EU and Regional Policies for Offshore Wind: Creating Synergies

FOUNDATION OFFSHORE WIND ENERGY

4POWER
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EU and Regional Policies for Offshore Wind: Creating Synergies

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Introduction

This report outlines key priorities for EU policies in support of offshore wind deployment, with an emphasis on the interaction and potential synergies between policy making at EU and regional levels. It is addressed to all parties interested in policy making regarding offshore wind at EU level, including policy makers in the EU, national and regional institutions, as well as economic stakeholders and civil society.

The report was compiled on the basis of the input provided by the partners of the 4POWER project, which brought together experts from ten regions of nine EU Member States who engaged in an intensive dialogue on the regional policy dimensions of offshore wind development. The experts came from a variety of organisations, including regional government, regional economic development agencies, research institutions and the offshore wind sector.

The partners of the 4 POWER project are: The Province of Groningen (Netherlands), the Province of Rimini (Italy), the Sustainable Industries Institute at Dundee College (Scotland, UK), the Latvian Association of Local and Regional Governments, the Rostock Business and Technology Development GmbH (Germany), the Maritime Institute in Gdańsk (Poland), the Azorina Society for Environment Management and Nature Conservation (Portugal), the Municipality of Corfu (Greece), the Malta Intelligent Energy Management Agency, the City of Emden (Germany) and the German Offshore Wind Energy Foundation.

This paper builds upon a dialogue between regional experts and the insights they provided. It generally reflects a consensus which emerged over the course of the project. However, not all views expressed in this report are necessarily endorsed by each of the project partners. Taking into account the institutional character of some of these partners, this would not have been possible. Thus, the final responsibility for the contents of this report lies with its lead author, the German Offshore Wind Energy Foundation.

Executive Summary

This document outlines key priorities for EU policies in support of offshore wind deployment, with a particular focus on the interaction and potential synergies between policy making at the EU and regional levels. The three key priorities at the EU level are:

- Adopting and implementing ambitious and binding renewable energy targets for 2030 and a longer-term energy policy vision extending to 2050.
- Ensuring that Member States can and will implement effective support schemes for offshore wind.
- Providing a favourable framework for connection of offshore wind power plants to the grid and for offshore and onshore power grid expansion.

The analysis shows that EU policy development in these and other areas of EU competence can have a significant impact on regional policies as well, thereby creating positive (or negative) synergies between the different levels of governance.

Chapter 1 describes the main rationales for considering offshore wind deployment a public policy objective: security of energy supply, economic development, climate change mitigation, and low impact on the regional environment. Offshore wind generates electricity both more steadily and predictably than onshore wind. Compared to onshore renewables in general, offshore wind requires very little land use and often enjoys greater levels of acceptance. For these reasons, offshore wind is an essential component of a future power system based on high proportions of renewable energies.

Chapter 2 illustrates the offshore wind deployment trends, based on European market statistics.

Chapter 3 discusses the large potential for economies of scale and for technological learning at each stage of the value chain. It shows that substantial cost reductions are achievable through steady deployment, and by providing a credible long-term political commitment for future deployments.

Chapter 4 briefly discusses the interaction between EU and regional policy making for offshore wind, in the context of the European multi-level system of governance. Ideally, the different levels of government complement and positively reinforce one another. However, the opposite may occur as well. For instance, if the EU level downgrades its degree of commitment to renewables and the associated policy framework in general, or specifically for offshore wind, regions that have invested in physical and social infrastructure to support offshore wind development may see these investments stranded. Resulting disappointment may lead to a loss of trust in any long-term energy and climate policy targets and in any pronouncements coming from the EU and/or national levels.

Chapter 5 looks at the key fields of EU policy making for offshore wind: long term vision and targets, support schemes and electricity market design, electricity grid issues, maritime spatial planning, RD&D, training and education, awareness raising and public acceptance. Each of these seven themes is discussed in a dedicated section, which includes a short analysis and the definition of the key priorities at EU level, with a particular focus on how positive synergies between the EU and regional policy making levels can be created. At the end of each subsection, the main priorities are summarised in a short text box.

1. Why offshore wind

Offshore wind deployment is instrumental in the achievement of several public policy goals. Security of energy supply, climate change mitigation and economic development are among the most urgent. To create an economically and environmentally sustainable supply system based on domestic European resources, Europe needs to deploy a strong mix of renewable energy sources and energy efficiency measures. Within this mix, offshore wind will play a major role in the long term, due to its specific advantages: a low level of land use, a low impact on people and environment, and a comparably steady and predictable generation profile.

Security of supply: the EU imports most of the energy it consumes. In 2012, import shares were 98% of the EU's uranium consumption (Euratom 2013), 86% of oil, 66% of gas and 42% of solid fuels (Eurostat database). Reducing Europe's dependence on energy imports is a top priority of EU energy policy making. Offshore wind can make a substantial contribution towards attaining this goal. Under ideal conditions, 150 GW of offshore wind capacity could be in operation in European waters by 2030. In an average wind year, this would produce approximately 562 TWh of electricity (EWEA 2011), equal to 14% of the EU's electricity demands. The total offshore wind potential is much larger. According to a 2009 study by the European Environment Agency, the technical potential of offshore wind in Europe is seven times larger than Europe's electricity demand. After excluding offshore wind projects in areas constrained by environmental regulations and other restrictions, the offshore wind potential is still a remarkable 80% of total electricity demand (EEA 2009). In conjunction with other renewables, offshore wind can power Europe with 100% domestic, renewable and unlimited energy.

In the long-term, security of supply can only be guaranteed by a strong mix of energy efficiency measures and sustainable production of renewable energy. Even if domestic shale gas or coal production would be expanded, these resources will one day be depleted, the resulting damage to the local environment and the global climate will however remain.

Economic development: Currently, Europe's industry is indisputably the global leader in offshore wind energy. According to data of Deloitte, total employment in the EU wind energy sector (onshore and offshore) was 238,000 in 2010, and "offshore wind energy is between 2.5 and three times more labour intensive than onshore wind energy" (EWEA 2012). Unlike other sectors, the wind energy industry is planning to expand its highly skilled labour pool: nearly 50,000 additional trained staff will be needed in the wind energy sector (onshore and offshore) by 2030 (EWEA 2013a). Jobs in installation and O&M in the offshore sector are on average better paid. Most of the turnover related to offshore wind energy remains in the European economy. Moreover, maintaining Europe's leadership will provide substantial export opportunities for the European economy as a whole. Significant positive effects on employment can occur, especially in regions where offshore wind is deployed.

Climate change mitigation: Offshore wind turbines produce no emissions in their operation and have an extremely low life-cycle climate balance (Wagner 2010). According to the low-carbon economy roadmap of the European Commission, all scenarios compatible with moderating climate change to a manageable level require an almost complete decarbonisation of the power sector by 2050 (Comm 2011a). The European Commission's Energy Roadmap 2050 sees energy efficiency and renewables as the no-regrets options to decarbonise the power sector (Comm 2011b). Therefore, regardless of the scenario which might be considered more likely, the large-scale employment of energy efficiency measures and renewables will in any case be necessary. The alternative options for decarbonising the power sector would be nuclear energy and CCS (carbon capture and sequestration). Since the Commission published the two roadmaps mentioned above, prospects for deployment of nuclear and of CCS in Europe have in the meantime declined (WNISR 2013, Global CCS 2014). Thus, to tackle climate change, the urgency to achieve high shares of renewables in the power sector has further grown.

Low impact on regional environment: Unlike offshore oil and gas (OSPAR 2009), offshore wind farms produce bulk amounts of energy with very low environmental impact (Wagner 2010). Increasing the understanding of the environmental context, along with careful siting, can further minimise the impact. Positive effects on local marine biodiversity have been observed (Lindeboom 2011, Wilhelmsson 2010). The industry is working hard to reduce the acoustic impact on marine life during construction.

Land use: Some European countries with high offshore wind potential are among the most densely populated in the world. Offshore wind facilitates large-scale renewable energy deployment with extremely low levels of land use.

Acceptance: In general, offshore wind deployment has a very low impact on the public. Usually, the concerns centre mainly on the visual impact of the turbines, especially if built close to shore. However, empirical studies show that, even in touristic areas, once the projects are completed, acceptance increases (Albrecht 2013). Dealing with acceptance issues implies comparing alternatives. The transition to renewables enjoys broad acceptance. A number of surveys (for instance Eurobarometer 2011, Eurobarometer 2014) have shown that an overwhelming majority of Europeans is in favour of increasing the use of renewables, more than any other energy sources. However, at a certain level of deployment, the acceptance for further onshore wind farms, biogas plants or other facilities can decline. In some regions, this trend can already be observed, even in countries where renewable energies enjoy particularly high public support, like for instance Denmark and Germany. Thanks to its generally low impact on people, and to very low levels of land usage, offshore wind provides the opportunity to achieve higher shares of renewables with fewer acceptance problems.

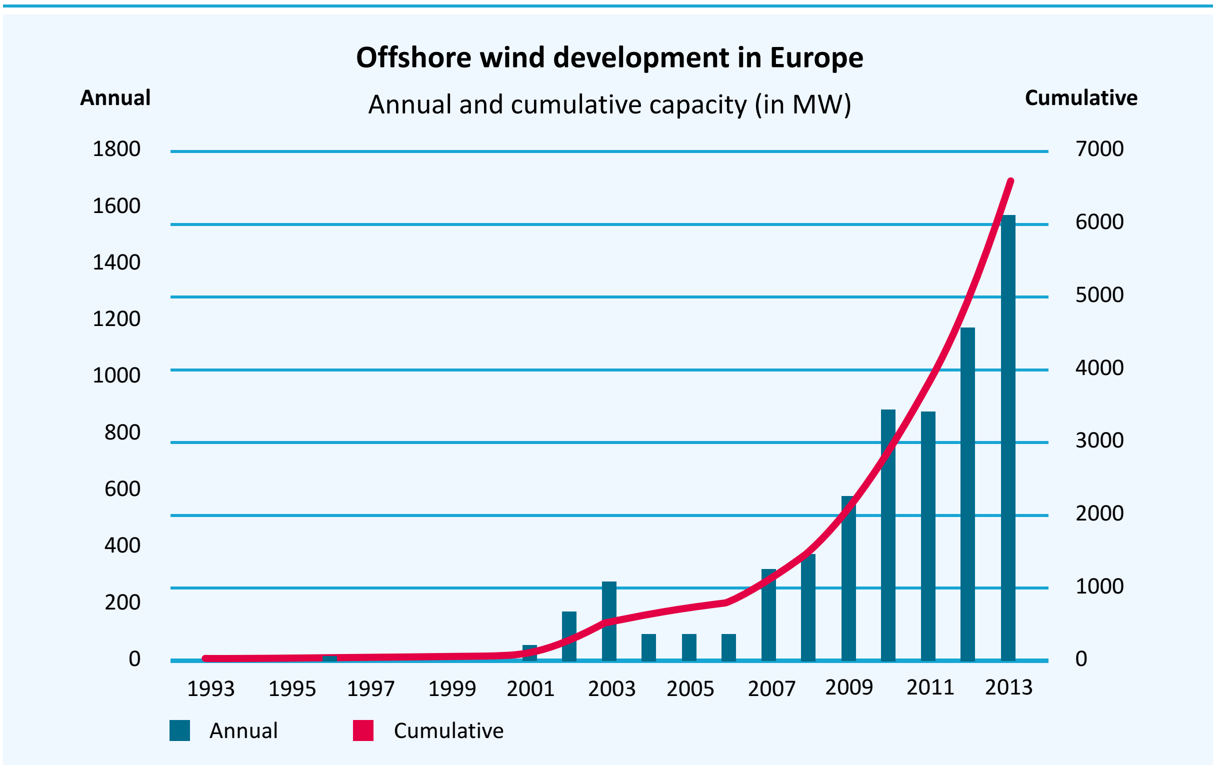
More constant and predictable generation: In a power system with high shares of renewables, offshore wind energy will play an essential role due to its specific strengths. With high shares of wind and solar energy, the power sector of the future will have to cope with a high degree of variability in generation. This challenge is manageable, but it comes with certain costs and adaption requirements. Offshore wind helps mitigate the challenge, since its generation profile is significantly more constant and predictable than onshore wind and solar PV (IWES 2013). Offshore wind increases the firm capacity deliverable by the renewable energy portfolio, and reduces the need for reserve generation capacities.

2. Offshore wind at the threshold to large-scale deployment

Offshore wind energy is a young, very rapidly developing technology, at the threshold to large-scale deployment.

The first test turbines were installed in the 1990s. By the end of 2013, 2,080 turbines were operating in European waters. During 2013 alone, 522 new turbines were erected, an average of 4.3 MW per day, although some of these are still awaiting grid connection.

The cumulative offshore wind capacity connected to the grid in Europe reached 36 MW in 2000, 712 MW in 2005, 2,956 MW in 2010 and 6,562 MW by the end of 2013. Furthermore, at this time approximately 3,000 MW were under construction and around 22,000 MW had been consented (EWEA 2014).



Data source: EWEA (2014)

Although the investment necessary to obtain all permits for an offshore wind farm is considerable, many consented projects are presently on hold because in several countries the current circumstances are not adequate to trigger investment. The most common hurdles are the conditions surrounding remuneration of investments (power market prices, inadequate support schemes) and grid connection problems. Nevertheless, the cumulative European offshore wind fleet is likely to cross the 10,000 MW mark by 2015/2016 at the latest, which would be a more than twelvefold increase within one decade.

The European Wind Energy Association estimates that total investments in offshore wind farms lay between €4.6 billion and €6.4 billion in 2013 alone. This refers just to investment in wind farms and does not include investments in the supply chain, R&D, and infrastructure on land.

Europe is the global leader

Europe is the global offshore wind leader. European manufacturers are internationally leading in most key technological areas, including offshore wind turbines, foundations, platforms, vessels and subsea cables. According to the Global Wind Energy Council, Europe was home to approximately 99% of the offshore wind capacities in operation in 2012. However, the potential for development is large also in other parts of the world. Large-scale projects are now being developed in North America and Asia. China has set itself a target of 5 GW offshore wind to be in operation by 2020. These trends will generate important export opportunities for the European offshore wind industry, but will also enable competitors from outside Europe to challenge its technological leadership position.

Geographical spread within Europe

The number of European countries actively involved in the offshore wind energy sector is increasing, with offshore turbines now operating in ten European countries, with others also producing components.

With its share of 56% of the European installed capacity at the end of 2013, the UK is by far the global leader in offshore wind. Together with Denmark and Belgium, 84% of the European offshore wind capacity currently in operation is concentrated in just three countries. However, with 2,325 MW under construction and a further 870 MW with firm investment commitments expected to come online by 2016, Germany is likely to become the second largest offshore wind energy producer in the near future (OffWEA database). However, this position might be challenged by France in a few years, which awarded tenders for 1,900 MW in 2012 and officially plans to build 6,000 MW by 2020. Additional capacities have also been approved in the Netherlands, Belgium, Sweden, Finland, Ireland, Estonia, Italy and Greece (EWEA 2014).

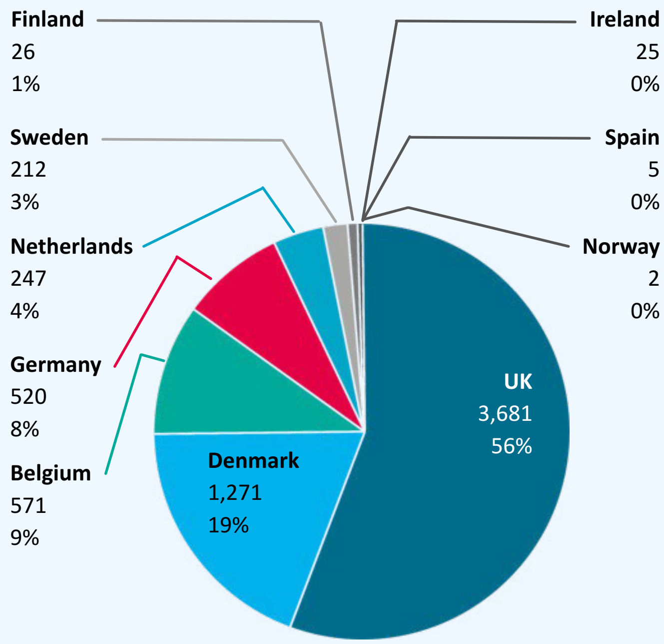
Larger, deeper and further

The technology and nature of offshore wind projects is evolving rapidly. The average capacity of an individual new offshore turbine increased from 2 MW in 2002, to currently around 4 MW. The average size of offshore wind projects increased from less than 100 MW during the last decade to 482 MW in 2013.

At the same time, offshore wind farms are being built progressively further from shore and in deeper waters. Most previously constructed projects are within 25 km from shore, and at less than 25 meters depth, whilst most of the projects currently approved are in deeper waters, in depths up to 40-50 meters, and located much further from shore, up to 100 km out (EWEA 2014).

Offshore wind installed capacity by country at the end of 2013

(in MW and as % of total in Europe)

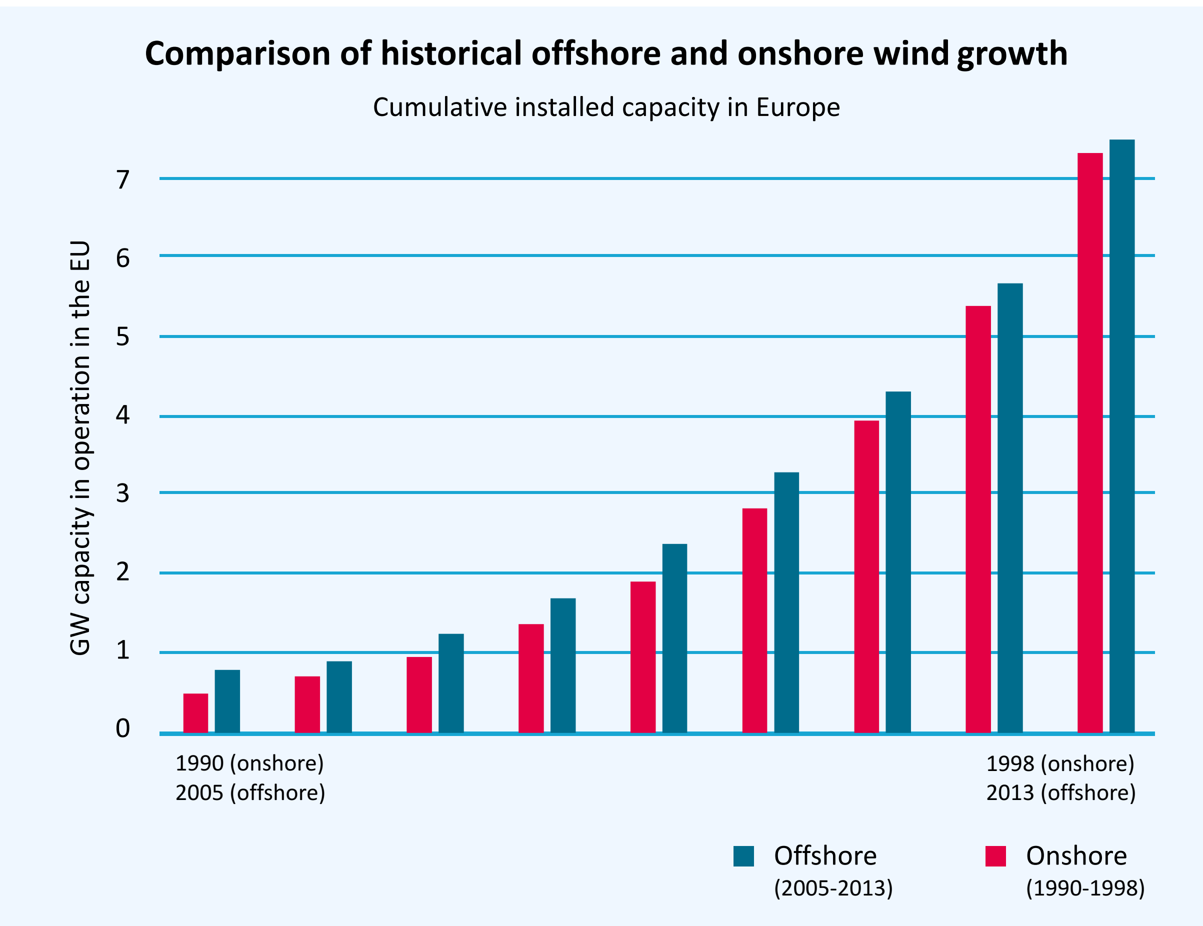


Data source: EWEA (2014)

3. Cost reduction through deployment and reliable long-term commitment

Currently, offshore wind has higher costs than other renewable energy sources such as onshore wind and solar PV. However, offshore wind is a young technology that started industrial level development only a few years ago. The potential for cost reduction through economies of scale and technological learning is large. This potential can only be realised through continuous deployment and long-term political commitment.

The chart below shows that offshore wind deployment during the last decade has followed a growth rhythm very similar to that of onshore wind 15 years earlier. During the 1990s, thanks to steady political support in some frontrunner countries (notably Denmark, Germany and Spain), onshore wind experienced continuous growth, triggering large-scale investments throughout the value chain. These investments paved the way for the technological improvements and economies of scale that fuelled onshore wind's spectacular global growth since the beginning of this century. Today, more than 110 GW of onshore wind are in operation in the EU, covering 8% of EU electricity demand (EWEA 2014a). That is nearly 20 times more than in 1998, the last year shown in the chart below. What's more, new onshore wind plants at good sites now produce electricity at a lower total cost than do new fossil fuel plants.



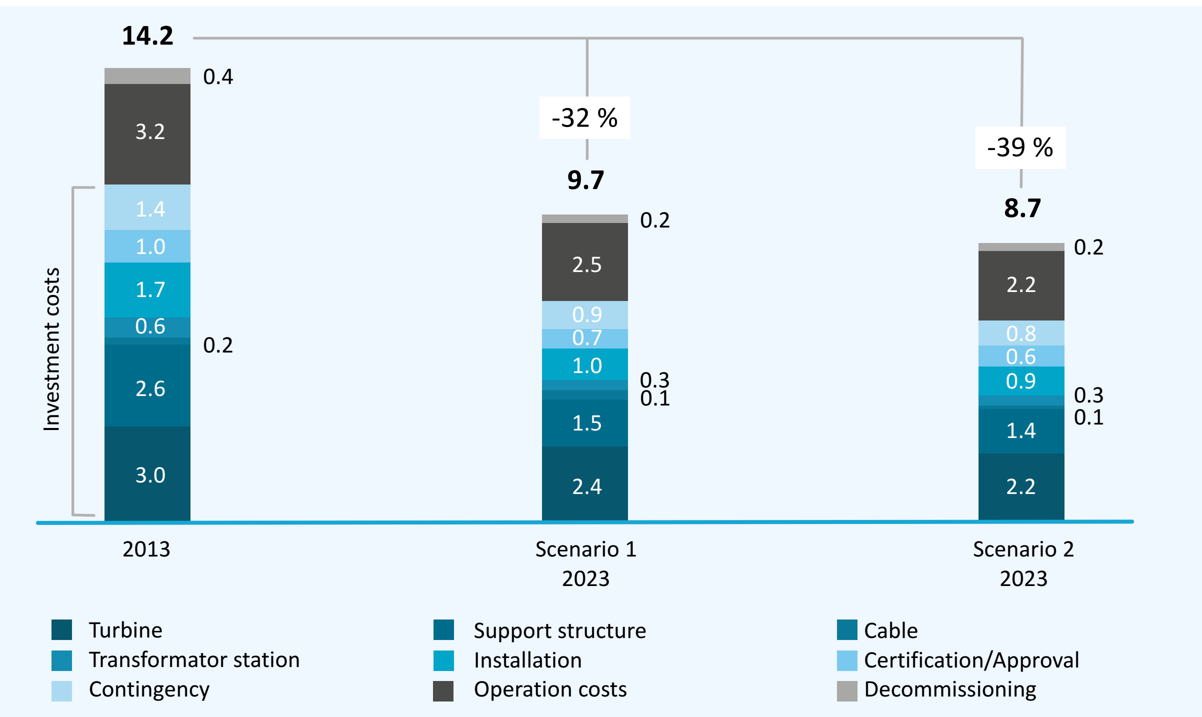
Data source: EWEA

For several reasons, cost decreases have not, or less rapidly than expected, materialised for offshore wind over the last years. One cause has been the presence of bottlenecks in parts of the supply chain, which could not cope with the rapidly increasing demand. This was partially also the case with respect to subsea cables or specialised vessels. At least for the latter, the situation has now improved. Moreover, some experts argue that deep-water, far-from-shore projects are very different from the "wet feet" projects, undertaken in shallow waters close to shore, which had been deployed in earlier years. Economies of scale and learning curves have been temporarily set back by a few years, until sufficient experience has again been gained (Piria 2012).

Bringing down costs is widely recognised as a key priority for the offshore wind industry. Industry insiders are convinced that very significant cost reductions can be achieved if deployment continues.

Development of the levelised cost for offshore wind energy in real terms

According to a detailed study on behalf of the German Offshore Wind Energy Foundation (Fichtner and Prognos 2013), the levelised cost of electricity from new offshore wind farms could decrease by 32% to 39% within the decade from 2013-2023. This data refers to an offshore wind farm site at 40 meters water depth, 80 km from port, and a wind speed of 10 m/s. Even in the less favourable scenario presented below (lower offshore wind deployment and therefore less technological learning and economies of scale), costs for offshore wind can become comparable with those of new fossil power plants within a decade from now, provided that the level of deployment enables cost reductions to materialise.



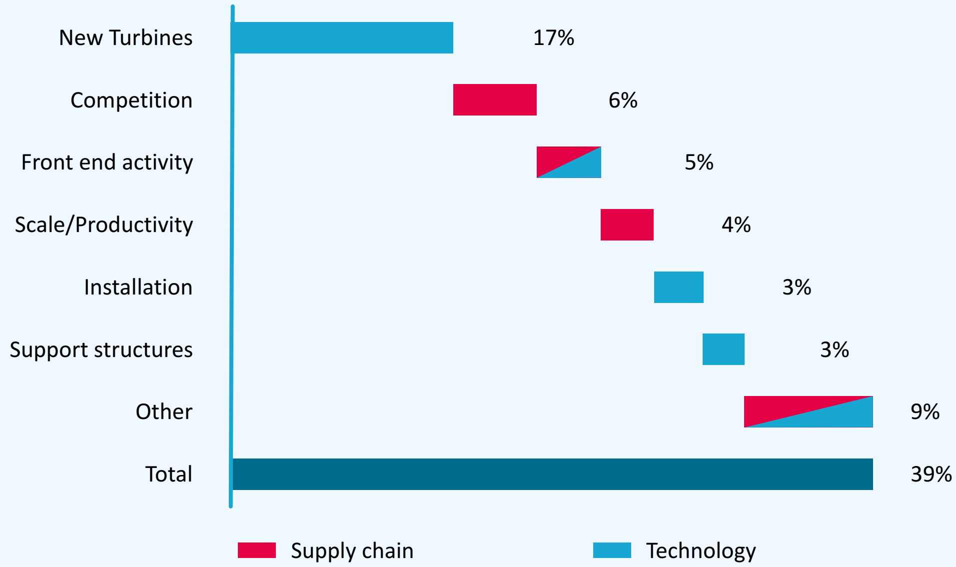
Data source: Fichtner and Prognos (2013)

The chart above shows that there is significant potential for cost reduction in all elements of offshore wind projects, most notably turbines, foundations, installation, operation and contingency. Last but not least, the cost of capital can be expected to decline significantly, as increasing project experience and learning curve effects caused by a stable market environment reduce risk premia.

A study by The Crown Estate, the public agency that manages the property owned by the Crown of the United Kingdom, comes to similar conclusions: a cost reduction of 39% could be achievable within just nine years (TCE 2012), as shown in the chart below. The UK results apply to offshore wind energy projects with a final investment decision occurring in 2020, i.e. commissioning 3-4 years later.

Offshore wind power cost reduction opportunities from technology and supply chain

% reduction in levelised cost of energy FID 2011 to FID 2020



Data source: The Crown Estate (2012)

The importance of providing a long-term perspective

This large potential for cost reductions will only be realised if a steady development of demand provides the incentive for long-term investments into the various elements of the supply chain.

Among renewable energies, offshore wind energy projects have the longest development times, the largest investment volumes and the most challenging infrastructural requirements. For these reasons, the offshore wind energy sector's development is particularly sensitive to long-term energy policy targets and debates. Taking into account the lead times for offshore wind energy investment strategies, the year 2030 is the day after tomorrow. Therefore, long-term energy policy targets and continuity in energy policy are essential prerequisites for offshore wind energy development.

4. Offshore wind in the European multi-level governance system

In the last decades, the European Union has developed into a multi-level system of governance. Public policies are shaped by a complex interaction of the European, national, regional and local political levels. In many ways, this applies also to the set of policies that are relevant to the development of offshore wind energy.

Ideally, the different levels of government complement and reinforce each other: according to the principle of subsidiarity established in the EU Treaty, the EU acts in areas where objectives cannot be adequately achieved by the Member States alone, either at central level or at regional and local level, and can be better attained at Union level. However, multi-level governance does not always conform to the ideal. Lack of coherence and coordination between the different levels of government can hamper the realisation of potential synergies. The different levels of government may pursue coherent objectives, but using instruments and measures that de facto hinder each other. In some cases, the different levels may even pursue conflicting objectives.

This paper focuses on offshore wind policy making at the EU level, with particular emphasis on its interaction with the regional level. Of course, the national level plays a decisive role as well, as it establishes the support schemes and grid connection rules within the framework of EU treaties and legislation.

Virtuous or vicious circle

In a virtuous circle, EU level policies are able to generate a positive climate for investments in offshore wind. Building upon this, engaged regional authorities invest money and develop political drive to create positive framework conditions at regional level, paving the way for those investments to be attracted to their region. The regional and the EU level positively reinforce each other, reducing the costs and time needed to achieve accepted public policy goals, such as climate protection, security of energy supply and sustainable economic development.

However, a vicious circle can occur if the two levels pursue diverging paths, or if they are not sufficiently coordinated in timing. If regional authorities do not support, or perhaps even impede, offshore wind deployment, the opportunities created by a positive framework at European/national level cannot be secured, or only at higher costs. This may jeopardise the achievement of the European targets. However, greater damage can occur in the opposite case, if for instance, the EU and/or a region´s national government decides to downgrade the core conditions for offshore wind deployment, such as the level of ambition and commitment to attain renewables targets, or the schemes for remuneration of offshore wind investments. In this case, regional authorities that may have invested in physical and social infrastructure in support of offshore wind development, having counted on the fact that offshore wind is essential to reach the long-term EU energy and climate policy targets, face stranded investments. The resulting disappointment may lead to a loss of trust in long-term energy and climate policy targets and pronouncements coming from the national and/or EU level.

The regions that have made, or are making, long-term investments in their physical and social infrastructure to favour offshore wind development have a legitimate interest in demanding that the EU and the national levels of government provide for stable framework conditions which enable offshore wind investments to materialise.

5. Policy priorities at the EU level

This section outlines the priorities for EU policy making from the point of view of the offshore wind energy sector, with a particular focus on the interaction between the EU policy level and the regional level. The key questions addressed here are:

1. How can the EU level of government support offshore wind development in its core fields of competence?
2. How can the EU level of government improve its interaction with the regional level in fields of regional or of shared competence?

The project partners identified the following key fields of particular relevance to the development of offshore wind in Europe:

- Long term vision and targets
- Support schemes and electricity market design
- Electricity grid issues
- Maritime spatial planning
- Research, development & demonstration
- Training and education
- Awareness raising and public acceptance
- EU flanking role for issues of regional competence

Long term vision and targets

The EU level has played a key role in developing a long-term climate and energy policy vision. Debates at EU level encouraged Member States to establish their own long-term energy policy vision. In the field of renewables, the EU provided leadership at global level. For the offshore wind sector, it is of utmost importance that these trends endure.

The long-term political commitment to a low carbon power sector is important, but not sufficient. Prices in the EU Greenhouse Gas Emission Trading Scheme have been, and will, in the foreseeable future, remain too low and volatile to trigger investment in offshore wind projects or in the supply chain. The most powerful stimulus for investment in offshore wind was the adoption of the EU Renewables Directive in 2009, including the binding renewable energy targets set for 2020. A rigorous implementation of this Directive is the first priority.

However, 2020 is a too short time horizon for offshore wind. Including development, permitting, financing and construction, typical lead times for an offshore wind plant are around a decade, and offshore wind plants are conceived for lifetimes of 20-25 years. Therefore, investments in the development of new projects, and even more so regarding the supply chain, require a political perspective until 2030 and beyond. The longer the timeframe that policy makers consider, the more compelling the arguments for offshore wind.

It is therefore essential that the level of political commitment, as expressed by the EU´s renewable energy targets, does not decrease after 2020. With ambitious and binding 2030 renewable energy targets, industry and regional authorities will be encouraged to further invest. The longer-term perspective, up to 2050, is also important for offshore wind.

If, however, the outcome of the 2030 debate would be a weakening of commitment and ambition regarding renewables, it might become more difficult to encourage regional authorities to engage.

Both industry and regional experts consider mere climate emission reduction targets to be not sufficiently focused to provide a significant incentive to investment in the offshore wind supply chain and infrastructure.

In this field, the key priorities for the EU level are:

- Rigorous implementation of the existing 2020 renewable energy targets.
- Adoption of ambitious and binding renewables and climate targets for 2030.
- Continued commitment to the long term climate policy targets, which imply a largely decarbonised power system by 2050 at the latest.
- Development of a stronger long term strategy for security of energy supply, favouring indigenous European energy sources like wind and other renewables over imported fuels like hard coal, uranium and gas.

Support schemes and electricity market design

The single most decisive element determining the development of offshore wind is the framework for remunerating investments. For the foreseeable future, revenues from the power market will not provide sufficient remuneration for investments in offshore wind energy. Without dedicated support schemes, offshore wind plants will not materialise.

However, this is true also for most other renewable and conventional power generation technologies in several parts of Europe. For this reason, capacity mechanisms are being discussed in many countries. Therefore, it would be more appropriate to talk about investment remuneration schemes, rather than “support schemes”, since most technologies in most places require some form of policy driven support (Piria 2013). Nevertheless, we here use the wording “support schemes”, to follow the prevailing terminology.

As an emerging technology, the full costs of offshore wind will for a while remain higher than those for some other renewables. And they will remain higher than those of fossil and nuclear, as long as the latter do not fully pay for their external costs, including waste disposal and decommissioning. Therefore, offshore wind requires stronger support schemes than onshore wind and some other renewables.

Support schemes for offshore wind and other renewables are generally established at national level, and financed by the electricity customers or tax payers of the respective country. However, they must comply with EU legislation, including competition law, as well as the EU Internal Electricity Market Directive (2009/72/EC) and the Renewable Energy Directive (2009/28/EC).

In April 2014, the European Commission adopted the new guidelines on state aid for environmental protection and energy for the period 2014-2020. Particularly for “new and innovative technologies” like offshore wind, these guidelines leave significant room for interpretation by the European Commission. Moreover, at the moment of writing, the European Court of Justice is handling various procedures, including one pertaining to cross-border access to the support schemes of other countries. In this context of turmoil and uncertainty, it is useful to state five key principles that support schemes must fulfil in order to be able to encourage offshore wind deployment:

1. Support schemes should provide sufficient remuneration for investments, enabling the offshore wind sector to go through the technological learning curve and to fully exploit the economies of scale that will be necessary to cope with Europe's needs in the long term.
2. For a technology with long lead times, such as offshore wind, the stability and reliability of support schemes are of outmost importance. Mere debates on retroactive changes can destroy investor confidence and thus reduce the future capacity of public institutions to act.
3. Member States must have the leeway to run schemes providing different degrees of support to different renewable technologies. If all technologies are supported with the same intensity, the consequence is either an over-compensation for the cheaper technologies, or a complete halt on investments for the currently more expensive technologies that will be necessary to achieve our long term targets, such as offshore wind. This approach neglects the importance of dynamic efficiency and the differences in degree of technological maturity between renewable energy technologies.
4. Although offshore wind projects are more suitable for tenders than some other smaller scale renewables, experience with offshore wind tenders has been mixed. Price-based support schemes (like feed-in tariffs and feed-in premiums) have often achieved better results in the past, and are currently being used by the two countries with the largest portfolio of consented offshore wind projects: the UK and Germany. For offshore wind deployment, it is desirable that member states can continue to use this kind of support scheme, if they wish to do so.
5. More committed or ambitious member states must have the possibility to deploy renewables and offshore wind more rapidly, if they desire so. Frontrunner countries help to bring down costs, and thereby create value also for other countries. Therefore, a hypothetical legal obligation to open support schemes financed by electricity users or tax payers of a certain member state to projects realised in other member states would be highly detrimental, since it would heavily jeopardise political acceptance of the scheme and could ultimately trigger downward competition towards lower or no support.

In this field, the key priorities for the EU level are as follows:

- Interpret the recently adopted Guidelines on Environmental and Energy State Aid in a manner that is compatible with achieving offshore wind cost reductions through steady deployment, not only in theory but also in practice.
- The five principles mentioned above must be taken into account.
- Closely monitor renewable energy and offshore wind deployment and, if necessary, revise the Guidelines on Environmental and Energy State Aid.

Electricity grid issues

From the point of view of offshore wind deployment, the three core issues pertaining to the electricity grid are the regime governing connection of offshore wind farms to the grid, the North Seas Offshore Grid debate, and the general process of transmission grid expansion on the European level.

Connection of offshore wind farms to the grid

One of the most crucial preconditions for offshore wind deployment is the existence of an adequate regulatory and economic framework for the connection of offshore wind plants to the onshore transmission grid. In the best case, planning and construction of one or several offshore wind plants go hand in hand with the planning of the relevant cables connecting the offshore wind plant to shore. In the worst case, large offshore wind plants are completed, but cannot commence operation because of delayed grid connection: this causes large economic losses. Uncertainty about the financing and the timing of grid connection can be a major barrier to investment decisions for offshore wind projects. In different EU Member States, there are, and have been, various regulatory arrangements, ranging from integration of the grid connection into the offshore wind project under the responsibility of the same investor, to a complete separation, with national transmission system operators or other ad-hoc companies responsible for the connection. A discussion of the pros and cons of the various systems would go beyond the scope of this paper. Satisfactory arrangements can be found with different systems, as long as they provide sufficient certainty to reach offshore wind investment decisions, including a clear definition of liabilities in the case of delays or interruptions in the offshore grid connection.

In this field, the key priority for the EU level is:

- Promote good practice by facilitating the exchange of experiences between regulators, transmission system operators, offshore wind farm developers and scholars of various member states.

The North Seas Offshore Grid debate

A particularly high degree of transnational coordination is required to bring forward the promising concept of an integrated North Seas Offshore grid.

With new advanced controlling technologies developed by European companies, it is becoming possible to use the same infrastructure (subsea HVDC cables, transforming stations at the landing points) for two different purposes: the connection of offshore wind plants to shore, and the connection between different countries. This concept is particularly relevant for large-scale, far-from-shore wind projects. Such an integrated offshore grid could have several potential benefits: It can bundle and reduce the local impact of infrastructure at the landing points, save money, and increase the resilience of the power system. It can also help reduce risk and thus the capital costs of offshore wind developments (De Decker & Kreutzkamp 2011).

Collaboration in this field has been pursued, among others, by the North Seas Countries Offshore Grid Initiative (NSCOGI), involving the governments, energy regulators and transmission system operators of nine EU Member States and Norway, with participation of the European Commission. The plural in the word sea indicates that this concept is relevant for various maritime areas with high potential for offshore wind deployment and subsea power cables, including the Baltic, the North Sea, the Channel and the Irish Sea. In the future, similar concepts might also become relevant in certain areas of the Mediterranean and the Atlantic.

After years of debate, it is now essential that a first generation of demonstration projects is built soon, in order to test in practice the innovative technologies (e.g. fast DC breakers, multi-terminal DC stations) required to operate an integrated offshore grid. Such projects have proven difficult to realise, not only because of the required technological innovations, but also because they are highly demanding in terms of coordination requirements between project developers, TSOs, regulators, permitting authorities and energy regulators of the countries involved (and ultimately connected).

However, in the short and medium term, the vast majority of offshore wind capacities will still be connected to one country only. Therefore, while the potential benefits of an integrated offshore grid infrastructure should be tested in practice, this longer-term vision for the offshore grid is no reason to hold back on construction of stand-alone offshore wind farms and bilateral interconnectors, nor is it a reason to harmonise, or even unify, the national support schemes for offshore wind without taking proper care of differences at national, administrative and economic level (Piria 2012).

In this field, the key priorities for the EU level are:

- Provide ad-hoc funds and/or guarantees to facilitate the development and the construction of innovative projects involving multi-terminal DC nodes and other key infrastructure for integrated offshore grids.
- Facilitate their implementation by encouraging dedicated state aid in this area.
- Adoption of ambitious and binding long-term (2030 and 2050) renewable energy targets is particularly important in this field, due to the long lead and payback times of an integrated offshore grid.

The transmission grid expansion process in general

Connecting offshore wind plants to the power grid is necessary, but not sufficient. In many cases, reinforcement of the transmission grid on land is needed or at least advisable to help integrate the electricity generated by offshore wind plants into the power systems of the various countries, as consumption centres are often not in direct proximity to the landing points of cables connecting the offshore wind plants to shore. This is, for instance, the case in Germany, parts of the UK and France.

With its infrastructure package adopted in 2011, the EU has created important positive new regulatory and funding conditions to support electricity grid expansion. However, effective grid planning requires a clear long-term vision for the future power sector, and especially for the politically favoured power generation mix. Without ambitious and binding 2030 targets for renewable electricity, and without clear commitments for 2050, the momentum for the necessary expansion of electricity grids, both offshore and onshore, could slow down. Transmission grid planning is largely the task of transmission system operators and electricity regulators at national and EU level. However, to begin with, both TSOs and regulators need the political guidance of both national and EU-wide legislators.

In this field, the key priorities for the EU level are as follows:

- Continue efforts to coordinate transmission grid planning at European level.
- Closely monitor the implementation of the infrastructure package, notably the facilitation of permitting for projects of European interest.
- Strengthen the link between grid planning and the establishment of ambitious and binding renewable energy targets.

Maritime spatial planning

The seas surrounding Europe are more crowded than one might think. As human activities in marine waters are ever increasing, there is growing competition between different maritime user groups, including oil and gas extraction and pipelines, maritime transport routes, subsea electricity and telecommunication cables, fishing and sea farming, nature conservation areas, military areas, and others.

Historically, offshore wind was last to come. Although there is theoretically sufficient space in European waters to cover 80% of the total EU electricity demand with offshore wind (EEA 2009), there is competition for the most economically (or environmentally) attractive areas, and offshore wind projects have often suffered from conflicting rules stemming from different sectors and jurisdictions, both between and within countries.

Inadequate maritime spatial planning (MSP) procedures may cause uncertainty, project delays and unnecessary costs, effectively hindering the implementation of Europe's offshore wind potential (Seanergy 2012). Solutions can be found through an integrated and coordinated effort by European (Commission, ACER, ENTSO-E) and national (government, energy regulators, transmission system operators and permitting authorities) institutions, in collaboration with the offshore wind industry (Windspeed 2013). In some countries, regional authorities also play a role in maritime spatial planning. A key element of input for effective MSP is a clear framework for desired and expected offshore wind deployment in the short and in the long term: space must be reserved to guarantee the future satisfaction of Europe's needs with respect to security of energy supply and climate change. This leads, once again, to the overarching issue of defining long-term (2030, 2050, and even further) climate and renewable energy targets.

In March 2014, the European Council reached an agreement on the draft EU Maritime Spatial Planning (MSP) Directive, which was proposed by the European Commission in 2013. Once entered into force, the MSP Directive will help improve the quality of national MSPs, and the coordination among countries with neighbouring marine areas. At the moment of writing, the specifics of the deal are not yet known. The offshore wind sector has welcomed the proposal of the Commission, thereby arguing in favour of strengthening cross-border cooperation. "(…) There are potential cross-border synergies between large-scale offshore wind projects and interconnectors that are not being exploited and taken into consideration in MSP regimes. (…) Grid and offshore wind investments risk to be sub-optimal if made from an individual project and national perspective. Cross border cooperation on MSP would aid projects crossing several Economic Exclusive Zones such as large-scale offshore wind projects, and the interconnectors of the future pan-European grid" (EWEA 2013).

Once the MSP Directive has been adopted, the priority for the European Commission will be the active monitoring of its implementation, providing assistance to EU Member States to coordinate their maritime spatial plans, and fully taking into account the long-term climate policy requirements when it comes to defining priorities.

In this field, the key priorities for the EU level are:

- Active monitoring of the implementation of the MSP Directive.
- Encouraging and facilitating the exchange of good practice experience and the coordination between Member States.
- Adopting ambitious and binding climate and renewable energy targets for 2030 and a clear perspective for the long-term (2050) to provide guidance for national MSP.
- On this basis, taking an initiative to ensure that Member States reserve sufficient marine space for future offshore wind deployment.

Research, development & demonstration

Europe's industry is the global leader in the wind energy sector. According to a report by DG Economic and Financial Affairs of the European Commission:

"In 2012, EU-27 had a trade surplus of around 2.45 billion EUR in wind components and equipment with the rest of the world. This trade performance has been constant since 2008 with the exception of 2009, when the surplus was around 1.6 billion EUR (…). Over the last decade, the share of EU-27 in total world patent applications was 32.5% (…) in the wind industry the EU-27 share was 55% of world applications, well above any other country and well above the EU average in all industries." (European Commission 2014)

The data above refer to the wind energy sector in general, i.e. mainly to onshore wind. Specific data, for offshore wind technologies alone, are not available, but they are certainly higher, taking into account that to date 99% of the global offshore wind energy capacities are located in European waters, whilst only 38% of the global onshore wind capacities in operation are in Europe.

These figures show that Europe's industry was able to consolidate its first-mover advantage obtained by earlier onshore wind market development as well as by public and private RD&D investments. The same can reasonably be expected for offshore wind technologies, if Europe maintains the technological leadership during the decisive next decade. RD&D investments at an early stage of development are particularly likely to produce positive results.

The foremost priority for offshore wind is cost reduction. According to the Strategic Research Agenda developed by the European Wind Energy Technology Platform, the six RD&D priorities for the offshore wind energy sector are:

- **Substructures,** including the development of innovative fixed-bottom and floating designs, improved manufacturing processes, lifetime extensions e.g. in view of repowering.
- **Logistics, assembly and decommissioning,** including methods, infrastructure and products.
- **Electrical infrastructure,** including offshore wind farm collection grids, optimisation of offshore grid infrastructure and system services.
- **Wind turbines,** to achieve commercialisation of 10 MW turbines as soon as possible.
- **Operation and maintenance,** including versatile service fleets, safe access and asset management optimisation.
- **External conditions:** soil conditions, meteorological and marine conditions, monitoring and evaluation of interactions with the environment.

Another important source of information on RD&D priorities and methods is the UK Carbon Trust's Offshore Wind Accelerator, a flagship collaborative RD&D programme set up in 2008 that aims to reduce the cost of offshore wind by 10% by the year 2015.

In the field of RD&D, the EU level can play a key role by:

- Fully implementing its own research and innovation programs.
- Reallocating budgets and support from fully established conventional energy technologies, such as fossil fuels and nuclear, to expanding renewable energy technologies, especially emerging ones, such as offshore wind.
- Providing coordination and vision for national research programs.
- Promoting effective collaboration between national RD&D programs.

Training and education

Even though it might sound paradoxical in times of high unemployment, the availability of skilled labour can be a significant bottleneck for offshore wind deployment. Specialised workers are scarce, especially for installation work, operation and maintenance, but also for manufacturing of components, as well as design, project management and planning (iit & dsn 2012, SB OFF.E.R. 2013). As mentioned above, nearly 50,000 additional trained staff will be needed in the wind energy sector (both onshore and offshore) by 2030 (EWEA 2013a).

Therefore, training and education is a key requirement for supporting the offshore wind sector. Public authorities from the regional to the European levels can contribute towards tackling this challenge. To structure the allocation of responsibilities between the various levels of government, it is useful to distinguish between professional profiles that are typically rooted in the regional or national labour markets, and those more likely to benefit from cross-border mobility.

The latter typically applies to the highly skilled or specialised workforce and/or to functions that are required in specific phases of the offshore wind project development, e.g. project and installation engineers, service and maintenance technicians, but also divers, dedicated vessel crews, and others from the maritime sector. For these professional functions, the establishment of a cross-border labour market is more likely. The EU level can help by encouraging the creation of EU-wide curricula and cross-border coordination of advanced training courses, including mutual recognition of qualifications. Moreover, the possibility of promoting specialised cross-border online job portals can help make the labour market more fluid.

For professional functions more likely to be rooted in the regional labour market, the EU level can contribute by supporting the exchange of experience on good practice, but has no major direct influence. However, the EU level has the key responsibility to create a stable and supportive general policy framework (see sections above on targets and vision, support schemes, grid issues). This general framework is essential to encourage all regional stakeholders (companies, training providers, public institutions and the workers) to invest in training.

In the field of training and education, the EU level can play a key role by:

- Promoting the creation of EU-wide curricula for professional job profiles likely to be involved in cross-border mobility.
- Promoting the cross-border coordination of advanced training courses.
- Promoting the creation of specialised international online job portals.
- Promoting exchange of good practice experience, e.g. regarding training for professional profiles typically rooted in the regional labour market.
- Establishing a positive long-term general framework for offshore wind development (visions and targets, support schemes, electricity grid issues) that encourages all relevant stakeholders to invest in training.

Awareness raising and public acceptance

Offshore wind has a lower direct impact on people than do most other electricity generation technologies. This is one of its main advantages. Nevertheless, public acceptance may be an issue in some cases.

Acceptance problems arise more frequently in the case of near-shore wind farms that are visible from the coast. This may raise concerns about their potential effect on tourism. For this reason, some countries refuse to permit any offshore wind visible from shore. As the hub height of modern offshore turbines today lies at around 100 meters, with the blade tips reaching 160 m and more, this can imply prohibiting offshore wind deployment up to 30-40 km from shore. By the same logic, many maritime shipping routes as well as numerous buildings and industrial and commercial activities currently located on European coasts should not have been allowed.

In reality, experience shows that these concerns are often not justified. “Several representative studies have revealed the assumption that tourism will suffer due to offshore wind farms to be more of a subjective fear than a measurable fact” (Albrecht 2013). In fact, offshore wind farms can function as an additional tourist attraction. Communicating the experiences of other regions may help to tackle negative concerns in this regard.

If not grounded, subsea cables connecting offshore wind farms to shore are visible at the point of landing, but this is usually not a major issue, as the impact is very limited in size. Regarding DC cables, the large transforming stations have a greater impact, but this problem is minimised since these facilities can be located inland, far from more sensitive coastal areas. Finally, upgrades or extensions of the transmission grid on land may become necessary, which, without careful planning and consultation, could result in further public acceptance discussions.

In general, acceptance issues can best be tackled at the local and national levels. Nevertheless, the EU level can play an important role by supporting and promoting best practices and the exchange of experiences via awareness-raising and information campaigns conducted at a local, regional or national level. Previous projects supported by the European Commission, for instance by the INTERREG programme (e.g. South Baltic Offshore Wind Energy Regions) or by the Intelligent Energy Europe programme (now Horizon 2020), have been instrumental in sharing information and developing solutions. Moreover, the EU level should support systematic research on the real impact of offshore wind on people and on different economic activities. The offshore wind industry is convinced that acceptance problems are rooted in prejudices rather than based on facts. Therefore, empirical, fact-based research is highly welcome.

Another useful initiative at EU level could be a database bringing together information on acceptance in areas which have already installed offshore wind farms, as well as an exchange of experiences on how to deal with acceptance issues at a local level.

However, it is not appropriate to discuss offshore wind acceptance without also considering the alternatives. If asked, many people would probably express a preference for not seeing electrical or energy infrastructure of any kind in the areas where they live, work, and spend their free time. However, energy infrastructure is necessary. Considering virtually all objective parameters, offshore wind is one of the energy producing technologies with the lowest impact on people. Numerous surveys (among others Eurobarometer 2011, Eurobarometer 2014) have shown that renewables enjoy higher acceptance than fossil and nuclear technologies. Once the need to attain high shares of renewables is established, a reasonable balance of onshore and offshore sources is likely to increase acceptance when compared to renewables deployment only onshore.

In the area of acceptance and awareness raising, the EU level can play a key role by:

- Supporting and promoting best practices and the sharing of experience regarding awareness raising and information campaigns conducted at local, regional or national levels.
- Supporting systematic research on the real impact of offshore wind on people and on various economic activities.
- Promoting a database to collect information on acceptance in areas with existing offshore wind farms, as well as experience on how to deal with acceptance problems at local level.
- Continued promotion of the debate on the long-term energy mix compatible with climate change mitigation and security of energy supply. Without very high shares of renewables, these targets cannot be achieved in the long term. Once this is accepted, the need for large scale offshore wind deployment becomes evident.

EU flanking role for issues of regional competence

In a related document, titled "Regional Policies for Offshore Wind: A Guidebook" and produced in the context of the same INTERREG project as the present report, the German Offshore Wind Energy Foundation and its 4POWER partners have compiled guidelines for regional authorities that intend to promote a positive framework of conditions for offshore wind deployment in their region.

Some of the core issues contained in this document have already been mentioned above, because both the regional and the EU levels of government can take relevant action in these fields: training and education, raising of awareness and acceptance, maritime spatial planning. Other topics not treated in the present document include local spatial planning, local infrastructure (ports, roads) or the establishment of regional offshore wind industry and service clusters. Some of these initiatives may and should be supported by European regional development funds, which should give higher priority to projects related to energy efficiency and renewables, including offshore wind energy. Beyond that, these policy fields fall mainly under regional or national competence, and the EU level has little or no possibility to make a direct impact.

Indirectly, however, the EU level can also play a key role in these areas by providing vision and guidance regarding the long-term prospects for climate and energy policy. Impacts at local level are more acceptable if there is a clear sense of a shared effort at European level to mitigate climate change and ensure a secure and sustainable energy supply. Ambitious and effective EU targets for renewable energies create a compelling case for regional authorities, businesses, individuals and civil society to invest in offshore wind development.

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