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Effect of auctions on financing conditions for renewable energy

A mapping of auction designs and their effects on financing





D5.1, Identification of auction design elements affecting financing

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Executive summary

The revised Renewable Energy Directive (European Commission, 2018) mandates EU Member States to employ auctioning procedures for awarding renewable energy support. While auctions have proved to be a reliable mechanism to stimulate the development of renewable energy projects with lowest production costs, little is known about their effects on financing conditions. Costs of capital are one of the most significant cost factors for renewable energy projects, due to their typically very high capital intensity (large upfront investments in comparison to operational costs).

This report maps out the effects that auctions might have on financing conditions of renewable energy projects. We discuss potential effects that relate to entire renewable energy markets (for instance, a decrease in debt and equity margins due to higher competitive pressure), and on individual projects (for instance, risks that affect Weighted Average Costs of Capital). We investigate the impacts on cost of debt, cost of equity, debt-to-equity ratio, and hurdle rates separately and we also take into account loan conditions, including Debt Service Coverage Ratio requirements and loan tenor. We discuss the effects in three main dimensions of impact. These are financing type (project financing vs balance sheet financing), project phase (project development timeline) and actor type.

In identifying and assessing the potential effects, we employed mainly qualitative research methods. After consulting the literature on financial theory and auction designs, we conducted seven semi-structured interviews with bankers, project developers and a financial advisor from Germany, Denmark and the UK. Besides this, we conducted a validation workshop at the Wind Europe 2019 conference in Bilbao, where we invited participants to evaluate from their own experience, the potential effect of auctions on financing. The limitation of our approach is in the fact that we do not quantify any of the impacts that we discuss, and we have conducted only a limited number of interviews. Therefore, our considerations are rather hypotheses than conclusions, and may best be read as a starting point and guideline for future work. In the next steps of the AURES II project, we aim to conduct 140 interviews with stakeholders in all EU member states, and will quantify some of the effects by using stochastic modelling techniques and cash flow analysis.

The main findings from this report are:

- Equity investment (including hurdle rates and cost of equity) may be affected by auctions in several different ways. We argue that growth limitations and competitive pressure may force project owners to accept lower profit margins. However, projects also face risks during auction procedures, which may translate into higher risk premiums. For instance, bid bonds and other pre-qualification requirements, which project owners have to incorporate into their project development process, may require investing more risk capital upfront. Market actors with small balance sheets (capital availability), such as small project developers or energy cooperatives, may be affected and experience short-term liquidity issues. More importantly, such actors might find it more challenging to diversify their risks, through developing and bidding with multiple projects. Auctions may also lead to a decrease in support payments to individual projects, making them more dependent on volatile market revenues, potentially causing an increase in cost of equity.
- Debt financing is most likely impacted more by the remuneration scheme than by other auction designs. Remuneration schemes directly affect the cash flows of projects during their operating lifetime. We find that two-sided Contract for Difference (CfD) schemes (which provide a fixed remuneration independent of the market price) have the most positive impact on loan financing conditions, since they provide the most predictable revenues. One-sided CfD schemes (sliding premiums) allow investors to receive additional revenues at high market prices, but generally provide lower secured revenues than two-sided CfDs. Auctions for fixed premiums (constant add-ons to market prices) result in relatively low support remuneration levels and thus secured revenues. Here, investors must sometimes already today actively seek securitisation of the market-based part of revenues (e.g. through private PPAs) to obtain project financing. This makes debt financing more complicated and possibly more expensive.
- Financing conditions have a significant impact, not only on the cost of individual projects, but also on the broader market situation. Auctions may change the investor landscape of a market, and in doing so affect actor diversity. Competitive bidding schemes create new market conditions, in which size and resources



play a very important role. Actors with greater access to capital, such as power utilities and large energy companies, might have a competitive advantage over smaller project developers. This is because they can use their greater pool of resources to diversify risks, e.g. bidding in auctioning rounds with more projects.

- Auctions can improve the stability of support schemes, especially in countries that have experienced retroactive changes and/or which have faced pressure on public finances from their renewable energy schemes. This could simply be due to the fact that auctions tend to decrease support levels and help control deployment volumes, making the fulfilment of long-term targets more likely. But policy makers could also actively pursue to increase stability of support schemes, e.g. through improving the contractual commitments between auction winners and the respective governmental institution, so that support payments and operating conditions are well protected. This stability effect might be positive for financing, both on the equity and debt side. However, auction systems also need active political commitment. A lack of long-term market predictability (in terms of continuity and schedules) may lead to a decreased willingness and ability to develop and finance new projects as well as to worsened financing conditions, and might ultimately make RE deployment more expensive.
- Overall impacts on financing conditions could be either positive or negative. This will depend greatly on the individual designs and market circumstances. A two-sided CfD system could have a positive effect on cost of capital but if this is accompanied by stringent bid bonds, unrealistic project realisation deadlines, unclear auction volumes, low auction round frequency etc., the introduction of an auctioning system might affect financing negatively. Furthermore, much of the impact will depend on individual project and market circumstances. The effects from policy decisions for auction design that we discussed in our report might be negligible in comparison to country risks, monetary policy, or even regulatory barriers (including unclear grid connection rules, high administrative hurdles, etc.).

These findings are presented as hypotheses that need further research and validation. Our findings are influenced by views of the experts we interviewed, who represent mostly a Western European perspective. However, we expect that some of our findings are also valuable in other jurisdictions, for e.g. in Energy Community countries, as they have started to implement auctioning schemes under similar rules as in the EU. We focus mostly on onshore and offshore wind energy, but expect our considerations as broad enough to also be applicable to other technologies, especially solar PV. We intend to further investigate this in the continuation of the AURES II project, including a more detailed investigation into the effects of individual designs (for instance bid bonds and their impact on actor diversity) and an analysis on the differences in the impacts for different technologies (for instance onshore wind vs. solar PV).



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List of Abbreviations

AURES	Auctions for Renewable Energy Support
CAPM	Capital Asset Pricing Model
CDS	Credit Default Swaps
CFADS	Cash Flow Available for Debt Service
CfD	Contract for Difference
DSCR	Debt Service Coverage Ratio
EU	European Union
GDP	Gross Domestic Product
IRR	Internal Rate of Return
LCOE	Levelised Cost Of Electricity
MW	MegaWatt
NPV	Net Present Value
PPA	Power Purchase Agreement
PV	Photovoltaics
RE	Renewable Energy
SPV	Special Purpose Vehicle
TSO	Transmission System Operator
WACC	Weighted Average Cost of Capital



1 Introduction

Auctioning procedures are rapidly being adopted by governments around the world to allocate renewable energy (RE) support, and in 2018 they have been integrated into support systems of 94 countries (based on a forthcoming IRENA report). They are also increasingly being implemented within the European Union (EU) and the neighbouring Energy Community countries. However, the effect of auctions and individual auction designs on financing conditions for renewables has until now not been investigated systematically. This report is the first step in this direction. We examine the potential effects of auctions on costs of capital, with the aim of understanding how certain design choices may contribute to improving financing conditions of RE investments. Besides looking at individual designs, we also establish some general market-based implications of introducing auctions for financing conditions.

1.1 Scope and structure of the study

We investigate the effect of auctions on financing conditions for new investments in RE projects. We focus here mainly on onshore and offshore wind energy projects in the EU but the implications could also be drawn for Energy Community countries that are currently in the process of implementing the same EU acquis on energy, environment and competition. We also expect many of the results to be transferable to other technologies (such as solar photovoltaics (PV)) and countries outside the European continent.

We systematically explore possible impacts of different drivers (exogenous and endogenous) on financing conditions (cost of capital as well as loan conditions) for investments in new RE assets. We have found that the impacts are very different when considering different actor types, different financing types, and different project phases. We treat them as three different 'dimensions' in our analysis.

Drivers: We distinguish between two categories of drivers: exogenous drivers that focus mainly on broader macroeconomics effects and endogenous drivers, which includes the support system in place (see Figure 1). We focus mainly on the impacts of RE policy, and in particular auction design (which we categorise as part of the endogenous drivers). Here, we distinguish between the impact of introducing auctions 'as such', and the impact of individual auction design elements. Under auction designs, we consider both the designs that regulate the auctioning process and rules itself, and the remuneration systems. We go into detail with several individual auction design elements, such as bid bonds. We only touch very briefly on exogenous drivers, such as economy-wide effects including the monetary policy of the European Central Bank (ECB), to examine the relative importance of auctions in relation to these larger drivers.

Impact mechanisms: Some drivers affect financing conditions directly, e.g. very strict penalties may lead to a higher cost of equity. Other drivers affect financing more indirectly, e.g. the introduction of auctions in a market may lead to lower remuneration (through more competition and timely support level adjustments), thus affecting the quality of the revenues (i.e. less secured income) and the financing conditions (e.g. lower debt capacity). We analyse both of these impact mechanisms. For impacts via quality of revenues, we focus mainly on remuneration design (i.e. the choice of support type), and contractual (offtaker) risks as major drivers.

Financing conditions: With financing conditions, we mean both the ability to source financing for an investment and the cost of sourcing it. Therefore, we analyse effects via indicators related to 'cost of capital' on the one hand, and indicators related to 'loan conditions' on the other. We thus differentiate seven different impact indicators: weighted average cost of capital (WACC), cost of equity, cost of debt, debt-to-equity ratio, hurdle rate, debt service coverage ratio (DSCR) requirements and loan maturity. We have chosen these indicators after reviewing the existing literature on cost of capital and renewables. Our interviews have confirmed the validity and relevance of focusing on these indicators. Of course, all of these indicators are interdependent and cannot be analysed separately from each other.

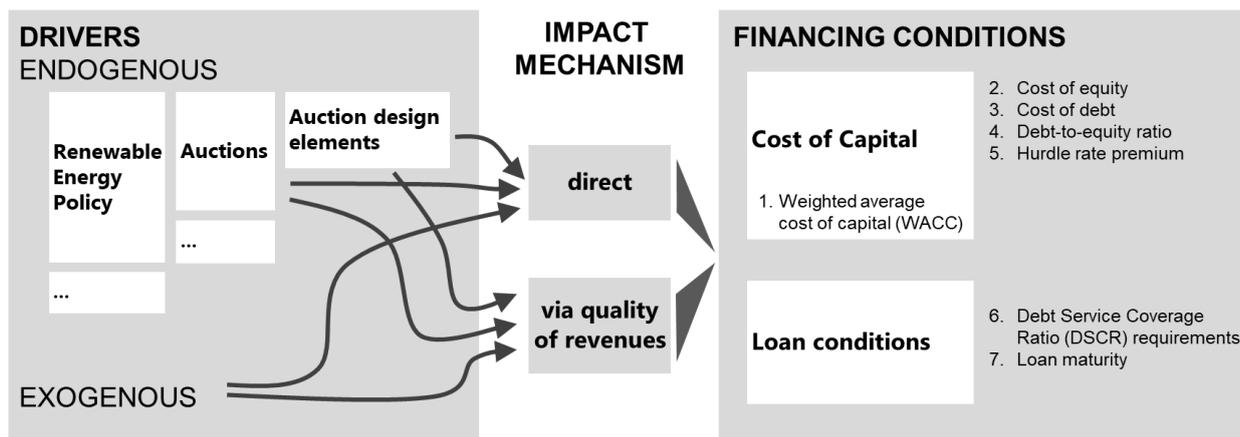


Figure 1: Structure and elements of the analysis in this report (drivers, impact mechanism and financing conditions indicators)

The report is structured as follows. After finishing this introductory section with a description of our methods, we first give some background on the drivers and dimensions of financing conditions for RE projects in Europe (Section 2). We then elaborate on the indicators chosen to assess financing conditions (Section 3), and the dimensions in which the effects may occur (Section 4). We proceed to put forward our hypotheses of cause-effect relationships for different potentially significant effects based on our previous considerations from a project and market perspective (Section 5). We then turn the perspective away from ‘what is affected’ (i.e. projects and markets) and towards ‘what is affecting’ (i.e. the auction design) and elaborate on how individual design elements in auctions may influence the financing conditions of participating RE projects (Section 6). We then briefly turn to exogenous factors that affect financing conditions, to set our work into context (Section 7). We conclude (Section 8) with a summary and an outlook into the next steps of the work in AURES II towards identifying auction designs that improve financing conditions for RE investment in Europe.

1.2 Methods

This study identifies and maps out the cause-effect relationships between auctions and their impact on financing conditions for renewables. We have employed three steps: 1) literature review of auction design and financial theory literature; 2) semi-structured interviews with seven industry professionals, with a background in financing RE investments and/or project development; and 3) a validation event with industry stakeholders at the Wind Europe conference in Bilbao in April 2019.

Literature review: The existing literature on the effects of support schemes on financing conditions has not yet investigated the effects of auctions in detail – the scientific literature on this topic is scarce. The most apparent reason behind this is the fact that auctions are a new instrument for allocating support. The number of countries that have adopted auctions globally increased from 6 in 2005 to 94 in 2018 (based on a forthcoming IRENA report). Besides this, EU Member States have started implementing them on a larger scale only since 2014, when the EU Commission introduced State Aid Guidelines (European Commission, 2014), and established for the first time that future RE support shall be eligible, provided it is allocated based on a competitive bidding process.

Considering the scarcity of the research in our field of study, we have investigated two streams of literature. First, we reviewed directly relevant literature that included peer reviewed research articles and conference proceedings in the field of auctions for RE support in general. Here we also reviewed grey literature including reports from EU funded research projects such as AURES I, and reports from international organizations such as IRENA (IRENA, 2017; IRENA and CEM, 2015) and other research institutes. Next, we reviewed the broader literature, including scientific articles and reports in the field of support policies in general, and more specifically financing effects of support policies. Here, we also reviewed financial theory articles and books,

including cost of capital, portfolio theory and risk theory in general.

Our review process consisted of the following steps:

1. Screening of the AURES I reports for the most relevant search terms from RE auction design literature.
2. Building block search of scientific literature in Web of Science and grey literature in Google. We screened the directly relevant literature by conducting a Boolean search with the terms "auctions for renewable energy support" OR "renewable energy auctions" OR "auctions for renewable electricity" and have based on this yielded 15 relevant articles. On the other hand, the secondary literature Boolean search with the terms "renewable energy support scheme" OR "renewable energy support" OR "feed-in tariff" OR "feed-in premium" OR "green certificate" yielded 759 results after excluding the irrelevant Web of Science categories. When combining these two searches with terms from financing theory such as "cost of capital", "financing conditions", "investor risk" we yield a much smaller number of results. Using the same terms, the primary literature search using private browsing in Google Chrome yields 49.000 total hits, the most relevant ones being reports from the AURES I project, IRENA and other international organizations, universities and research institutes. When we conduct the same search type for the broader literature search terms we obtain 3.4 million hits, also authored by similar organizations.
3. After identifying the key literature through the steps that we described above, we conducted a cited reference search. For instance we reviewed a key book on financing for RE (Donovan, 2015), and this led us to find additional resources in financing theory including materials on costs of capital (Pratt & Grabowski, 2014), corporate finance (Brealey & Myers, 2010), risk and uncertainty (Dixit & Pindyck, 1994) general portfolio theory (Markowitz, 1952), and more.

Stakeholder interviews: While our literature review helped us identify the main cause and effects of auctions on financing conditions, we relied on stakeholder interviews to corroborate the causal relationships. In total, we have conducted seven semi-structured stakeholder interviews, which lasted between 45 to 60 minutes each. This included three debt providers from the UK and Germany, two large and one medium sized project developers from Denmark and Germany and one financial advisor (with experience in these markets) . Each interview was conducted based on the four-eye method, meaning that in each of them at least two persons from the AURES II project team have been present. The participants have on average ten years of investment experience, and some were active in multiple European and global markets, both in onshore and offshore wind. The interviews were recorded and transcribed, except in case of one who declined recording.

Validation event: We conducted a stakeholder workshop at the Wind Europe 2019 conference in Bilbao, which attracted a number of different stakeholders including project developers, investors, debt providers, and academics. In the event we used a World Café method to initiate discussions, and have asked attendees to evaluate the impacts of auctions on risk in different project development stages, and if they can assign any of the identified impacts to a particular auction design.

2 Financing conditions for renewable energy projects in Europe: Drivers and dimensions

The cost of electricity from wind and solar PV has significantly decreased over the last decades. This is due to decreasing investment expenditures on the one hand, but has also been driven by decreases in financing cost on the other. Financing conditions are a significant factor in RE investments in Europe: As Ondraczek, Komendantova, & Patt (2015) found, the most attractive countries for investment in solar PV are those with a well-developed financial market, and not those with the highest solar radiation potential.

Financing is the 'art' of finding the right sources of capital to pay for an investment. The different sources of capital have all benefits, drawbacks – and cost. The cost of capital that is needed to finance an investment



is central to this study.

Costs of capital for RE projects are driven by a combination of endogenous and exogenous factors, which we distinguish in the following way: the term endogenous factors includes all aspects of RE policies such as design of instruments, RE targets etc. Exogenous factors are defined as all aspects apart from RE project-specific and RE policy aspects. In the discussion of exogenous factors below, we focus on cost of debt, as less data are available on cost of equity.

2.1 Endogenous drivers

We consider all drivers as endogenous that are directly related to policy actions and their consequences. In this study, we focus on deployment support payments to investor or operator. Deployment support can include investment-based payments (grants), fiscal measures (e.g. tax credits), generation-based payments, and more. We consider operation-based support only, which is the major support type applied in Europe (Kitzing, Mitchell, & Morthorst, 2012). We distinguish between four different types of support: Fixed premiums, Sliding premiums (also denoted one-sided contracts for difference (CfD), two-sided CfDs (with a fixed strike price), and tradeable green certificate markets. These remuneration schemes are elaborated in more detail in Section 3.9. The support level (i.e. premium) that projects receive within these support schemes can either be administratively set or allocated through competitive bidding processes, i.e. auctions.

There is broad consensus in the literature that RE support policy, and especially remuneration design has a significant impact on cost of capital (e.g. Boie et al., 2016; Criscuolo & Menon, 2015; Giebel & Breitschopf, 2011; and Kitzing & Weber, 2015). Besides the design of policies, there is also some literature emphasising the need for strong policy, stability, credibility and reliability (Criscuolo & Menon, 2015). High uncertainty regarding future policy support schemes or changes that affect existing schemes (such as the retroactive changes of feed-in tariffs), create a high degree of uncertainty with respect to future cash flows (Gatzert & Vogl, 2016). This is the reason why several studies (e.g. Angelopoulos et al., 2016; CEPA, 2015 and Gatzert & Kosub, 2017) identified policy risks and regulatory risks – often used synonymously – as the most relevant risks in the EU, and thus, barriers for investment into RE.

Although policy risks have been a main factor contributing to the riskiness of investments, especially in early phases of RE support deployment (Liu & Zeng, 2017), policies have fulfilled two important functions during that time: compensating high capital costs and mitigating other risks such as price and sales (market) risks. With decreasing RE costs and increasing market integration, the dependence of RE projects on support payments is declining, while the significance of market risks and further external factors for financing costs increases. Both, political and economic risks for RE investment, are discussed in more detail in Section 3.1.

2.2 Exogenous drivers

Although RE policy design has a significant impact on the cost of capital, it is by far not the only driver. For example, Boie et al. (2016) or Giebel & Breitschopf (2011) investigated the impact of specific feed-in design elements on the cost of capital. Their findings suggest an increase in cost of debt between 1-2 percentage points (in financial terms also denoted as 100 to 200 basis points) if the support scheme shifts from an administratively set feed-in premium to an auction-based premium and from a feed-in tariff to a premium, respectively. However, the actual differences in cost of capital between the EU countries are much larger than what can be explained by policy design. For example, both, Germany and Portugal have a feed-in tariff as reported by Boie et al. (2016), but their WACC differs by about 400 basis points (Angelopoulos et al., 2016). Spain and Sweden, or Poland and UK, each pair with a similar RE policy, display a difference in the WACC of at least 100 and 200 basis points, respectively.

Exogenous drivers affect financing conditions typically through their risk impacts, and are associated with economic aspects, politics, legal framework and social capital (Javakhadze, Ferris, & French, 2016). Also, the structure of the capital market, monetary policy, and similar, have an impact, as illustrated in Figure 2.



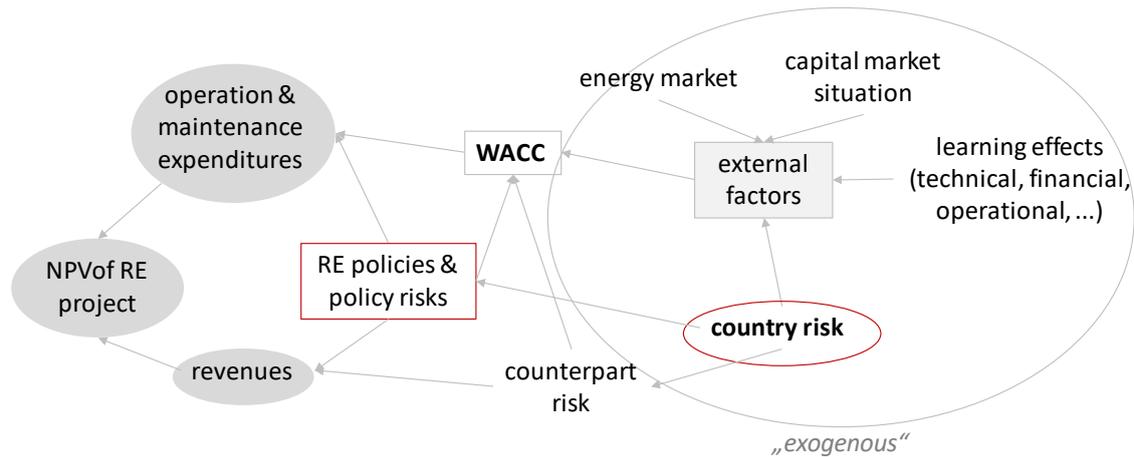


Figure 2: Interdependence of exogenous and endogenous drivers for financing of renewable energy

2.3 Dimensions of impacts on financing conditions

In this report, we adopt a multi-dimensional view of risk. We define three main dimensions through which the endogenous and exogenous drivers described above affect financing conditions and risk for project owners. These dimensions are:

1. **Financing type:** auction schemes might influence the financing types that project developers and investors employ, and subsequently their costs of capital. Essentially, companies can either finance projects on their balance sheets (also known as corporate finance or balance sheet financing), or engage in non-recourse project financing, where the project is grounded in a separately established Special Purpose Vehicle (SPV) and in which shareholders are only liable to the extent of their investment. In such project-financing structures, the lenders collect debt repayments only from the project's cash flows, with only its assets as collateral, and not the assets of the sponsors. When companies utilise their balance sheets, in accounting terms the project becomes part of their assets, and the sponsoring company is not shielded against any losses.
2. **Project phases:** projects change their risk profile during different project development phases. During the era of administratively determined support schemes such as feed-in tariffs, the risk was highest at the beginning of the process, during the development phase. As the project development progressed, the number of unknowns and risk decreased, until the project received financing and reached financial close. Auctions have changed the distribution of risk throughout the project development lifecycle. More risk is incurred in earlier project development phases due to the uncertainty of the future awarded price and allocation risk.
3. **Actor type:** RE market actors differ with respect to their size, sophistication, technologies they invest in and capital availability. They also require different returns on equity, for instance utilities tend to have higher equity return requirements than private actors such as households. Since auctions might affect the actor composition of a market, they might also affect the average market costs of capital.

We describe these dimensions in more detail in Section 4.

3 Indicators for financing conditions

3.1 Risk

Investment decisions are complicated by the fact that the future is not certain. Decision makers typically lack perfect information about the specific outcomes of key factors that determine the success of an investment. By investing, they become exposed to the risk of financial loss (or gain). Risk can be defined as the degree of uncertainty regarding the realisation and timing of future economic income, and can be measured by variability of returns. According to financial theory, risk exposure is the determining factor for the level of return that (risk-averse) investors require an investment to yield.

Risks are often distinguished in four categories: 1) Political risks, 2) Economic risks, 3) Social risks, and 4) Technical risks. Although social risks (including damages to the environment, safety risks, public acceptance issues, etc.), as well as technical risks (risks of equipment breakdown, unexpected cost increases, substitution risks, etc.) are certainly relevant and highly important in RE projects, the focus of this study is on political and economic risks, as they have the more direct relation from policy making to financing conditions.

Political risks include regime stability risks, (retroactive) regulatory changes in operating conditions (incl. support schemes), changes in fiscal regulation (incl. taxation), and legal risks. These include lack of legal options (recourse), enforcement of court awards (remedies) and changes in general regulations that affect the operation of assets (e.g. environment, water, health & safety issues). Some of these risks, such as retroactive regulatory changes, and rules concerning contractual arrangements, may have an effect on cash flows and support payments. Other risks, such as regime stability risks, directly impact the cost of raising capital for investment in a certain country.

Economic risks include contractual risks (non-compliance and bankruptcy of counterparties), cost of insurances, hedging, swaps, risk of exchange rate fluctuations, and market risks, relating to both the capital and the commodity markets. Market risk exposure is significantly influenced by support policy design through choice and design of the remuneration scheme, and through many other design elements, as elaborated below.

Competitive bidding systems create new kinds of risks that affect investors' cash flows, costs of capital, hurdle rates and overall financing conditions. These are for example qualification risk (the risk of not meeting prequalification requirements for becoming eligible for an auction), allocation risk (the risk of not being awarded support after having participated in an auction), and non-compliance risk (the risk of not meeting contractually agreed deadlines or production obligations and thus having to pay penalties). Auctions also change political risks (as the procedures e.g. regarding the implementation of RE deployment targets are changed).

The above listing shows that RE investments are subject to many different risks. However, it is not the single investment that determines the risk exposure of an investor. Instead, it is its contribution to the risk of the portfolio that an investor holds. This fundamental idea has been developed in the seminal work by Markowitz (1952) and has dominated financial theory ever since. As many of the risks of different assets or stocks are correlated, overall risk exposure can be reduced simply by diversifying (investing into different stocks and assets).

The risk remaining in a perfectly diversified portfolio is the systematic risk, or market risk. Systematic risks arise from dynamics on the market, which are faced by all market players, e.g. government policy, international economic forces, or acts of nature. Investors appraising the investment into a new asset should only consider systematic risk, which measures how the new investment would affect the investor's overall risk exposure in relation to the market portfolio. This is assuming that perfect portfolio diversification can be obtained at shareholder level without transaction cost (also, because it is assumed that firms can go bankrupt and be re-established at no cost; see Modigliani & Miller, 1958). Portfolio theory is used in financial analysis, especially because unsystematic risks (also called specific or idiosyncratic risks), do not have to be considered in pricing of cost of capital. However, the approach contains simplifications and has several unsatisfactory features. A major assumption is that all investors are rational and risk-averse, and markets are efficient. Market imperfections, such as corporate taxation, asymmetric information, cost of bankruptcy



and financial distress, cost of funding new investments, and more, are not captured in portfolio theory (Frenkel, Hommel, & Rudolf, 2005). In fact, modern developments in economics increasingly consider these aspects. It is now generally recognised that bankruptcy does incur irreversible costs (Bris, Welch, & Zhu, 2006), and that firms prudently employ mitigating measures to address this risk.

3.2 Cost of capital as indicator for risk and financing conditions

Cost of capital can most easily be understood as the costs under which different capital providers are willing to invest and lend money to a business or an undertaking. If the business uses that capital and achieves returns that are higher than capital costs, then it is creating additional economic value to its shareholders. Cost of capital can also be defined as the opportunity cost of investing funds into the best alternative on the market. If investors lock in their funds into a specific RE project, they forgo the opportunity of investing them into other assets with equal or better returns such as stocks, real estate, commodities etc. (Pratt & Grabowski, 2014).

Cost of capital is an aggregate indicator, determined by different factors, all of which are described in detail in the subsequent sections. Figure 3 gives an overview of the different elements. We distinguish between the cost of equity and cost of debt. Aggregating these two, considering their relative weights, yields the weighted average cost of capital (WACC). In standard financial theory, the WACC should be used as the discount rate in investment appraisals. In practice, we often see that investors instead apply a hurdle rate (corresponding to a required rate of return) that is different from the WACC. We simplify here by assuming that this difference can be depicted in form of a hurdle rate premium that is added on top the WACC. We then assume that the resulting hurdle rate (WACC plus premium) is the rate used for investment appraisals (as depicted in Figure 3).

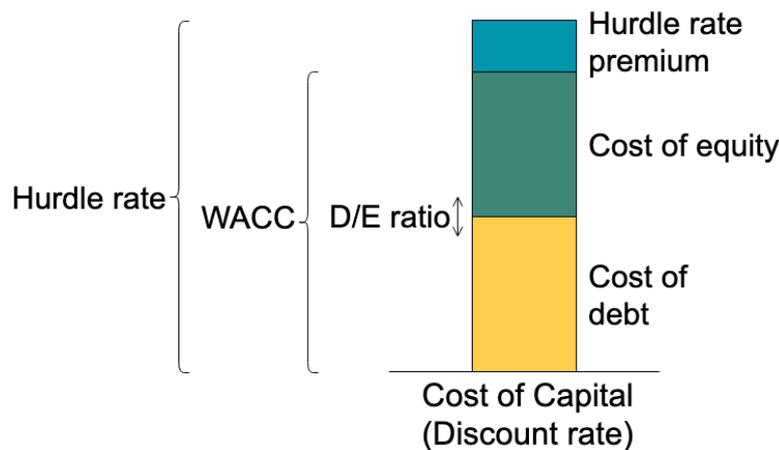


Figure 3: Conceptualisation of cost of capital, hurdle rate, WACC and discount rate

3.3 Weighted average cost of capital

Capital can be sourced from different kind of investors and debt providers. When cost of debt and cost of equity are aggregated, considering their relative weights (shares) in the financing structure, we arrive at the weighted average cost of capital or WACC. Denoting E as the total equity invested, D the total debt, V the total value of financing (so that $D + E = V$), cost of equity as r_e , cost of debt as r_d and the corporate income tax rate as T, we derive the WACC formula that is typically used in financial analysis (although other WACC definitions also exist and depend mainly on the treatment of tax in the formula; see Steffen, 2019):

$$WACC = \frac{E}{V} r_e + \frac{D}{V} r_d(1 - T)$$

Until 2014, there was no structured and comprehensive overview on the actual cost of capital for RE at EU level. This changed with the projects DIA Core in 2014 (Noothout et al., 2016) and RE-Frame in 2016 (Eclareon, 2016), in which national project developers, investors and banks were interviewed with a focus on onshore wind projects. The interviews covered all Member States of the EU (except for Luxemburg and Malta) and provided information on WACC and its subcomponents cost of debt, cost of equity and the ratio of debt and equity for 2014 and 2016. These interviews revealed that both in 2014 and in 2016, there was a substantial difference in WACC among the different EU countries, as illustrated in the following map:

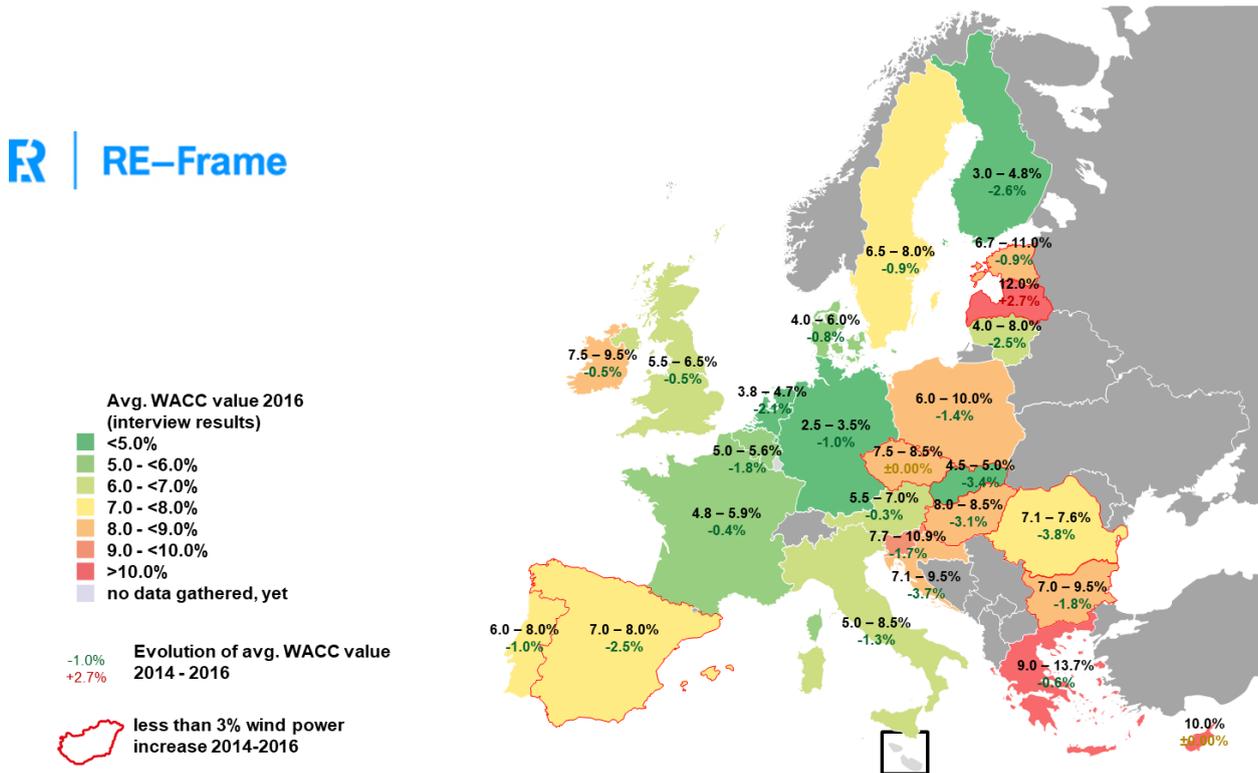


Figure 4: Overview on WACC for wind power 2016, Source: Brückmann (2018)

Figure 4 demonstrates that there is a gap between markets with a low WACC of 2.5% – 5%, such as Belgium, Denmark, Finland, France Germany or the Netherlands, and countries with a significantly higher WACC of 7% up to more than 13%, such as Bulgaria, Croatia, Greece, Hungary, Latvia, Romania, Slovenia or Spain¹. The comparison of the WACC development between 2014 and 2016 showed further that the values went down in almost all markets with a quite dramatic decrease, particularly in some markets in Central and Eastern Europe (see Section 3.5 for a more detailed discussion). However, this decrease in WACC did not necessarily lead to an ambitious deployment of wind power capacities in all countries: For example, in Hungary, Romania, Slovakia and Spain, there was hardly any or even no deployment of onshore wind despite a strong decrease of WACC. The reason for that perplexing situation was that investors in those countries lacked a clear business case. In most of them, support schemes were ineffective or completely missing which could be explained by different and country specific reasons (lacking interest of political decision makers to deploy RE in the respective Member State, lack of resources and unintended consequences from earlier support schemes). This underlines the fact that investors do not invest if the investment costs are low but if they

¹ The reason for the high WACC in Spain were probably the aftermath of the financial crisis of 2008 (Southern Europe and Ireland were all heavily affected in 2014) and/or the unfavourable situation for RE investments. Both conditions improved after 2014.

have a business case – and this (in many cases) still relies on an effective policy support scheme.

When being asked about the factors for differences between the WACCs in the different Member States and their development during the period 2014-2016, the interviewees often named the following three factors:

- Country specific risks (independently from RE risks),
- RE specific risk premium in that country, and
- Competition between investors and banks.

The effects of costs of capital on Levelised Costs of Electricity (LCOE) are significant. To illustrate this, we have roughly estimated the impact of a WACC increase on LCOE for two average RE projects in Europe (see Figure 5): a 2 MW solar PV plant (top), and a 20 MW onshore wind farm (bottom). The impact of a WACC increase on LCOE is significant, e.g. a WACC increase of 600 basis points (e.g. from 4% to 10%) reveals a two-thirds rise in overall LCOE of the solar PV plant and a 50% increase of overall LCOE of onshore wind.

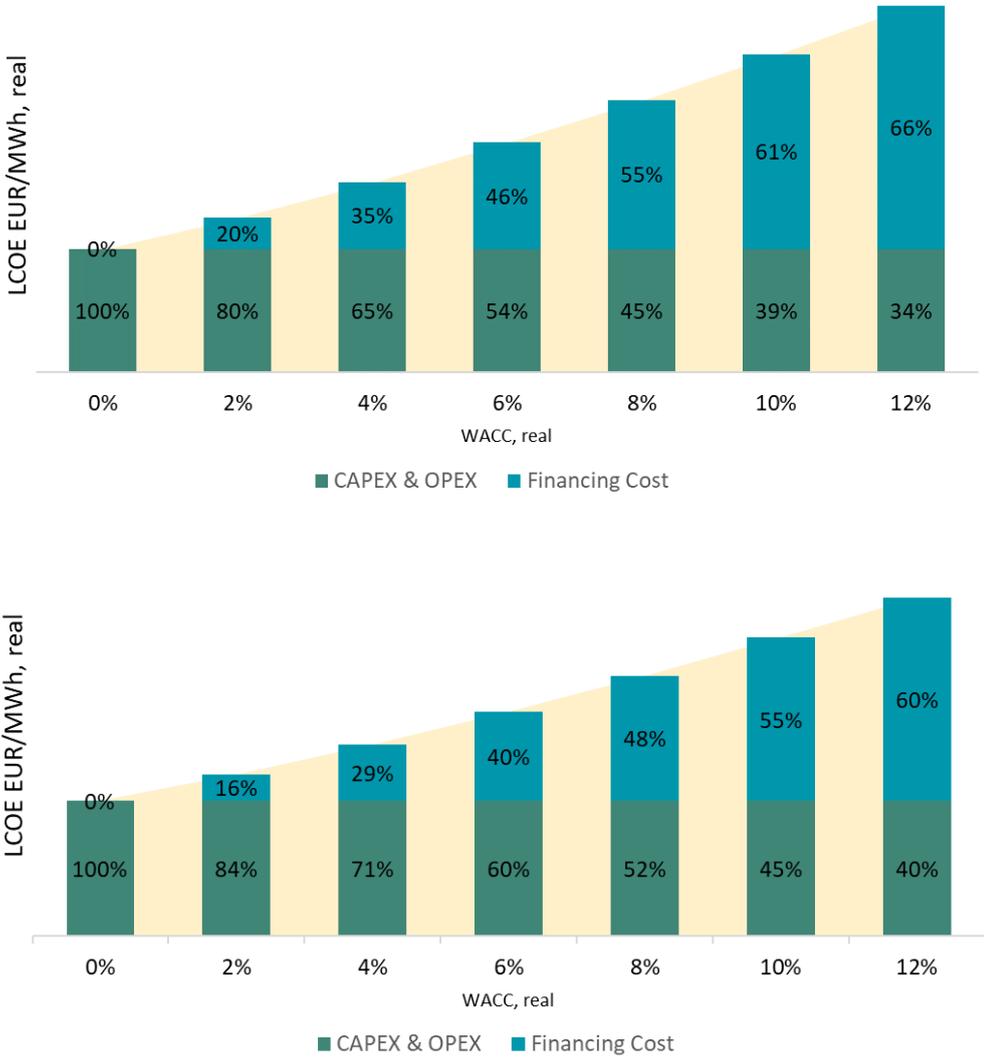


Figure 5: Impact of costs of capital on LCOE (top is solar PV and bottom is onshore wind). Source: own calculations, inspired by an illustration in Egli, Steffen, & Schmidt (2019).



From the interviews and the research undertaken in DIA Core and the RE-Frame project, it is difficult to derive any conclusions about the effect of introducing auctions on WACC, since the interviews were conducted at a time where only few onshore wind auctions had taken place. A noteworthy observation is that in markets with a high degree of competition (such as the SDE+ in the Netherlands or the Green Certificate scheme in Sweden), market actors seemed less inclined to reveal any figures about their overall WACC estimations, and in particular cost of equity, presumably for fear of revealing information to competitors. This might imply that the introduction of direct competition through auctions could lead to a new market situation in which less information about business cases, costs and profitability reaches the public domain. From that perspective, we assess the information collected in interviews on cost of debt as the most reliable element in cost of capital estimations.

3.4 Cost of equity

Cost of equity refers to the return offered to equity investors to compensate for the risk they assume by investing their capital. It can represent the rate of return that shareholders expect for investing into a specific asset or firm. The most commonly used method for estimating cost of equity is the Capital Asset Pricing Model (CAPM) (Lintner, 1965; Sharpe, 1964). A survey on 392 CFOs from companies in the United States and Canada found that three quarters of them relied on this method (Graham & Harvey, 2001), and this is mainly due to its simplicity and comparability. The CAPM is based on optimum portfolio theory (Markowitz, 1952), which deals with selecting the best combination of stocks that investors should hold depending on their preferences for expected returns and associated risks. Its simplicity comes from the fact that only systematic risk (the risk of the market as whole) is taken into account, while other (unsystematic) risks can be diversified and are thus not priced (see also Section 3.1).

In the CAPM, the cost of equity is estimated based on three elements only: 1) risk-free rate, r_f , i.e. the return available on a security that is assumed free of default, for example the German government 10-year bond, 2) market risk premium ($r_m - r_f$), i.e. what a fully diversified investor can earn on the overall market in excess of the risk-free rate, and 3) beta, β , i.e. a measure for sensitivity of the returns of a specific asset as compared to the market returns. The cost of equity is then estimated as:

$$r_e = r_f + \beta(r_m - r_f)$$

The market risk premium can only be indirectly derived by measuring the market returns r_m , that can e.g. be found by taking the average over historical returns on a market portfolio such as S&P 500 or DAX. Beta is simply derived by quantifying how changes in the returns of the specific asset (r_a) are related to changes in the market returns (i.e. determining the covariance of the two variables).

$$\beta = \frac{Cov(r_a, r_m)}{Var(r_m)}$$

By dividing the covariance with the variance of the market returns, beta becomes a relative measure. Thus, it always holds that if $\beta = 1$, the asset has the same risk (expected return) as the overall market. If $\beta > 1$, the asset's return is high when market return is high (and vice versa), meaning that if the asset is added to a market portfolio, the latter becomes more risky. If $\beta < 1$, the asset's returns are less volatile than the market's returns. Adding the project into the portfolio would decrease its volatility of returns, and thus lower the risk for the investor.

This definition of cost of equity (through risk-free rate, market returns and beta only), represents the standard financial theory, assuming no market imperfections. In real life applications and investment decisions, there are many other effects that are accounted for in cost of equity, and that are very specific to a single industry.

Through our interviews, we have found that smaller project developers do not always use the CAPM model to estimate costs of equity and instead rely on less systematic methods and make their investment decision intuitively. Moreover, companies might not find Beta an adequate measure of risk, or they might lack data on publicly traded companies whose Betas they could use as proxies. In such cases, other methods to estimate equity cost of capital may be used, such as the build-up method, in which the expected rate of return is calculated by adding individual components relating to 1) market premium (related to revenue volatility); 2) size premium (for small companies); 3) company specific risk premium (idiosyncratic risks based on the

operations of the firm); and 4) country risks (Pratt & Grabowski, 2014).

The interviews undertaken in the DIA Core and RE-Frame projects collected data on cost of equity. The results should (as mentioned above) be read with more caution than the other numbers derived, as strategic considerations may have led to distorted responses. The development of cost of equity mirrors that of overall WACC and cost of debt: there is a decrease in almost all Member States. It is notable though, that in countries with a significant increase of wind power in the past years (Germany, Lithuania, Portugal), the values for cost of equity plunged below 10%, while in countries with a cost of equity significantly higher than 10% there was hardly any wind power deployment. An illustrative example is Germany, where cost of equity ranged between 4 - 6.5 %.

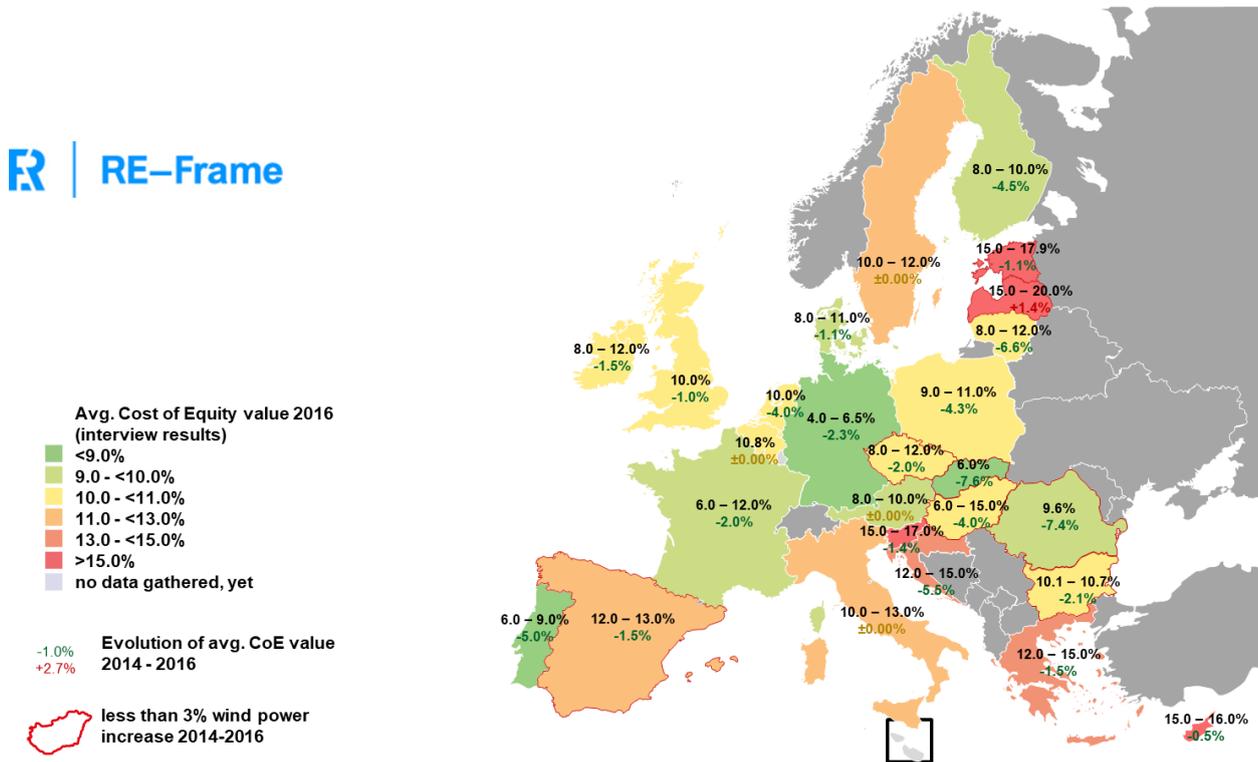


Figure 6: Overview on cost of equity for wind power 2016, Source: Brückmann (2018)

3.5 Cost of debt

Capital that has been sourced as debt, e.g. a loan taken in a bank, is usually charged an interest. The interest that is paid on the debt corresponds (in a simplified way) to the cost of debt. A starting point for determining cost of debt (if one does not use direct quotes by banks) is the risk-free rate of government bonds. Acquiring a government bond corresponds to providing a loan to the government in return for a certain cash flow of interest payments. Any other loan-taker promises interest payments as well. However, they will not be considered as safe as the government payments and are subject to default risk. Therefore, banks add a risk premium (the default spread) to account for this additional risk. Consequently, there is a difference between the risk-free rate and an interest rate that is offered by the banks to a company needing a loan. This debt margin depends on the individual loan-taker. Companies with a high credit worthiness (and rating) will be able to achieve lower cost of debt (see more on this in Section 3.8).

RE investors source debt either from debt providers such as commercial banks, or through capital markets by selling corporate bonds. In case of less developed markets, debt is also provided by multilateral development banks (Steffen & Schmidt, 2019).

The research in the DIA Core and RE-Frame projects showed that cost of debt is the decisive factor for the development of the WACC – which is not very surprising considering the predominant share of financing

from debt for wind energy projects in almost all EU markets (Steffen, 2018). The map below visualises the key findings of the research:

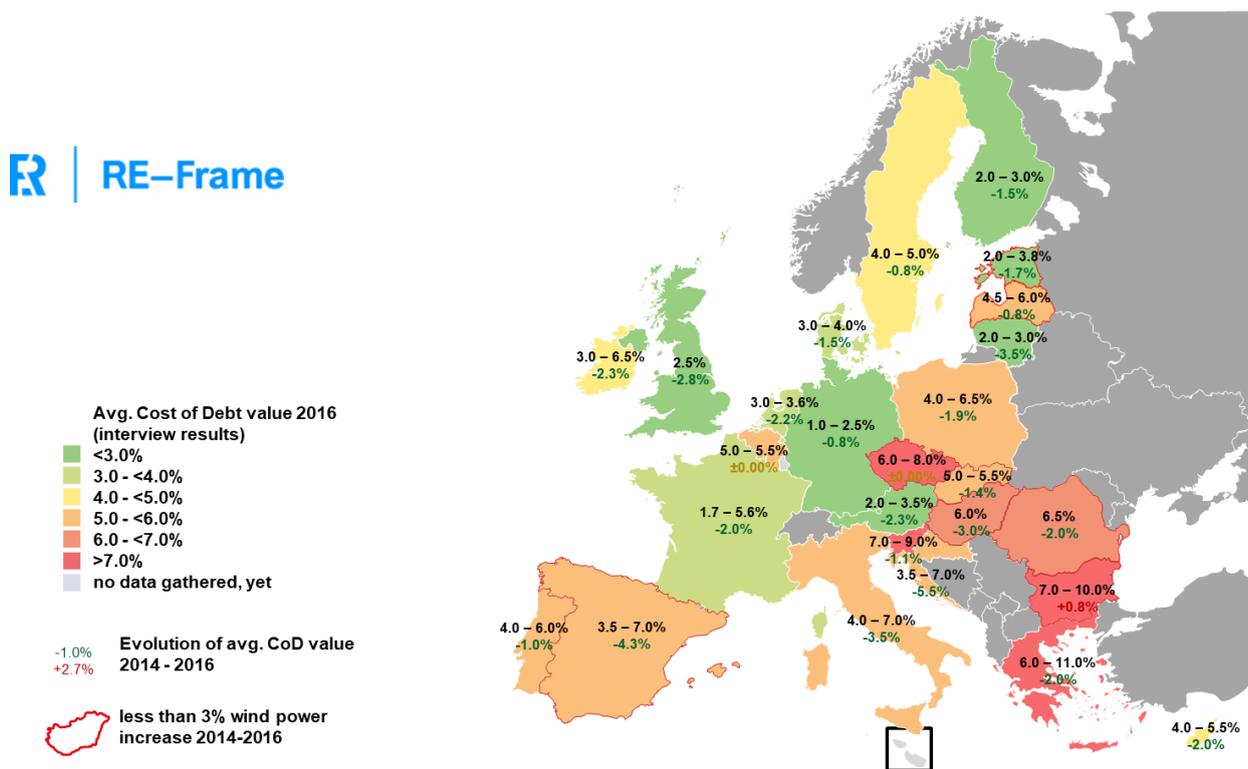


Figure 7: Overview on cost of debt for wind power 2016. Source: Brückmann (2018)

These cost of debt results underline and enforce the conclusions from the observation of the WACC figures: The disparity between countries with a low (such as France, Germany or the UK) and a high cost of debt (such as Bulgaria, Greece or Romania) is even greater. But, also here, a significant decrease of the values can be attested in almost all Member States. According to the interviewees (mainly representatives from banks), the main reason for that decrease was the abundance of liquidity on financial markets due to ECB politics within the period 2014-2016, namely the low and in some cases even negative interest rates and the so-called Quantitative Easing with a volume of 2,6 Trillion EUR for 2015-2018. As a result, projects with stable and secure business cases were in high demand for investors, and the competition between banks drove down the cost of capital. The effect of that competition is a positive sign from the cost of deployment perspective. However, interviewed bankers also pointed out that such fierce competition increases risks for banks. Moreover, the more competitive situation makes it harder for banks to maintain risk buffers in their interest margins.

3.6 Debt-to-equity ratio (debt capacity)

The debt-to-equity ratio is an indicator of the capital structure that indicates from which source and in which shares the money for investment has been obtained from. With E again being the total equity invested, D being the total debt, and V being the total value of financing (so that $D + E = V$ and $\frac{D+E}{V} = 100\%$), we denote the equity share as $e = \frac{E}{V}$ and the debt share as $d = \frac{D}{V}$, then the debt-to-equity ratio is equal to d/e . Firms with a high debt share (d) are considered to have a high 'leverage' or high 'gearing', as they have a relatively high share of debt in comparison to equity.

The shares of equity and debt invested into projects differ across Europe. For example, in Germany, the debt to equity ratio can be 80/20 or even more, while there are other markets where this is much lower, for instance

in Sweden where it more likely to be around 55/45.

Comparing the development of the debt-to-equity-ratio for wind projects between 2014 and 2016 from data collected in the DIA Core and RE-Frame projects draws an ambivalent picture: in some markets, there was an increase of the debt share, but in others, the equity share grew. There is still a wide gap between markets with a high share of debt of up to 80 % & 85 % and others with much lower share of 55 - 60 % (such as Estonia, Latvia, Romania and Sweden most of them with a low deployment of wind power). The reasons for the difference in the countries are also here:

- Country specific risks (independently from RES risks),
- RES specific risk premium in that country, and
- Competition between investors and banks.

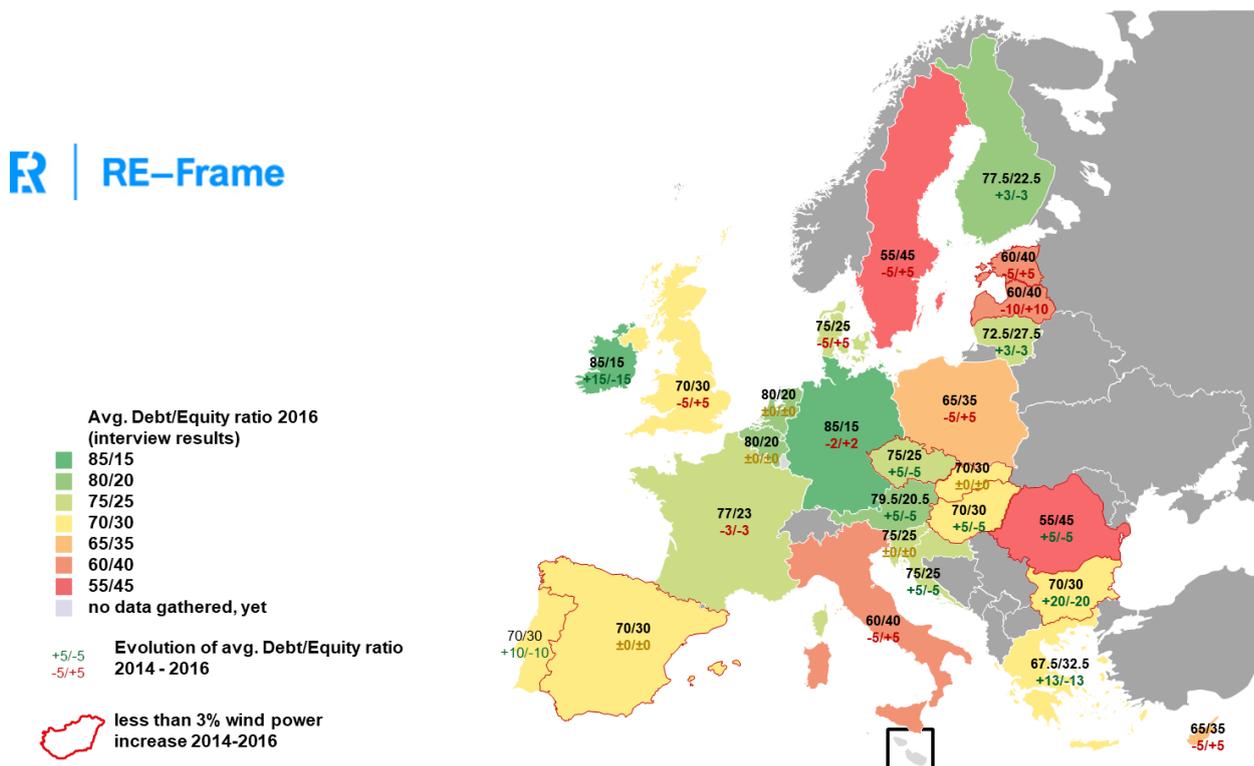


Figure 8: Overview on debt and equity ratio for wind power 2016. Source: Brückmann (2018)

Some countries show a very strong development towards higher debt shares and at the same time a noteworthy growth of wind power capacities in the past years (Greece, Ireland and Portugal). These markets were particularly strongly impacted by the financial crisis in 2008 and the following years. It is not clear what the reason were for the strong deployment of wind power – the improved procedures and support schemes for wind power projects, an improved general financing framework or something else.

In markets with an already high ratio of debt-to-equity-ratio in 2014, the share of debt did not change (Belgium, Netherlands) or even went down (Denmark, France, Germany). This might reflect the state of wind energy markets in 2016 where different and partially contradicting forces showed an impact – on the one hand, abundance of financing and, on the other hand, uncertainty about national policies.

It should be noted that, according to the Modigliani & Miller (1958) theorem, the value of a firm is unaffected by how the firm is financed, meaning that the capital structure is irrelevant (assuming a situation without taxes). The proposition is that the overall WACC will stay constant, no matter the leverage (debt-to-equity-ratio). This is, because increasing the debt share would automatically lead to higher risk for shareholders (they might lose more of their money to the bank in case of financial difficulties), who then require higher returns for their investment. The lower cost of debt would be offset by a higher cost of equity. However, this

proposition only holds if no transaction costs exist, there are no taxes, and shareholders and firms all borrow at the same rate. When adding taxes into the picture (and tax exemptions for interests paid to banks), the advantage of less expensive debt financing is not fully offset anymore, and it becomes an incentive for firms to borrow. In this study, we thus generally assume that an increased debt-to-equity-ratio will lead to a decrease in overall WACC. Since debt is typically less costly than equity, projects with a higher debt share will therefore have lower cost of capital.

The decision of capital structuring, i.e. of how much debt and equity should be used in a company or for a specific investment, is a central aspect for cost of capital. In line with the point made above, where debt is expected to generally have lower cost than equity, we also speak in this context about the debt capacity of a RE project, referring to the maximum amount of debt that a project can obtain in project financing. The debt capacity is typically limited by restrictions imposed for loan conditions, as further elaborated in Section 3.8, and will often depend on the share of secured revenues, either through fixed price agreements (PPAs), or through regulated income from support policies (or both), as discussed in Section 5.4.

3.7 Hurdle rate premium

We define hurdle rate as the minimum rate of return on an investment required by the project developer or investor. The hurdle rate is also known as the minimum acceptable rate of return (MARR). A company might have determined a hurdle rate of 10%, meaning that it would accept only projects for investment that yield a return higher than that. If a project is being prepared for investment decision, and an internal rate of return (IRR) of e.g. 12% has been estimated for it in a cash flow analysis, it would fulfil the hurdle rate requirement and would be accepted for investment. Note that we simplify here by only considering hurdle rate premiums. Some firms also involve other means of 'NPV cushioning', i.e. deviating from the strict 'NPV ≥ 0 ' investment decision rule (Donovan, 2015), e.g. by simply only investing into projects that have a certain minimum positive NPV.

Strictly adhering to the finance theoretical framework, investors would use their WACC as hurdle rate for investment decisions. In practice, hurdle rates are often distinguished from WACC, due to diverse reasons. Empirical studies have found that firms often apply hurdle rates above their WACC, where hurdle rate premiums (or WACC uplifts) of 5% or more are not unusual for industrial companies (Driver & Temple, 2009; Meier & Tarhan, 2007). Arup (2018) cites industry evidence for onshore wind in the UK to have a differential between 100-200 basis points between WACC and hurdle rate.

There are different reasons why firms may apply hurdle rate premiums (i.e. hurdle rates that are higher than the cost of capital). In the energy context, this may be due to limited capital and human resources, meaning that for some firms it is simply not possible to undertake all profitable projects, requiring firms to select only the most profitable projects out of a pool of projects that all have a positive NPV (Donovan, 2015). In such a case, the hurdle rate may be better estimated by the returns of the 'next best project' that has to be rejected in favour of the evaluated project than by the (theoretically-derived) WACC (Titman & Martin, 2008).

The effect of project selection through hurdle rate premiums is often seen in industries characterised by high growth rates and high return rates of previous projects (Meier & Tarhan, 2007), and by financially successful firms with a range of attractive investment opportunities. Other incentives for applying a hurdle rate premium are related to financial flexibility considerations, low confidence in beta estimates (OXERA, 2011) and the financial health of firms (Meier & Tarhan, 2007). The presence of asymmetric risks may also play a role (Driver & Temple, 2009; OXERA, 2011).

Note that firms are not always explicit about their application of a hurdle rate premium. When asked in surveys or interviews, they often report using a discount rate in investment decisions that is higher than an objectively calculated WACC while asserting that they are using a CAPM-based WACC as discount rate (Meier & Tarhan, 2007). In our interviews, we have also encountered companies that only have a very rough idea about their WACC, while being much more concerned with comparing project IRR to a (somewhat negotiable) management-determined hurdle rate when making investment or bidding decisions.

Another reason for firms using hurdle rates different from cost of capital in investment decisions are real options (see Dixit & Pindyck, 1994). In the real option approach, an investment opportunity is not only valued at the return it can deliver if invested here and now, but also at the potential return it could deliver, e.g. if

invested in one year's time. This is especially relevant for capital-intensive infrastructure investments like RE projects that are (at least to some extent) irreversible (they cannot be sold and reinvested without significant loss). The option of waiting to commit to irreversible projects may justify higher hurdle rates. Another real option category prevalent in RE investments is the creation of follow-up options, e.g. if the investment into a first project in a new market can entail additional future opportunities to invest. This may then justify hurdle rates lower than cost of capital, because of the strategic value of projects that open up additional business opportunities (Driver & Temple, 2009).

3.8 Loan conditions

When we speak about loan conditions, we mainly refer to those under project-based financing, which we explore in more detail Section 4.1.1. The most common loan type is the annuity loan, where a project owner pays a fixed amount in each repayment period to its lender or debt provider. We have already discussed interest rates in Section 3.5. Besides this key condition, another aspect that debt providers take into account, and that is very relevant for our discussion, is the loan tenor or loan maturity period.

Loan tenor is the duration of time in which the loan is expected to reach maturity or become fully repaid. Debt providers will tend to give out loans with shorter maturity if their perceived risk of a project is higher, because this reduces their risk exposure to a shorter period. In contrast, longer loan tenors are an indication that banks have a higher confidence in a project. The additional exposure of some RE projects to market prices is being reflected in shorter loan tenors (Egli, Steffen, & Schmidt, 2018).

Banks also apply a Debt Service Coverage Ratio (DSCR) requirement to assess and monitor project financed companies. DSCR is used to measure the ability of a project to repay debt obligations and can be defined with this simplified formula:

$$DSCR = \frac{\text{Cash flow available for debt service (CFADS}_t\text{)}}{\text{Instalment (principal}_t\text{ + interest}_t\text{)}}$$

In order to service debt, the DSCR must be at least 1 ($DSCR \geq 1$) in all relevant periods. In simplified terms, this would mean that a company has more cash than what it needs to pay in instalments for its loan. Many banks require additional safety margins, or buffers, to cover for cases of cash flow complications (e.g. poor project performance, low resource availability or low prices). Projects that do not meet the minimum DSCR requirements are categorised as unbankable, meaning that they would not be given a loan. In general, banks assign greater DSCR requirements to projects with higher risk.

We are not aware of an extensive database of DSCR requirements for RE projects in Europe, although recent research indicates that they have been steadily decreasing in Germany for both onshore wind and solar PV in the last 20 years, in large part due to learning effects of debt providers (Egli et al., 2018). A debt provider we interviewed has indicated that the DSCR rates for onshore wind in Germany are currently between 1.1 and 1.2 for low-risk projects. This means that a bank will finance a project only if its expected cash flows available for debt service (CFADS) are at least 10% to 20% higher than the project's debt service obligations (during the loan tenor period). Such low DSCR rates are only possible in markets that are stable and where projects owners are subject to relatively high revenue stability, as is the case with the German CfD system, and where high competition among banks contributes to easing of financing conditions. We learned that DSCR requirements for projects in Sweden are much higher, in the range of 1.5 to 1.6. This is mainly due to the higher market price exposure of projects in the Swedish market.

The cost of debt of a company will in large part depend on its credit worthiness. Typically, banks evaluate the credit worthiness of the borrower (debtor, loan-taker) according to a number of criteria, including the asset base, profits and losses, past and present cash flows, experience of executive management, past and present business activities, market shares, future outlook of the business, etc. They then make quantitative forward-looking assessments of the default risk of the borrowing company. Based on this evaluation, they typically assign a credit rating score to the borrower, which then determines the debt interest rates they offer. See e.g.



the very transparent rate model applied by the KfW in Germany (KfW, 2018). Since the implementation of Basel II (recommendations on banking laws and regulations), the bank internal ratings are similar to what rating agencies such as Standard & Poor's and Moody's Services do.

	MOODY'S		S&P		FITCH		
	Long term	Short term	Long term	Short term	Long term	Short term	
INVESTMENT GRADE	Aaa	Prime 1	AAA	A-1+	AAA	F1+	HIGHEST
	Aa1		AA+		AA+		
	Aa2		AA		AA		
	Aa3	AA-	AA-				
	A1	Prime 2	A+	A-1	A+	F1	
	A2		A		A		
	A3		A-		A-		
	Baa1	Prime 3	BBB+	A-2	BBB+	F2	
	Baa2		BBB		BBB		
	Baa3		BBB-		BBB-		
NON-INVESTMENT GRADE	Ba1	Not prime	BB+	B	BB+	B	LOWEST
	Ba2		BB		BB		
	Ba3		BB-		BB-		
	B1		B+	C	B+	C	
	B2		B		B		
	B3		B-		B-		
	Caa		CCC	D	CCC	D	
	Ca		CC		CC		
	C		C		C		
				D	D	D	

Figure 9: The ratings structure. Source: Santos (2007)

Simplified, one can say that a company needs to have an 'investment grade' rating in order to e.g. receive project financing, this is, a rating of at least Baa3 or BBB- (see Figure 9). There is a strong correlation between credit rating and interest rates offered by banks for loans. The higher the rating, the lower the debt rates.

The evaluation of credit worthiness and the credit ratings are influenced by many of the risk elements discussed in this report – as they either directly affect the cash flows (through remuneration design and competitive support level setting) or have an indirect impact on default risk (e.g. allocation risk or penalties) – because any additional risk that a project developer faces (including those related to the introduction of auctions), can also increase the probability to default. The quantification of the impact of different auction designs on credit rating and loan terms is subject to further analysis within the AURES II project.

The amount of debt a company can take will also depend on the assumed production probability scenario. Banks typically apply a more cautious production estimation than project owners when assessing debt capacity of a project. Our interviews confirmed that banks in Germany assume production scenarios ranging from P-75 to P-90, i.e. they apply a production estimation with 75% to 90% probability of realisation, whereas project owners often use P-50 estimates. According to industry experts, some banks also make the DSCR requirement dependent on the production scenario, with a lower DSCR requirement for a more cautious production estimate, i.e. minimum DSCR of 1.4 for P-50 and minimum DSCR of 1.1 for P-90.

In addition, banks often impose management, monitoring and reporting requirements. This could be e.g. the requiring of holding a certain cash buffer within a SPV, or of adhering to certain project development milestones. This way, banks can assume some influence on project schedules, cash management, contractual relations and even auction bidding strategies.



3.9 Cash Flow aspects and relevant remuneration designs

A typical RE project has two revenue streams:

1. Market-based. Here, production is remunerated based on a power price. This can either be agreed upfront in an offtake agreement, usually for a longer period of time to assure project finance (5-10 years), or achieved through short-term and spot sales over an energy exchange or pool (merchant sales).
2. Support-based. These are government-guaranteed revenues for each produced unit of energy, typically paid out by a government-appointed independent entity, e.g. the Transmission System Operator or an energy market regulator. These support payments can be designed in different ways, e.g. as feed-in premium or green certificates. The support level is typically defined administratively or via an auction bid, for a fixed amount of time.

In some markets (mainly outside of the EU and often where there is no liberalised electricity market in place), the two revenue streams are combined into one. Then, the 'support' is given through a governmental or public utility power purchase agreement. Other revenue streams, such as delivering ancillary services, or producing and selling other types of products (such as hydrogen), etc. are typically still minor sources of revenues for RE projects in Europe.

Market-based revenues have long been given little focus in RE analysis and policy design, maybe due the long history with high and stable support payments that had made the market-based income stream less significant. As a consequence, the market for long-term offtake agreements and power purchase agreements is still rather immature in Europe. Merchant sales on short term and spot power markets are characterised by high volatility, both in the longer term (where yearly averages swing considerably) and in the short term, with high variations within a day and between days and seasons.

We currently see four major types of support payments for new RE projects in Europe:

1. Sliding premium, or one-sided Contract for Difference (CfD). This is in effect a floor price that the RE producers will always achieve for produced electricity during the support period
2. Fixed strike price, or two-sided Contract for Difference (CfD). This is in effect a fixed guaranteed price that the RE producer will always achieve for produced electricity during the support period
3. Fixed premium, in effect a fixed guaranteed add-on to the market price that the RE producer will receive for produced electricity during the support period
4. Green certificates, that the RE producer will receive for produced electricity during the support period and that they then can sell on to buyers (typically subject to a quota obligation).

Common for all of these four types of support schemes is that they are premium-based, i.e. the support only comprises a financial component – the payment of support for a produced electricity volume – but it does not comprise the actual offtake of the electricity by the government entity. The power is still being sold on the market by the RE producers, either merchant on the short-term markets or through offtake agreements.

Hence, both the one- and the two-sided CfD, as well as the fixed premium are sometimes grouped into the category 'market-based premium', which is also the support type advocated for by the European Commission in RED II (European Commission, 2018). Figure 10 below shows that market-based premiums are expected to become all-dominant for e.g. new wind development on the European market.



Figure 10: (Expected) share of new wind capacity per type of support. Source: WindEurope (2018)

There are many different design choices to be made for each support type, and not one scheme is implemented in the same way as another. These design choices e.g. include the support duration, the way of paying support at negative market prices, the determination of the relevant market price for calculating the differential premium, etc. In this report, we discuss only the effects of some most generic characteristics of the first three support types (one- and two-sided CfD, and fixed premiums).

In case revenue stabilisation from support payments is not sufficient, a private offtake agreement can become critical for project finance. If lenders can see the company has a purchaser before production begins, it is easier to obtain financing to construct a facility (Adkins, 2017). An offtake agreement is here defined as an agreement between a producer and a buyer to sell/purchase portions of the producer's future production. A RE offtaker typically can be a power provider (e.g. ENEL, ENGIE, RWE, Statkraft) or a large consumer (e.g. Google) or a corporate (e.g. IKEA). There is also a growing number of new entrants, such as risk resolution companies (Allianz). In non-liberalised markets, the RE offtaker can be a vertically integrated utility, the energy company or dedicated government agency (e.g. Energorynok in the Ukraine). As noted above, the government support scheme may also include a form of contractual offtake agreement.

4 Dimensions of risk in the financing of renewable energy projects

We introduced the concept of three distinct dimensions of risks in financing RE projects in Section 2.3. These dimensions are crucial in our understanding of the effects of auctions on financing conditions. They help us in answering these questions:

- 1) Do the effects on financing conditions differ with the financing type employed (project vs. balance sheet financing)?
- 2) How do the effects of different auction designs on financing conditions change along the project development lifecycle?
- 3) Do auction designs affect various market actors differently?

In order to explain the scope of our analysis of different effects, we first explain these dimensions.

4.1 Dimension 1: Financing type

RE projects are financed in two main ways - either directly through a project owner's balance sheet, or through a separate project company, also known as a Special Purpose Vehicle (SPV). When employing balance sheet financing (a form of corporate financing), a sponsoring company provides guarantees for loans through their

whole balance sheet. Moreover, using such financing type, companies can also raise debt on bond markets, and avoid due diligence from commercial banks. In non-recourse project financing, the sponsoring company creates a new legal entity or an SPV to host the project. The project's cash flows are then the only source from which the debt providers can get their loan repaid – they are non-recourse. In project financing, debt is secured only against the project's assets, while shareholders are exposed to losses only to a level equalling their equity investment in the SPV.

4.1.1 Project financing

The use of project financing for RE investments globally has been steadily increasing from just 16% in 2004 to 42% in 2017 (FS-UNEP, 2018). Recent research on the reasons behind the uptake of project financing in Germany has concluded that companies use this financing type mainly due to debt overhanging (Steffen, 2018). Companies with high levels of debt obligations in comparison to their assets – are more impaired in further borrowing. They will be less able to use their balance sheet to finance otherwise NPV positive projects. Project financing solves this problem by moving new debt to a separate legal entity (SPV) and away from the host companies' balance sheet. However, other reasons are also discussed and they may apply more in the context of other countries. For instance, project financing could be used by companies to hedge against contamination risk. This could otherwise occur if a company financed a project that achieved losses and 'contaminated' the main balance sheet, leading to potential bankruptcy risks. In addition, assets that are securitised in a separate entity such as an SPV could be financed at lower costs, if the core business of the company has a higher risk profile. This could be a reason why e.g. a utility with traditionally high risk and high return projects would want to move its lower risk RE assets into separate legal entities. Other reasons for project financing include the development of citizen owned RE installations where many citizens pool resources together to realise a project.

4.1.2 Balance sheet financing

In balance sheet financing, the sponsoring company is exposed to the project's total losses. Investors with large balance sheets, such as power utilities, have traditionally preferred to employ balance sheet financing, because it provides them with more flexibility in using funds, and it involves less bank oversight in form of due diligence and monitoring. However, the downside of this is the exposure of the company to the project's total losses.

Companies that employ balance sheet financing secure debt periodically for the company as a whole, for example through taking loans at the corporate level or issuing bonds. For instance, Enel Finance International issued EUR 1.25 billion of 10-year bonds in 2017 and was in the same year one of the largest single investors into RE (FS-UNEP, 2018). Such funds are not directly related to a single project, but are used for funding a portfolio of projects in their different stages of development. The use of balance sheet financing provides greater freedom for a project developer, as there is no third-party involvement in the planning and construction phase, as is often the case with project-based financing. In 2017, 52 billion EUR worth of green bonds were issued in Europe, out of which approximately 60% was used for energy purposes. Organisations that dominate this field are large energy companies such as EDF, Enel, Engie, Iberdrola and Ørsted (Filkova, Martinez, Meng, & Rado, 2018).

Medium to large sized project developers also use balance sheet backed loans to finance the development of their project pipeline. Such revolving facilities are given with a loan maturity of between one and three years and its financing costs will depend on several factors. Besides the credit worthiness or the borrower and experience with project development, debt providers will also observe the RE rollout plans of a market. A long term and clear roll out plan and auctioning schedule plays an important role in determining the willingness of a bank to provide a revolving project development facility.



4.2 Dimension 2: Project phase

The risk profile of RE projects change along the project development phases, as illustrated in Figure 11. In general, risk decreases as more unknowns become known, and reaches its lowest point during the operation phase. Accordingly, projects that are in early phases may attract investors that seek high-risk/high-return investments, implying high cost of equity. In later development stages, where risks will have declined, other types of investors are attracted that may require lower returns on equity (see Section 4.3 on actor types). The timing and duration of the different phases might be different, depending on if the auction is placed early or late in the project's development process (in late auctions, most project development work is done before bidding).

During the development phase, site assessments, preliminary technical studies, business case analysis, environmental impact assessments, landowner agreements, grid connection studies etc. are conducted. This phase is usually financed by a project owner's own equity, but sometimes also by multilateral development banks and utilities. In order to participate in an auction, project owners will have to meet certain pre-qualification requirements, and depending on the country, this might involve having a construction permit. Up until that point, owners may have already invested between 1% and 2% of the project's value. Before financial close, the owners must go through the bidding process. Unlike in support schemes with administratively allocated support rights, auctions require additional resources for bid preparation, which most likely also are financed by equity. In addition, it requires placing of either one or two bid bonds (depending on the auction design, e.g. one before and one after the bidding process).

After having won in an auction, the project owner will seek to achieve financial close. This process is different depending on the financing type involved. Whereas in balance sheet financing, the responsible project manager seeks to achieve internal approval to move forward with construction, in project financing project owners must specifically negotiate terms with commercial or multilateral banks. This involves detailed technical and financial studies, and a detailed due diligence process conducted by the banks.

During the construction phase, the project owners seek to achieve commercial operation date before the realisation period expires (which was defined in the auction designs). If the project is not developed on time, penalties may ensue (see discussion on non-compliance risk in Section 5.2).

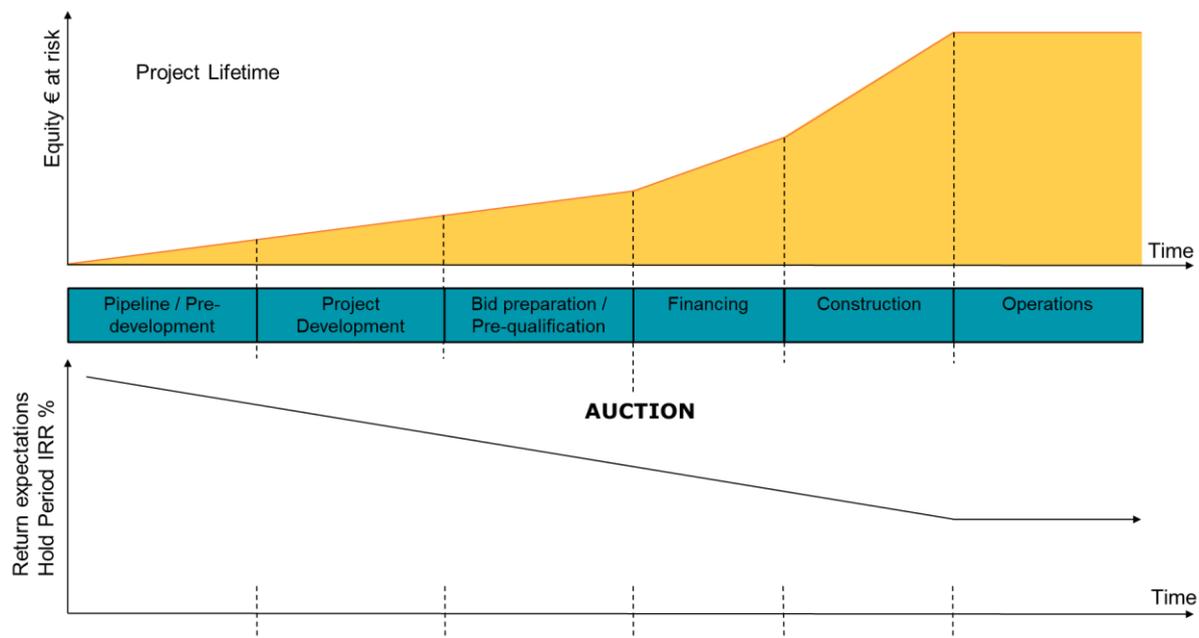


Figure 11: RE project lifetime and the development of risk. Inspired by an illustration in Pinsley (2019)

In summary, auctions change the project development process and introduce new phases (such as the bid preparation phase). They also change the distribution of risks – more risk is assumed in the development phase, mainly due to additional pre-qualification requirements (including financial pre-qualifications or bid bids), and the sunk costs that may occur when a project is not awarded.

4.3 Dimension 3: Actor type

In our analysis, we consider the following market actors:

Utilities and large energy companies: here we consider incumbent investor-owned or national utilities. Market players that belong to this group have traditionally invested into high risk and return fossil fuel generation which could explain their unwillingness to invest into relatively low risk and return RE, leading to low RE market shares, for instance in Germany where they owned just 7% of all RE capacity in 2013 (Helms, Salm, & Wüstenhagen, 2015). However, in 2016 alone, European power utilities impaired (wrote off) 23 billion EUR worth of assets due to the decline in power prices, overcapacity due to the increased deployment of renewables, decrease in electricity demand and other factors (EY Global, 2018). Hence, major European utilities (such as RWE) are starting to increasingly focus on RE, both through investment in RE generation assets and through venture capital investment into clean tech start-ups (John, 2018). While keeping in mind that there are exceptions, we assume that utilities and large energy companies tend to get involved in projects during different phases of their development (early or late) and stay vested throughout their lifetime (see previous section on project phases). Hence, they take part in the bidding process and are affected by auction designs in all stages of the project lifecycle.

Banks: here we consider commercial and multilateral development banks that provide debt financing, and in some cases equity (for example some multilaterals invest into RE in early project stages to help them kick-start). Banks usually get involved in projects after the bidding stage and in case of project financing, they stay vested in the project until the debt matures (is paid back in its entirety). Banks also finance project owners on their balance sheets (see Section 4.1 on balance sheet financing), for instance for development work through short-term revolving loans.

Institutional investors: these include pension funds, insurance companies and other long-term investors. Combined, these investors have \$71 trillion in assets and form one of the largest sources of private capital in the world (Nelson & Pierpont, 2013). Such investors have been the main subscribers of green bonds that were worth EUR 17.5 billion in 2017, and most of which were issued by corporations such as Iberdrola, ENGIE, TenneT, Innogy and Ørsted for financing their green energy portfolios (Mbistrova, 2018). Institutional investors prefer long-term investments with limited risks and stable cash flows and they actively seek to diversify their portfolio (Kaminker & Stewart, 2012). These investors will aim to get involved in projects just before financial close or even later when the assets are already in construction or operational. Hence, they do not take part in the bidding process.

Project developers: developers can best be distinguished by the timing and type of cash flows that they have. The first type develops projects for a later sale to other owners that would construct and operate them. In doing so, they receive large injections of liquidity in relatively few time periods. The second kind develops projects and keeps them as part of their assets. These projects then provide a steady stream of moderate cash flows. The third kind both sells and keeps projects. Project developers also conduct operation and maintenance work and provide other services that add to their revenues. Developers that have such a diversified stream of revenues will be more capable of accessing financing, both from equity and debt providers. In the pre-development stage, project developers invest into multiple possible projects – in other words, they develop a portfolio. Not all of these projects will get fully developed, hence the larger the portfolio the greater the developer's diversification of sunk cost risk. Larger project developers will be able to afford such a strategy due to their larger capital availability. Smaller developers will in this sense be more restricted. Such developers have fewer assets, and lower existing revenue streams, meaning that banks will be less willing to finance their development costs.

Private investors: this group would contain larger private investors such as corporate investors and industrial enterprises, and co-operatives that invest into larger projects that are obliged to enter auctions (for instance they have a large membership base from which they can draw funding) and smaller private investors such



as households, farmers and small co-operatives (that have a smaller membership base and tend to invest into smaller projects, often exempted from auction participation). Here, we focus on community energy projects when mentioning private investors.

We describe these market actors in relation to the timing of their involvement in projects in Figure 12.

Actor	Pipe. / Pre-dev	Prod. Dev.	Bid pre./ Pre-qua.	Finan.	Constr.	Ops.	Notes
Utilities and large energy companies	Yes	Yes	Yes	Yes	Yes	Yes	Major investor-owned national utilities that traditionally have invested in fossil fuel power generation with high risks and returns. This actor is present in all stages of the project.
Institutional investors	No	No	No	Yes	Yes	Yes	Pension funds, insurance companies and other long-term investors that favour limited risks and stable cash flow and, therefore, gets involved in the later stages of a project.
Banks	Maybe	Maybe	No	Yes	Yes	Yes	Commercial and multilateral banks typically with involvement in post-auction stages. However, some have shown interest in providing equity and revolving loans in early stages.
Developers	Yes	Yes	Yes	Maybe	Maybe	Maybe	depending on their strategy: (1) sell the project post-auction; (2) keeps the project on their balance sheet; (3) conduct both activities.
Private investors	Maybe	Maybe	Maybe	Yes	Maybe	Maybe	A broad group of investors consisting of corporates, large and smaller co-cooperatives and citizens, which are present in all project phases, depending on the specific investor type.

Figure 12: Market actors and their investment timeframe.

5 Potential effects from a project and market perspective

In this report, we set out to explore the effects of auction designs on financing conditions. As we progressed with the research, it became apparent that the effect of competitive bidding itself needs to be explored first. The introduction of auctions already has a distinct impact on the market, project planning and development, no matter which specific design elements are chosen. Therefore, we have mapped out different potential effects that auctions may have from a project and market perspective, before proceeding to dive into the individual auction design elements in the next chapter. These effects are mainly discussed from the aspect of financial theory, and empirical research of previous RE auctions. We complement this with findings from our semi-structured interviews and workshop with stakeholders. The results should be read as a first indication of possible effects or in more scientific terms, as hypotheses. We will within the AURES II project conduct additional quantitative research to turn these still rather hypothetical effects into actual findings and subsequently policy recommendations.

We have previously stressed that the effect of auctions on financing is multi-dimensional. It changes through time and impacts market actors in different ways. During the pre-development and development phase, it starts increasing and reaches its maximum during project construction, but reduces drastically once the plant is operational and generates positive cash flow. The switch from a support scheme with administratively set remuneration levels to a competitive bidding process changes the risk dynamics of RE development, as elaborated in this section.

5.1 Auctions could lead to a reduction of margins and hurdle rates

Recent research has found that in Germany between 2000 and 2017, debt margins have decreased for solar PV and onshore wind by 11% for every doubling of cumulative capacity. This has mainly been ascribed to the decrease in the general interest rate and learning rates of debt providers (Egli et al., 2018). During this period, the cumulative capacity of onshore wind in Germany increased from 6,097 MW to 55,777 MW while solar PV

grew from 114 MW to 42,339 MW (BMW, 2019). The introduction of auctions might have contributed to some of that decrease. Auctions might prompt debt providers such as commercial banks to compete harder for the best projects, and thus reduce their debt margins. This is assuming that they have yearly credit volume targets that they strive to achieve. According to an interview with a German financing professional, debt margins have since the introduction of the auctioning system in 2014 reduced from 1.1 – 1.3 % to 0.8 – 0.9 %. Note that this has only been mentioned by one interviewee from Germany so far, and we do not have similar information for other EU member states.

At the same time, several sources have pointed out that auctions might induce a reduction in hurdle rates. This indication is supported by empirical research, which has shown that companies apply high hurdle rates in industries with high growth expectations, and lower hurdle rates with more limited opportunities for growth (Meier & Tarhan, 2007). Auctions, through their stricter schedules and predefined budgets, may introduce growth restrictions in the industry, limiting the future deployment opportunities to a level below the industry's growth appetite. This restriction may then lead to a reduction of hurdle rate premiums.

The introduction of direct competition between projects may also be a driver for reductions in hurdle rates or cost of equity. This would also reflect the potential willingness of bidding companies to accept lower returns in order to win in an auction and secure their project pipeline.

It has to be noted that during our interviews, industry experts have acknowledged that auctions may have contributed to a decrease of hurdle rates, while they do not perceive growth restriction or competition as a substantial driver for that development. This is an interesting aspect for further investigation, as this discrepancy could be a matter of perspective (i.e. experts could experience this effect as an exogenous factor rather than induced by auctions) as well as a contradiction to previous empirical results.

5.2 Auctions may create new project risks that mainly influence cost of equity/hurdle rates

Auctions create new uncertainties, i.e. risks, at project level that could lead to increased financing costs:

Allocation risk: In auction schemes, project owners do not control the decision of going forward with a project. Instead, this has been transferred to the market, depending on the project's relative strength in comparison to its competitors. In competitive incentive-compatible schemes, only the projects with lowest LCOE will be awarded, while average projects might have to be abandoned. This weakens the projects developers' position in the development process, and magnifies the risk of sunk costs.

Qualification risk: project developers need to qualify to participate in an auction through fulfilling material or financial pre-qualification requirements (the latter often in form of bid bonds as guarantees so that penalties can be claimed). This is a risk especially in the early (pre-)development phase of a project, when major milestones have not been reached and qualification rules for future auction rounds still may be changed. These requirements pose a threat to projects that they will not (be able to) qualify, and this might lead to additional sunk costs. The qualification risk might also increase the project development costs and require developers to invest more equity upfront.

Non-compliance risk: With the introduction of auctions, often a contractual commitment is introduced to install and commission awarded projects within a certain time period. This is typically enforced through a penalty scheme. Project owners thus face the risk of having to pay penalties if they do not deliver the project, or deliver it too late. In case of partial non-compliance or delays, gradual penalties are usually applied (reduction in support level or support duration, retention of parts of the bid bond), while in case of full non-compliance (the project is not built) the contracts are revoked. In that case the project loses the right of being supported, and its owners must pay a penalty for not delivering the project (typically enforced through retaining the bid bond placed at bidding or contract signing). The design of deadlines and delivery schedules play a very important role. Through our interviews, we have learned that unrealistic deadlines might create an "on/off switch" effect. In case of too tight deadlines for project realisation, project owners might upfront decide not to participate in an auction, or simply decline to participate because of issues with planning or with securing project financing, which are created under such risky circumstances.

The first two risk types (allocation and qualification risks) affect projects in the pre-development and



development stage, through the use of bid bonds and other pre-qualification requirements. We expect their effect mostly to be on the equity side (e.g. cost of equity, hurdle rate), while cost of debt will probably remain mostly unaffected. Debt providers typically sign financing agreements for projects only after they have been awarded in an auction, so that risks that stem from auction participation itself have already been resolved.

The third risk type (non-compliance risk) refers to the period after a project has been awarded in the auction. Penalties materialise typically within (or at the end of) the period granted to comply with the contract and install the project (e.g. 24 months after the award). Full non-compliance (where the awarded project is abandoned) can occur due to a number of different reasons, including the winner’s curse, where the awarded bidder overestimates the value of the project (e.g. they have underestimated costs, or overestimated future revenues). Unfortunately, the bidders who overestimate their project’s value the most, are also the mostly likely to win an auction. We know from auction theory that the winner’s curse is a pronounced problem in auctions with a high common value element (that is, where all bidders are subject to the same cost and revenue structures, such as wind turbine and PV module prices, and power market prices). We further know that experienced bidders are better at avoiding winner’s curse (Kagel & Levin, 1986). Hence, risks related to non-compliance are evolving over time, alongside the experience that bidders gain.

The risks affect individual markets actors differently. We illustrate the risks according to actor types and project phases in Figure 13. As we described above, all market actors who develop a project, no matter how small or large, or well experienced they are, may be affected by allocation risk. They will also be affected by qualification risk, although we expect this to affect larger actors (such as utilities and energy companies) less, due to their larger capital availability. We expect the risks to be more pronounced for project developers with smaller balance sheets, for instance family owned project development businesses, energy cooperatives, citizen initiatives etc. All market actors will face non-compliance risk during the construction phase, and as the grace period for project realisation runs out, this risk might increase (depending on the project status). Banks and institutional investors will most likely be less affected by these risks, since they do not take part in bidding, as discussed above.

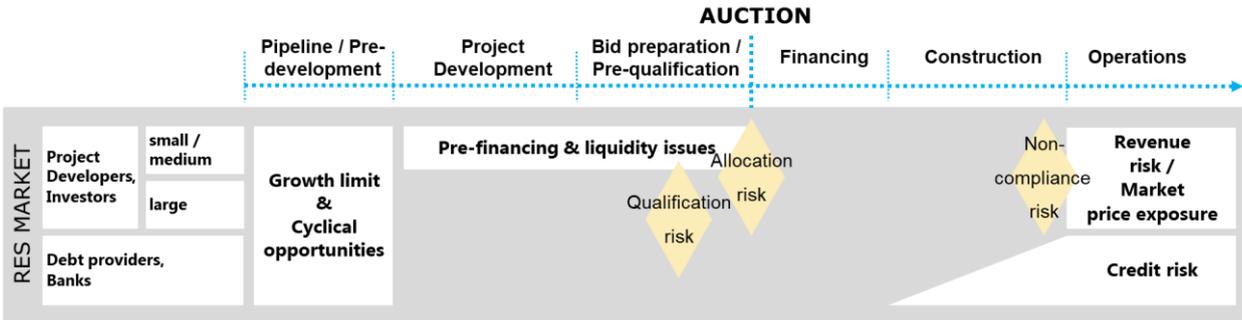


Figure 13: Auction induced risks during project lifetime

5.3 Auctions may affect financing types and capital structuring options

Capital structuring is a highly important and complex business decision, depending on a number of market and individual business factors. In Section 4.1, we have discussed how different actor types may decide between balance sheet financing and project financing. As the final capital structuring decision is typically made at financial close, after a project has been awarded in an auction, we do not expect the auction procedure and its design choices to play a significant role in the choice between using project vs. balance sheet financing.

However, remuneration designs that expose investors to market price volatility (and thus create revenue risks) might induce some tendency to using more balance sheet financing, simply because non-recourse project financing is not an option anymore. This is especially the case in countries where banks do not have experience with market-based remuneration systems, and where they would demand from project developers to employ their balance sheet to shield their loan (and the project) against any potential losses. We have learned that this might be the case in peripheral EU member states such as Croatia, whose financial industry does not have much experience with market-based support system. Despite being legally defined

as of end of 2018, Croatia has still not implemented in practice its sliding premium and auctioning system (Vlada Republike Hrvatske, 2018). In such circumstances (where the bank's assessment of project risks might deteriorate as a consequence of market-based designs and less predictable revenues), we suspect that the share of equity in the projects might then also need to increase. Some projects may be able to mitigate this effect by entering into long-term private power purchase agreements, but this is currently not seen on a large scale in Europe yet. It may also be questioned if enough offtaking counterparties with sufficient credit ratings can be found on a large scale in the future to compensate for that effect.

5.4 Auctions could make financing more difficult and expensive through changes in quality of revenues

We expect auctions in certain circumstances to lead to more difficult and expensive project financing. This could happen in case they lead to an increase of the share of unsecured revenues, and thus an increase in volatility of returns. Empirical research into previous auction implementations has shown that auctions tend to reduce support levels, taking away some of the revenue stabilisation, and hence market risk mitigation, provided through the schemes. The significance of this effect depends on the remuneration design, which we explore in this section. The design of support and remuneration payment structures have several other impacts on project financing conditions, which we discuss in Section 6.2. Moreover, the ability for projects to receive debt financing depends on multiple other features of auctions (in addition to remuneration design), including non-compliance risk and legal status (e.g. of permits), which we discuss in more detail in Sections 5.2 and 6.6.

In auctions, the remuneration from support is determined through a competitive bidding process, where project owners determine their required remuneration typically through a discounted cash flow analysis. We illustrate project revenues and related debt capacities in Figure 14, for the three major support types discussed in this report. A RE producer under a two-sided CfD scheme (type (a) in Figure 14) is entitled to a fixed price (or tariff) for each produced MWh. Producers will not benefit from market prices that are higher than the fixed price, as the additional value will be absorbed by the support system. Either the 'excess' revenues are transferred to a designated government agency, or they are settled against support payments in subsequent periods. In such systems, auction bids and thus strike prices tend to be relatively high as there are no options for RE producers to earn additional returns from market upsides. In one-sided CfD (sliding premium) schemes (type (b) in Figure 14), auction bids can be lower, because investors often can expect to earn additional market revenues at times of high market prices. In fixed premium schemes (type (c)), the bids only contain the support remuneration and are thus much lower than in the other two schemes.

From a financing perspective, the strike price can often be set equivalent to the level of secured revenues. This level is crucial for the determination of the maximum debt capacity from a bank perspective. The debt capacity is important not only for the question whether a project can be undertaken (i.e. if the sponsor has limited capital resources available and needs a certain debt financing level), but also for the question of how costly the financing becomes. As debt is typically less expensive than equity, an increase in debt capacity reduces overall cost of capital for a project.

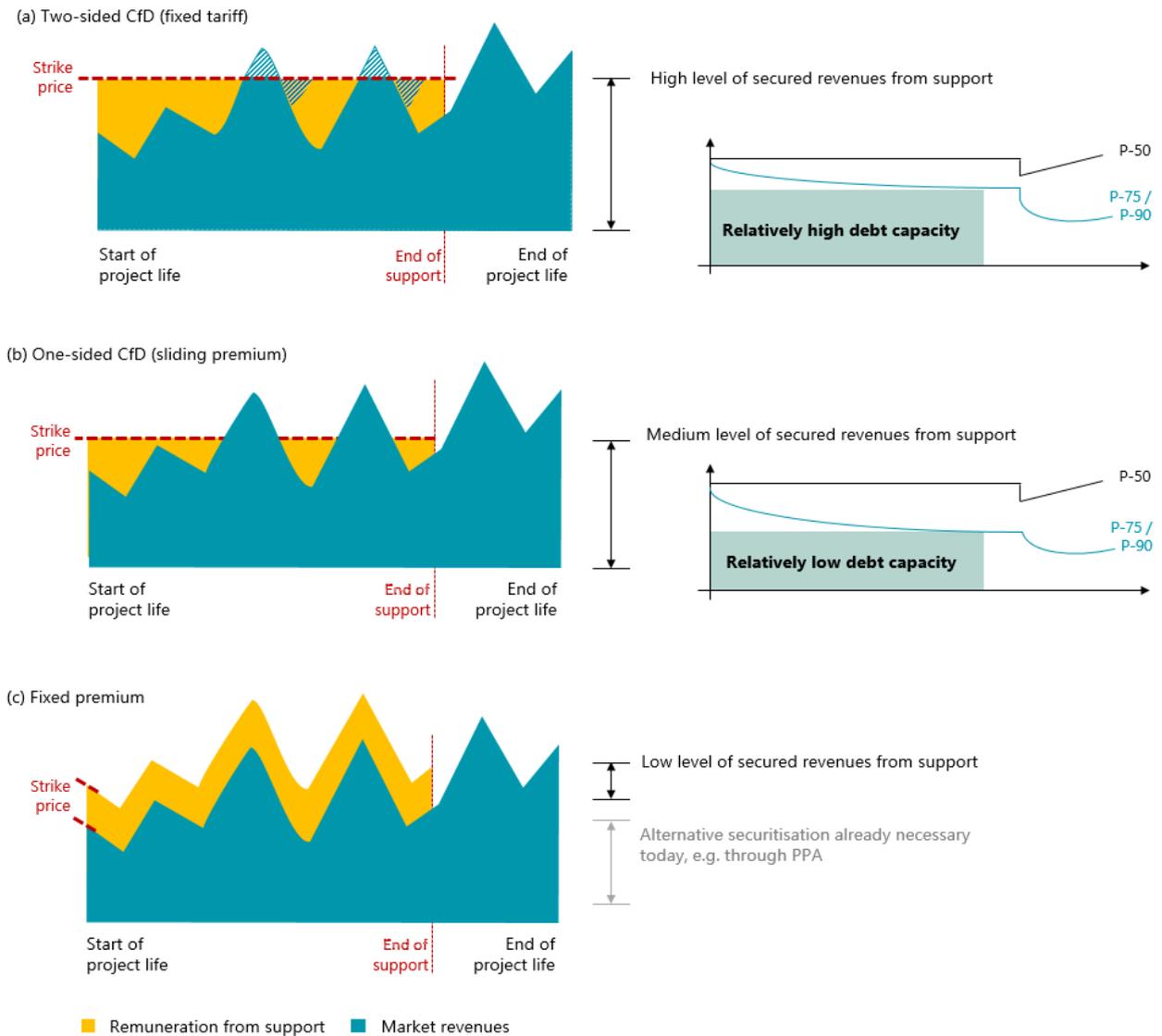


Figure 14: Strike prices, secured revenues and debt capacities under the three discussed support types

With decreasing support levels, projects might need to rely on market prices for a higher share of their revenues, exposing them to additional risks. Depending on the design of support payments (fixed vs. sliding premium), they are more exposed to market price volatility. The lower remuneration rates and larger shares of market price risk in the revenues might affect the debt provider's risk assessment of projects and lead them to increase cost of debt. Our interview with a banker who financed projects under different support regimes in Europe confirmed that a project with higher shares of unsecured revenues may also face a higher DSCR requirement. It will also affect the cost of equity because of the higher volatility of revenues (see Section 3.4).

Our conceptual consideration is supported by a recent analysis that has investigated the effect of a two-sided CfD on financing for onshore wind projects in the UK as compared to a situation where no revenue stabilisation is being provided. The two-sided CfD has been estimated to result in higher debt capacities, or gearing ratios (60 - 80 % as compared to 50 %), lower cost of debt (3.0 - 4.0 % instead of 3.8 - 4.3 %), and also lower cost of equity (7 - 9 % instead of 9 - 10 %) (Arup, 2018). Overall, the two-sided CfD could lower the WACC of an onshore wind project by between 140 and 320 basis points, which in turn lowers the levelised cost of energy of an onshore wind project by between 7 €/MWh and 14 €/MWh (Arup, 2018). Therefore, although two sided CfD systems may stimulate higher bids (as discussed above), meaning more support payments

per kWh, they may lead to overall lower LCOE of projects through less expensive financing.

The chosen time period for which the applicable reference price in CfD schemes is determined (and in some cases averaged), may also have an impact on financing. The averaging on a daily or monthly basis significantly reduces the ability of RE projects to capitalise on high market prices when under a one-sided CfD scheme, and will thus also impact the strike price and level of secured revenues. Also, if the determination of the reference price involves an averaging across multiple RE projects, individual projects may risk to perform 'worse' than the average and fail to fully receive their 'secured' revenues.

An additional aspect of remuneration design that could influence financing conditions is price indexation. Premiums with price indexation eliminate inflation risk, help maintain healthy project cash flows and may increase a project's debt capacity. Another increasingly important point is the interplay of support schemes with private power purchase agreements (PPA). Fixed premiums typically leave RE project owners much more exposed to the market, and thus also more vulnerable to private power off-takers, should they choose to market the power through a PPA. In markets with significant power price fluctuations, the off-taker may want to index the PPA price to market price fluctuations or renegotiate the agreed price for power in a PPA to optimise their cost of purchase. Retroactive changes of a fixed feed-in tariff (for example in Italy and Spain; see Gehle, 2014, and Solarserver, 2014) or imposing additional revenue tax (as it happened in 2010 in the Czech Republic, see RenewableEnergyFocus, 2010) may have a similar effect. In addition, auctions may accelerate the phase-out of support, which then increases the importance of private PPAs.

5.5 Auctions can change off-taker risks and level of contractual commitments

In addition to the risks related to cash flows and the quality of revenues discussed above, there is a number of off-taker risks related to RE projects. Off-taker risks are highly relevant particularly in emerging economies and non-liberalised markets. Auctions can significantly alter the off-taker risks. Relevant risks to consider in this context are:

Economic risks: (1) **Agreed electricity volumes and alternative outlets** – Through interviews undertaken for this study, we have learned that, for project financing, banks often not only require the secured prices (see effect above) but also require the secured off-take of power volumes by a contracted off-taker. Often, this includes a minimum required rating of the off-taker (e.g. 'investment grade'). Depending on the market and country, the required securing can be up to 100% of the expected production volumes, or well below. Depending on the contracted volumes and the contractual structure, RE projects may have to find another buyer, sell excess electricity via other routes (through an exchange), or have to curtail production. Alternative outlets and potential financial compensation mechanisms should be clearly defined in the off-take agreement, be it with private companies or public institutions. Some countries, e.g. the UK, offer an option of the "buyer of the last resort", a backstop power purchase agreement between the generator and a licensed supplier at less favourable than market conditions (ofgem, 2015). A similar solution is offered for Polish participants of the quota scheme. Such backstop PPAs ensure that RE producers will always find an outlet for power production. (2) **Financial market risks** – the most common financial market risks are related to the currency exchange fluctuations and inflation. These can be partly insured through currency indexation in support schemes or payments of the support in major international currencies (in which most of the debt will be serviced). E.g. Romania offers floor price for certificates, indexed in EUR (Eclareon, 2019).

Contractual and counterparty risks: (1) **Bankruptcy, unilateral cancellation of the agreement or cease of operations of the off-taker** – such a situation had taken place several times in Poland, where power prices experience substantial fluctuations and green certificates prices fell by 90% between 2014 and 2017. Wind power investors sued off-takers for unilateral breach of the PPA and won the case in the Supreme court, claiming in total 0.78 billion EUR compensation from two off-takers (GRAMWZIELONE, 2017; Onet, 2019). This risk is also particularly important in countries with vertically-integrated utilities where the state utility functions as the only off-taker but might be heavily indebted and therefore have a low credit rating. (2) **Credit rating:** For commercial off-takers, an investment grade credit rating needs to be secured. To achieve this a firm PPA, e.g. on a take-or-pay basis, needs to be signed to minimise the commercial off-taker risks. (3) **Delays in payment** – this may impact project cash flow; the UK energy satisfaction survey indicates that 19% micro



PV owners experienced delayed feed-in tariff payments from off-takers in 2019 (Ingrams, 2019).

Political risks, including insufficient stability of regulations or independence of courts, are often sought to be mitigated through provisions on rights and dispute settlement mechanisms in offtake agreements.

We expect auctions to push the development into a direction in which the risks described above become more pronounced and appear earlier than under more protective support schemes (such as feed-in tariffs). It may thus be part of prudent auction design to address these issues on policy level. There is a number of regulatory measures to minimise the described offtaker risks for RE projects. These can e.g. be, buyers of last resort or guarantee funds. In all cases, stability and transparency of the legal system as well as independence of courts, potential arbitration & dispute settlement mechanisms are key for minimising offtaker risks. Risk hedging instruments or even state guarantee funds may be needed to minimise offtaker risks (Fletcher & Pendleton, 2014). These could be instruments targeting to cover termination risks or instruments covering liquidity issues. Alternatives are a national bank guarantee or fund, a corporate guarantee fund, or relying on legislative support: for example, payments to independent power producers are secured by a law governing funding allocation in the electricity sector of Cote d'Ivoire. Some countries' auction programs, e.g. in Argentina, offer their own guarantees against offtaker risk (ClimateScope, 2018).

5.6 Auctions may restrict project development optimisation and increase project cost

The auction process may create additional costs for project developers, including the additional resources needed to prepare a bid (for example, respond to the specified Terms of Reference). Hence, the upfront costs that a project owner incurs during project development might be higher than in support systems without auctions. This larger upfront financial commitment could increase the project owner's risk exposure.

In addition, auction schemes impose time and size restrictions on project owners. For instance, developers have to adjust their investment decisions according to the auction frequency, auction volumes, bid size limits, expected market competition etc. Hence, they operate in a more restrictive environment that may limit their choice of optimal projects or the optimisation of them. Therefore, the projects they develop might be less cost-effective and might have larger costs of capital.

5.7 Auctions might change the actor composition in a market

Auctions might change the actor composition of a market and, in specific, favour larger market players with greater balance sheets and capital availability, while disregarding smaller actors of smaller size and less ability to diversify risks. Research into this question is still limited. For the case of Germany, it was found that auctions might be having a negative effect on community energy projects (Grashof, 2019). A similar case has been made for community energy projects in Latin America and the Caribbean (Lucas, Leidreiter, & Cabré, 2017). We describe some potential effects for all individual actor groups below.

Utilities and large energy companies: through our interviews, we have learned that financing conditions of large actors are not (noticeably) affected by individual auction designs during the development, bidding and construction stage (bid bonds, pre-qualification requirements and penalties). The additional costs and cash flow impacts that these design elements create are accounted for in the companies' budget planning and are relatively small in comparison to their overall balance sheet. For such larger project developers and investors, the effect of auctions lies mostly in the design choices for elements that have a direct impact on the level and quality of project revenues. The most important aspects here are risks related to 1) timely provision of grid connection; 2) permitting processes; and 3) level of exposure to market price risks. All of these aspects could affect financing conditions (DSCR requirements, loan tenor, cost of equity and debt).

From the perspective of competitiveness, larger market players have a competitive advantage over smaller actors because of their larger capital availability and greater capacity to absorb potential sunk costs. Their cash flows will suffer less if they incur penalties due to non-realisation or if they have to meet relatively costly pre-qualifications, such as having a building permit. The ability to absorb these costs might enable them to invest strategically, for instance with the aim of increasing their market share. The additional competitive

pressure of auctions might incentivise them to bid with projects where they demand smaller hurdle rates i.e. they might reduce their equity return requirements.

Institutional investors: this investor group typically gets involved in projects after the project has been awarded support rights in an auction. Hence, institutional investors will most likely not be impacted by auction designs that affect projects in the development stage. However, they may be affected by remuneration designs to the extent by which these expose projects to market price volatility – where higher risk exposure could increase their equity return requirements. As we graphically present in Figure 14, fixed feed in premium schemes expose investors to most risk, while two-sided CfD systems expose them to least.

Banks: since banks mostly get involved with projects only after the bidding stage, they are not affected by auction designs relating to auction procedures (type, pricing rule, selection criteria etc.). In contrast, they might very well be impacted by the remuneration design. Support schemes that provide less secured revenues and expose project owners to more market risks may change the credit rating and thus charged interest rates and debt capacity of RE projects and project owners. This may have an impact on the composition of project owners as some of them will find it harder to obtain financing under these conditions. Also, the banks themselves might be affected, as e.g. banks with greater flexibility in loan requirements may gain higher market shares. In some circumstances, banks may also be involved in financing project development – such as in case of multilateral development banks through development equity. Here, auctions may have a direct impact on bank business through their inducing of additional risks.

Developers: auctions introduce a number of risks related to the ability to realise projects (see Section 5.2). The inability to diversify the risk of sunk costs, e.g. by developing a larger portfolio or projects, might inhibit the competitive position of smaller developers in a market with auctions. Smaller developers might not be able to afford a strategy that potentially yields large sunk costs – for instance if only one out of five projects that were placed in an auction gets awarded, while the others are not. This might lead to a consolidation of developers, i.e. the merging of smaller developers or their acquisition by larger ones.

Private investors: as discussed in Section 4.3, within the private investor group, we focus mainly on community energy initiatives that invest into project that are above the thresholds required to undergo an auctioning process. Community energy initiatives are mostly composed of individual citizens who buy shares in individual RE projects and/or in the cooperative itself. Such actors have been the traditional base of the German energy transition, but have also been important in countries such as Denmark, UK, Spain, Belgium, Netherlands, Sweden and Austria. Recent research shows that such investors are in one part willing to forge higher returns in order to help support the local energy transition, and in some extent to provide resistance against larger investors (Salm, Hille, & Wüstenhagen, 2016). Citizens tend to seek returns that are higher than what they receive from bank deposits, or from investing into other consumable good such as a private vehicle. These tend to be substantially lower than the returns required by business shareholders. We do not have an inventory of equity returns on such ‘private’ investments, but as an example one could take a typical energy cooperative in Germany that offer returns on onshore wind and solar PV investments of 4-5% (Bürgerenergie Pfaffenhofen, 2019). A study for the German government has indicated that such investors might be ‘scared off’ from participating in an auction due to the pre-qualification requirements and inability to manage the additional risk of sunk cost associated with losing in an auction (Tiedemann, Wigand, & Klessmann, 2015).

5.8 Auctions may favour incumbents through better financing options, and make market entry harder

In auction schemes, the success of a project depends largely on the developer’s capability to correctly forecast, design and manage the project. Therefore, the chances of success are higher for companies with more experience and expertise. Such companies will due to their larger size and accumulated knowledge be more capable of developing projects with lower LCOE than new market entrants who are at the start of their learning curve. More established and larger companies will also benefit from the so-called size premium (Pratt & Grabowski, 2014). The financial literature defines this as an effect where larger players achieve lower costs of capital simply due to their bigger size and larger resource availability. In the context of auctioning, more established project developers that have a greater project pipelines might be able to achieve greater



economies of scale, negotiate down component prices and place lower bids. They will also have cheaper access to capital, for instance through issuing bonds, and will be less subject to bank due diligence processes. Similar effects have been observed in auctioning systems of Brazil and Mexico (Hochberg & Poudineh, 2018).

5.9 Auctions could affect the stability of support schemes and related political risks, both positively and negatively

Auctions often significantly alter the way politics are made around RE deployment. Auctions in Europe are typically introduced with a political (side-)goal of achieving some control over future RE build-out volumes. Deployment targets, previously often acting as an informative beacon to navigate towards, become now enforced in concrete auction volumes. This can have a positive impact in some market environments, especially where the previous support scheme was unstable or where retroactive changes occurred. For example, a rapid pace of RE deployment, together with an inflexible feed-in tariff scheme that failed to adjust to declines in technology costs, created pressure on public finances of countries such as Spain, Bulgaria, Romania, Czech Republic, Greece and Croatia. Some of these, like Spain, resorted to retroactive adjustment measures that caused financial damage to investors, and deteriorated the risk perception of their support scheme. Here, auctions that feature fixed auction volumes with long-term schedules, and contractual commitments between auction winners and a governmental institution, can have a stabilising effect on the market. We have indeed learned from debt providers we have spoken to in our interviews, that auctions can decrease such political risk perception in high risk markets.

We have previously made the point that auctions reduce support costs. During the feed-in tariff era, many EU Member States experienced problems with financing the accelerating RE expansion. Countries like Germany, Greece and Croatia experienced rapid increases in the RE levy, causing the overall consumer electricity prices to increase, igniting public debates on consumer burden and decreasing the appeal of RE. The case of Greece shows that auctions managed to place public support costs under control. Especially if auctions feature ambitious price caps (maximum allowed bids close to current average LCOE), they can guarantee for a more financially sustainable support system that may be less likely to be discontinued or cut down in times of budgetary constraints.

On the other hand, political decisions on auction volumes could also have a de-stabilising effect in some market environments. If long-term commitments are lacking, RE deployment may become subject to political bargaining. Auction volumes can risk to be determined during budgetary negotiations in political trade-offs. A lack of predictability in auction volumes could create instability in the market, uncertainty in growth expectations, as well as boom and bust cycles of RE investments. This makes development more expensive than in a system with well planned auction rounds. For example, in Denmark, there was a long period (between 2016 and 2018) of uncertainty about future offshore wind auctions, leading to the stalling of the domestic offshore sector². All of these factors add to a higher risk perception by investors and lenders, most likely with impacts on financing costs.

Longer idle periods without auctions may also lead to lay-offs and decrease of workforce in the sector, which then needs to be ramped up again when auctions continue. This could contribute to bottleneck situations in periods of high activity and may even affect the whole supply chain as all project developers may start to order wind turbines from equipment manufacturers and commence financing negotiations with banks and institutional investors at the same time.

The political process of auction volume setting also has a direct influence on the auction outcome. If ambitious deployment targets lead to large auction volumes regardless of if there is sufficient supply of

² The last offshore auction (Kriegers Flak) was finalised in late 2016. Only in 2018, a political agreement has paved the way for a long-term schedule of offshore wind auctions lined up until 2030.

projects that can bid and compete in the auctions or not, the resulting support levels might be affected and increase rather than decrease over some auction rounds. This is partly due to the fact that the larger volumes can accommodate higher cost projects, and partly due to strategic bidding considerations by the participating projects, which do not experience the same competitive pressure as under tighter volumes. For example, a period of undersubscription has recently been experienced in German onshore wind auctions. This may have led project developers to retain their projects from the auctions in anticipation of future price increases, or simply to raising their hurdle rates by a factor that reflects the anticipated support level increases.

6 Potential effects from the perspective of individual auction designs

In this section, we endeavour to relate the potential effects (hypotheses) that we have described in the previous sections to the individual auction designs. Until now, there has not been any research dedicated specifically to the effects of individual auction designs on financing conditions and costs of capital. Hence, it is not possible to report on the significance of effects of different design elements. We can here only provide guidance as per the potential effect that an individual design might cause. For this, we draw on theoretical as well as conceptual considerations, literature on adjunct topics and industry knowledge that we gathered through interviews and the stakeholder workshop.

For a full description and elaboration of relevant design elements for RE auctions, please refer to Del Río et al. (2015) or Ferroukhi, Hawila, Vinci, & Nagpal (2015). For our study, we use the following overall categorisation:

- 1) General auction designs (auction scope, format, auctioned item, auction volumes, bid size limits)
- 2) Support design (remuneration type, support duration, contractual setup, guarantees)
- 3) Auction procedures (auction type, pricing rule, selection criteria, schedule, price caps and floors)
- 4) Conditions for participation (timelines, pre-qualifications, bid bonds)
- 5) Deadlines and penalties (grace periods, delays, non-compliance)
- 6) Other designs (site development, grid connection)

In the following sections, we analyse the design elements we have found most important in regards to their potential effect on financing conditions.

6.1 General auction designs

Auction volumes and frequency: auctions that provide a clear and long roll out schedule, for instance through inscription in law, and that ensure sufficient frequency for the developers to maintain and realise a constant project pipeline, are likely to increase capital availability, lead to lower hurdle rates and reduce cost of debt. Debt providers finance medium- to large-sized project developers with revolving loans, who use these for project development work, and oftentimes utilise them as a source of capital for placing bid bonds. Without a clear market outlook, commercial banks will be less willing to provide such loans, or would provide them at higher interest rates.

Bid size limits: minimum and maximum bid sizes restrict the project owner's ability to optimise their projects, which may impact its costs and therewith financing conditions, as described in Section 5.6.

Besides this, we do not expect that other general auction designs, including the auction scope (single vs. multiple-item) and the auctioned item (i.e. the question of whether to auction MW or MWh), have a measurable effect on financing conditions.

6.2 Support design

Empirical research into previous auction implementations has shown that auctions tend to reduce support levels and lead to more efficient support allocation (Wigand, Förster, Amazo, & Tiedemann, 2016). While this is positive from a public policy standpoint (RE targets can be achieved at lower costs), it affects projects from a financial perspective. Support schemes typically provide some kind of revenue stabilisation as compared to a fully merchant market revenue, and so increase the 'quality of revenues' for financing. This market risk mitigation allows investors to access more debt (achieve higher debt to equity ratios, or gearing), longer debt tenor (loan maturity) and lower interest rates (cost of debt), as was elaborated in Section 5.4. Whenever auctions lead to a decrease in support level, part of the state-secured, stable revenues are 'lost'. Projects become more exposed to market prices. The exposure to price volatility on electricity markets can put significant pressure on a project's ability to meet its obligations, leading to several different consequences (Arup, 2018):

1. Project financing becomes significantly more difficult and expensive with more volatile revenue structures, as debt service obligations are more difficult to satisfy at all times (see Section 5.4).
2. Balance-sheet investors have internal hurdle rates to satisfy. They seek price stability to protect shareholder value, and will be affected by higher volatility of returns, responding with higher risk premiums (see Section 5.2).
3. Risk-averse external equity investors with low cost of capital (hurdle rates), such as institutional investors, may be deterred from financing any significant capital outlay (see Section 5.7).
4. Exposure to price volatility reduces the pool of potential investors, thereby decreasing the pool of potential bidders in an auction (see Section 5.8).

As we have elaborated in Section 5.4, the impact of support design on financing depends significantly on the remuneration type chosen. Note that this effect is not exclusively related to auctions, but to support design in general. As we have argued, some remuneration designs offer a high degree of secured revenues, such as two-sided CfD schemes. One-sided CfDs (or sliding premium schemes) tend to offer somewhat lower protection due to the typically lower strike prices as compared to two-sided CfDs. Fixed premiums typically offer a very low degree of quality of revenues for financing in comparison, making it often already now necessary to secure revenues through alternative routes, such as PPAs. Projects with lower quality revenues (that is lower share of revenues secured by government), are likely to have higher cost of debt and higher DSCR requirements, and hence lower debt capacity, than projects with fully regulated revenue streams. However, companies that finance their projects based on their balance sheets obtain their debt financing on company level, meaning that they can cover the risks of an individual project with their other cash flows, and are not subject to such project financing requirements. In addition to effects on cost of debt, projects with a lower quality or revenues from secured support payments might also see higher hurdle rates and costs of equity through their higher volatility of revenues.

A higher share and level of regulated income creates projects with higher debt capacity. As debt is cheaper than equity, this could reduce the project's overall cost of capital. Policymakers should be aware that in CfD schemes, despite an often seemingly higher support level per MWh (through the higher strike price as auction result), overall support cost are not necessarily larger than in other designs. On the contrary, schemes with a higher regulated income can reduce the project LCOE due to lower costs of capital, potentially leading to an overall support cost benefit. In conclusion, a remuneration design that shall contribute to minimise cost of capital must maximise the secured part of the revenues for a project to the extent possible.

6.3 Auction procedures

Bidding procedure: the choice of auction type (e.g. dynamic or static auction) has an influence on the information that is revealed during the bidding process and may lead to different strategic behaviour for different bidder groups. In this, the different auction types may influence the bidding strategies of auction participants and hence affect auction outcomes. This may then change the realised rate of return of a project, but not necessarily the required rate of return (hurdle rate) or the cost of capital itself. Over a longer period with repeated auctions, dynamic procedures could reveal more information about competitors' cost of capital (as others see them dropping out at certain price levels with certain projects), which could then in turn

lead to adjustments of hurdle rates across the participants, potentially leading to some convergence. This hypothesis in particular has not been tested yet and is subject to further investigation. In addition, complex bidding procedures could require smaller and less experienced developers to acquire additional skills or seek outside assistance, meaning that their overall project development costs would be higher. As in the case with more stringent pre-qualification requirements, a higher equity investment would imply that the project would have higher costs of capital (since equity is generally more expensive than debt).

Pricing rule: different pricing rules (e.g. either pay-as-bid or uniform pricing) have a profound impact on the cash flows of individual projects. In pay-as-bid auctions, all awarded projects are paid exactly what they have bid for. This makes them vulnerable to their own capability of project evaluation (investment appraisal) as well as external uncertainty factors. We have learned in our empirical work as well as in our interviews that pay-as-bid auctions can lead to the adding of a risk premium in the bids (e.g. through an increase of the hurdle rate), to account for that potential loss. Auction theory supports that, having found that in auctions with high common value elements (as RE auctions are due to the dependence of project profits on both power markets and equipment prices), experienced bidders are better at avoiding the winner's curse problem (Kagel & Levin, 1986). Under uniform pricing rule, the issue is different entirely – here, most awarded projects will receive more support than they have asked for (namely the highest awarded bid or lowest rejected bid). Due to this option on higher returns, we expect that project owners may be inclined to accept lower hurdle rates in the pre-development phases when preparing to enter the auction.

Price caps and floors: price caps (i.e. ceiling prices, maximum allowed bids) sometimes act as an orientation point in situations with uncertain price structures. Also this may influence bidding behaviour and hence realised returns rather than cost of capital itself. Price floors (minimum allowed bids) can act as risk mitigation in the project development phase, as they ensure a certain minimum project value given by the lowest allowed bids. It is at this moment unclear to us in how far this may translate into lower hurdle rates or cost of equity.

Volume reduction rules: in some rare cases, auction rules include an (automatic) volume reduction that comes into effect whenever the bids placed in an auction are collectively less than the auctioned volume (the auction is undersubscribed), for instance if the auctioneer offers 500 MW but only receives 350 MW of bids. In this case, the rule leads to a reduction in comparison to the originally auctioned volume (for instance by awarding only 80% of the received bid volume) or by reducing the price cap below its original level (so that bids above the new level are not awarded). Automatic volume reduction rules have been suggested as a remedy for the recent undersubscription of the German onshore wind energy auctions (Hill, 2019), and have been implemented before, for instance (somewhat more informally) in France, in response to an undersubscribed onshore wind energy auction. There, the auctioning authority implemented the design by reducing the ceiling price, resulting in the exclusion of projects that have placed the highest bids (AURES II Policy Brief, forthcoming). Through our interviews, we have learned that commercial debt providers view volume reductions as negative because they increase uncertainty and decrease confidence in the political commitment to RE deployment.

6.4 Conditions for participation

Pre-qualification requirements: pre-qualification requirements come in different forms and they have been described in detail within the AURES I project (Soysal & Kurgpold, 2016). They will mainly affect project owner's cost of equity. Early auctions that do not require permits, will create lower participation hurdles, but might reduce realisation rates, as awarded projects without permits might run into realisation problems, for instance because of lawsuits. More stringent requirements and late auctions might reduce the number of participants in an auction, but they will also create a pool of projects from larger and more financially able project developers, potentially able to realise projects at lower cost of capital.

Bid bonds: bidders must often provide bid bonds during the auctioning process, to prove their financial capacity, and to increase seriousness of the bids. Bid bonds also serve as security to the auctioneer to enforce penalties. In case of non-realisation, the bid bond can be withheld (retained) by the auctioning authority (Kitzing et al., 2016). Besides placing the bid bonds from their own equity, project owners are often allowed to place a bank guarantee (i.e. letter of credit / guarantee). In such cases, banks could ask for a cash collateral. From our interviews, we learned that in Germany this equals to between 20 to 40% of the guarantee.



Project owners that seek to sell the project after having won in an auction, may be inclined to place bid bonds rather than a guarantee because this could make the sales easier. We have learned that such financial pre-qualification requirements create additional financial stress for smaller project developers, in the worst case inhibiting them from participating in an auction. The effect of this will depend on the size of the bidders' balance sheet, relative to the bid bond amount. Larger project developers and investors will find it easier to submit bid bonds due to larger capital availability and better access to it. For instance, they might have more assets, enabling them to obtain a bank guarantee with more ease, or they simply have larger cash reserves.

In Figure 15, we demonstrate the effect of bid bonds for the balance sheets of three market actors of different sizes. We have chosen three specific market actors, among which one is a large utility that invests across Europe, while the other two represent project developers of medium and small size. We researched their financial statements and compared the amount of equity that each would have to 'lock down' in order to participate in a bid for a generalised 20 MW onshore wind project, and a 2 MW solar PV installation. We assume the bid bond levels demanded by several EU countries in 2016, based on the research conducted during AURES I. We find that for the same design, a small market actor would need to lock down up to 40% of their equity (in case of Italy), whereas the impact for a large developer seems negligible.

Country	Technology focus	Bid Bond sizes		Actor size					
				Large		Medium		Small	
		1. BB	2. BB	1. BB	2. BB	1. BB	2. BB	1. BB	2. BB
Solar PV 2 MW									
Germany	Solar PV	4 €/kW	50 €/kW	0,0%	0,0%	0,0%	0,0%	2,6%	3,2%
Italy	Multi	5% of CAPEX	10% of CAPEX	0,0%	0,0%	0,1%	0,1%	19,8%	39,7%
Onshore wind 20 MW									
Portugal	Wind and biomass	10 €/kW	25 €/kW	0,0%	0,0%	0,2%	0,5%	1,8%	4,5%
Spain	Onshore wind and biomass		20 €/kW		0,0%		0,4%		3,6%
Italy	Multi	5% of CAPEX	10% of CAPEX	0,0%	0,0%	0,9%	1,9%	9,1%	18,1%

Figure 15: Effect of bid bonds on balance sheets of three market actors

6.5 Deadlines and penalties

Penalties and realisation periods: penalties that are designed to take effect gradually (a gradual retention of the bid bonds, or decrease in support levels and duration) and which are combined with a realistic project realisation period are likely to have a neutral effect on financing conditions. However, penalties that are imposed in one single step, and which are combined with unrealistic realisation periods, could have negative impacts on risks and financing conditions. Project developers sign financing agreements before construction, and so any potential and significant future damage to the project's cash flow could increase cost of capital. Besides the actual design of the penalty, this will also depend on the project developer's history of project realisation. We describe non-compliance risk in detail in Section 5.2.

6.6 Other designs

Grid connection: clear grid connection rules play a critical role in timely project realisation, and they could have a significant impact on cost of capital. In auction designs where the grid connection is included as part of the bid, the project developer is responsible for its development. This is favourable for those developers

that can afford to take on this extra capital expenditure, because the direct control could entail a higher likelihood that the connection will be ready at the same time as the project (Guillet, 2017). This might have a positive effect on cost of equity and cost of debt of financially capable market players. However, it might have a negative impact on smaller market actors, who, due to their smaller balance sheets might be required to raise additional capital or take on more debt at less favourable conditions. An alternative to this would be that a Transmission System Operator (TSO) develops the grid. The benefit of this in regard to overall financing costs will depend on the cost of capital of the TSO. If it is lower than that of a project owner, the effect could be positive from a societal perspective.

Site development: in some auctions, authorities pre-develop the sites, meaning that they conduct measurements, clear up land rights etc. This can be beneficial in markets where site development has traditionally slowed down project realisation, for instance in Croatia where land parcels are split into smaller sizes and where land ownership is hard to transfer. Pre-developed sites could reduce the risk of sunk costs from project failure (due to regulatory issues, e.g. connected to land ownership). From a societal perspective, this could be beneficial if the government agency developing the sites has lower cost of capital than project owners. In addition, other factors such as efficiency, incentive to cost-effective development, as well as skills and expertise of the agency as compared to that an experienced project developer play a role. Due to the complexity and highly specific nature of the issue, we cannot make a general assessment as of the nature of the effect without further analysis.

Guarantees and securitisation: policy makers may choose to provide governmental guarantees and securitisation products to RE projects. These offers are generally independent of auctions – or are at least not a dedicated design feature of them. However, guarantees and securitisation could become an important factor in mitigating some of the risks and their effects discussed in this report and thus become an important part of RE policy in the future.

7 Exogenous drivers for financing cost of renewable energy projects in Europe

For a better understanding of the significance of the endogenous drivers for financing cost of RE projects, which we have discussed in detail in the previous sections, we now explore some exogenous drivers.

First, we have a brief look at the monetary policy of the European Central Bank (ECB). The ECB has several instruments to control the supply of money. At the beginning of the financial crisis in 2008, the ECB primarily aimed at providing liquidity to banks and keeping the capital market functioning because banks no longer relied on borrowing from each other. Later, they addressed markets' malfunctioning and credit constraints by offering short- and long-term (re)financing options at low price. Thus, the ECB have significantly reduced their rates for deposits, lending and refinancing options and reached even negative rates for the deposit facility in 2014 (see Figure 16)³. These monetary policies have significantly affected the trend or development of cost of debts in the Euro-area (see Figure 17), i.e. even in countries with low growth rates and less reliable policies, interest rates decreased, although at different levels. Nevertheless, the costs of borrowing of selected countries reveal a larger volatility than the ECB rates and local peaks of countries' rates differ from the EU average. This indicates that the ECB's monetary policy is not the only factor affecting cost of debt.

³ The rate on the deposit facility and the rate on the marginal lending facility define a corridor for the overnight interest rate at which banks lend to each other. The deposit facility rate acts as the floor of this corridor and the marginal lending facility acts as the ceiling.

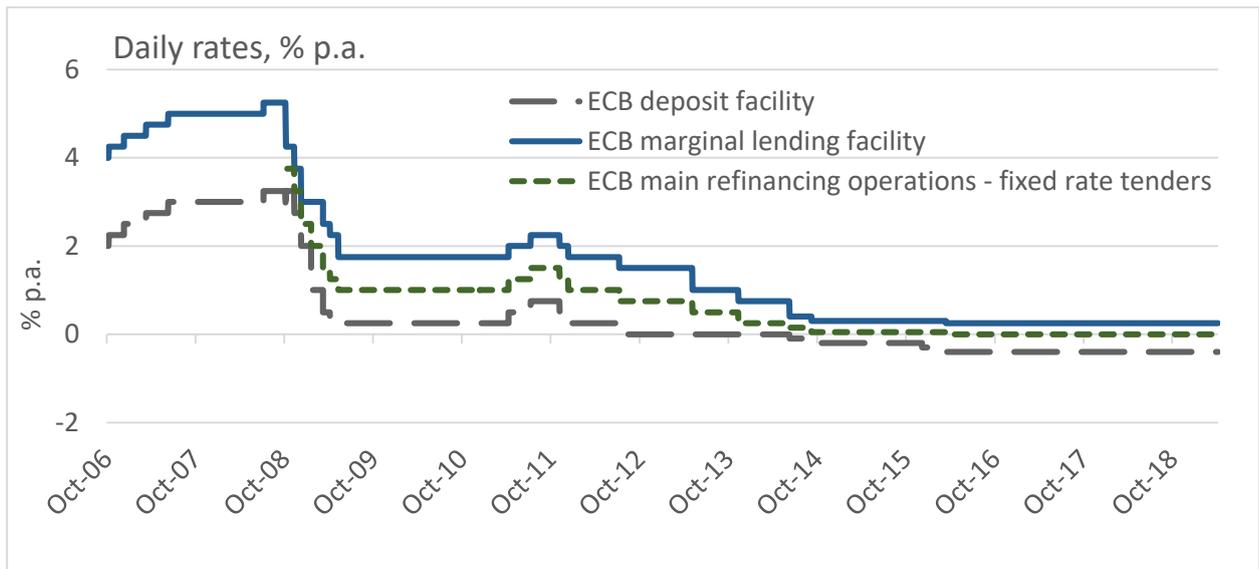


Figure 16: Daily rates for ECB deposit, lending facilities and refinancing operations. Source: ECB (2019)

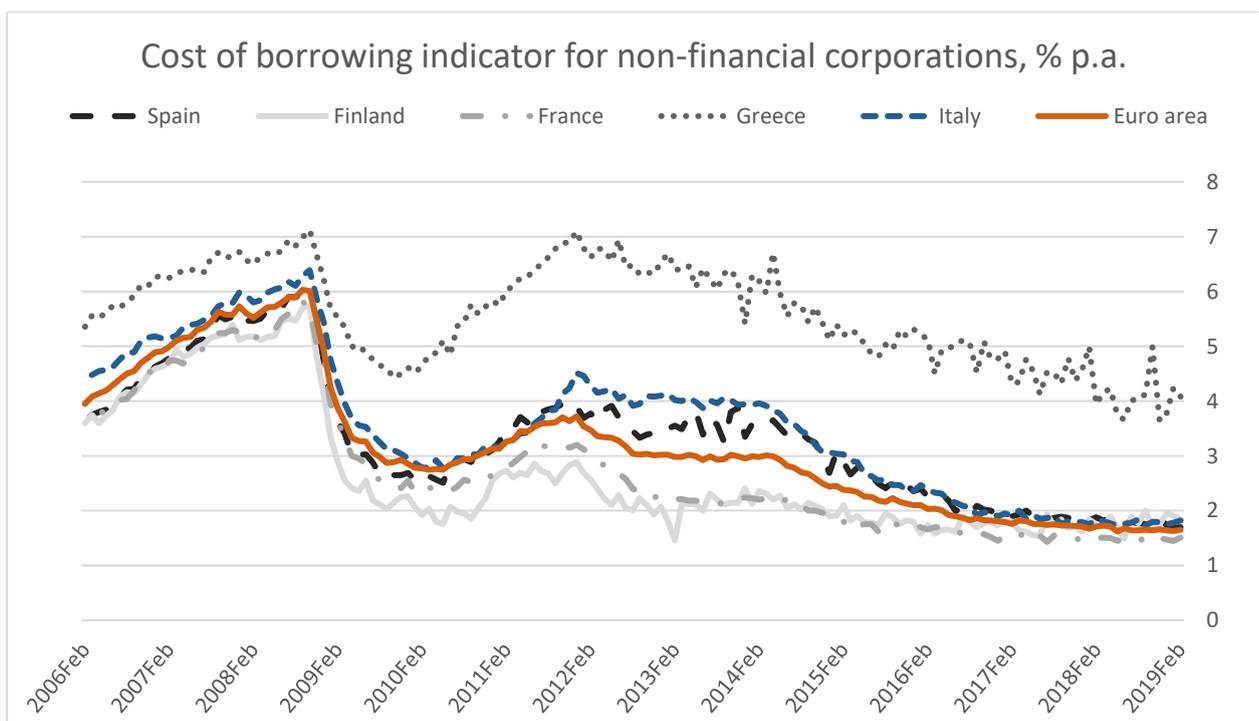


Figure 17: Cost of borrowing indicator for non-financial corporation. Source: ECB (2019)

The comparison of treasury, government bonds or credit default swaps (CDS) reveals a large difference between countries. They include different types of risks, reflecting economic, financial, legal, political or societal dimensions. For example, sovereign risk refers to a state that could default on its obligations and applies for treasury or government bonds, deviations of national rates from risk-free rates include further risk aspects, which are often summarised in the term country risk.

Analogous to policy risks, a clear definition of country risks does not exist. Rather, several different concepts are applied to estimate this risk. These concepts are based on several factors including for example

economic structures, government stability, legal environment, levels of corruption and socio-economic factors (Justice, 2009; Pap & Homolya, 2017). Similarly, Damodaran (2016) attribute risk variations between countries to different economic growth life cycles, political stability, corruption and violence, structure and efficiency of the legal system, and economic structures. A combination of these factors provide a composite country risk score encompassing qualitative and quantitative data on several categories or dimensions - political, economic, operational, security risks. The score is moderately correlated with CDS spreads according to Pap & Homolya (2017). Sovereign risk has a long history of measurements and is considered as the most direct measure of country risks when lending to governments while for business the level of country risks that cannot be eliminated by diversifying remains an issue (Damodaran, 2016). While there exist several mitigation instruments (investment, trade and export insurance) tackling especially political risks (Pap & Homolya, 2017), economic, legal and socio-economic risk factors are not yet really addressed.

Besides the country risk and monetary policy issue, there are other drivers of cost of capital such as the market structure or competition in the capital market, the structures and competition in the energy market, and a growing as well as diverging experience of diverse actors (project manager, operators, developers, bankers, etc.) in the RE industry between countries with high and low shares of RE. We call this growing experience 'learning effects' (see Figure 2). A proxy for the learning index could be the deployment status indicator⁴ of RE (see Boie et al., 2016). The capital market situation is triggered by the economic business cycle (growth) as well as by the market structure, such as size and number of actors and regulations (Breitschopf & Pudlik, 2013). For example, in Finland the population per credit institution is by the factor 10 lower than in Spain while the market concentration (share of top five largest credit institutes in total assets) is higher in Finland and Spain than in Italy (European Central Bank, 2015). Growing (policy-based) RE deployment increases the deployment status indicator and leads to learning effects in all phases of projects. In case RE deployment is policy driven, policies exert an indirect influence on learning effects as well.

In the context of RE project financing, the country risks influence the counterparty risk and RE policy risk, because uncertainties in legal and economic issues affect the counterparty's creditworthiness and weakens the reliability, stability and credibility of policies. Therefore, exogenous drivers have a direct impact on the cost of capital through the current capital market situation and learning effects and an indirect impact through country risks that are passed on to the counterparty and policy risk, both increasing uncertainty of revenues.

Several institutions and private companies have set up country risk ratings, for example the EU Euler Hermes (2019) or the World Bank (2018). We apply some indicators of the WGI data set (Kaufmann, Kraay, & Mastruzzi, 2010) as they classify the country risks into several categories and provide public access. The categories of their indicators cover aspects such as commitment, credibility, reliability and efficiency. The selected data of the WGI reflect the extent to which agents have confidence in and abide by societal rules such as quality of contract enforcement, property rights, the police and courts. Thus, it shows the effectiveness and credibility of the government. The values are depicted in Figure 18 for selected countries in the year 2016. Figure 18 reveals low values for Greece and high values for Finland and Denmark, the latter reflecting a high credibility and effectiveness. Based on the assumption that economic growth also has an impact on the cost of capital, we include this indicator as well (Figure 18, GDP). We see a rather similar pattern for growth rates of Gross Domestic Product (GDP), and the effectiveness and credibility values. They reflect elements of the country risk, and thus, should have a similar pattern as cost of capital⁵. To compare the development of those country risk elements and cost of capital, we use data on cost of debt, as we hardly have data on returns on equity. The cost of debt for governments is depicted by the bond yields (Figure 18) and for private investors by cost of debt for wind power (Eclareon, 2016).

⁴ Deployment Status Indicator compiles information reflecting how advanced the renewables market in each EU country is for a certain technology. It is the sum of three sub-indicators: RE production as share of electricity consumption, RE production as share of 2030-RE-potential, and installed capacity.

⁵ GDP stands for the economic performance and reflects to some degree economic strength and a potential element of country risks. Effectiveness and credibility reflects perceptions of the extent to which agents have confidence in and abide by the rules of society, the quality of contract enforcement, property rights, the police, and the courts. Thus, it reflects elements of country risks as well. To which degree these elements determine the country risk level is country specific.

If the combination of economic growth and credible and effective politics (thought to reflect country risks) had a strong influence on the cost of debt, bond yields and wind power financing rates should correlate with the country risk proxies. Figure 18 shows some similarity between both, but also some divergence. For example, Greece's debt and bond rates are high, while the relation of those parameters varies in Spain. This reveals that besides the country risk, the monetary policy of the central banks - in combination with the confidence in the economy/country - impacts the cost of capital through the cost of debt. The ECB's low rates for lending and borrowing contribute to low cost of debt in the Euro-area, but they are not the only factor influencing them.

In summary, we can say that the perceived credibility and effectiveness of governments and economic growth have some impact on the bond rates. However, the impact of economic growth on cost of debt is ambiguous: in times of high economic growth a large amount of capital is needed, making capital scarce and expensive. On the other hand, high growth rate signals lower probabilities of defaults. However, more interestingly, the 'country pattern' between the cost of debt for wind power and the bond rates is not strong, and the correlation between cost of debt and GDP even weaker. For example, Poland's credibility and economic growth is higher than Italy's, but the cost of debt are almost the same in both countries. Thus, learning effects, capital and energy market structures as well as RE policy designs might be essential factors to explain differences between countries. Beyond them, other factors such as the structuring of individual projects affects the cost of capital (see EEFIG, 2017).

We conclude that the differences in cost of debt between countries are the result of several factors that are policy-exogenous and -endogenous:

- The monetary policy of the ECB influences cost of debt, yet has lower impact on the difference between countries.
- There is some correlation between bond yields and the proxies for country risk indicating that economic conditions as well as credibility and effectiveness of policy may drive cost of debt.
- The structure of and competition in the capital market affects cost of debt.
- When considering the advanced deployment status indicator of wind power in Denmark (Boie et al., 2016), the economic situation and policy credibility seem to drive cost of debt in wind power projects, while learning effects of the wind industry seem to be less relevant (see Denmark in Figure 18).
- According to several studies (e.g. Boie et al., 2016; and Polzin, Egli, Steffen, & Schmidt, 2019), the design of RE policies seems to matter as well, when comparing bond yields and cost of debt for wind power e.g. for Greece.
- The EU capital market is influenced by the ECB, i.e. the monetary policy influences the supply of money and hence the prices. In addition, as in any market, the market structure and the degree of competition affects prices of the product, and hence cost of debt as well.

While country risks are also accounted for in cost of equity, monetary policy has no direct impact on the supply of equity, and hence on cost of equity. Instead, cost of equity depends more on the design of RE policies, investor type, project structure and other country risk factors. Generally speaking, if RE policies ensure a steady and reliable cash flow, i.e. low counterparty risk albeit high country risks, cost of equity and equity share will be low contributing to low cost of capital. Thus, it seems that exogenous as well as endogenous factors are relevant for the analysis of cost of capital.

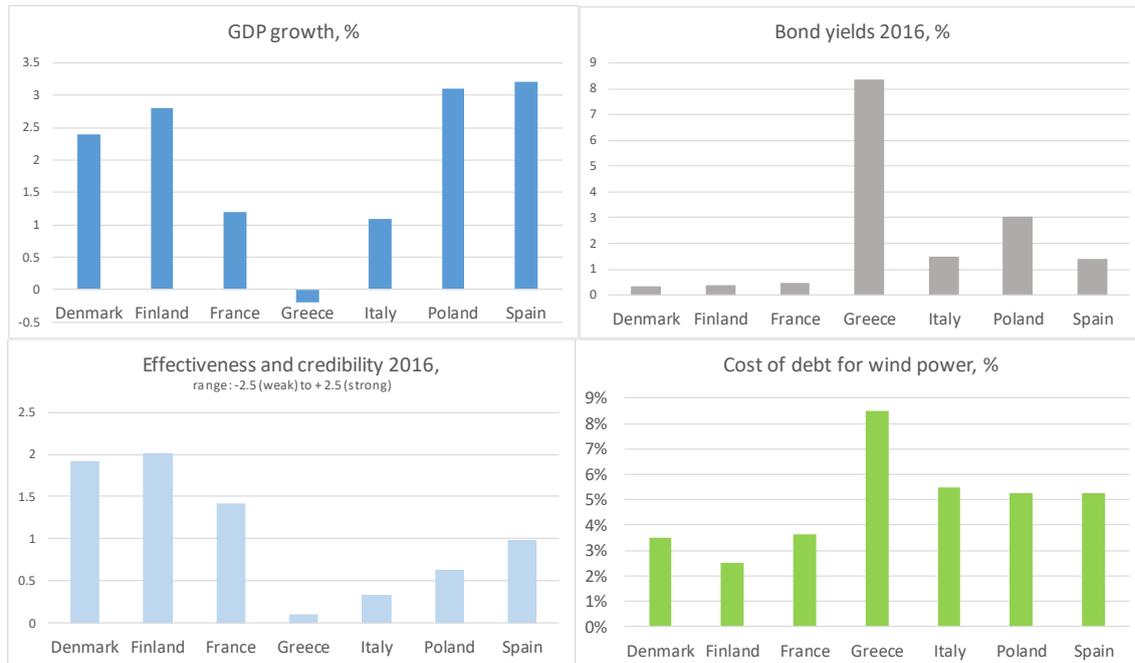


Figure 18: Effectiveness and credibility, GDP growth, government bond yields, cost of debt for wind power in some selected countries in 2016. Sources: Brückmann (2019), European Central Bank (2015), Eurostat (2019) and Kaufmann et al. (2010)

8 Conclusions

This report maps out potential effects of auctions on financing conditions for RE investments. We focus mainly on onshore and offshore wind energy within the EU, but the considerations are mostly conceptual and are thus also applicable for other areas, e.g. for Energy Community members that are implementing auctions under similar legal conditions as EU Member States. Within the scope of the report, we have focused on the market effects of introducing auction schemes and the effects on financing of individual design elements. We discuss these effects in terms of cost of debt, cost of equity, debt to equity ratio, hurdle rates and WACC – and in connection to DSCR requirements and loan tenor. We emphasise that the effects need to be distinguished along three main dimensions (financing type, actor type and project phase), and discuss the potential effects of auctions on financing conditions while taking them into account.

8.1 Summary of findings

The main findings of this report are:

#1: Cost of equity and hurdle rates experience both a downward and upward pressure from auctions.

We have argued that, on the one hand, growth limitations and competitive pressure induced by auctions may force project owners to accept lower profit margins, i.e. lead to a reduction in hurdle rates. On the other hand, they also face new risks in the auction procedures, which may be translated into higher risk premiums. Moreover, auctions leading to reduced remuneration (as secured by government) may increase revenue volatility and thus cost of equity. We also expect an impact from stringent bid bonds and other strict pre-qualification requirements. Project developers, especially small ones, will here be affected the most. The requirement to place bid bonds will have a bigger impact on the liquidity of small project developers and owners (such as energy communities) than on larger market actors (such as utilities). We expect penalties to mostly have an impact on the willingness or capability to finance a project rather than on the cost of

financing it. If project realisation schedules and deadlines are too tight, projects might simply not be put forward into the auction.

#2 Debt financing seems more affected by remuneration design than by the auction procedure.

We expect the support design in auctions to lead (under certain circumstances) to more difficult and expensive project financing. Lower remuneration rates from support and larger shares of market price risk in the revenues might affect the debt provider's risk assessment of projects and lead to higher safety margins in the requirements of debt service coverage ratios, lower debt capacities (debt-to-equity ratios), and increased interest rates (cost of debt). The exposure to more market price volatility may also entail that project financing simply will not be available for certain project owners in certain markets. Developers may not always be able to mitigate this effect by securing revenues through long-term power purchase agreements. This effect depends on the remuneration type chosen for the auction. The choice between a one-sided or two-sided CfD scheme, or fixed feed-in premiums directly impacts a project's cash flows during its entire operating life, which are, in the case of project financing, often the basis to assess secured revenues for debt service. The choice of remuneration system will therefore most likely affect debt financing more than any other auction design. At the same time, the higher competitive pressure of auctions might also be reflected in the banking business, and potentially lead to a small decrease in debt margins.

#3 Auctions may change the investor landscape, through their diverging effects on actors.

Auction schemes create new market conditions, in which size and resources are very important. Project owners always face the prospect of sunk costs when developing a project, regardless of the support scheme in question. However, with auctioning, the decision to be able to realise a project and to receive eligibility for support has been transferred to the market and the project's relative competitiveness. Project developers can thus benefit from creating a portfolio of projects to diversify their risks. Unlike larger actors (such as utilities) that have diverse cash flows and easier access to capital, smaller project developers do not necessarily have the resources to diversify, and the risks they are exposed to could lead to greater financial distress. This is e.g. reflected in the effect of bid bonds, which may lock-in a relatively large share of a small actor's balance sheet. The more difficult access to project financing and a worsening of loan conditions play a role here as well. Auctions may thus lead to a decrease in actor diversity and market consolidation among actors.

#4: Auctions are a policy tool that, depending on its specific implementation, can be a barrier to RE financing, but also provide market stability.

In markets with a history of unstable support or retroactive changes, a prudent auction implementation with fixed auction volumes, long-term schedules and contractual commitments between auction winners and a governmental institution can have a stabilising effect on the market and a positive effect on financing through a decrease in political risk perception. The effect may be equally pronounced for banks as for equity investors. However, if the auction volumes and rounds are not well defined in terms of their frequency, size and long term predictability, for example if auctions are only announced for a year or two in advance or if the volumes are made dependent on political budgetary negotiations, investors may be subject to additional political risks. This will be reflected in a decreased willingness and ability to develop and finance new projects as well as in worsened financing conditions, and will ultimately make RE deployment more expensive than necessary.

Finally, it has to be kept in mind that significant decreases in cost of capital, especially those related to decreases in hurdle rate premiums or interest margins, could, if they are already aggressively tight, start to impact the attractiveness of the sector for investors and lenders. This should remind us that a decrease in cost of capital cannot be a political target in its own right – the lowest costs of capital have no positive effect on the success of the energy transition if deployment volumes become insufficient in turn.



8.2 Limitations of the study

We have presented cost of capital trends for onshore wind projects in the EU in 2014 and 2016, based on studies undertaken in the DIA Core and the RE-Frame project. The numbers show decreasing cost of capital, although it was not finally established where these decreases stem from. As auctions were not the primary research topic of these projects, information on auctions has not been collected systematically there. Some of the indications reported here, and that were given during these interviews, can at best be called anecdotal for our context.

None of the effects we have listed in this study have been tested empirically on a larger scale, nor have they been subjected to any kind of quantitative analysis to test their validity. It was not our focus to substantiate any of the potential effects discussed here – as we conducted a mapping exercise that serves as basis for our future work. We list the effects purely based on conceptual considerations and findings from stakeholder interviews and our validation event. Moreover, we have included results from only seven interviews, and only from several EU countries including Germany, Denmark, UK and France. Therefore, we must expect that our results are biased, depending on the stakeholders we consulted, and our conclusions might change as we conduct further research.

Also, we only cover the perspective of the ‘supply’ side of the market – i.e. the actors involved in providing RE production. It is not in the scope of this report to analyse the policy makers’ side. This will be an important next step, as a change in risk exposure for project owners may entail a change in risk exposure for policy makers or society as a whole.

8.3 Future research

This report is the first part of our work on the effects of auctions on financing that we will conduct within the AURES II project. Its main purpose is to identify possible causal relationships and chart the course for future work. In the next steps, we will conduct 140 interviews with stakeholders across the EU, and potentially some Energy Community countries. These interviews will provide us with more concrete data on financing conditions for individual projects, and hence we will be able to update the WACC numbers from the RE-Frame study (Eclareon, 2016).

The upcoming research of WACC data during the AURES II project will reveal how the cost of capital has changed since the last investigation in 2016. It remains to be seen how the concluded or at least limited quantitative easing of the ECB will affect the future development of cost of capital. This and other exogenous factors can have a detrimental effect on the successful realisation of already awarded projects if the costs of capital increase against expectations.

Moreover we plan to update the cash flow model developed in AURES I, and include stochastic elements. We will use this to analyse the listed effects on a microeconomic level and derive more concrete and robust conclusions. Finally, we will also develop guidelines on creating auction schemes that contribute to improving financing conditions for RE investments.

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AURES II is a European research project on auction designs for renewable energy support (RES) in the EU Member States.

The general objective of the project is to promote an effective use and efficient implementation of auctions for RES to improve the performance of electricity from renewable energy sources in Europe.

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