Impacts of Changing Renewable Energy Market Design on Institutional Onshore Wind Project Lenders

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MANAGEMENT SUMMARY

The EU has set itself ambitious energy policy goals: security of the energy supply, integration of the European energy market, efficiency of energy production and consumption, and de-carbonization of the economy. Achieving those goals would require substantial investments in renewable energy sources, particularly in wind farms.

During the past two decades, the renewable energy policy framework in the EU has been focused on bridging the cost gap between renewable energy power plants and conventional technologies through fixed feed-in tariff subsidies. However, recently, the situation has changed: the cost of renewable energy generation has come down considerably and now support schemes have evolved toward more market-based incentives. Debt providers focused on the renewable energy construction market – especially project finance lenders – need to make changes to adapt to these new systems.

The main objective of this paper is to answer the examine the impact of changing renewable energy market design, particularly the change towards a competitive bidding process and market-based subsidy schemes on institutional onshore wind project lenders. The process of answering this question involves analysis of the EU legislative frameworks for the Renewable Energy Sources, technical and economic aspects of wind energy production and direct examination of the project finance lending process in a universal bank.

Using a combination of 'field' and 'desk' research methods such as systematic literature review, case studies, and interviews, the paper identifies the key aspects of the renewables support policy design which may directly or indirectly influence the project finance process. It further analyses the manner and extent of such influence.

In the 'Conclusions and Recommendations' section the author explains how the EU and national policy changes (e.g. specific elements of subsidy scheme and auction design) affect project finance lenders, identifies the most relevant market trends caused by such policy changes, and provides specific recommendations that can be implemented into different stages of the project assessment process.

ACRONYMS, ABBREVIATIONS, UNITS, TERMS

AEP	Annual Energy Production
CfD	Contract for Difference
COP21	The 21st annual session of the Conference of the Parties (COP) to the UN Framework Convention on Climate Change (UNFCCC)
Dispatchable generation	refers to sources of electricity that can be dispatched at the request of power grid operators; that is, generating plants that can be turned on or off, or can adjust their power output on demand.
DSCR	Debt Service Coverage Ratio
DSRA	Debt Service Reserve Account - reserve account required by lenders to ensure timely payment of principle and interest
EEA	European Environment Agency
EED	Energy Efficiency Directive (Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC)
EPC contract	Engineering, procurement and construction agreement entered into by and between the developer and EPC contractor
EU ETS	European Union Emission Trading System.
EUSEW	EU Sustainable Energy Week
GHG	Greenhouse Gas
GW	Gigawatt, 1 GW = 1000 MW
ICPE	"classified facilities for protection of the environment" (installations classées pour la protection de l'environnement)
IEA	International Energy Agency
INDCs	The Intended Nationally Determined Contributions
IRENA	International Renewable Energy Agency
kWh	Kilowatt-hour
LCCC	Low Carbon Contracts Company
LCOE	Levelized Cost of Electricity - represents the per-kilowatt hour cost of building

	and operating a power plant over an assumed financial life and duty cycle.
MW	Megawatt
MWh	Megawatt-hour (1 million watt-hours)
OECD	Organisation for Economic Co-operation and Development
OECD Europe	All EU countries
PPA	Power Purchase Agreement - a legal contract between an electricity generator (the project developer) and a power purchaser (the government, a distribution company, or any other consumer)
PV	Solar photovoltaic energy
RE	Renewable energy
RES	Renewable energy sources
RES-E	Renewable energy sources electricity
ROC	Renewable Obligation Certificate
TSO	Transmission System Operator - an entity entrusted with transporting energy in the form of natural gas or electrical power on a national or regional level, using fixed infrastructure
WACC	Weighted Average Cost of Capital

Terms that are used interchangeably in this paper:

1. 'auction' = 'tender' = 'tendering process' = 'competitive bidding' = 'bidding process'. The minor difference in meaning is explained in Section 3.4.
2. 'developer' = 'generator' = 'Sponsor'
3. 'institutional project finance lender' = 'lender' = 'financier'

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1. INTRODUCTION

1.1 Brief overview of the EU renewable energy market

"Cheaper coal and cheaper gas will not derail the transformation and decarbonisation of the world's power systems. By 2040, zero-emission energy sources will make up 60% of installed capacity. Wind and solar will account for 64% of the 8.6TW of new power generating capacity added worldwide over the next 25 years, and for almost 60% of the $11.4 trillion invested."

Bloomberg Energy Finance, 2016

Renewable energy is the energy that can be obtained from different types of natural sources including wind, solar, hydro, tidal, geothermal, and biomass. In the mix of renewable energy sources (RES) in the European Union (EU) wind energy plays an important role: by 2020, most of the EU's renewable electricity will be produced by onshore wind farms (Zervos et al., 2009). According to the International Energy Agency (IEA), in 2015 there was 433 GW of wind power capacity installed around the world, 63 GW of which were commissioned last year - a 22% increase from 2014. The Global Wind Energy Council in their annual Global Wind Energy report estimates that investment in wind will total USD 3,6 trillion between 2014 and 2040, or more than one third of total investment in renewable power capacity (Global Wind Energy Council (GWEC), 2015).

Over the past few decades, the EU has put a lot of effort into building the most competitive, sustainable, secure and integrated common energy market in the world. The transition to a decarbonized energy mix is an important step on the way to addressing issues of climate change, environmental protection, security and affordability of the European energy supply. The EU 2009 Renewable Energy Directive outlines the binding national renewable energy targets for Member States for 2020 and forms a fundamental part of EU energy policy. It has become the key driver for European-led global investment in renewable technologies and for supportive renewable energy policies, helping renewables emerge as a cost-competitive energy source in Europe and globally.

Within the renewable energy mix, onshore wind has an important role: so far, it is the most competitive and cost-efficient RES technology. Many experts agree that wind power can play a major role in achieving the European renewable energy targets. The EU RES development goals and roadmaps indicate that in coming decades total capacity of onshore wind installations will increase substantially and will require new investments.

1.2 Problem statement, the research question and the structure of this thesis

Motivation and problem statement

The trend towards clean energy and the projected investment volumes needed to make a transition to a decarbonized economy attracts attention of various types of investors, including banks that are interested in providing loans for wind farm projects. In the last few years, several EU Member States have reduced support for renewable energy, leading to numerous claims that these policy changes retroactively affected existing investments (Egenhofer, C., Alessi, M., Núñez Ferrer, J., & Hassel, A., 2016).

Policy makers believe that market-based support mechanisms such as auctions will help to reduce information asymmetry between governments and developers in identifying the appropriate level of public support (IRENA, 2014). The policy change has already happened: in 2014 European Commission adopted the legislation and policy which indicates an evolution towards tendering (competitive bidding) as the primary system for public support allocation to renewable generators from January 1st, 2017 (EWEA, 2014).

Only some Member States have undertaken RES auctions thus far (e.g. the UK, Ireland, France, Denmark and the Netherlands). This experience shows that the effectiveness of auctions lies very much in the details of the design. Currently, there is no unified set of features and rules about how tenders should be arranged in different countries. Each Member State has to come up with its own auction design. Differing auction structures can have a material effect on the investment and financing value for similar projects and as a result, market participants, such as banks, have to adapt their financing models to constantly evolving auction arrangements (EWEA,2014).

The research question of this thesis:

What will be the impact of changing renewable energy market design, particularly the change towards a competitive bidding process and market-based subsidy schemes such as Feed-in Premium Tariff and Contract for Difference, on institutional onshore wind project lenders?

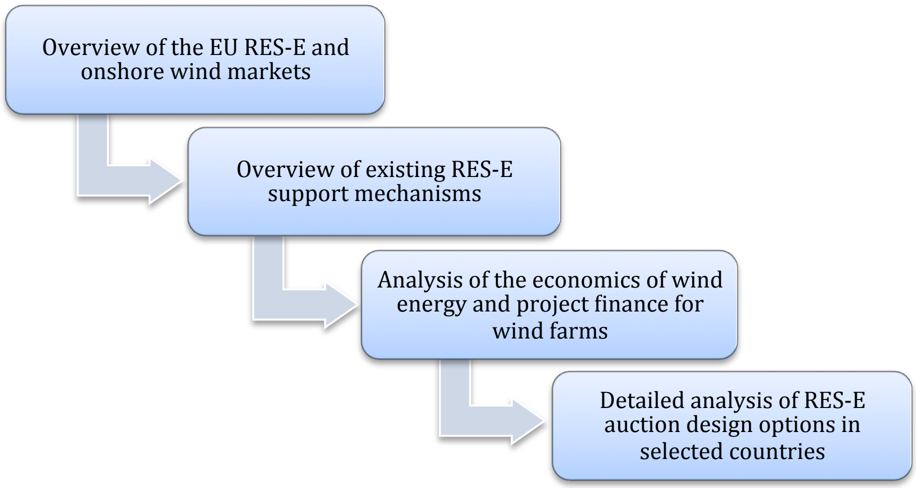
Structure of the thesis

In order to answer this research question, the author had to first gain an understanding of:

1) the EU electricity markets in general, strategy and long-term goals, main players and regulations, proceeding with a specific focus on the role of onshore wind energy, market trends, and market forecasts. The European Energy market is a complex and state-regulated system that involves various stakeholders on both the demand and supply side. At this point, the EU regulation applies to all RES. The aim is to identify which of these elements have a substantial impact on the outcome of project finance. This analysis is carried out in **Chapter 3**.
2) RES-E support mechanisms and options for RES-E auction designs. The amount, duration, and other features of specific types of subsidies as well as the mechanism of subsidy allocation are the key elements of the research analysis. The aim is to identify how those elements influence the RES-E market and ultimately onshore project finance from the lender`s perspective. EU and national support mechanisms are explained in **Chapter 4**.
3) The third stage was learning about the economics of wind energy and project finance for wind farms. Typically lenders involved in wind project financing have a good understanding of the wind energy technology, electricity market design, price formation, and of legal aspects of project finance. Therefore **Chapter 5** aims to give the reader an overview of the elements of the onshore wind farm important for project finance and explain the project finance process in banks. That knowledge was used to identify the key issues that lenders take into consideration before they close the deal. The aim is to identify what exactly lenders are concerned about before they issue a loan for a wind farm construction and, most importantly, how those concerns are reflected in risk assessment and financial modeling.

In summary, to answer the main research question, the author gradually explains and analyzes several topic-related concepts as shown in Figure 1.

Figure 1. Basic topic-related concepts



Chapters 3, 4, and 5 address the relationship between RES-E tendering process and project finance. It should be noted here that typically, the project finance deals are signed after the Sponsor has won the auction and signed a Power Purchase Agreement. However, the success of the outcome of wind farm project finance (from the lender`s perspective) depends on a number of *variables* that are shaped by specific country market design, subsidy and auctioning frameworks that exist in that country (see Figure 1).

In **Conclusions,** the author answers the main research question by providing an assessment of how and to what extent the variables identified in the process of the research affect project finance of onshore wind farms.

Finally, based on the conclusions of the research, in the **Trends and Recommendations** section of the thesis the author presents (1) a number of the key onshore wind market trends affected by policy change in Europe, with related strategic recommendations on how to adjust the current business model and project evaluation process to the new market design and (2) a selection of design elements important for the institutional project finance lender to ensure effective risk assessment of onshore wind projects.

Approach and scope of the research

In the EU the energy produced from renewable sources serves three sectors: heating and cooling (RES-H&T), transportation (RES-T) and electricity (RES-E) (Ragwitz et al., 2006). This research examines only renewables that are used to supply electricity and to only one technology - onshore wind. Onshore wind energy is mostly used to generate electricity to power households and businesses. This thesis is done from the point of view of a specific type of lender – a universal bank that focuses its business activities mainly in Western European markets and a specific type of renewable energy - onshore wind.

The author has combined "field" and "desk" research methods in each of the chapters of the thesis. The research is entirely qualitative and aims to identify how the specific elements of market-based support schemes and tendering process influence the project finance process from the perspective of institutional onshore wind project finance lenders. This paper presents current statistics and historical data available online about electricity consumption and production and the impact of onshore wind energy on the electricity generation mix. This data also contributes to conclusions about the electricity market design in the EU and trends in the policy and regulatory framework. The "field" portion is based on materials from the EU Sustainable Energy Week conference (EUSEW) and on interviews with experts in the field, such as banks and advisors.

2. RESEARCH DESIGN AND METHODOLOGY

2.1 Research design and methods

This paper uses a qualitative methodological approach that combines several different methods: systematic review, narrative review, case study and expert interviews. Qualitative research is well-suited to the main objective of this thesis: to describe and explain the relationship between financial modeling, debt sizing and margin determination and RES subsidy schemes in different EU countries and explore the impacts of policy change on project finance for onshore wind energy.

The primary method used is this paper is systematic literature review. A systematic review is a type of literature review that collects and critically analyzes multiple research studies or papers. Kitchenham & Charters (2007) give the following definition of systematic review: "Systematic literature review (often referred to as a systematic review) is a means of identifying, evaluating and interpreting all available research relevant to a particular research question, or topic area, or phenomenon of interest".

Petticrew and Roberts (2006) in their book *Systematic Reviews in the Social Sciences: a Practical Guide*, state that it is particularly useful to use systematic reviews for gathering all the evidence on a particular question if there is some uncertainty about the answer, especially when (1) there is uncertainty, for example about the effectiveness of a policy; (2) In the early stages of development of a policy, to identify the evidence of the likely effects; (3) when the wide range of research on the relevant topics is available, but the main question remains unanswered. Mulrow (1994), mentions a few other rationales behind systematic review methodology, such as preventing duplication of already existing research, explanation of inconsistencies and conflicts in existing data, cost, and time efficiency and generalizability of the findings of systematic reviews compared to other methodologies.

Khan, Kunz, Kleijnen, & Antes (2003) outline five steps of a systematic review, which were followed to conduct the systematic literature review for this research:
1) define the research question;
2) identify relevant work - determine the types of studies needed to carry out the study;
3) assess the quality of studies;

4) screen, structure and summarize the evidence;
5) interpret the findings

Narrative review has a similar nature. It is characterized as the process of summarizing different primary studies, which can be interpreted comprehensively with existing theories and case-studies (Petticrew et al., 2006). In this paper, narrative and systematic reviews are mostly used in the third chapter where the author describes the dynamics of the EU RES-E and onshore wind markets.

The interview as a qualitative research method has been a popular tool for many important studies across the range of disciplines and subjects. This paper uses the information obtained through unstructured and informal interviews. These types of interviews are recommended when the researcher already has an understanding of basic concepts of the research topic and wants to enhance or revise his or her knowledge of the topic (Fontana & Frey, 1994).

Another method used in this thesis - the case study approach - is appropriate when the research topic needs to be defined in a broad framework of analysis, when the area of research is characterized by complex conditions, and when the measurement of evidence is necessary to gain an insight into the research topic (Yin, 2002). All three characteristics are present in this thesis.

The results presented in Chapters 3, 4, and 5 use the combination of literature review, interview and case study methods. Interviews were conducted to obtain the first-hand information and opinion of the industry experts that work on real-life onshore wind project finance. Therefore, the theoretical framework obtained through the literature review was complemented by the information from interviews with industry experts and case study examples of onshore wind and solar PV (the project finance process for solar and wind is similar) projects in selected countries with detailed information about legal, technical and financial due diligence based on which lenders perform financial modeling for project finance.

2.2 Analysis design and data collection

Data collection was conducted in the following manner. First, a literature review of existing EU RES-E support policy schemes and auction designs was conducted, and second, a selection was made of reliable online resources that provide the most up-to-date statistical and policy implementation information on wind energy deployment, technology, investment, climate and trends. This information was analyzed using a systematic review method. The latest updates on political and policy support, investment climate and structural readiness of countries, in terms of grid infrastructure, permitting process and local supply-chain considerations were collected from news articles published by WindPower [1]Monthly, Bloomberg Energy Finance[2], and other leading news magazines that provide balanced information on wind power and are known for their independent status. The most recent information about auction scheme design in different countries was collected using the information provided by the AURES (Auctions for Renewable Energy Support) project. AURES is a European research project on auction designs for renewable energy support, it "addresses the important and urgent issue of improving current support policies for electricity from renewable energy sources through competitive market measures" (AURES, 2016). Among other sources, the author referred to the publications of leading European renewable energy agencies and consultancy firms, such as Ecofys, Wind Europe, the International Energy Agency, the International Renewable Energy Agency (IRENA), and the Council by European Energy Regulations (CEER), REN 21, DNV GL.

Initial data collection and industry orientation was provided by "EU Sustainable Energy Week" – a European conference dedicated to sustainable energy policy issues. During the conference, 15 sessions on various topics related RES development, electricity policy and market design, wind energy technology and financing were referenced, providing background and detailed information on current and ongoing developments at the forefront of the energy industry.

Conclusions derived from Internet resources were combined with the interviews conducted London in July 2016. The interviewees were professionals whose area of expertise are the onshore wind project finance sector. Interviewees represent legal and technical advisory firms, banks, and wind turbine manufactures.

The interview questions varied according to the background of each person, but their core was focused on explaining the present situation of onshore wind power markets in Europe, policy barriers and investment risks in the EU Member States that have an experience with the RES-E auctions. The responses were classified

[1] http://www.windpowermonthly.com
[2] http://about.bnef.com/

into categories based on the most relevant and important factors that affect onshore wind project finance:

1. Trends in onshore wind energy market in the EU: projected capacity, investments needed, support policy changes.
2. Specific country market design: how do EU Member States markets function, who are the main players in the market and what kind of support mechanisms are applied.
3. Details about existing auction designs in Member States.

Categories were selected after analysis of practical tools and processes used at banks, and the results were later used to draw conclusions and outline recommendations.

3. THE DYNAMICS OF THE EU RES-E AND ONSHORE WIND MARKETS

The European Energy market is a complex and state-regulated system that involves various stakeholders on both the demand and supply side. The aim of this chapter is to identify which of these elements have a substantial impact on the outcome of project finance. This analysis is carried out in this chapter uses the methods of systematic literature review and the information presented at the EU Sustainable Energy Week 2016.

This chapter starts with an introduction of the EU strategy and long-term goals with regard to the electricity market. It outlines key elements of the regulatory framework of the EU energy market, as well as the main strategies and goals for RES deployment. The chapter continues with an overview of the onshore wind energy market in the EU concerning deployment and investments.

3.1. Overview of EU legal regulatory documents for the RES energy sector: goals, strategies and drivers for growth

Since the beginning of the last decade, one of the key priorities of the European Union (EU) is the creation of a resilient Energy Union with a long-term climate policy goals that will encourage the transition to a more secure, affordable and decarbonized energy system in the EU (EUSEW, 2016). To encourage this transition the EU first adopted short-term climate and energy targets for 2020; then mid-term goals for 2030; and finally the long-term goal to reduce EU-wide greenhouse gas (GHG) emissions by 80–95 % below 1990 levels by 2050 (European Council, 2009). Meeting these objectives will require switching to low-carbon energy sources and significant investments in power generation and electricity grid infrastructure and technologies. Most of these investments will have to be financed by the private sector through project finance (European Commission, 2016).

The development of the legislative framework for RES goes back to October 2005 when oil prices went up globally, creating urgency for a new long-term and comprehensive energy policy. In March 2006, in response to a European Council request, the European Commission published a Green Paper entitled *European Strategy for Sustainable, Competitive and Secure Energy*. According to the Commission, the European Union had entered a new energy era, and the paper identified six key areas where action was necessary to address the challenges, such as 'diversification of the energy mix' and 'sustainable development' (Ruska & Similä, 2011), among others.

Two years later, in 2008, the Commission proposed its Energy and Climate Package with "20-20-20" goals for the year 2020. By 2020, the EU has committed itself to (Stankeviciute & Criqui, 2008):

- Improving energy efficiency by 20%
- Reducing greenhouse gas emissions by 20% (a 30% reduction if other countries make comparable commitments)
- Increasing the share of renewable energies to 20% of the total EU primary energy consumption
- Increasing the share of renewable energies in transport to 10%.

In the end of 2008, the European Parliament and the Council established an agreement for the *Directive 2009/28/EC on the Promotion of the Use of Energy From Renewable Sources*. The legislation entered into force in June 2009 and laid out the framework for implementing the binding 20% RES target for the EU and also binding targets for each Member State by 2020.

The *Energy Efficiency Directive 2012/27/EU (EED)*[3] is another piece of legislation that has had a significant impact on shaping the EU Member States` approach to RES. It entered into force in December 2012 and was meant to be implemented into national legislation by June 2015[4]. EED establishes a set of binding measures that help to foster the implementation of additional measures required to reach the EU`s 20% energy efficiency target by 2020. Under the Directive, all EU countries are required to use energy more efficiently at all stages of the energy chain from its production to its final consumption.

In April of 2014, the European Commission (EC) released its new Guidelines on environmental and energy state aid for 2014–2020[5] (hereinafter referred to as the Guidelines). According to the Guidelines, Member States that wish to keep their support for renewable energy deployment must implement a pilot bidding process for part of their renewable energy capacity additions in 2015 and 2016. Starting in 2017, aid should be granted based only on a competitive bidding procedure (European Commission, 2014) (IRENA & CEM, 2015).

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[3]. OJ L 315, 14.11.2012, p. 1–56

[4]. Art. 28 of the Directive

[5]. Guidelines - binding non-legislative acts - can be considered ‘soft law’, Member States have to indicate how would they implement them.

In October the same year, the European Council decided on a new set of 3 policy targets for 2030 (EU, 2014):

- At least 40% cut in greenhouse gas emissions (from 1990 levels)
- At least 27% share for renewable energy
- At least 27% improvement in energy efficiency

A selective list of policy and regulatory documents that outline strategies, roadmaps and action plans for the RES energy sector are provided in Appendix 1.

In 2014 the EU established the Horizon 2020 program - the main European tool for developing research in renewable energy. The funding of the program is €5.9 billion (Mellár, B., 2016). In 2015 the European Investment Bank approved €8 billion to be invested in energy efficiency and renewables (European Investment Bank, 2015).

The regulatory pressure towards an increase of the share of renewables in the total energy consumption of Europe continues. Throughout 2014-2015 two main regulatory processes emerged that are driving climate and energy policy across Europe: the 2030 Climate and Energy Package, which became the foundation of the EU's contribution to addressing climate change at the UN Framework Convention on Climate Change (UNFCCC) negotiations; and the development of the Energy Union - a single European energy market with integrated legislation and interconnected network (Raines & Tomlinson, 2016). In 2016 the European Commission plans to release the outcome of the consultation and policy debates concerning the revision of Renewable Energy Directive for the period 2020-2030, to succeed the above mentioned 2009 Directive, which set renewable energy targets for 2020.

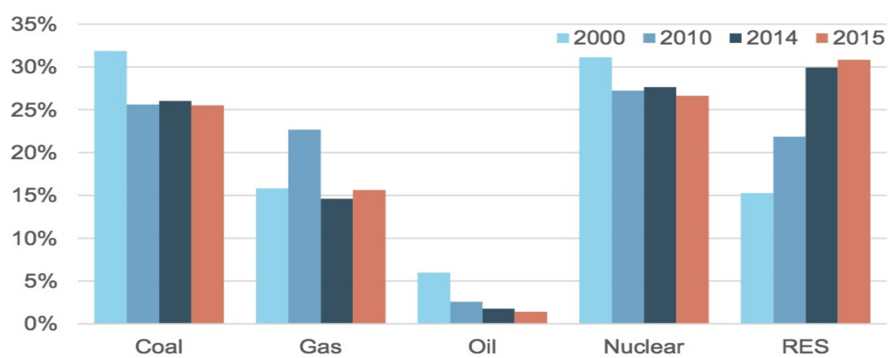
3.2 RES and onshore wind electricity markets

During the last decade, the share of renewables in the EU energy mix was growing rapidly: in 2004, RES-E accounted for about 14% of European Union electricity generation; by 2015 this number had exceeded 28.5% (Agora Energiewende, 2016). In 2014 RES-E consumption was 26.9 % and together with the shares of RES-H&T (16.6 %) and RES-T (around 5.5 %) the EU reached 16 % of renewables in final gross energy consumption and is on the track to achieving 20 % target by 2020.

Most energy consumed in the EU is produced from five major sources: oil, gas, coal, nuclear and renewables such as hydropower, wind, solar and biomass. Historically, the energy mix in the European Union's electricity generation used to be dominated by fossil fuels sources. In 2009 coal and nuclear used to dominate the power generation market - each having a larger share in the mix than all the RES put together (Vattenfall AB, 2011).

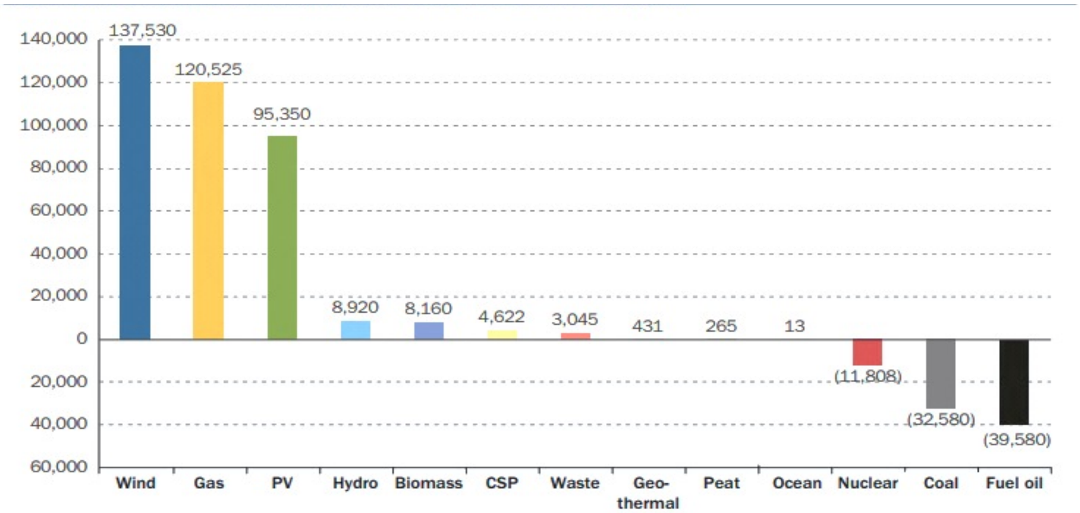
However, last year for the first time renewables were the energy source that accounted for the largest share in the EU electricity supply. At almost 29 per cent, renewables were ahead of nuclear power (27 per cent) and coal (26 per cent) (Agora Energiewende, 2016). Figure 2 illustrates the change in power generation mix in the EU throughout the years 2000-2015. The graph shows growth in renewable energies, decline in oil and coal deployment and no increase in energy coming from gas. The same trend applies to new installations: Figure 3 demonstrates the cumulative installed capacity of electricity generating installations over the last 15 years and shows that most new power generating capacity units installed through 2000-2015 were wind farms and some nuclear, coal and oil fuel units were decommissioned.

Figure 2. Change in power generation mix in the EU (reproduced from Charriau & Desbrosses, 2016)



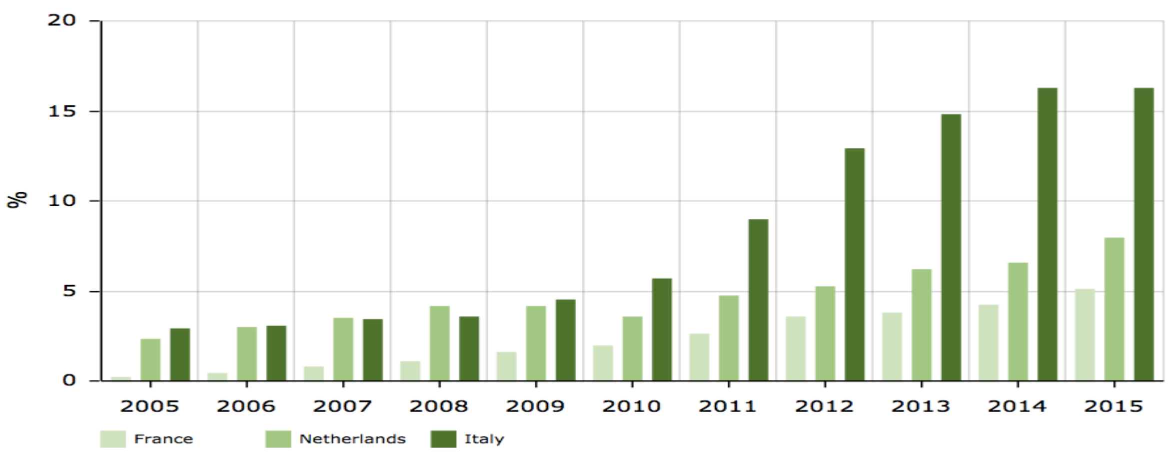
Note: y-axis is a percent of total power generation

Figure 3. Net electricity generating installations (in GW) in the EU 2000-2015 (reproduced from Energy Post, 2016)



Since the beginning of the 21st century, the world wind electricity generation capacity doubled approximately every three and a half years (Leung & Yang, 2012). However, the share of wind energy in different EU Member States was not growing equally fast. Figure 4 illustrates growth of the share of wind and solar in total electricity generation in three European countries: France, Italy and the Netherlands.

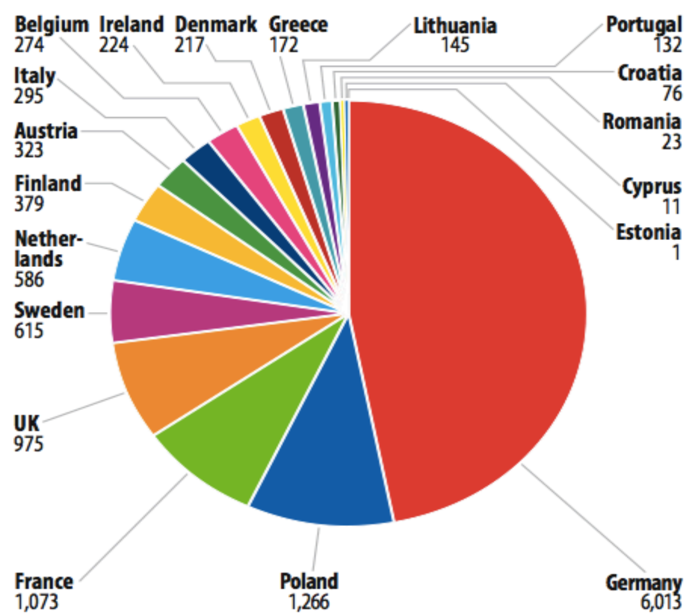
Figure 4. Growth of the share of wind and solar in electricity production during 2005-2015 in France, the Netherlands and Italy (composed using Global Energy Statistical Yearbook, 2016)



Note: y-axis is a percent of wind and solar electricity out of total capacity installed

According to the EU`s Renewable Energy Directive requirements, each Member State submitted a National Renewable Energy Action Plan (NREAP), where they indicate the strategy for meeting target levels of renewable energy deployment and what the share of each technology in it would be. Under these plans, Member States indicated that they will deploy 170 GW of onshore wind capacity by 2020 (EWEA, 2014). The most recent data published by Wind Europe, the International Energy Agency and the Global Wind energy Council indicate that by the end of 2015 there were 142 GW of wind power installed in the EU, of which 131 GW is onshore wind and 11 GW offshore wind. Wind can now provide 11.4 % of Europe's energy demand. The new capacity installed in 2015 totaled 12,800 MW; the share added by each Member State is presented in Figure 5. New installations were up by 6.3 % compared to 2014, with 9.766 MW of the extra capacity onshore and 3.034 MW offshore.

Figure 5. Member State shares of new installations in 2015 (MW) (reproduced from GWEC, 2015)



The diagram in Figure 5 shows that nearly half of new wind installations in the EU were in Germany, which also remains the EU market leader with the largest installed capacity of 45 GW, followed by Poland (1.3 GW new capacity), then France (1.1 GW). Investment in wind increased by 40 % in the same year (European Wind Energy Association (EWEA), 2016).

4. EU AND NATIONAL SUBSIDY SCHEMES AND REGULATIRY TOOLS

This chapter explains EU and national support mechanisms for RES-E deployment. It presents the detailed overview of various features and elements (e.g. duration and amount) of subsidy schemes used in Member States. The aim is to identify how those elements influence the RES-E market and ultimately onshore project finance from the lender`s perspective.

4.1 EU subsidy schemes for onshore wind energy production

In order to implement the EU goals of rapid and exponential growth of the share of RES among the energy sources, the Member States were compelled to subsidize their RES markets. The market is not yet mature enough to meet the growth targets based on private investments only. Therefore, the development of all the renewables in the EU has largely been stimulated through the introduction of national subsidizing policies. Apart from regulatory pressure, the motivation for subsidy schemes in the EU was also driven by negative externalities coming from the use of fossil fuels such as climate change and CO2 emissions, and by the need to stimulate the technological change for developing more efficient sources of energy (Menanteau, Finon, & Lamy, 2003).

The link between governmental subsidies and the development of the RES sector is demonstrated in a study conducted by Council of European Energy Regulators: the EU countries with a higher share of renewables have higher budgets for RES electricity support per unit of gross electricity produced (CEER, 2016). In 2012 the biggest RES spending was attributed to Italy, Germany, Denmark and Spain. In the following years these same four countries had some of the highest levels of renewables in total energy consumption (Eurostat, 2016). González & Lacal-Arántegui (2016) also link the evolution of RES deployment, particularly wind energy, to the stability of regulatory framework and to the historical evidence of strong commitment to support policies.

Overall, policies to support wind energy are often designed to align with broader objectives including diversification of the electricity sources for more predictable and stable energy prices and security of supply; reduction of greenhouse gas emissions and water use; and to stimulate the innovation in 'green' technology (IEA-RETD, 2016).

Types and classification of subsidies

Although governmental support of RES is a general trend, the form of subsidies differs per Member State given the specificities and different stages of development of national RES markets. The International Energy Agency (2004) provides a classification of different support policies based on the direction of their support. Policies can be directed towards either consumers or suppliers and either towards stimulating the capacity to be installed or the generation of renewable energy.

Another differentiation suggested by experts from Ecofys, a Dutch consultancy firm specializing in renewable energy projects, is between volume-based and price-based support schemes. For the price-driven schemes, the government fixes the price and the corresponding volume evolves depending on the respective cost-potential curve. For volume-based support schemes the volume is set and the price develops according to the existing resource conditions and technology costs (Held, A., Ragwitz, M., Gephart, M., De Visser, E., & Klessmann, C., 2014).

A comprehensive and broadly used classification of subsidy schemes is provided in the book "Assessment and optimization of renewable energy support schemes in the European electricity market" (Ragwitz et al., 2007). The author divides existing promotional strategies for renewables into direct (promote RES immediately through subsidy payments) and indirect (improve a long-term framework conditions) and into regulatory and voluntary, which can be further classified into investment focused or generation focused (Figure 6).

Figure 6. Classification of RES support schemes by type (composed using Ragwitz et al., 2007)

	DIRECT		**INDIRECT**
	Price-driven	**Quantity-driven**	
REGULATORY			
Investment focused	Investment incentives Tax credits Low interest /Soft loans	Tendering system for investment grant	Environmental taxes Simplification of authorization procedures
Generation based	(Fixed) Feed-in tariffs Fixed premium system Contract for Difference	Tendering system for long-term contracts Tradable Green Certificate system Renewable Obligation Certificates	Connection charges, balancing costs
VOLUNTARY			

Investment focused	Shareholder programs Contribution programs		Voluntary agreements
Generation based	Green tariffs		

Note: this paper focuses on analyzing direct generation-based price and quantity-driven instruments such as tendering, feed-in premium tariff and contract for difference (highlighted in red).

Up to now, the most widely used policies in the EU are regulatory generation-based direct incentives. Especially common for the wind energy support are (Fruhmann, C., & Tuerk, A., 2014):

- “feed-in tariff” (FiT) schemes in which RES producers are guaranteed a sector-specific price that replaces wholesale power market prices or supplements them by a fixed amount regardless of how they may fluctuate.
- “green certificate” or "quota obligation" schemes in which wholesale purchasers of electricity must meet a certain quota of RES electricity (evidenced by tradable certificates issued to RES power producers).

Besides the two support schemes mentioned above, there are many other ways in which governments may stimulate the deployment of renewables, such as tax credits and investment grants. Moreover, the designs of FiTs and green certificate schemes are not unified across the EU Member States and can vary depending on the specifics of a particular country. Examples of such variations are "feed-in-premium" (FiP), "contract for difference"(CfD) and "renewable obligation contract" (ROC) schemes.

1. FiP is an evolved version and an alternative to FiT. It works in a similar way, except that instead of a fixed price for the unit of energy generated, producers receive a fixed premium on top of the market price. Hence the total payment varies with the wholesale market price of electricity and investment in a power plant with FiP bears greater risk compared to the same type of investment in a plant that is guaranteed a feed-in tariff (Baudry & Bonnet 2015). It is also important to distinguish fixed (fixed add-on is offered over the market price) and sliding (variable add-on is paid over the market price to achieve a previously defined target tariff) FiPs (González & Lacal-Arántegui, 2016).

2. ROC is essentially a separate (from the electricity itself) product generated by the wind farm. It is a mechanism through which the government places an obligation on all licensed electricity suppliers, including coal, gas and nuclear plants to have a proportion[6] of the electricity they supply to customers from renewable energy sources. Suppliers comply with the requirement by purchasing ROCs either from renewable generators or from the ROCs market (International Energy Agency (IEA), 2004)

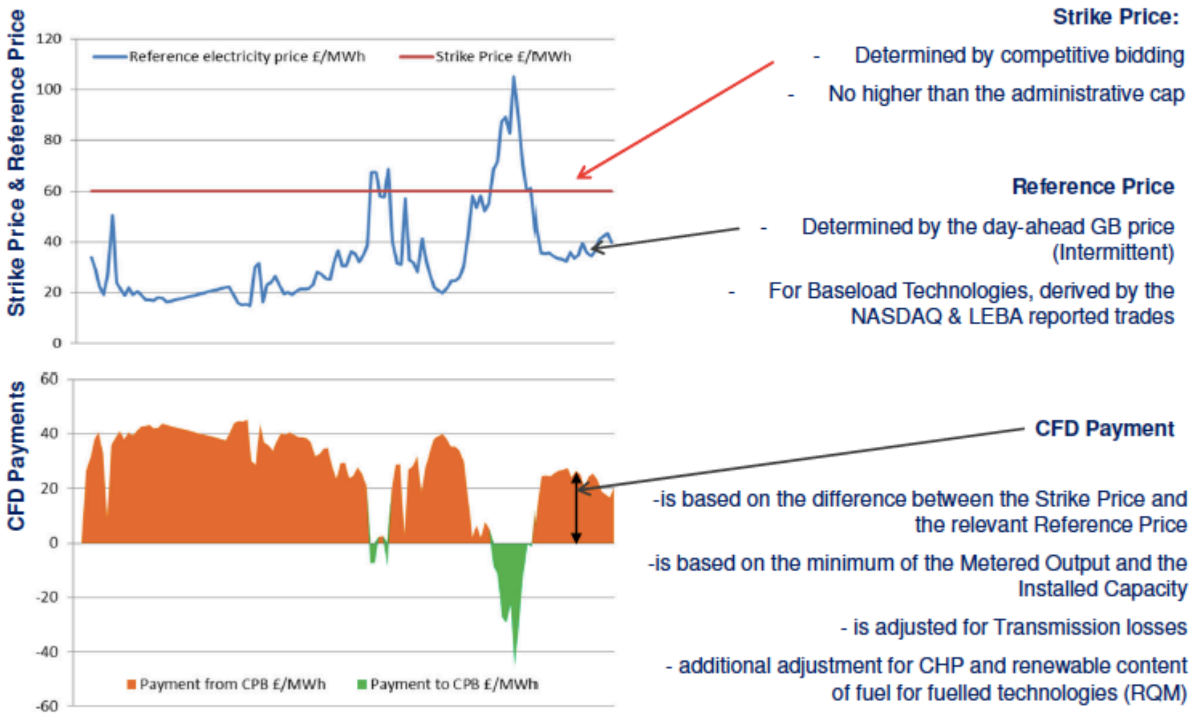
3. CfD (sometimes called "sliding premium") is an instrument that guarantees a ‘strike’ or ‘reference’ price for the energy generator by energy supplier. The energy can be sold to the energy suppliers at a price that can be above, below or the same as the strike price. Three cases are possible (Held, Ragwitz, Gephart, de Visser, Klessmann, C., 2014):
   - selling price is equal to the strike price -nothing happens;
   - selling price is below strike price - supplier (the party that purchases electricity from the energy producer) compensates the difference to the generator.
   - selling price is higher than strike price - generator compensates the difference to the supplier.

   Such design makes a CfD a risk-hedging instrument for both parties: the energy generator and the supplier.

Contract for difference was introduced for the first time in the U.K. as a part of Electricity Market Reform in 2014. An example of how the premium payment is calculated under the CfD in the U.K. is presented on Figure 7. Under the CfD the power generator receives revenue from two sources: from the sale of electricity in the market and from the payments provided by state-owned fund.

[6] in the UK for example it used to be 3 per cent

Figure 7. Payment calculation under the CfD in the U.K. (Low Carbon Contracts company, 2015)



Note: X axis corresponds to the timeline and Y axis to the payment in GBP per MWh

In conclusion, regardless of the fact that EU Member States have similar energy policy objectives – reduction of CO2 emissions, more secure energy supply, decrease in the environmental pollution – the policy framework that a country has in place to achieve these objectives varies. The preferred policy instruments depend on many specific country-related factors such as the political and economic situation, level of bureaucracy, history and even culture (Fichaux, Singh, Lee, & Vinci, 2013). The complete and recent summary of existing support schemes, particularly for wind energy is presented in Figure 8.

Figure 8. Overview of support instruments in EU MS in 2014 (reproduced from González & Lacal-Arántegui, 2016)

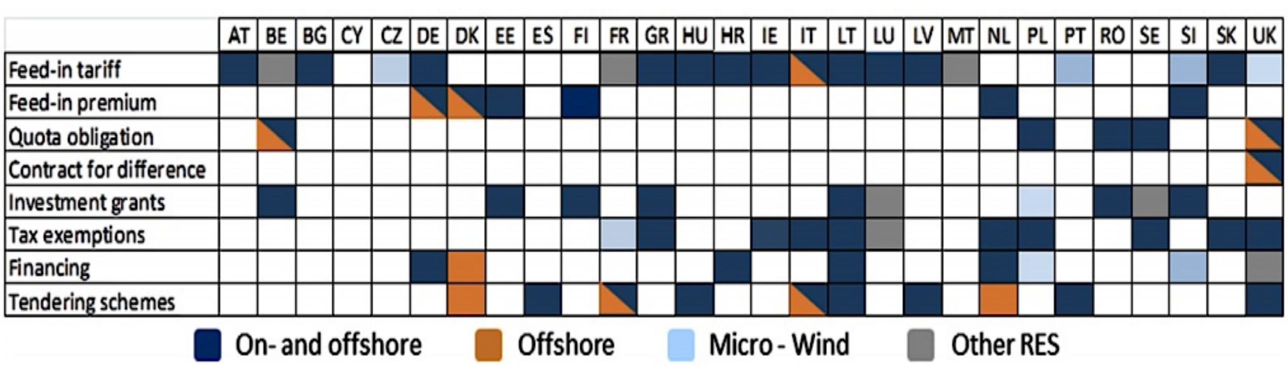
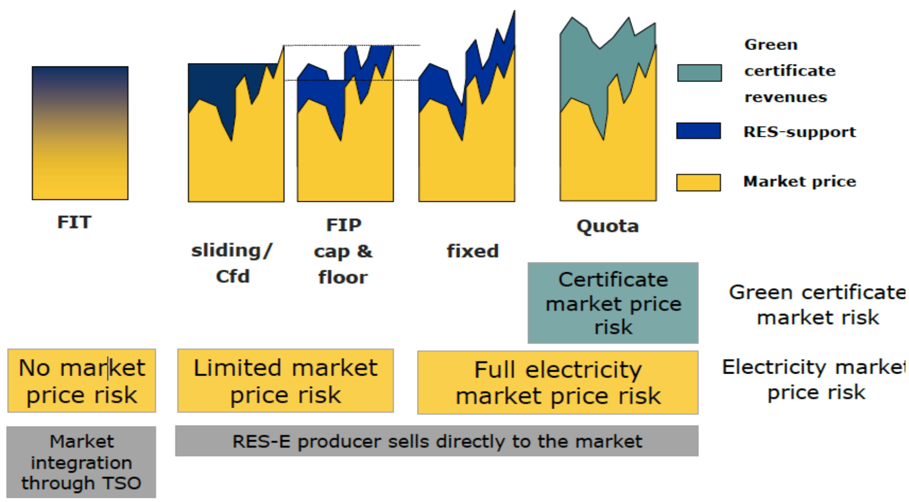


Figure 9 gives a visual representation of how the payments in different subsidy schemes are distributed. The figure shows that revenue predictability highly depends on the type support tariff that is guaranteed. The fluctuations in the revenue stream expose electricity producers to different levels of risk and, ultimately, affect lenders that base their financial models on the numbers driven by assumptions about risk and expected return.

Figure 9. Project`s revenue stream and risk exposure under different subsidy tariffs (reproduced from Klessmann C., 2016)



The 'safest' (from the investor`s point of view) and at the same time the least market-based subsidy - FiT- is currently in place in French and Italian market. In France the level of feed-in tariff for onshore wind is fixed (EUR 8.2 cent/kWh). However, according to a new piece of legislation – *The Energy Transition Act* - published by French Parliament in 2015, the French onshore wind market should expect a policy change: from January 2019, the FiT tariff for onshore wind will be replaced by a market mechanism such as CfD and tendering system, in line with EU guidelines (Dodd Jan, 2015). Online pay-as-bid auction system for solar PV are in place in France since 2011. Currently offshore wind and biomass also receive the tariff based on the outcome of the tendering procedure (Wigand, Förster, Amazo, & Tiedemann, 2016).

In Italy, according to the new 2016 *Renewables Decree* legislation, the level of FiT for wind farms and the process of subsidy allocation depends on the size of the installation: larger than 5 MW is determined and granted based on the outcome of a tendering process (Interviewed bank, 2016).

The renewable energy subsidy schemes are a very complex and country-specific mechanism precisely designed to promote and support deployment of RES in each particular market. There is no unified cross-EU system on either the procedure of granting a subsidy or on the amount or term for which the subsidy should be granted.

4.2 Auctions for wind farm projects

Auctions are not a panacea, however, they involve a lot of favorable characteristics that make them a promising approach for RES-E (Auctions for Renewable Energy Support (AURES), 2016)

In previous chapters, it has been established that the current state and development trends of the EU RES market, and in particular the wind energy market, are largely driven by the binding targets established in EU legislation and distinct national policies aimed at implementing those targets. This lack of harmonization among national measures and policies bears certain risks. To begin with, the EU RES market remains highly fragmented with some Member States being more successful and/or better positioned than others in achieving their goals and therefore endangering the ultimate objective of the *single* market in RES. Secondly, some national policies and implementation measures are more *efficient* than others, hence there are missed opportunities related to potential use of best practices across national borders. To bridge this gap of a lack of harmonized implementation measures, the EU has made the first step by issuing non-binding Guidelines recommending Member States to introduce compulsory auctioning mechanism for the purpose of granting subsidies. The Member States may choose to commit themselves to compliance with the Guidelines.

One of the goals of the new legislation is to find a way to keep a balance between the increase in renewables deployment and ensuring that power generators are not overcompensated, markets are fair and competitive and that subsidy payment burdens aren't placed on consumers or tax payers.

The Guidelines indicate that starting January 2017 all Member States must set up a bidding process (tenders/auction) to grant subsidies to all new installation, with only very few exceptions (European Commission, 2014).

Under Article 126 of the Guidelines, Member States may withdraw from tendering in the following cases (EC, 2014):

- when only one or very limited number of projects or sites could be eligible;
- when a competitive bidding process would lead to higher support levels (for example to avoid strategic bidding)
- when it is demonstrated that a competitive bidding process would result in low project realization rates.

The Guidelines also stated that the budget must be a binding constraint in the sense that not all market participants can receive the aid. The transition period was scheduled for 2015-16 with establishment of at least 5% of planned new capacity through auctioning.

Auctioning was thus imposed as a means to introduce some degree of regulation of national implementation, and specifically national subsidies, as well as some degree of harmonization and comparability of markets in different Member States. However, in order to measure the impact of this newly imposed tool for regulating national subsidizing of RES, it is important to understand the nature of auctioning in general as well as the specific features of auctions for RES: what are they exactly and how do they work?

In the World Bank study *Electricity Auctions: An Overview of Efficient Practices* (Maurer & Barroso, 2011), the authors define an auction as "a selection process designed to procure (or allocate) goods and services competitively, where the award is made to a pre-qualified bidder and is based on a financial offer". Very often in the literature as well as in practice, terms "auction" and "tender" are used interchangeably. However, AURES (Auctions for Renewable Energy Support) - a European research project on auction designs for renewable energy support, defines auctions as a (mostly) price-based allocation mechanism used for the sale or the procurement of electricity; tendering is seen as a process of procuring the product via the auction, most often tendering is referred to as a multi-criteria auction, where both price and non-price factors are used to determine the winning bids.

As a RES support instrument auctions can help to (del Río, Haufe, Wigand, & Steinhilber, 2015):

1. Allocate financial support to the appropriate developers

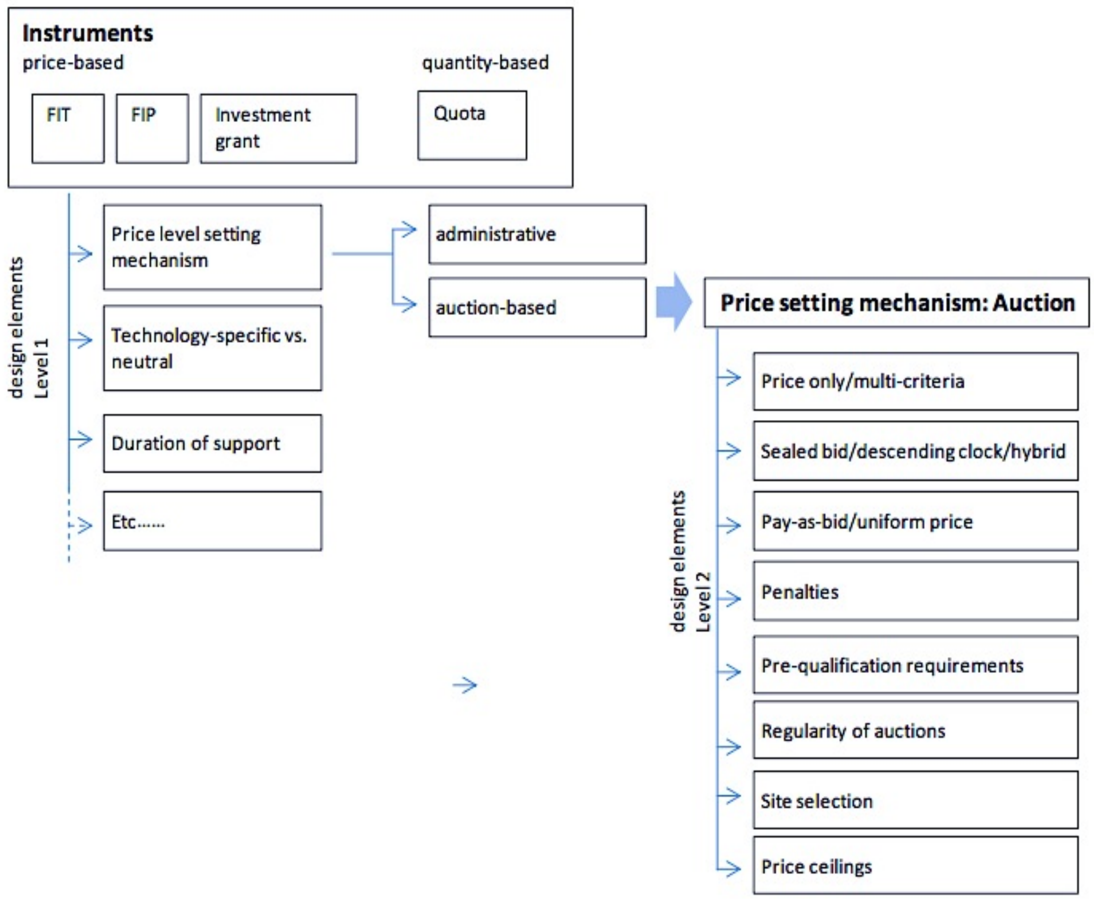
2. Determine appropriate support level.

In France, Hungary, Italy, Latvia and Lithuania a tender procedure is used to determine the fixed remuneration to be received by plant operators during the predetermined period (González & Lacal-Arántegui, 2016).

According to Battle et al. (2012), auctions can be used as a tool for cost and volume control to feed-in systems. Another incentive behind implementation of auctions for RES-E is the option of controlling expansion and the technology mix (IRENA & CEM, 2015). Meaning that the auctioneer can either have the fixed limited annual auction budget for RES-E, where the number and total size of awarded projects is uncertain, or have a fixed target number of projects or total capacity leaving needed uncertain (Latacz-Lohmann & Schilizzi, 2005).

It is important to keep in mind that auctions are not a support schemes by themselves, they always have to be combined with a remuneration type, e.g. a feed-in premium tariff or contract-for-difference. Essentially, auctions are an alternative to the administrative subsidy level regulation that has been common in European FIT and FIP schemes in the past. The Figure 10 demonstrates the set of design elements that characterize auctions. It differentiates between two levels of design elements: more general elements of the remuneration process on the first level, and the elements that describe specific rules and mechanism of competitive process (del Río et al., 2015).

Figure 10. Levels of design elements (reproduced from del Río et al., 2015)



The level two design elements refer to several aspects (Del Río & Linares, 2014):

- The objective and the product of bidding procedure. Is the auction aimed to set the support level or whether the support level is determined by a subsidy type (i.e., FITs) and auctions are used to grant procurement rights to deploy the project. The product of the tender can be either budget or capacity (EWEA, 2015).

- Tender procedure. There are different types of tendering procedure:

    1. Sealed bid auction - bidders submit an offer amount, bids are accepted until the predetermined targeted tender volume is reached or no more offers exist. Payment then follows either according to the bids (pay-as-bid), amounting to the highest accepted bid (pay-as-cleared) or amounting to the lowest not accepted bid (Vickrey auction)

2. Descending clock auction - auctioneer offers a price in an initial round, and developers bid with offers of the capacity they are able to produce at that price. Gradually, the auctioneer reduces the price together with the volume until the offered volume equals the desired one.

3. Hybrid auction - takes "the best of both worlds"; e.g. descending clock stage followed by pay-as-bid auction or first-price sealed-bid stage followed by an iterative descending auction.

- Penalties for non-delivery or delays. Penalties can come in different forms: the termination of contracts, enforcement of bid bonds, support reduction, and shortening support periods.

- Banding. Auctions can be either technology-neutral whereby all technologies compete on par or technology-specific whereby technologies are differentiated and compete in separate tenders.

- Duration of the project. The length of support affects investors' risks and profitability.

- Other relevant design elements include requirements for permits and authorizations, minimum and maximum size of the plant, caps on project volume or subsidy budget, realization deadlines, etc.

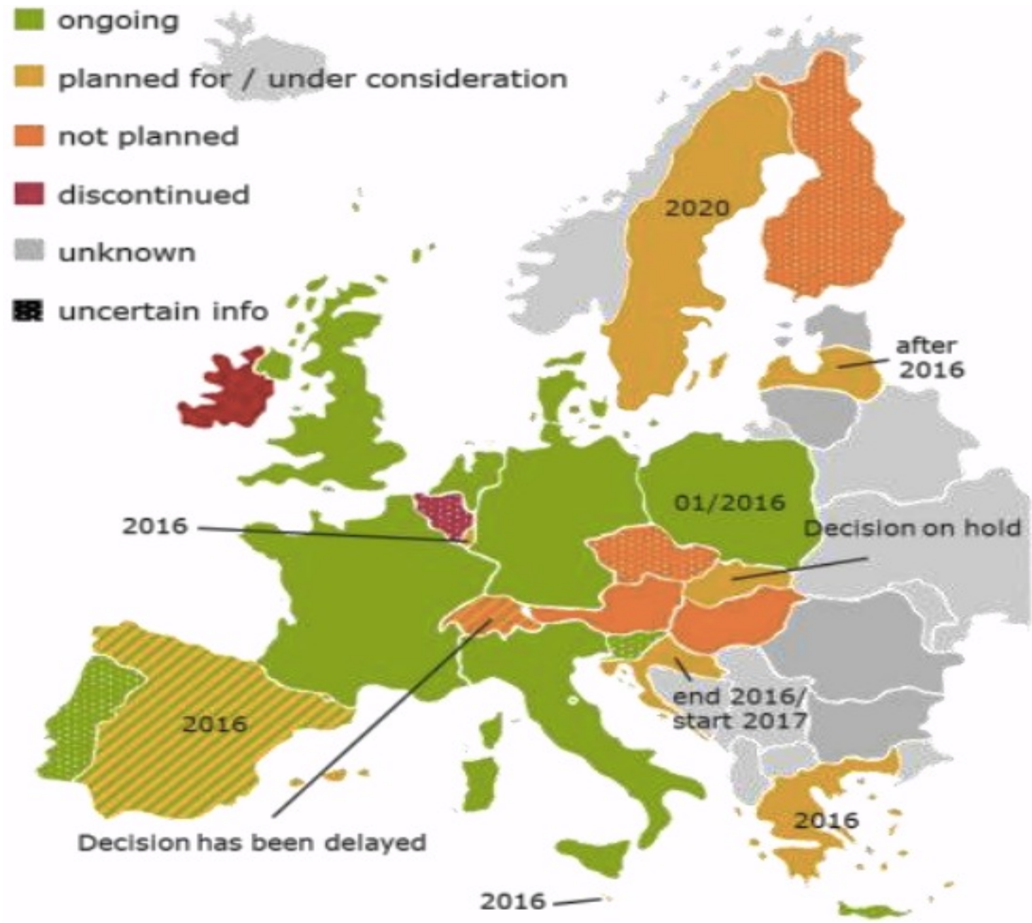
In order to enter the auction, the generator typically has to meet pre-qualification requirements. For European countries it is common to have demanding criteria to enter the auction and have projects on the later stage of development to participate in the bidding process (Wigand et al., 2016).

A more complete overview of the design elements of RES-E auctions is presented in Appendix 2.

Auctions for RES-E are rather new development in the energy policy. Some EU and many non-EU countries have only recently introduced auctions as an alternative or as an additional tool to other support schemes. According to REN21 (2015), more than 60 countries had held renewable energy tenders as of early 2015, up from 9 countries in 2009. Figure 11 illustrates the presence of auction schemes for at least some technologies, in 10 EU Member States: the

UK, France, Germany, Italy, Denmark, Spain, the Netherlands, Portugal, Poland and Cyprus.

Figure 11. RES-E auction implementation in Europe (reproduced from Wigand, Förster, Amazo, & Tiedemann, 2016)



Because of the novelty of RES-E auctioning system, the tendering experience with onshore wind energy projects is very limited. Whether the policy is a success story or not is still unclear due to the fact that even though the onshore wind auctions were already held in some countries (the U.K., Italy, Spain), the design elements of both subsidy tariff and auction greatly vary across those countries, therefore it is difficult to see the pattern. Besides, onshore wind is a particularly challenging technology for tendering because of the complex project development process, the involvement of various permitting authorities and the need for local acceptance (EWEA, 2015).

The impact of auctions on the Weighted Average Cost of Capital (WACC) of the project and on the stimulation of the RES-E deployment and investment flow has been studied by several EU-sponsored projects: Market4RES, DIA-CORE, AURES, Re-shaping and other. The experts conclude that the implementation of the auctions in most of the cases increases the investor`s perception of risk and results in higher cost of debt. According to the results of DIA-CORE project, which is based on the interviews with investors and case studies, the introduction of an auction system in Italy in 2012 led to increase in project riskiness of up to 1.5 % in comparison to riskiness of administratively set feed-in tariff system (Noothout et al., 2016).

The expert from Ecofys C. Klessmann (2016) identifies some general challenges and opportunities related to auctions:

Table 1. Opportunities and Challenges of RES-E auction system

Opportunities	**Challenges**
Control of maximum volume and support cost	Ensuring high realization rates/target fulfillment
Support level is determined by the market, not the administration	Higher risk for RES-E producers than administrative FIT/FIP, favouring bigger market actors
Competition between RES-E producers may lower prices (compared to administrative FIT/FIPs)	Risk of collusive behaviour leading to high prices and support costs

This chapter has examined the EU onshore wind energy markets and existing national policy frameworks for renewables, and specifically the rationale and importance of national subsidy schemes for meeting the binding EU targets set in the relevant Directives. Although reliance on national subsidies is a common feature of RES markets in various Member States, the state of development of national markets, as well as the amount and types of subsidies in place, varies substantially. In other words, the implementation of common EU targets is a largely unharmonised process.

In order to introduce more efficiency, competiveness and harmonization of RES markets, the EU has recommended (in the form of Guidelines) a compulsory auctioning process, to be implemented by 2017 in the Member States that undertake to comply with the Guidelines. The auctions constitute an administrative regulatory tool for the national subsidizing process and are thus helpful from the perspective of broader EU objectives of harmonization and a single market for RES energy, as well as from the perspective of a single member state that strives to make its national policy framework and its subsidy support system more effective and efficient (via more competitive allocation of financial support for instance).

From the perspective of project finance and private investors, the compulsory auctioning brings risks as well as opportunities. A more efficient and orderly market is less risky in itself, and it also enables more accurate quantification of risks. Well-designed tendering systems may have a positive indirect influence on investor margins. On the other hand, in an underdeveloped market with a lot of small participants, auctioning may favor bigger actors thus (at least at the beginning) hampering competition. As any other complex administrative process, auctioning may be prone to abuse (e.g., in the form of collusive behavior for prices or support costs), especially in countries with higher levels of bureaucracy/corruption.

5.WIND ENERGY MARKET AND THE ECONOMICS OF WIND ENERGY

In the onshore wind project finance process, lenders carry out a considerable amount of work before they agree to sign a loan agreement. They need to check every aspect of the planned wind farm to ensure that the project will have the level of return needed to repay the loan. Lenders involved in wind project financing usually have not only a good understanding of financial aspects of the projects, but also of the wind energy technology, electricity market design, price formation, and of legal aspects of project finance.

This chapter gives the reader an overview of the elements of the onshore wind farm important for project finance lender. This information is used to identify what exactly lenders are concerned about before they issue a loan and how those concerns are reflected in risk assessment and financial modeling.

The chapter starts with general information about wind energy, wind turbine technology and the process of wind farm construction. Afterward, the chapter describes cost and revenue components of onshore wind projects. The chapter concludes with a description of the wind farm project finance process and risks that are assessed form the lender`s perspective.

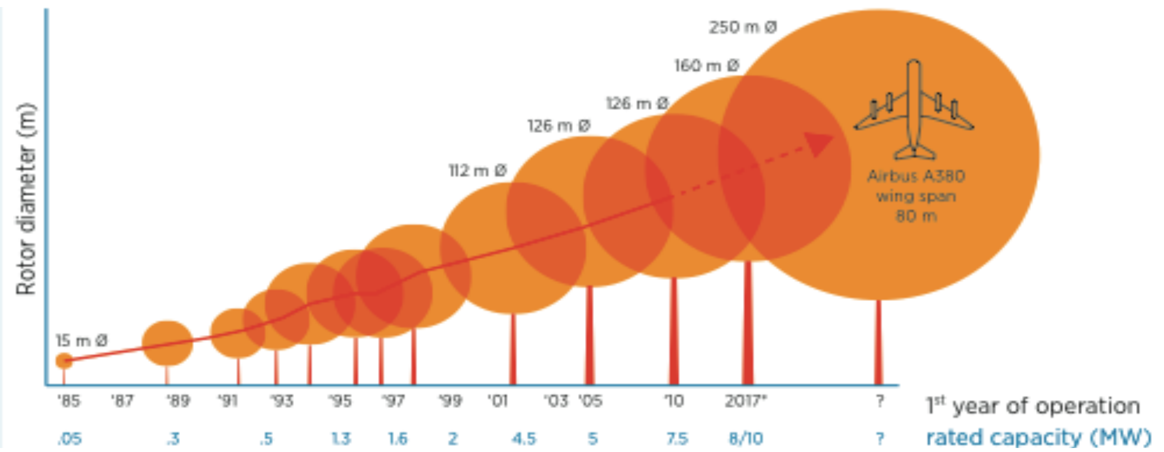
5.1 Wind energy explained

Wind energy is a form of solar energy that describes the process by which wind is used to generate electricity (Wind Energy Programmatic EIS, n.d.). Wind turbines convert the kinetic energy of wind into mechanical power. The mechanical power is converted into electricity directly by the generator. Wind energy is one of the cleanest ways to produce electricity: it does not generate any emissions that contribute to global warming (American Wind Energy Association (AWEA), n.d.). It is also more efficient than other sources of energy: wind farms generate between 17 and 39 times as much power as they consume, compared to 16 times for nuclear plants and 11 times for coal plants (GWEC, n.d.).

Wind energy began to emerge in the 1970s with rapid acceleration in the end of 1990s. Initially, wind power was developed in response to the oil crisis, and particularly in countries exposed to fossil fuel price inflation with limited reserves of their own, such as Denmark. The wind market has grown from 1.7

GW in 1990 to 282 GW in 2012 (International Energy Agency, 2014). The main factors that determine the output of power are the wind speed and the swept area, which is directly related to the length of the blades on a wind generator. Continual technology improvements (e.g., longer blades, improved power electronics and construction materials) have made it possible for a typical wind turbine to grow from 0.5 MW of capacity in 1985 to 7.5 MW in 2010 (see Figure 12)(Vattenfall AB, 2011). The largest commercially available wind turbines to date reach 8.0 MW each, with a rotor diameter of 164 meters.

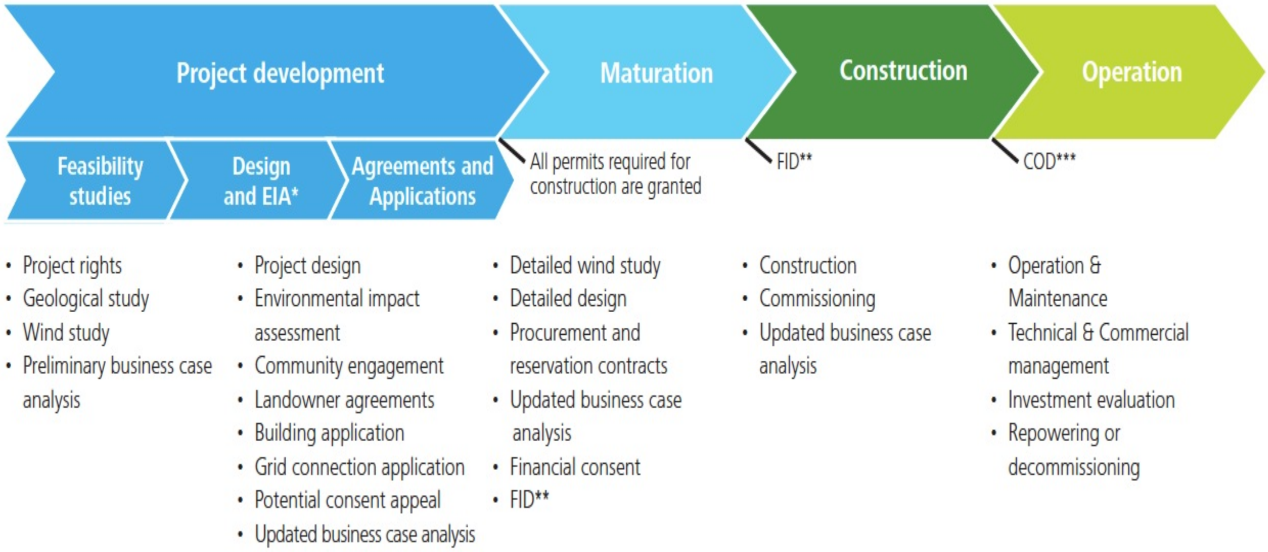
Figure 12. Growth in capacity and rotor diameter of wind turbines, 1985-2016. (reproduced from IRENA & IEA-ETSAP, 2016)



Wind turbines installed in groups form wind farms. Wind farms can be either onshore (turbines located on land) or offshore (turbines located on the continental shelf). Wind farms also vary in size: a large wind farm may consist of hundreds of individual wind turbines, interconnected by a transmission system and cover hundreds of square kilometers (Leung & Yang, 2012).

The life span of a wind farm can be split up into four phases: development, maturation, construction and operation (Figure 13), and a final decommissioning phase, not included in the figure, which typically lasts less than one year.

Figure 13. Project lifecycle of wind farm projects (reproduced from Deloitte, 2015)



Note: * Environment Impact Assessment, ** Final Investment Decision, *** Commissioning Date. Note that differences will occur between offshore and onshore wind parks and countries

Typically the operation phase of modern wind farms lasts for 20-25 years. The construction can take somewhat between 1-3 years; development and maturation up to 10 years.

It is important to note that the final investment decision for Project Finance lending (e.g. commitment to fund from a bank) is not made until all the technical studies, permits, and licenses have been obtained. The critical step that precedes any debt or equity financing is the signing of a Power Purchase Agreement (PPA)- essentially securing the future revenue stream for the power generator.

A PPA secures long-term cash-flows through the term of the contract for power sales to an electric cooperative private or state-owned utility in a local or international market, or individual wholesale or retail customers in unregulated markets. The buyers of electricity through a PPA are called off-takers. Off-takers sign an "off-taker contract" that effectively transfers the revenue risk from the Project Company to the Off-taker. For Project Finance lending, a PPA usually has to last for 15-20 years (Interviewed bank, 2016).

Since the utility company is the party that secures the PPA, the project lenders consider the ownership status of the company. Many of the major energy utility companies in Europe have significant levels of state ownership. For example, around 85 per cent of French Électricité de France (EDF) is owned by the French government (Sokolski, 2010), Gestore dei Servizi Energetici (GSE) and Enel are 100 and 25 per cent owned by the Italian government (Benedetti, 2014).

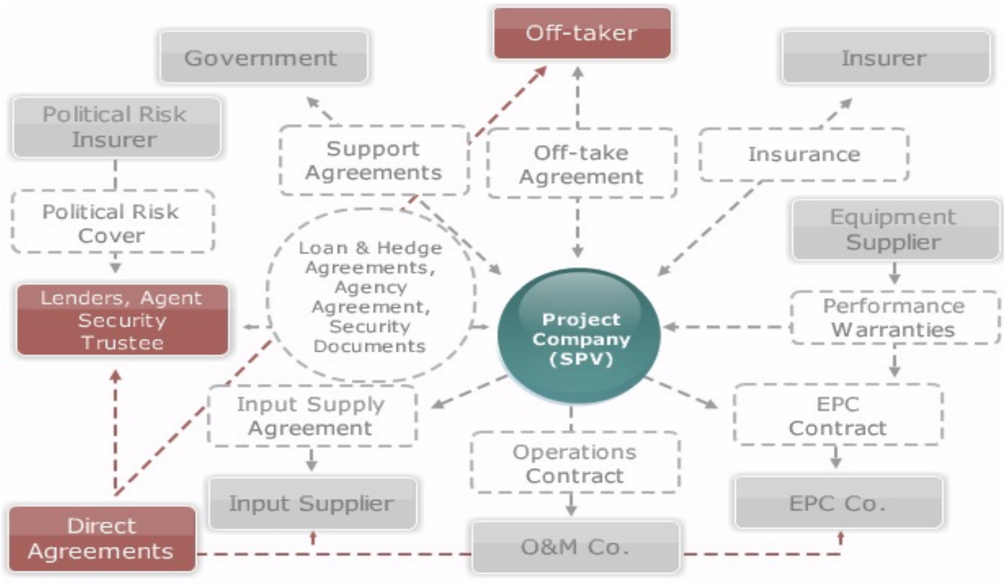
The report *The Rise of Corporate PPAs,* published by the American law firm Baker & McKenzie, examines a new trend on the energy market - corporate PPAs. Corporate PPAs are different from a standard PPA in that instead of selling power directly to utilities, independent generators sign a long-term power purchase contract with businesses, who at the same time might also invest in the generation assets of the power plant. Examples of off-takers under corporate PPAs are some of the largest businesses in the world, including Google, Facebook, and Amazon (Baker & McKenzie, 2015).

In addition to the project developer and the off-taker, wind farm project development and operations involve a number of other participants, among which are (Project Finance Foundations, 2016):

- Project Sponsor – an entity which develops the project, usually invests equity, and is sometimes one of the contractors providing project management.
- Project Company - the borrower which owns all the assets of the project and enters into a number of contracts with various counterparties to secure the revenue stream.
- Construction Contractor - also referred as "EPC Contractor" - the party that does the engineering, procurement, and construction.
- O&M Contractor - the party that operates and maintains the project once it is built.
- Debt Financiers - commercial banks, pension funds, and multilateral agencies (World Bank, EIB, etc.)
- Insurer - project assets are always entirely insured by one or two insurers.
- Host Government - usually the grantor of concession and/or guarantor of the off-taker`s obligation.
- Land owners..
- Grid connection..

Beyond the participants mentioned above, there are many other parties which play an active role in wind farm project finance: consultants, legal and technical advisors, lawyers, suppliers, rating agencies, etc. The relationship and connection between different parties is demonstrated on the Figure 14.

Figure 14. Direct agreements between different counterparties of wind farm project (Project Finance Foundations online course, 2016)



One of the main considerations when developing and operating a wind farm is overall project costs and how these are split between main cost elements. The most expensive phase of the project is the construction phase; costs during project development and maturation are typically insignificant relative to total project cost (Deloitte, 2015).

5.2 The cost of wind farms and LCOE

The great advantage and the fundamental difference between wind and other conventional power generators is that wind farm fuel costs are zero (Blanco, 2009). Due to this fact, the total cost of wind energy generation throughout the lifetime of a wind turbine can be predicted with relatively great certainty. The operational costs of the wind farm are not affected significantly by coal oil, gas or carbon prices (European Wind Energy Association (EWEA), 2009)**.** For example, in a nuclear power plant 28 percent of the costs are related to fuel, compared to around 10% for an onshore wind farm ("Wind power," 2016).

According to Manwell, McGowan, & Rogers (2009), the total generating costs for an electricity-producing wind turbine system are determined by the following factors:

- wind regime (explained in section 5.3);
- energy capture efficiency of the wind turbine(s);

- availability of the system;
- lifetime of the system;
- capital costs;
- financing costs;
- operation and maintenance costs.

The first two factors, wind regime and energy capture efficiency of the wind turbines, largely depend on the terrain and technical characteristics of the turbine (Manwell et al., 2009).

The key elements of the total cost of wind farm are (Krohn, Morthorst, & Awerbuch, 2009):

- Capital costs, including wind turbines, foundations, road construction and grid connection, which can be as much as 80% of the total cost of the project over its entire lifetime, especially for an onshore wind farm. The largest share in the total capital costs belongs to the wind turbine. The capital cost breakdown is presented in Figure 15.
- Variable costs, the most significant being the operation and maintenance (O&M) of wind turbines, but also including other categories such as land rental, insurance and taxes or management and administration. Variable costs are relatively low and will oscillate around a level of 20% of the total investment.
- Electricity production, the resource base and energy losses.
- The cost of capital, i.e. discount rate and economic lifetime of the investment. These reflect the perceived risk of the project, the regulatory and investment climate in each country and the profitability of alternative investments.

Figure 15. Comparison of capital cost breakdown for typical onshore and offshore wind power systems in developed countries (reproduced from IEA-ETSAP& IRENA, 2016)

Cost share of:	Onshore (%)	Offshore (%)
Wind turbine	64-84	30-50
Grid connection	9-14	15-30
Construction	4-10	15-25
Other capital	4-10	8-30

The example of capital costs breakdown for a 20 MW onshore wind farm in Mexico can be found in Appendix 3. On average, construction of a wind power facility costs between $1 million and $2 million per megawatt of capacity.

In order to compare a cost of energy generated by power plants that use different types of technology and different cost structures, the calculation of levelized cost of electricity (LCOE) is used. The basic concept is that the cash values of all expenditures are divided by the cash values of power generation. This then yields LCOE in Euro per kWh (Kost et al., 2013).

For calculating the LCOE for new plants, the following formula applies (Konstantin 2009):

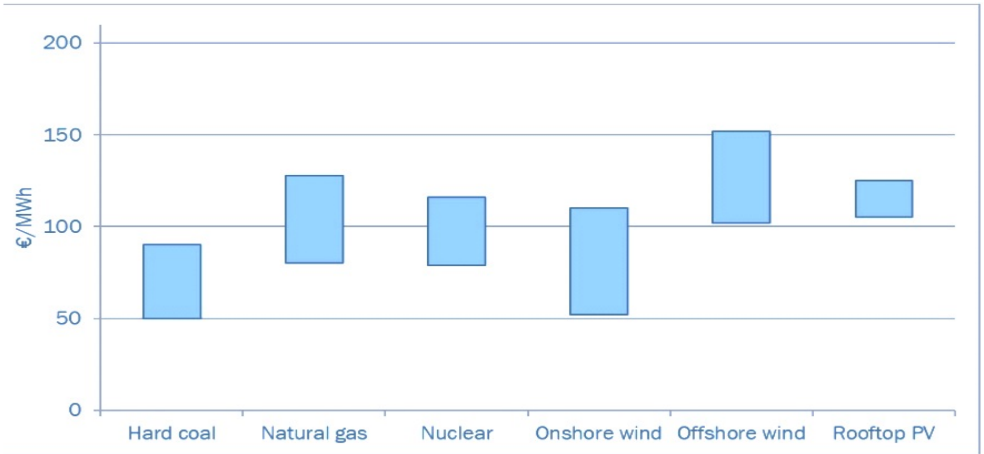
$$\boldsymbol{LCOE} = \frac{\boldsymbol{I_0} + \sum_{t=1}^{n} \left(\frac{\mathbf{At}}{(\mathbf{1} + \boldsymbol{i})^{t}} \right)}{\sum_{t=1}^{n} \left(\frac{\mathbf{Mt, el}}{(\mathbf{1} + \boldsymbol{i})^{t}} \right)}$$

$\boldsymbol{I_0}$ – Investment expenditures in Euro
At – Annual total costs in Euro in year t
Mt, el – Produced quantity of electricity in the respective year in kWh
$\boldsymbol{i}$ – Real interest rate in %
$\boldsymbol{n}$ – Economic operational lifetime in years
$\boldsymbol{t}$ – Year of lifetime (1, 2, ...n)

LCOE is an essential in a subsidy scheme design since the calculation is used to either determine an administrative support level of FiT/FiP or to set a ceiling price for RES tender (EWEA, 2014) .

According to the information provided by Wind Europe, in 2015 LCOE of onshore wind, depending on country, ranged from €52 to €110/MWh. If taken into consideration along with pollution costs and subsidies, those costs made onshore wind the cheapest renewable power generation technology (Figure 16) (Wind Europe, n.d.). Last year Bloomberg research pointed out that wind energy is the cheapest technology for electricity production in the U.S., Germany and the U.K. even without government subsidies (Tom Randall, 2015).

Figure 16. LCOE of different power generating technologies in Europe (Wind Europe, n.d)



Over the last five years, wind and solar PV have become increasingly cost-competitive with conventional generation technologies. The latest outlook by Bloomberg New Energy Finance (2016) forecasts that the costs of onshore wind projects will have a 41% decrease by 2040. According to Kost et al., (2013) LCOE of all renewable energy technologies has decreased significantly due to innovations in RES technology, more efficient production processes, and automated mass production of components.

5.3 Wind energy production, price and revenue

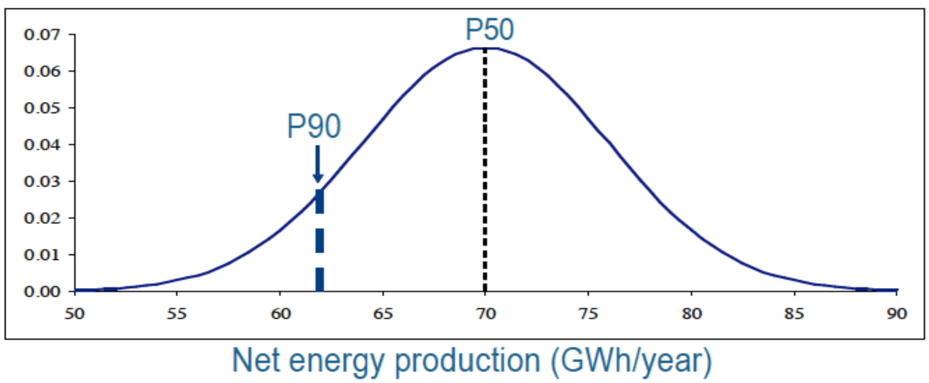
The revenue and profitability of the wind farm project is affected by three primary factors: electricity production from wind, subsidy tariff and price of electricity.

The production depends on the available potential of wind turbines and characteristics of the site where the wind farm is located. There are several key factors that influence production capacity (Manwell et al., 2009):

- Meteorological potential - available wind resource.
- Technical potential - the site potential, accounting for the available technology.
- Implementation potential. Implementation potential takes into account constraints and incentives to assess the wind turbine capacity that can be implemented within a certain time frame.

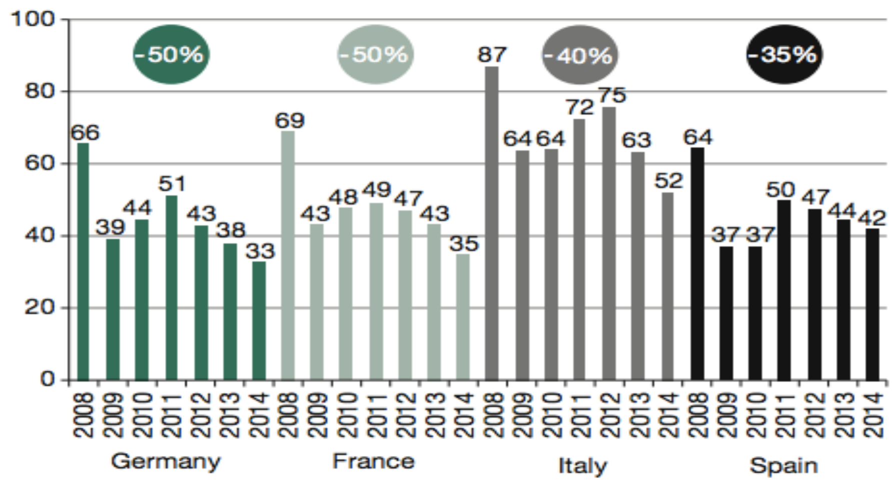
For project finance it is essential to have a reliable estimate of the annual energy production because the production is directly linked to project`s revenue. Such energy yield prediction is determined via onsite measurements and an extensive Energy Yield Assesment, providing an average expected energy yield output (P50) and the uncertainty in that forecast, reflected in a P75 and P90 number. It is assumed that the energy production curve is normally distributed and P50 means that there is a 50:50 chance of reaching a higher or lower annual energy production (see Figure 17). P75 and P90 would mean that the risk of not reaching the power output that matches those points at the curve is 25 per cent and 10 per cent respectfully. Financiers typically prefer to take lower risk assumptions and choose to use either P75 or P95 for the financial modeling (Klug & Wilhelmshaven, 2006).

Figure 17. Energy production curve (GL Garrad Hassan, 2012)



Two other factors that have a direct impact on project revenue are subsidy tariff and the wholesale market price of electricity. The price of electricity on the wholesale spot market depends on supply and demand forces. On the supply side, fuel prices, prices for CO2 allowances, wind speed, and technical capabilities of power plants have great influence. The demand side is impacted by consumer behaviour, time of the day and the season of the year, state of the economy and other factors (RWE AG, n.d.). Generally, over the last couple of years electricity prices on the market significantly dropped (see Figure 18). It has been driven by two main factors: the economic crisis, which decreased overall energy consumption, and overcapacity on the market, which occurred when wind and other renewables came online without changing the amount of conventional power output available.

Figure 18. Wholesale power prices in Germany, France, Italy, Spain (reproduced from Genoese & Egenhofer, 2015)



A study on the impact of support policies on the wholesale market prices in Germany and Spain shows that the increase in power capacity due to increase in wind energy in Germany and Spain has led to a decline in wholesale prices sufficient to offset the cost of subsidizing wind (Sáenz de Miera, del Río González, & Vizcaíno, 2008; Sensfuß, Ragwitz, & Genoese, 2008).

The subsidy part of the revenue stream is shaped by the support policy of each particular country as described in Chapter 3. The more predictable the tariff is, the less dependent the revenue is from the volatile market price and other conditions, and the less risky the project will be perceived by the investor.

5.4 Tools for wind energy finance. Project finance for wind farms

Project finance is the form of debt where the lender relies solely on the projected technical and economic performance of the project to generate cash flows sufficient to repay the loan and service interest (Groobey, Pierce, Faber, & Broome, 2010). Such debt might hold project`s assets and/or rights as a collateral.

Project finance is one of the primary sources of financing for wind farm projects. It is done in a form of non-recourse loan provided by a bank based on the specific project's risks and future cash flows, which must be predictable and secure. The quality of these cash flows is a function of the contractual arrangements that the developer enters into with various third parties. Non-recourse refers to the type of loan in which lender is unable to access the capital or assets of the borrower to repay the debt.

Usually, the project is not 100 per cent financed by a debt investor; it is typical to have 25-30 per cent of project value coming from equity investors and 70-75 per cent from loan provided by the bank.

Debt lenders pay special attention to the revenue stream, which is typically generated from a PPA (explained in section 4.2) with utility company. The tariff stated in the PPA along with many other project-specific technical and financial calculations serve as an input for financial modeling and sensitivity analysis, based on which the lender determines whether the project is 'financeable'. Main inputs are fixed during the due diligence process are (Interviewed bank, 2016):

- Correct long-term production assumptions (P50 or P90?);
- Correct CAPEX assumptions including contingency;
- Accurate CAPEX timing forecast;
- Correct commercial operations start date;
- Reasonable OPEX assumptions reflecting contract prices and industry standards;
- Correct energy pricing mechanisms.
- Impacts of poor wind farm performance (power curve, availability);
- Curtailment risks (noise, shadow flicker, grid);
- Delays in commercial operation (grid delays);
- Increased operational costs both long term assumptions and periodic increases in costs due to major failures;

The inputs listed above are usually provided through due diligence reports issued by third parties such as legal, technical and financial advisory firms. Those firms work closely with the lender and provide a support during the loan origination process.

The day when the final decision to finance the project and when loan documents are signed is called 'financial close'. Typically in project finance deals bank`s first objective is to reach Financial Close once a decision has been made to finance a project. Drivers behind such a finance decision come from business objectives, which can consist out of : (1) fee target (absolute or relative number per year); (2) total amount of money to lend per year; (3) amount of risk-weighted assets (4) target for long-term profitability (5) syndication (ratio) target (Interviewed bank, 2016). Those objectives define bank`s 'risk appetite' and general business strategy in project finance deals.

There are several contract and agreements that the generator has to have in place in order to reach the financial close. The list varies, depending on technical and legal aspects of particular project and requirements of the country where the project is located. For instance, in the case of a French project, banks would be looking to provide financing after certain administrative authorizations are available, among which are building, grid connection and environmental permits, executed PPA, property rights, etc. (Interviewed bank, 2016).

It is also important that the project does not have any outstanding legal claims because solving those might result in the significant delays in construction or operation of the project.

After obtaining complete information about all the legal and technical aspects, assessment of bankability, and of the project, lenders do cash-flow projections and debt sizing and determine an appropriate margin. Three loan parameters have the most effect in determining the size and cost of the loan for a wind project: the interest rate, the loan term, and the most important - the Debt Service Coverage Ratio (DSCR). "The DSCR is a measure of the projected operating cash flow available to meet interest and principal payments on the loan" (Investopedia, n.d.). A DSCR of 1.45 means that the project is obliged to generate operating cash flow in a given time period, e.g., one year, equal to 145% of the scheduled debt service obligations, principal and interest, during such time period (Harper, Karcher, & Bolinger, 2007).

Commercial banks in the wind sector in Europe typically quote interest rates as a spread over EURIBOR (Euro Interbank Offer Rate), such fixed rate is called the “coupon rate.” When a debt instrument specifies a margin rather than a fixed rate, the margin is usually measured in basis points above an interbank rate, such as LIBOR or EURIBOR (Harper et al., 2007).

5.5 The risks in wind farm project finance

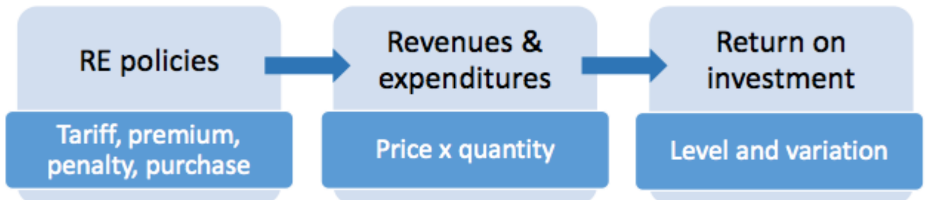
The topic of investor risk appetite is well-researched and there are many classification systems available in the academic literature. *Transitioning to Policy Frameworks for Cost-Competitive Renewables* report provides a list of risks that are relevant for renewables project investors (IEA-RETD, 2016):

1. Off-taker risk. The risk that the off-taker (i.e. utility) purchasing the power does not fulfill its obligations, fails to pay on time, defaults.
2. Curtailment risk. The risk that the power output will be curtailed unexpectedly and therefore fail to be fully remunerated.
3. Policy and Market Design Risk. The risk that project cash flows will be negatively affected over the course of the project's life due to any of a range of factors, including changes to the power purchase price (or tariff), or to the project's output.
4. Currency risk. The risk that the currency in which remuneration is made depreciates significantly, thereby eroding the real value of revenues earned. This risk is also often referred to as "exchange rate risk".
5. Market Risk. The risk that changes in market circumstances will negatively impact a project's revenues, competitive positioning, or access to the market.
6. Macroeconomic Risk. The risk that significant economic shocks or changes negatively impact the profitability of a given power project, such as runaway inflation.
7. Sudden Policy Change Risk. The risk that the political or regulatory conditions deteriorate and negatively impact the operations of a given project or the regulatory conditions that govern it (retroactive policy changes, international sanctions).
8. Grid Access Risk. The risk that the project either fails to gain access to the grid, or fail to do so in a timely manner.
9. Technology Risk. The risk that the particular technology chosen fails to perform as expected. This risk becomes less important as renewable energy technologies improve over time.
10. Project Risk. The risk inherent to a particular project, such as site selection, construction- related delays, as well as the risk that actual project output is below what resource forecasts suggested.
11. Social Acceptance. The risk that the individual project will fail to obtain (or maintain) the social license to operate. Failure to maintain social acceptance for a project can directly contribute to a project's failure.

Depending on the characteristics of a specific project, some of the risks are perceived to be more important than the other. In a scope of EU-led DIA-CORE project, experts interviewed onshore wind project investors from 24 EU Member States and asked to rank risk categories. The results showed that on average in the EU policy and market design risks concern onshore wind investors the most. This means that a stable regulatory framework is a pre-requisite for European onshore wind projects stable investment conditions (Noothout et al., 2016).

From lender`s point of view, the policy design risk is directly linked to project`s revenues and expenditures (see Figure 19).

Figure 19. Impact of RES policies on investments (reproduced from Noothout et al., 2016)



In order to identify a bankable borrower, reach the financial closure of project finance deal, and ensure timely repayments of the loan, lenders have to perform detailed analysis of all risk-related aspects of potential borrower. Many of those risks are directly linked to specific country`s energy market design and RES subsidy schemes. Therefore, the potential lender needs to understand how policy change may affect renewable energy market trends and design and how project finance lenders can adapt their business model to those changes.

Project finance investors' perceptions of risk have a significant impact on project financing costs. Higher risk perceptions require debt investors to demand higher margins, coverage ratios and increased returns. Typically banks use the in-house financial models and commercial software to quantify their perception of specific project risks. The effective risk assessment has a direct impact on the outcome of the project finance deal.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

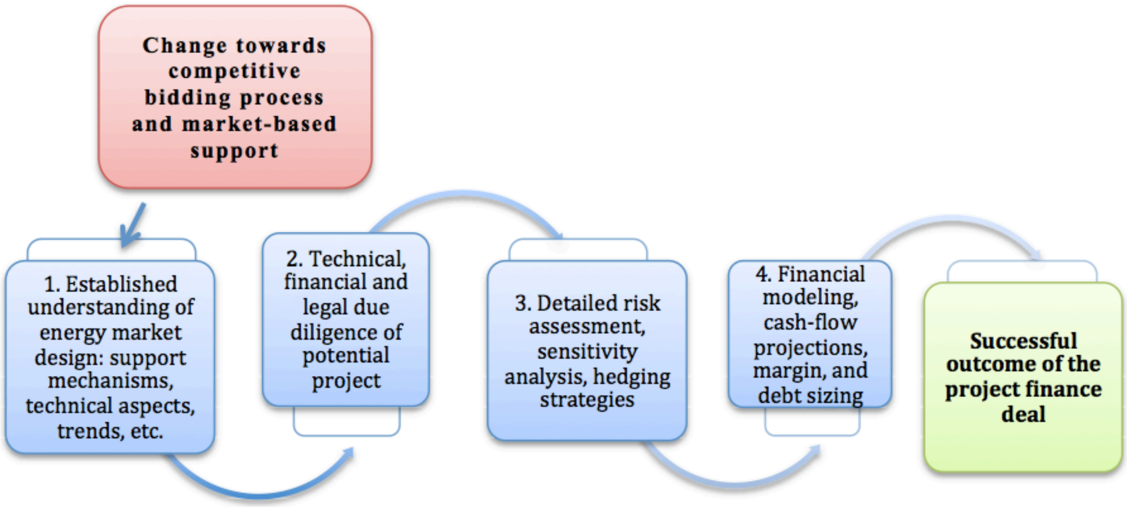
The main objective of this paper was to answer the following research question:

What will be the impact of changing renewable energy market design, particularly the change towards a competitive bidding process and market-based subsidy schemes such as Feed-in Premium Tariff and Contract for Difference, on institutional onshore wind project lenders?

This thesis assumes the perspective of a specific type of s lender – a universal bank with business activities mainly in Western European markets (hereinafter – the lender), and a specific type of renewable energy - onshore wind. Using the methods of literature review, examples of case studies and interviews with industry experts, three main findings were identified:

(1) **Overall, the changes in EU regulation or policy of a particular country, and particularly the recent introduction of competitive bidding process for RES wind projects do not *directly* affect the project finance process**, i.e. lender signs loan documents after the project was granted the Power Purchase Agreement. The existing EU legislation is primarily oriented towards reaching broad renewable energy objectives and committing Member States to binding goals of increased share of RES among energy sources. The Directives do not envisage requirements, rights or obligations for private market participants such as project finance lenders. Similarly, national policy frameworks and specifically subsidy schemes adopted in particular Member States are designed to *directly* influence the producers of RES, and only rather *indirectly* the private investments (including project finance).

In order to reach a financial close and successful outcome of the project, lenders perform a thorough due diligence analysis and detailed risk assessment. Based on the information provided in due diligence reports lenders perform financial modeling, calculate DSCR and other ratios such as probability of borrower`s default, and do debt and margin sizing. The model below shows the sequence and relationship between the key aspects that the bank has to analyze in order to reach a successful outcome of the project finance deal and the place of policy change issue in it.



Given that the market is to a large extent driven by national subsidies (the lenders are financing government-subsidized projects), any changes affecting market participants. including introduction of the auctioning, do influence market dynamics. Such changes should be factored in the project finance process of the lenders.

(2) The new auctioning system being introduced in some Member States poses new risks as well as opens new opportunities for the project finance lenders.

The previous system with the long-term PPA for guaranteed market-independent feed-in tariff signed with reliable state-owned utility company was easy for the lenders to operate in. For investors wind market was characterized with high degree of certainty, tight margins and long-term profitability. A new system - with auctions and market-based subsidies - raises concerns among project finance lenders in a way that the specific design features of policies in different countries expose projects to additional risks that need to be adequately reflected in financial modeling and in deal structuring. At the same time, the auctions are going to contribute to harmonization and hence higher degree of comparability among national RES markets. They are meant to facilitate implementation of targets set in EU regulation and hence speed up the development of mature RES markets. Most importantly, the auctions may help in allocating national subsidies more efficiently (and effectively) by introducing rigorous standards and requirements for the [supply side] market participants.

(3) **The EU and national regulatory and policy changes, including introduction of the auctioning, create or stimulate certain market trends which exert the indirect impact on lenders mentioned above. This impact manifests itself and should be dealt with on two levels: general business strategy level and loan origination level.**

The recent reforms and continuous development of RES markets partly driven by the EU regulatory agenda creates certain market trends, which exert indirect impact on project finance lenders and, as mentioned above, pose new risks as well as new opportunities for them. In author's opinion, this impact can be dealt with by the lender in the context of overall business strategy on RES wind projects as well as on ad-hoc basis at the level of loan origination.

Trends and Recommendations section below provides an overview of the market trends induced by the recent reform and the author's recommendations on how to deal with them on the level of overall business strategy or on ad-hoc basis in the loan origination process.

6.2 Trends and Recommendations

<u>Part 1: general business strategy</u>

From a general business strategy perspective, project finance lenders need to know the answer to questions like "How are RES-E market trends changing because of the introduction of competitive bidding and market-based tariffs?" and "What would be the impact on developers/investors/other market players?". This paper identified the trends on European RES market and short recommendations on how lenders may adjust the project finance process following those trends. There are 4 main trends that have been identified and 4 recommendations given.

Trend 1:

- There will be increased use of market-based support mechanisms allocated via a tendering process and a reduction of direct subsidies with guaranteed long-term tariffs from all the EU Member State markets.

The EU is in a transition process towards making markets fit for the RES EU regulatory framework. National Policies of the EU Member States have a significant influence on both the supply and the demand side of their respective national markets. This is due to the fact that all national markets for wind energy are government-subsidized in one form or another. In this context, tight state budgets directly influence energy policy and regulations for renewables, and by extension, energy markets. To endure public acceptance of sustainable energy, it is necessary to keep the costs of RES subsidies interventions at acceptable levels while avoiding market disruptions.

Almost all major global and European energy agencies forecast that in the future the cost of renewable energy will continue to go down. The LCOE of wind energy has already become competitive with the LCOE of conventional power plants, which makes policy makers think that there is no need to subsidize wind farms. Following this notion, the pricy-for-tax-payers FiTs and ROCs are being replaced with FiP and CfD, remuneration levels of which are determined by a competitive bidding process. Depending of the specific country design, in some cases the new system might introduce less long-term certainty for the project, and, therefore, is considered more risky from the lender`s point of view. Because of the change in risk perception, the financing parameters that banks currently use will differ in the future.

Recommendation 1:

- Essentially, there are three ways in which an institutional project finance lender can deal with increased riskiness of onshore wind farm projects:

1) Charge higher interest on the loan: Whether the bank would be able to do this or not depends on competitive dynamics and the strategy of other lenders on the market - but a sufficiently high rate of return may compensate for a higher risk of default across the portfolio
2) Find a way to make a loan less likely to default: introduce covenants on the loan requiring higher collateral, minimum debt service reserve accounts, higher debt service coverage ratios, or other security measures;
3) Exit or reduce exposure to the renewable energy project finance market.

Of the options listed, #1 is unlikely to work in the short-term as other project finance lenders may not appreciate, and appropriately price, the new risk profile of market based energy subsidies, leading to a competitive imbalance. #3 is difficult to reconcile with the lender’s stated institutional objective to obtain deal-flow and create assets. #2, however, may provide flexibility to reduce the risk of default while still working at a market-appropriate interest rate and allowing the lender to obtain deal-flow.

Trend 2:

- Overcapacity at the market versus ambitious national renewable energy goals.

In the context of the commitment to contribute to tackling the issues of climate change and reduce GHG emissions, the EU has set for itself ambitious long-term renewable energy deployment goals. At the same time, the European market suffers from overcapacity, which causes electricity prices to go down and gives negative signals to RES developers and investors, especially in the context of a subsidy cut. The current grid codes and storage capabilities, which were made for conventional plants with dispatchable production, should be redesigned to ensure that 'green' capacity stays online and has room for growth. Furthermore, most experts agree that inefficient conventional power plants should stop being subsidized and governments should find a way to gradually remove those from the market.

Recommendation 2:

- Gain a complete understanding of what is happening on the entire electricity market of the country where the project is located. Do extensive long-term supply and demand forecasting of energy market.

While thinking about establishing business partnerships with Sponsors from a particular country, the lender should try to see a 'big picture'. The current energy demand profile might change in the future, especially if the EU moves forward with the goal to build the Energy Union - cross-border energy network between Member States. Particularly the occurrence of (even occasional) negative energy prices might have a large influence on project`s profitability, especially if the wind farm operates under the Contract for Difference tariff. Last year the research conducted on behalf Federal Ministry for Economic Affairs and Energy of Germany (Höfling et al., 2015) shows that by 2025 the number of negative electricity price hours per year can reach 230, which is a substantial number considering that the onshore wind turbine only operates for approximately 3000 hours per year. Whether the issue of negative wholesale electricity prices has a substantial impact on investment returns or not depends on the Member States' local legislations.

Trend 3

- The onshore wind market has a lower growth rate than the offshore wind market.

Experts from Wind Europe, Global Wind Energy Council, Ecofys, and DNV GL mention in their report that onshore wind can be regarded as a mature technology, which is well-established in many European countries (Italy, Denmark, the U.K, the Netherlands, Spain, Germany). Onshore wind may have reached its maximum growth rate, in many countries good sites for onshore wind are already occupied, and because of noise and visual concerns in some European countries (the Netherlands, the U.K and France for instance) large onshore wind parks have started gaining public resistance. According to Member States` NREAPs for 2015-2020, offshore wind power in the EU would need to have a compound annual growth rate of 39 per cent per year (EEA, 2016).

Large-scale offshore projects are gaining popularity among institutional project finance lenders: during the first six months of 2015 new offshore capacity installations were more than twice the capacity installed during the same period the previous year. Nevertheless, at this point, offshore wind projects are still classified as immature and expensive to build. Significant constraints from both technical and policy design perspectives and high costs make offshore wind too risky for many risk-averse lenders, such as universal banks.

Recommendation 3:

- Consider expansion to other markets: either to follow the trend and add offshore wind projects to the portfolio, or explore less mature markets including Eastern Europe, Asia, or North Africa.

Trend 4:

- The economies of scale of wind energy and the tendering system will lead to market consolidation of both developers and investors.

The general view on the wind market is that if you want to lower costs you need to 'think big'. Due to the introduction of tendering lowering the cost might become the main objective for developers since in order to obtain a contract for power supply they would need to offer the lowest bid of the price of energy that they produce. Strict technical and financial pre-requirements for the participation in the auction might leave small and inexperienced players out of the market. On the financiers' side, after some years of uncertainty because of economic crises and changing views on renewable technology and incentives, there is an increased number of larger investors coming to the market. Those investors perceive the wind market as a stable one which does not require high margins but rather aim for stable and long-term returns. On the top of that, as the market evolves, new types of investors may arise, such as insurance companies, pension funds, large corporations, multilateral lenders, and local communities. This might mean additional competition for the traditional project finance lenders.

Recommendation 4:

- Existing lenders will have an opportunity to continue to place assets only if the pricing in the market is reasonable with respect to risk. Lenders may use their existing expertise and specialized reputation in the industry to continue sourcing deals, but should be careful to work with partners who will have the ability to pay in the future. As the size of market participants' increases, new partnership models and an increase in syndication lending may be more appropriate.

Part 2: loan origination level

General recommendation: add an'auction risk' variable to the project risk assessment tool used for debt and margin sizing.

The research identified that the loan origination process might be affected by policy changes during three different stages of project finance: prior bid preparation, prior auction completion and after auction completion. Considering that this paper is focusing on two aspects of renewables support mechanism: subsidy schemes and auctions as an allocation method, the author assessed key design features of each of those two aspects.

As a result of the combination of the literature review and interviews with industry experts, specific design elements have been identified which should be included into the different stages of the project assessment process. The recommendation on which stage of the process it is relevant to include which elements is given below.

Stage 1. Bankability assessment of the support policy and market design of the potential borrower (prior bid preparation).

It is important to keep in mind that although banks make a modest return on charging fees for bid preparation and financial consultations, the main goal for an origination team (decides whether the borrower is eligible for the loan and works with a borrower during the loan origination process) is to achieve Financial Close. RES-E support frameworks in the EU Member States differ significantly and currently are in transition period. Therefore, to make sure that the bank does not waste time and resources on requests that do not match its risk 'appetite', initial bankability assessment of the current systems using the most up-to-date data is necessary.

The assessment model should include **design elements of the relevant onshore wind energy support mechanism:**

- Form of support auctioned: FiT ('the safest') or FiP ('riskier') or CfD ('the riskiest'), etc. The main idea here is that bigger is exposure of the project`s revenues to the electricity market price, the riskier the project is for the lender.
- Market players. This element should include the assessment of the (1) reliability of contract off-taker (private or state-owned utility), (2) costs allocation (who is paying for the top-up part of the tariff: end consumer or the state), (3) budget allocated (how much money per year the government allocates to the subsidy payments). The detailed assessment of market players will help to reduce regulatory and compliance risks, especially in countries like Italy, Cyprus and Spain.
- Support duration (whether the PPA covers the full duration of the loan, and if not, - whether there is a possibly to extend the PPA in the future). For instance, In Italy the tariff for onshore wind projects will be granted for a period of 20 years, in France - for 15 years. Longer contract duration might support a lending decision or structure.
- Frequency of auctions. More frequent actions with the fixed and upfront-announced schedule increase the probability of constant deal flow.
- Volume or budget cap. Budget cap is preferred since the volume cap leaves uncertainty about support costs of the capacity auctioned.

Stage 2. Project evaluation process prior auction completion.

It is very likely that with the introduction of auctioning system lenders would need to establish business relationship with the project Sponsor early in the process (before obtaining PPA). The environment in which the lender operates before the auction completion is very uncertain due to the fact that the Sponsor does not know whether it will be granted the project or not and because of that the lender has no guarantee of continued business. At this stage it would important for the lender to ensure that it does not start working with the project that has a low probability to win the auction.

In order to mitigate this risk, the lender may review specific **auction design elements that define how bids are awarded** and see whether the Sponsor would be a competitive bidder in such auction.

The assessment model may include following elements**:**

- Auction format: multi (the volume or the budget that is auctioned can be split among different winners and bids can be submitted for only part of the total auctioned amount) or single item.
- Auction procedure: static (sealed-bid/ sealed bid online) or dynamic. Dynamic auction ensure better price discovery.
- Evaluation criteria: price-only or multiple criteria. In multiple criteria auction the Sponsor would need to compete based on other characteristics besides the bidding price.
- Pricing rule. The most popular is pay-as-bid rule bidders receive the tariff not higher than was their bid.
- Ceiling price: the Sponsor can not have higher bid than the predefined price.

Stage 3. Deal structuring after auction completion.

At this stage the lender faces a high degree of uncertainty about whether the project is going to be realized or not. There is a chance that the winning bid is too low to ensure that the project can be executed within the deadline and will be able to repay the principal and the interest on the loan, or even will be executed at all.

The assessment model may include following **auction design elements that ensure that projects are realized:**

- Stage of the project development when the auction is held. If tendering takes place at the late stage of the project development is results in higher costs for the Sponsor, which it would likely need to recover in future projects.
- Complexity of pre- qualification requirements. Clear and strict requirements help to ensure that the project has everything that is needed for being realized and fully-operational within the given realization period.

- Penalties for non-compliance or delay. Well-tailored penalties ensure that there are only 'serious' bidders participating in the auction. By examining the design of the penalty the lender can estimate the probability
- Realization period/ deadline. The project realization period given to the winning bid should be realistic and correspond to the timeframe needed for obtaining the required financing, technology components and remaining permits. It also should correspond to local 'level of easiness of doing business'. For instance, for the project in Italy Sponsor has 31 months to make a wind farm fully operational; in France (for solar PV) and Germany the realization period after the auction is only 18 months.

REFERENCES

1. American Wind Energy Association (AWEA). (n.d.). Wind 101: the basics of wind energy. Retrieved from http://www.awea.org/gencontentv2.aspx?ItemNumber=900&mainnav=8190&navItemNumber=8198
2. Baker & McKenzie. (2015). *The rise of corporate PPAs A new driver for renewables*.
3. Baudry, M., Bonnet, C., & 7235, U. (2015). Market pull instruments and the development of wind power in Europe: a counterfactual analysis.
4. Benedetti, L. (2014). Italian experience in deploying renewable energy. In *RES4MED DAYS* . Rabat.
5. Blanco, M. I. (2009). The economics of wind energy. *Renewable and Sustainable Energy Reviews*. http://doi.org/10.1016/j.rser.2008.09.004
6. Bloomberg New Energy Finance. (2016). New Energy Outlook 2016. Retrieved from https://www.bnef.com/dataview/new-energy-outlook-2016/index.html#section-0
7. Charriau, P., & Desbrosses, N. (2016). *2016 Energy Trends | World energy upcoming for G20*. *Enerdata*. Retrieved from http://www.enerdata.net/enerdatauk/press-and-publication/publications/peak-energy-demand-co2-emissions-2016-world-energy.php
8. del Río, P., Haufe, M.-C., Wigand, F., & Steinhilber, S. (2015). *Overview of Design Elements for RES-E Auctions* (Vol. 2).
9. Del Río, P., & Linares, P. (2014). Back to the future? Rethinking auctions for renewable electricity support. *Renewable and Sustainable Energy Reviews*, *35*, 42–56. http://doi.org/10.1016/j.rser.2014.03.039
10. Deloitte. (2015). Establishing the investment case Wind power.
11. Dodd Jan. (2015). Analysis: Market mechanism uncertainty clouds ambitious targets | Windpower Monthly. *Wind Power Monthly*. Retrieved from http://www.windpowermonthly.com/article/1374612/analysis-market-mechanism-uncertainty-clouds-ambitious-targets
12. Energy Post. (2016). Wind number one new power generation source in EU. Retrieved from http://www.energypost.eu/wind-top-new-power-generation-source-europe/
13. European Commission. (2016). Questions and Answers on a Roadmap for moving to a low carbon economy in 2050 (March 2011). Retrieved July 29, 2016, from http://ec.europa.eu/clima/policies/strategies/2050/faq_en.htm
14. European Investment Bank. (2015). Investment Plan for Europe to support renewable energy and strategic infrastructure projects. Retrieved from http://www.eib.org/infocentre/press/releases/all/2015/2015-104-investment-plan-for-europe-to-support-renewable-energy-and-strategic-infrastructure-projects.htm
15. European Wind Energy Association (EWEA). (2009). *Wind Energy - The Facts (executive summary)*. *European Wind Energy Association*.

http://doi.org/10.1260/0309-524X.33.3.305
16. European Wind Energy Association (EWEA). (2016). *Wind in power 2015 European statistics*.
17. Eurostat. (2016). File:Share of electricity from renewable sources in gross electricity consumption (%).png - Statistics Explained. Retrieved July 29, 2016, from http://ec.europa.eu/eurostat/statistics-explained/index.php/File:Share_of_electricity_from_renewable_sources_in_gross_electricity_consumption_(%25).png
18. EWEA. (n.d.). *Design options for wind energy tenders*. Retrieved from http://www.ewea.org/fileadmin/files/library/publications/position-papers/EWEA-Design-options-for-wind-energy-tenders.pdf
19. EWEA. (2014). *Wind energy scenarios for 2020*. Retrieved from http://www.ewea.org/fileadmin/files/library/publications/scenarios/EWEA-Wind-energy-scenarios-2020.pdf
20. Fichaux, N., Singh, G., Lee, W.-J., & Vinci, S. (n.d.). 30 Years of Policies for Wind Energy: Lessons from 12 Markets (2013 Edition). Retrieved from www.irena.org
21. Fontana, A., & Frey, J. H. (1994). Interviewing: The Arts of Science. *Handbook of Qualitative Research*, *i*, 361–376. http://doi.org/10.1016/j.jconhyd.2010.08.009
22. Genoese, F., & Egenhofer, C. (2015). The Future of the European Power Market Designing a Market for Low-Carbon Electricity. *Intereconomics*, (4). http://doi.org/10.1007/s10272-015-0541-3
23. Global Wind Energy Council (GWEC). (2015). *GLOBAL WIND REPORT*.
24. González, J. S., & Lacal-Arántegui, R. (2016). A review of regulatory framework for wind energy in European Union countries: Current state and expected developments. *Renewable and Sustainable Energy Reviews*, *56*, 588–602. http://doi.org/10.1016/j.rser.2015.11.091
25. Groobey, C., Pierce, J., Faber, M., & Broome, G. (2010). Project Finance Primer for Renewable Energy and Clean Tech Projects. *Wilson Sonsini Goodrich & Rosati*. Retrieved from www.wsgr.com
26. GWEC. (n.d.). WIND IN NUMBERS | GWEC. Retrieved from http://www.gwec.net/global-figures/wind-in-numbers/
27. Harper, J. P., Karcher, M. D., & Bolinger, M. (2007). *Wind Project Financing Structures: A Review & Comparative Analysis*.
28. Höfling, H., Klobasa, M., Haendel, M., Eßer-Frey, A., Ragwitz, M., Jachmann, H., … Günther, R. (2015). *Negative Prices on the Electricity Wholesale Market and Impacts of § 24 EEG*.
29. International Energy Agency. (2014). How2Guide for Wind Energy - Roadmap Development and Implementation.
30. International Energy Agency (IEA). (2004). Renewable Energy - Market and Policy Trends in IEA Countries.
31. Investopedia. (n.d.). Debt-Service Coverage Ratio (DSCR) Definition | Investopedia. In *Investopedia*. Retrieved from http://www.investopedia.com/terms/d/dscr.asp
32. IRENA. (2014). *Adapting Renewable Energy Policies To Dynamic Market*

Conditions. *Irena*. Abu Dhabi. Retrieved from http://www.irena.org/DocumentDownloads/Publications/policy_adaptation.pdf

33. IRENA, & IEA-ETSAP. (2016). Wind power - technology Brief. *Energy*, (16), 1–16. http://doi.org/10.1049/ep.1976.0231
34. Khan, K. S., Kunz, R., Kleijnen, J., & Antes, G. (2003). Five steps to conducting a systematic review. *Journal of the Royal Society of Medicine*, *96*(3), 118–121. http://doi.org/10.1258/jrsm.96.3.118
35. Kitchenham, B., & Charters, S. (2007). Guidelines for performing Systematic Literature Reviews in Software Engineering. *Engineering*, *2*, 1051. http://doi.org/10.1145/1134285.1134500
36. Klug, H., & Wilhelmshaven, D. (2006). What does Exceedance Probabilities P90-P75-P50 Mean? *DEWI Magazin Nr*, *28*.
37. Kost, C., Mayer, J. N., Thomsen, J., Hartmann, N., Senkpiel, C., Philipps, S., … Schlegel, T. (2013). *Levelized Cost of Electricity Renewable Energy Technologies*. *FRAUNHOFER INSTITUT FOR SOLAR ENERGY SYSTEMS ISE LEVELIZED*. http://doi.org/10.1613/jair.301
38. Krohn, S., Morthorst, P.-E., & Awerbuch, S. (2009). *The Economics of Wind Energy*.
39. Latacz-Lohmann, U., & Schilizzi, S. (2005). *Auctions for Conservation Contracts: A Review of the Theoretical and Empirical Literature*. *Report to the Scottish Executive Environment and Rural Affairs Department (Project No: UKL/001/05)*. Retrieved from http://www.scotland.gov.uk/Publications/2006/02/21152441/0
40. Leung, D. Y. C., & Yang, Y. (2012). Wind energy development and its environmental impact: A review. *Renewable and Sustainable Energy Reviews*, *16*(1), 1031–1039. http://doi.org/10.1016/j.rser.2011.09.024
41. Manwell, J. F., McGowan, J. G., & Rogers, A. L. (2009). *Wind energy explained: theory, design and application*. *John Wiley&Sons Ltd, UK*. http://doi.org/10.1002/9781119994367
42. Maurer, L., & Barroso, L. (2011). *Electricity Auctions*. *Journal of Economics & Management Strategy* (Vol. 10). http://doi.org/10.1596/978-0-8213-8822-8
43. Menanteau, P., Finon, D., & Lamy, M. L. (2003). Prices versus quantities: Choosing policies for promoting the development of renewable energy. *Energy Policy*, *31*(8), 799–812. http://doi.org/10.1016/S0301-4215(02)00133-7
44. Mulrow, C. D. (1994). Education and debate Systematic Reviews: Rationale for systematic reviews. *BMJ*, *309*, 597–599.
45. Noothout, P., de Jager, D., Tesnière, L., van Rooijen, S., Karypidis Robert Brückmann, N., Jirouš Barbara Breitschopf Dimitrios Angelopoulos, F., & Doukas Inga Konstantinavičiūtė Gustav Resch, H. (2016). The impact of risks in renewable energy investments and the role of smart policies.
46. Petticrew, M., & Roberts, H. (2006). *Systematic Reviews in the Social Sciences: A Practical Guide*. *Cebma.Org*. http://doi.org/10.1027/1016-9040.11.3.244

47. Ragwitz, M., Fraunhofer-Isi, F. T., Resch, G., Faber, T., Haas-Eeg, R., Hoogwijk, M., … Rathmann-Ecofys, M. (2006). Economic analysis of reaching a 20% share of renewable energy sources in 2020.
48. Ragwitz, M., Held, A., Resch, G., Faber, T., Haas, R., Huber, C., … Heyder, B. (2007). Assessment and optimisation of renewable energy support schemes in the European electricity market. *Energy*, 1–246.
49. Raines, T., & Tomlinson, S. (2016). *Europe's Energy Union: Foreign Policy Implications for Energy Security, Climate and Competitiveness*.
50. Ruska, M., & Similä, L. (2590). Electricity markets in Europe Business environment for Smart Grids. *VTT RESEARCH NOTES*. Retrieved from http://www.vtt.fi/publications/index.jsp
51. RWE AG. (n.d.). RWE AG - How the electricity price is determined. Retrieved from http://www.rwe.com/web/cms/en/403722/rwe/press-news/how-the-electricity-price-is-determined/
52. Sáenz de Miera, G., del Río González, P., & Vizcaíno, I. (2008). Analysing the impact of renewable electricity support schemes on power prices: The case of wind electricity in Spain. *Energy Policy*, *36*(9), 3345–3359. http://doi.org/10.1016/j.enpol.2008.04.022
53. Sensfuß, F., Ragwitz, M., & Genoese, M. (2008). The merit-order effect: A detailed analysis of the price effect of renewable electricity generation on spot market prices in Germany. *Energy Policy*, *36*(8), 3076–3084. http://doi.org/10.1016/j.enpol.2008.03.035
54. Stankeviciute, L., & Criqui, P. (2008). Energy and climate policies to 2020: the impacts of the European "20/20/20" approach. *International Journal of Energy Sector Management*, *2*(2), 252–273. http://doi.org/10.1108/17506220810883243
55. Tom Randall. (2015). Solar & Wind Reach a Big Renewables Turning Point : BNEF - Bloomberg. *Bllomberg*. Retrieved from http://www.bloomberg.com/news/articles/2015-10-06/solar-wind-reach-a-big-renewables-turning-point-bnef
56. Vattenfall AB. (2011). *Six Sources of Energy – One Energy System*. Stockholm: Alloffset. Retrieved from http://corporate.vattenfall.com/globalassets/corporate/about_vattenfall/generation/six_sources_of_energy_one_energy_system.pdf
57. Wigand, F., Förster, S., Amazo, A., & Tiedemann, S. (2016). *Auctions for Renewable Energy Support: Lessons Learnt from International Experiences)*. Retrieved from http://auresproject.eu/files/media/documents/aures_wp4_synthesis_report.pdf
58. Wind Energy Programmatic EIS. (n.d.). Wind Energy Basics. Retrieved January 1, 2016, from http://windeis.anl.gov/guide/basics/
59. Wind Europe. (n.d.). Wind energy is competitive. Retrieved from https://windeurope.org/policy/topics/economics/
60. Wind power. (2016). In *Wikipedia*. Retrieved from https://en.wikipedia.org/wiki/Wind_power
61. Zervos, A., Kjaer, C., Azau, S., Scola, J., Quesada, J., & Bianchin, R.

(2009). Pure power–wind energy targets for 2020 and 2030. *European Wind Energy Association*, *250*, 1–96. Retrieved from http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Pure+Power.+Wind+Energy+targets+for+2020+and+2030#0

Additional sources:

1. Employees of Norddeutsche Landesbank office in London (July, 2016). Personal interview.
2. Four Quadrant Project Finance. (n.d). *Project Finance Foundations [online course]*. (2016). Retrieved July 29, 2016, from https://fourquadrant.articulate-online.com/Login.aspx?ReturnUrl=/UserPortal/Content.aspx?Cust
3. Low Carbon Contracts Company (2015, October). *The CFD and LCCC's approach to contract management.* Presentation at Investor Event.
4. GL Garrad Hassan (2012, January). *Technical Risks in Wind Farm Investments*. Presentation at Norddeutsche Landesbank.

Appendix 1.

A selective list of policy and regulatory documents for the RES energy sector

Strategies, roadmaps and action plans

1. Communication from the Commission, 'A policy framework for climate and energy in the period from 2020 to 2030', COM(2014) 15.
2. Green Paper, 'A 2030 framework for climate and energy policies', COM(2013) 169 final.
3. Regulation (EU) No 347/2013 on guidelines for trans-European energy infrastructure and Commission Delegated Regulation (EU) No 1391/2013 amending Regulation (EU) No 347/2013 of the European Parliament and of the Council on guidelines for trans-European energy infrastructure as regards the Union list of projects of common interest.
4. Regulation (EU) No 1316/2013 establishing the Connecting Europe Facility.
5. Report from the Commission to the European Parliament and the Council, 'The state of the European carbon market in 2012', COM(2012) 652 final.
6. European Commission Communication 'Making the internal energy market work', COM(2012) 663 final.
7. European Commission Communication 'Energy Roadmap 2050', COM(2011)885 final.ss
8. European Commission Communication 'A Roadmap for moving to a competitive low carbon economy in 2050', COM(2011) 112 final.
9. European Commission Communication 'Roadmap to a Resource Efficient Europe', COM(2011) 571 final.
10. Commission Staff Working Paper 'Energy infrastructure investment needs and financing requirements', SEC(2011) 755 final.
11. ENTSO-E – European Network of Transmission System Operators for electricity, 'Ten-year Network Development Plan'.
12. ENTSOG – European Network of Transmission System Operators for Gas, 'Ten-Year Network Development Plan'.
13. Member States' National Renewable Energy Action Plans.247
14. Member States' National Energy Efficiency Action Plans.248

Electricity and renewable sources

1. European Commission Communication, 'Delivering the internal electricity market and making the most of public intervention', COM(2013) 7243 final.
2. European Commission Communication, 'Renewable Energy: a major player in the European energy market', COM(2012) 271 final.
3. European Commission Communication, 'Smart Grids: from innovation to deployment', COM(2011) 202 final.

4. Directive 2009/72/EC concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC and Regulation 714/2009.
5. Directive 2009/28/EC on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.

Energy efficiency

1. Commission Staff Working Document, Guidance note on Directive 2012/27/EU on Energy Efficiency, amending Directives 2009/125/EC and 2010/30/EC, and repealing Directives 2004/8/EC and 2006/32/EC.
2. Directive 2012/27/EU on Energy Efficiency.
3. Directive 2010/31/EU on the Energy Performance of Building

Appendix 2.

Common design elements of the RES-electricity auction

COMMON DESIGN ELEMENTS	
Target setting	Targets are an inherent design element in TGCs (quotas) and tenders. Absolute (MW, MWh), relative (% of electricity demand). Capacity (MW), generation (MWh), budget (M€) caps. RES targets are currently relative. In the past, absolute capacity caps (FITs, tenders), generation caps (TGCs) and budget caps (the Netherlands) were common.
Budget vs. consumer-financed.	The cost burden for RES-E support may lie on either electricity consumers or taxpayers (i.e., the public budget). In the EU, it usually falls on consumers.
Existing vs. new plants included	Either existing or new plants may be eligible for support. The aim of support schemes is mainly to promote new capacity. However, following the principle of non-retroactivity, existing plants would be promoted under current (national) RES-E support schemes until these are phased-out (i.e., until the guaranteed period for support ends). Auctions can also be used to remunerate the continuous operation or retrofitting of existing plants where the old support duration is running out.
COMMON DESIGN ELEMENTS WITH INSTRUMENT-SPECIFIC IMPLEMENTATION	
Support-level setting	RES-E support is usually provided per unit of output (MWh), but can generally also be provided per unit of capacities installed (MW).The level of remuneration can be set in a different manner in different instruments. Under FIPs and FIT schemes, as well as for investment grants, support levels can be set either administratively or through an auction mechanism. Under a quota scheme with TGCs are also set competitively (depending on the interactions between supply and demand in the TGC market in this later case).
Technology-specific vs. technology-neutral	A similar support level might be provided for all technologies (regardless of their generation costs) or support may be modulated according to those costs. The manner in which support is provided to specific technologies is clearly very different under different support schemes in practice: FITs and FIPs are usually differentiated across technologies to reflect technology-specific generation costs. The alternative is to have a uniform fixed tariff or a uniform premium for all technologies. If the FIT or FIP level is set through an auction mechanism rather than administratively, technology-neutral auctions can be used to set a uniform tariff, and separate auction rounds for different technologies can be used to set technology-specific support levels. Quotas with TGC: Banding can be implemented through carve outs or through credit multipliers. Under carve-outs, targets for different technologies exist, leading to a fragmentation of the TGC market, with one quota for the mature and another for the non-mature technologies. Under credit multipliers, more TGCs are granted per unit of MWh generated for immature technologies compared to mature technologies. The

	alternative is no use of carve-outs or credit multipliers
Location specific vs. location-neutral	Support levels might be modulated according to the location of the plant, with greater support levels provided for plants deployed in places with greater generation costs (e.g., worse resource conditions). At first, this may seem at odds with economic efficiency, since installations would not be promoted where generation costs are minimised. However, if the good sites are limited, the producer surplus could be excessive and plant installation not be in pace with grid development. The rationale behind location-specific support is to avoid concentration of renewable energy projects in a few locations and avoid excessive remuneration levels in favourable locations. FIT and FIP: Administratively set support levels can be modulated according to the location of the plant (stepped FIT/FIP). The same is possible for FITs/FIPs allocated by auctions. In addition, site selection under auctions can be influenced by considering only pre-approved sites. TGCs: Different number of TGC according to the location of the plant.
Size-specific vs. size-neutral	Support may be differentiated according to the size of the installation, taking into account that, generally, the generation costs (€/MWh) of larger installations are lower since they benefit from economies of scale. FIT and FIP: Under administrative support level setting, FIT/FIP level modulated according to the plant size. Smaller FIT for large-scale and higher tariffs for small-scale plants. Only installations below a certain capacity threshold would receive the support (stepped FIT/FIP). Under FIT/FIP level setting with auctions, it is theoretically possible to control for plant size by holding different auction rounds for different size projects. However, allocating FITs/FIPs through an auction mechanism is generally more appropriate for large-scale installations. TGCs: Small-scale installations receive more TGCs than large-scale installations. Only installations below a certain capacity threshold are eligible to receive TGCs.
Constant or decreasing support level during support period	Support for existing plants may be greater at the start of the period and be reduced over time (either an annual percentage reduction or a stepped reduction after some years) or support may be constant over time. All in all, the terms and conditions of this reduction should be known beforehand and are instrument-specific.

Appendix 3

Capital cost breakdown of 20 MW onshore wind farm in Mexico

		2014 USD million	Share
Civil works and grid connection	Civil works of wind turbines	8.15	18.2%
	Measurement tower	0.09	0.2%
	Construction costs	0.31	0.7%
	Construction indirects costs	1.11	2.5%
	Land rent	0.17	0.4%
Sub-total		**17.57**	**22.0%**
Wind turbines and installation	Turbines price	20.64	46.1%
	Transportation of the wind turbines	2.27	5.1%
	Electrical infrastructure of wind turbines	7.74	17.3%
Sub-total		**22.91**	**68.5%**
Planning & management	Management cost	0.46	1.0%
	Administrative cost	3.80	8.5%
Sub-total		**4.27**	**9.5%**
TOTAL COST		**44.74**	**100.0%**