby force more 'skin in the game' from the equity side (decreasing leverage).

All in all, moving away from support schemes significantly increases the risk profile of offshore wind, as investors become exposed to merchant price risk. Conceptually, this is likely to decrease the availability of capital for offshore wind and increase the cost of capital. This is expected in a well-functioning capital market where higher risk leads to higher expected returns.

The extent to which the availability of capital will decrease in practice (and the cost of capital increase) also depends on the ability of offshore wind producers to limit their exposure to merchant price risk in a zero-subsidy environment. Support schemes are not the only way to reduce this risk. Offshore wind producers can hedge merchant price risk, for example, by establishing long term power purchase agreements (PPAs). This has been addressed in section 3.3.

It should be noted that the development of a mature PPA market is closely linked to the (dis)continuation of support schemes that hedge merchant price risk. There is no incentive to hedge merchant price risk through PPAs if this risk is already hedged through government support schemes. If support schemes are maintained, this could distort the market because they hamper the development of a mature PPA market.

3.2 Impact in practice

The previous section outlined the conceptual impact on finance of transitioning from government supported offshore wind to a zero-subsidy environment. In this section, we argue that the expected conceptual impact - higher costs of capital and lower availability of capital - can also be seen in practice.

Our market consultation indicates that merchant price risk exposure is regarded as a significant risk. If merchant risk is not mitigated sufficiently, for example through PPAs, multiple parties, for whom risk exceeds their internal threshold, may drop out, thus reducing available capital. This is particularly the case for more risk-averse capital providers, like banks and pension funds. When parties are willing to expose themselves to merchant price risk, the cost of capital increases as the increase in risk is incorporated. This makes offshore wind projects more expensive.

The importance of merchant price risk is also demonstrated by how credit rating agencies value revenue stability in their rating assessment for (renewable) energy projects. Moody's, for example, takes the factor 'cash flow predictability' into account in their total credit rating assessment, and gives it a weighting of 20-25%.[16,17] Lower cash flow predictability is linked to a lower credit rating, reflecting a higher chance of default on debt (i.e. an increased risk profile). Specifically, Fitch mentions an indicative DSCR of 1.3 for fully contracted projects and 1.7 for fully merchant projects (i.e. full merchant price risk exposure) in order to receive an BBB rating (investment grade). [18,19] This example illustrates that increased exposure to merchant price risk increases the risk for debt providers, and that additional measures (such as increasing the DSCR and reducing tenors) may be needed to limit the increase in this risk for debt providers.

The 2018 report by Arup demonstrates the significant impact that revenue instability can have on the cost of capital.[20] They estimate that WACC (pre-tax, nominal) for onshore wind will increase by roughly 1-3% when moving from a CfD scheme to a zero-subsidy (merchant) model.[21] In keeping with our conceptual framework, they expect debt and equity providers to require a higher premium and lower leverage.

Due to increased capital costs, there is an increase in the levelized cost of energy (LCOE, which measures the cost of power production) for offshore wind. Assuming a 5.5% WACC for a typical Northern European offshore wind project, a shift to 6.5% WACC increases the LCOE by roughly 5%-10% [22,23]. All things being equal, the business case becomes tighter, which could limit the ability to attract the required capital or even make it financially unviable if margins were already low.

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16. Moody's Investors Service (2018)
17. Weighting depends on the contract structure
18. Fitch Ratings (2019)
19. As stated in the Fitch guidelines, these DSCRs are a guide and not a prescription for achieving a specific rating and are to be considered in the context of other factors (like operation risk, debt structure and exposure to market price risk).
20. Arup (2018)
21. Although this report focusses on onshore wind rather than offshore wind, it illustrates the impact of market price exposure to the business case of an intermittent renewable project.
22. WACC assumption from WindEurope (2019)
23. Based on a high-level analysis. In the end, impact on the LCOE is determined by project specifics (e.g. CAPEX, OPEX).

3.3 Hedging merchant price risk

In a well-functioning market, exposure to merchant price risk can be mitigated (hedged) via contracts. In the electricity market, a corporate PPA is a contract between a power producer and a consumer, where the consumer (or 'off-taker') agrees to buy a certain volume at a certain price level for a certain period of time.

The two most common PPAs are physical PPAs and virtual PPAs (or 'financial' PPAs). In a physical PPA, a physical transmission of electricity takes places via the electricity grid to the offtaker. In a virtual PPA, on the other hand, there is no physical transmission to the offtaker. If a contract like a CfD is in place, the power producer sells it electricity to the market at the market price and, if the market price is below the contract price, the off-taker pays the power producer and vice versa.

From an investors' perspective, PPAs increase the stability and predictability of revenues from offshore wind electricity production. Depending on the creditworthiness of the off-taker, a PPA decreases the risk for debt providers and equity providers, which could lead to an increase in the availability of capital and a decrease in the cost of capital compared to a zero-subsidy environment without PPAs. Therefore, at least theoretically, PPAs are an important instrument for mitigating increased exposure to merchant price risk when moving away from support schemes.

In practice, most parties in the market consultation expressed a concern that the Dutch green PPA market is not developed enough to hedge the merchant price risk for all projects in the Roadmap 2030. Offshore wind projects require many off-takers due to the high project capacity (at least 700 MW in the Netherlands). This pool of potential off-takers is further decreased as financiers require creditworthy counterparts in their PPA. Moreover, the demand for green PPAs is linked to the overall demand for green electricity, which is currently relatively low compared to total electricity demand. The demand for green PPAs could therefore increase substantially as demand for green electricity increases.

Current demand for, and supply of, green energy might be too low from a societal point of view due to the existence of market failure. Market failures that have an impact on the demand and supply of green energy are negative externalities[24], and include greenhouse gas emissions, coordination problems in the development of infrastructure (such as hydrogen transport) and knowledge spillovers from R&D efforts.

Uncertainty about government policies, which aim to correct these market failures, negatively affects demand for green energy and green PPAs. In the absence of government intervention, fossil fuels will generally be cheaper than green energy in the foreseeable future, which will make it risky to agree long-term contracts to offtake green energy. The depth of the corporate PPA market is driven by demand for green electricity. This demand is expected to increase due to the electrification of industry and, to a lesser extent, transport. These parties will require a certain degree of certainty about government policy if they are to agree purchase contracts of 10 years or longer.

Our market consultation also revealed that PPAs are more widely available in Nordic markets. PPA markets in Norway and Sweden are more liquid and have seen large deals agreed with long-term tenor (up to 29 years). The situation in the Nordic areas cannot be directly compared to the Netherlands, for example, due to differences in the production mix (e.g. large share of hydro power). Nonetheless, it could be useful to further investigate what lessons can be learned from developments in the Nordics market and how the Dutch PPA market can be made more liquid.

24. Externalities are costs that are incurred by third parties not involved in an economic transaction. Externalities can be either positive of negative.

3.4 Can the Roadmap 2030 be realized on a zero-subsidy basis?

As described in chapter 3.2, the availability of capital is expected to decrease (and the cost of capital to increase) in a zero-subsidy environment. This, however, does not necessarily mean that the tendered capacity up to 2030 cannot be financed. There have already been multiple successful zero-subsidy bids, both in the Netherlands and in Germany. Table 3 outlines several such zero-subsidy projects. It should be noted that all projects included in Table 3 still receive indirect subsidies as the offshore grid connection is outsourced to the offshore TSO in both countries. Furthermore, although Dutch bids are all zero-subsidy tenders, German bids are voluntary zero-subsidy bids in a tender where multiple projects will still receive subsidies once operational.

Table 3: recent zero-subsidy bids for competitive offshore wind tenders

Year	Country	Name	Capacity (in MW)	Developer
2017	Germany	He Dreiht	900	EnBW
2017	Germany	OWP West	240	Ørsted
2017	Germany	Borkum Riffgrund West 2	240	Ørsted
2018	Netherlands	Hollandse Kust I & II	760	Vattenfall
2018	Germany	Borkum Riffgrund west 1	420	Ørsted
2018	Germany	Wikinger Süd	10	Iberdrola
2019	Netherlands	Hollandse Kust III & IV	760	Vattenfall
2020	Netherlands	Hollandse Kust V	700	Crosswind (Eneco & Shell)

Sources: PwC analysis based on Ørsted (2018), Russell, T. (2019), Weston, d. (2018)

Despite several seemingly successful zero-subsidy tenders, the market has expressed serious concerns regarding the availability of capital for offshore wind farm development for the Roadmap 2030. A recent study conducted by AFRY researched whether a successful business case for offshore wind project is still possible in the long-term in a zero-subsidy environment. AFRY concluded that, under certain circumstances, the offshore wind targets in 2030 could be met without subsidies, but only if there is no material increase in the required return on investment. However, AFRY also noted that “there is a material risk of the Netherlands not meeting its 11GW offshore wind 2030 target at zero-subsidy under the current market environment. Whilst it is conceivable that targets could be met in 2030 without further intervention, the potential for the business case to become unviable as a result of changes in market conditions should be taken seriously.”[25]

AFRY considered various factors that have a major impact on the business case of offshore wind farms (and therefore the ability to meet the 2030 targets). These are shown in Table 4, which includes development in CAPEX and OPEX, the imbalance between demand and supply (capture prices) and the carbon price.[26]

25. AFRY (2020))

26. The capture price is the average market price a power producer “captures”. Due to the intermittent nature of offshore wind, the capture price for offshore wind is generally lower than the average market price as it is sold relatively more often to the market during periods of oversupply (i.e. lower market prices). As more offshore wind farms are built, capture prices for this technology will decrease, also referred to as the cannibalization effect.

Table 4: major drivers AFRY offshore wind business case

Description	Impact on business case
Decrease in CAPEX: offshore wind is highly capital intensive, a decrease in the expected CAPEX for a project improves the business case	↑
Decrease in OPEX: offshore wind has higher maintenance costs than onshore wind, due to its location. A decrease in the expected OPEX for a project improves the business case	↑
Demand / supply imbalance: in case demand lags, there is oversupply in the market resulting in lower market prices	↓
Increase roll-out offshore wind: more offshore wind capacity (in NL and neighboring countries) increases cannibalization and therefore lowers capture prices	↓
Decrease carbon price: a lower than expected carbon price, means that carbon-based energy becomes relatively cheaper lowering the market price	↓

Source: PwC analysis based on AFRY (2020)

Another sign that it might not be possible to achieve the target in a zero-subsidy environment is the decreasing number of participants in Dutch offshore wind tenders. This is illustrated in Table 5, which shows that the number of participants in recent Dutch offshore wind tenders (zero-subsidy) has been lower than in the past. Interviewed parties were concerned that it will be difficult to raise capital on a project finance basis for zero-subsidy tenders (at least as long as PPAs are not sufficiently available). This means that only developers with a strong balance sheet might be able to participate.

Table 5: participants in recent Dutch tenders

Tender winners displayed in **bold**

Borssele I/II	Borssele III/IV	HKZ I/II	HKZ III/IV	HKN V
Subsidy procedure	Subsidy procedure	Zero-subsidy procedure	Zero-subsidy procedure	Zero-subsidy procedure
Vattenfall	Vattenfall	**Vattenfall (zero subsidy)**	**Vattenfall (zero subsidy)**	Ørsted
Shell, Eneco, Van Oord	**Shell, Eneco, DGE, Van Oord (€54,49/ MWh)**	Eneco, DGE, Van Oord	Eneco, Van Oord, Shell	**Eneco, Shell (zero subsidy)**
Ørsted (€72.7/MWh)	Ørsted	Equinor	Ørsted	
Innogy, EPDR, Macquarie Capital	E.ON	Innogy	Green Investment Group (Macquarie), Iberdrola	
Unknown participant	Northland Power, Siemens, DEME		Engie, Northland Power, EDPR, Green Giraffe	
Unknown participant	WPD			
Unknown participant				
Number of participants				
7	6	4	5	2

Sources: PwC analysis based on RVO tender results and newsletters tender participants

To conclude, the impact of a zero-subsidy environment on the availability of capital for offshore wind is highly uncertain. There is serious concern in the market that the availability of capital will decrease to such an extent that not all tendered capacity up to 2030 will be financed. Ultimately the availability of capital will be determined by the viability of the business case for offshore wind projects, which is mainly influenced by ensuring proper offtake (PPA). We noticed that many developers and investors are concerned about whether sufficient production can be sold ex ante through PPAs. In the absence of a developed PPA market, the possibilities for hedging merchant price risk are limited. It is uncertain how many merchant projects developers will be able to fund (project finance and/or on balance sheet) in such an environment. Whilst there have been multiple successful zero-subsidy tenders, developers and other financiers fear that there is little appetite to take on many more fully merchant projects.

4. Recommendations: supporting the transition to zero-subsidy

In the previous chapters we tried to explain how the transition to a zero-subsidy industry will affect the availability and cost of capital. To summarize, we concluded that enough capital is currently available for healthy offshore wind projects. Compared to a situation with a support scheme like SDE+, a zero-subsidy environment leads to an increase in the risk profile. This higher risk profile leads to an increase in the cost of capital and reduces the availability of capital. Such an effect is not necessarily problematic: it reflects pricing uncertainty in financial markets, which ensures efficient allocation of capital. The potential problem is that zero-subsidy might affect the financial viability of offshore wind projects to such an extent that the Roadmap 2030 could be threatened.

We conclude that the transition towards a market without subsidies, and with exposure to electricity, needs facilitative policy from the government. In section 4.1 it is argued that the government could primarily develop policies to solve market failure on the demand side. This would help unlock demand for green electricity and reduce merchant price risk. In section 4.2 it has been explained that a temporary backstop policy instrument could be further developed and activated if there are clear signals that zero-subsidy will fail to deliver sufficient tender bids.

4.1 Unlocking demand by addressing market failure

Demand for green electricity is prone to market and/or government failure. Examples of potential market failures on the demand side are numerous and the transition into decarbonized production is complex. Firstly, there are externalities from greenhouse gas emissions, which may not be sufficiently priced in all industries (e.g. relatively low EU ETS prices). Secondly, potential offtakers may have invest in certain technology which is not yet fully developed to commercial scale and would therefore require access to subsidies. Thirdly, potential offtakers may need to rely on third parties when electrifying their operations, which will lead to coordination problems. Finally, there may be infrastructural constraints.

The consequence of these market and government failures is that demand for green electricity is lower than socially desirable, i.e. demand would be higher if all externalities would be priced properly. This has implications for the PPA market; development of the green PPA market might lag behind the development of green electricity supply. As a result, there will be fewer possibilities for developers to hedge risks through PPA's because there are only a limited number of offtakers of green PPA's.

The government can address the market failures on the demand side through a mix of policy. Policies should aim to coordinate new supply chains, solve infrastructural constraints, put the right price on carbon and offer access to support schemes. Such a combination of policies will help facilitate the transition for intensive energy users, which will create future demand for green electricity. The business case for offshore wind will improve if there is higher demand for green electricity.

Appropriate government interventions will result in higher demand for renewables and green PPAs. This will enable developers to effectively hedge merchant price risk, which will increase the availability of capital. In this context, we recommend conducting further research into: a) how to efficiently match demand and supply (e.g., through combined tenders) and b) if a more liquid PPA market can be established (for example, using alternative PPA structures or consortia PPAs to increase demand from smaller offtakers).

4.2 Developing a temporary backstop instrument

By developing the demand side, it may be possible to reduce the risk of offshore wind in a situation of full exposure to merchant price risk. However, it will take time to implement policies that aim to unlock demand. A zero-subsidy market might fail to produce enough healthy offshore business cases to meet the Roadmap 2030.Given the central role of offshore wind in meeting the Netherlands' climate targets, the government will likely want to avoid a scenario where the targets formulated in the Roadmap 2030 are not met.

To account for the potential risk of zero-subsidy not being effective, an additional backstop instrument could be introduced as a temporary measure. If there is not enough appetite for zero-subsidy tenders, a second round with an element of support could be maintained. The preferred design of the backstop instrument would need to be investigated. It could be an instrument linked to the tender, like tenders for contracts with a minimum price floor ("CfD light") or a financing instrument like government guarantees. We recommend that the government specifies what the backstop would entail and in which circumstances it would be activated. The backstop could be anchored in an adjusted offshore wind law ('Wet windenergie op zee').

It should be noted that prolonged use of government support schemes, which reduce exposure to merchant price risk, can slow down the transition to a mature PPA market. Firstly, there is no incentive for the market to develop this market if the government is already hedging this risk through support schemes. Secondly, support schemes can have a negative impact on electricity prices, which could generally reduce the viability of the business case for offshore wind farms. Therefore, we suggest that any such support scheme should be a temporary backstop.

Appendices

A. Literature

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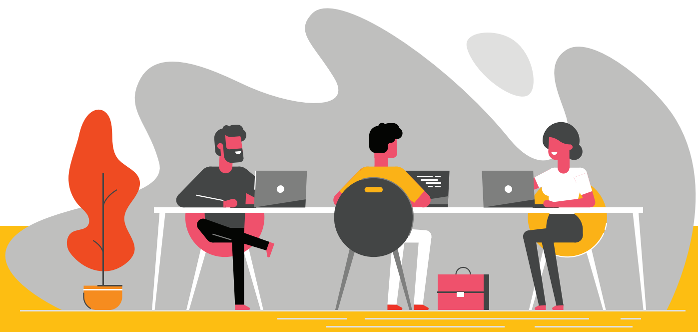
B. Interview list

For our research we have interviewed the following 15 developers and capital providers:

- ABN AMRO
- APG
- Atradius
- DEME
- European Investment Bank
- Eneco
- Macquarie Capital's Green Investment Group
- NN Investment Partners
- Northland Power
- Ørsted
- Partners Group
- RABOBANK
- SIEMENS
- SMBC
- Vattenfall



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D. About this report

In April 2020, PricewaterhouseCoopers Advisory N.V. (PwC) was asked by Invest-NL (Client) to conduct a study into the financing of future Dutch offshore wind farms in a zero-subsidy environment.

From May to August 2020, PwC assessed the impact of zero-subsidy on the availability and cost of offshore wind financing, and ways in which availability of finance can be improved.

The Report has been prepared for the sole benefit and use of the Client and not for the interests or priorities of any third party. The potential impact of COVID-19 (and of measures taken by the authorities to contain and/or prevent the spread of COVID-19) on the availability and cost of capital for offshore wind was not part of our scope. It is not possible for PwC to assess the implications of COVID-19 with any certainty, both generally in terms of how long the current crisis may last and more specifically in terms of its impact on the availability and cost of capital for offshore wind.

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