EWEA
THE EUROPEAN WIND ENERGY ASSOCIATION

Delivering Offshore Wind Power in Europe

POLICY RECOMMENDATIONS FOR LARGE-SCALE DEPLOYMENT OF OFFSHORE WIND POWER IN EUROPE BY 2020

By the European Wind Energy Association

EWEA was mandated by its Board of Directors to set up a working group on offshore wind power. This report is the result of the group's work, undertaken in the second half of 2007 and chaired by Gordon Edge, British Wind Energy Association (BWEA).

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Cover photo:
Platform for offshore wind turbine at Horns Rev, Denmark
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By the European Wind Energy Association

Foreword

Energy policy in Europe is entering increasingly stormy waters. The imperatives of combating climate change and securing energy supply are becoming ever stronger, while globalisation demands cost competitiveness. The sea, however, can provide a key element of the strategy – offshore wind. As a continent with a proud maritime history, blessed with a huge resource and the pioneer in onshore wind power, Europe is well placed to lead the world in this technology, so vital for our global future. Now is the time for the EU to act in a coordinated manner in order to develop this technology to its full potential and consequently export it around the globe. Only then can it can contribute fully to the urgent battle against climate change.

Offshore wind technology is progressing fast, but it needs to be driven faster by a policy framework as positive as that which promoted the offshore oil and gas sector from the 1960s onwards. Thirty years ago, North Sea oil came to the rescue of a Europe facing an international oil crisis. We are now faced with a different crisis, and we need offshore wind to help solve it. This report is the work of an EWEA Working Group on Offshore Wind Power; it is intended to map out the potential development up to 2020, alongside an analysis of the issues and barriers surrounding the sector, and which must be addressed if the potential for offshore wind is to be tapped fully. We intend this document to be the first step towards the kind of policy framework that European countries implemented for offshore oil and gas. Policy makers at all levels of the EU must engage with this agenda in partnership with the wind industry if the sector's benefits are to be captured for European citizens.

Let us be clear: offshore wind energy is at heart a European matter. Whether you have a coastline is not important. We are talking about exploiting one of the major domestic energy resources of the EU which to date has been largely untapped. The diverse companies that make up the offshore wind sector recognise the challenges that confront us to make our vision a reality, but at the same time stand ready to invest the time and money required to forge a pan-European industry. We look forward to charting a course with our partners that can lead us to calmer energy policy waters.

Gordon Edge
Chairman – EWEA Offshore Wind Industry Group

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Arklow Bank wind farm, Ireland (© Airtricity)

Introduction

Offshore wind is an emerging industry and a new user of the sea with distinct industrial and political development requirements compared to onshore wind power. If the vast potential of Europe's offshore wind energy resource is to be exploited, the EU institutions, EU Member States and regions must work together. They must develop regulatory framework conditions that encourage industry, sub-suppliers, researchers, developers, grid companies and planning authorities to take an active part in developing and deploying offshore wind technology.

Offshore wind power technology builds on onshore wind technology, and its future development will require participation from other sectors such as offshore oil and gas engineering and technology, the logistical skills of offshore service providers, transmission system operators and the infrastructure technology of the power industry.

Although long-term prospects for offshore wind power are promising, the technology faces a number of challenges in terms of technological performance, lack of skilled personnel, shortage of appropriate auxiliary services (e.g. crane vessels), impact on the local environment, competition for space with other marine users, compatibility with the European grid infrastructure and secure integration into the energy system.

This report comes from the EWEA Working Group on Offshore Wind Power[1]. It establishes scenarios for the development of offshore wind energy in Europe by 2015 and 2020, and suggests a series of policy recommendations to maximise offshore wind power by 2020.

The report estimates that between 20 GW and 40 GW of offshore wind energy capacity will be operating in the European Union by 2020. A fully developed European offshore wind resource could deliver a capacity of several hundred GW to supply our future energy demands. Developing less than 5% of the North Sea surface area would enable offshore wind to supply roughly one-quarter of the EU's current electricity needs[2]. In the period up to 2020, however, the amount of this potential that can be developed is limited by a number of factors; the extent to which the barriers are resolved will determine the capacity that will result. Offshore wind power could meet more than 4% of EU power consumption in 2020 (depending on the effect of energy efficiency measures[3]), or approximately 50% of EU power production from large hydro power stations today.

Industrial commitment and ambition, research and development efforts, political action at Member State and EU level and development of adequate grid infrastructure are all factors that will determine the level of offshore wind energy installations by 2020.

The rather wide range between the high (40 GW) and low (20 GW) scenarios reflects the uncertainty over several factors that will influence delivery.

1 For information on the Offshore Wind Advisory Group please see the inside front cover.

2 Going for 25% of EU-25 2004 consumption requires 180 GW over a developed area totalling some 17,900 km^2, which is approx. 3% of the total 575,000 km^2 surface area of the North Sea.

3 Assuming power demand according to the European Commission's 2020 baseline scenario, 40 GW of offshore wind power would meet 3.4% of demand.

Middelgrunden wind farm, Denmark (© Siemens AG)

create the necessary onshore and offshore infrastructure should be considered for the purpose of increasing renewables, reducing carbon emissions and improving the functioning of the Internal Energy Market through larger interconnectors.

On the industry side, the challenge is to create a sustainable offshore wind industry. While the onshore wind industry is starting to be integrated at European level, offshore wind is still primarily based around a limited number of European Member State markets. No series production in offshore wind manufacturing and installation has yet been established, and the sector is still developing and utilising large specialised components rather than the standard components needed for reducing cost. The different challenges of offshore wind require the industry to move more swiftly to establish links across borders and develop a European industry for a European market. The creation of such partnerships, necessary in order to deliver complex offshore projects, will inspire greater confidence in industry players to develop the techniques and technologies that will enable the sector to expand rapidly, as onshore wind power has done.

However, what is certain is that if we are to maximise the delivery of offshore wind capacity by 2020, industry and governments must join forces. It is also clear that the political and industrial decisions taken over the coming five years will determine offshore wind power's contribution to the EU's 2020 target of 20% renewable energy.

The role of national authorities and the EU is to provide a stable, predictable market framework which gives the industry the confidence to innovate and invest in the required manufacturing capacity. For this to happen, **a European framework for offshore wind power targeted at removing barriers**, reducing investment risks, planning interconnectors and grid infrastructure, guiding both the public and private sectors and strongly coordinating Member States' policies is urgently needed. In addition, there is a need to boost research and development significantly. A Joint Technology Initiative[4] to

4 In accordance with Article 171 of the Treaty Establishing the European Community, 'The Community may set up joint undertakings or any other structure necessary for the efficient execution of Community research, technological development and demonstration programmes'.

Europe's **energy challenge**

Energy is essential for Europe to function. The days of cheap energy for Europe seem to be over. The challenges of climate change, increasing import dependence and higher energy prices are faced by all EU members. Moreover, the interdependence of EU Member States for energy, as for many other areas, is increasing – a power failure in one country has immediate effects in others.

It is clear that a radical change is required in the way energy is produced and consumed. This means transforming Europe into a highly efficient, sustainable energy economy.

Security of supply

Europe's dependence on imported energy has risen from 20% at the signing of the Treaty of Rome in 1957 to its present level of 50%, and the European Commission forecasts that imports will reach 70% by 2030. If energy trends and policies remain as they are, the EU's reliance on gas imports will jump to 84% of gas consumption and 93% of oil by 2030[5].

Europe is already paying the price of energy dependence. According to the European Commission, the EU's gas import bill alone increases by €15 billion annually for every $20 increase in price of a barrel of oil. Hence, the past few years' increase in oil prices from $20 to $80 (November 2007) has added €45 billion to the EU's annual gas import bill.

In addition, several EU Member States are essentially dependent on a single gas supplier, and once

5 'Energy for a changing world – An energy policy for Europe' – European Commission 2007 http://ec.europa.eu/energy/energy_policy/doc/2007_03_02_energy_leaflet_en.pdf

Horns Rev wind farm, Denmark (© DONG Energy A/S)

Beatrice project, Scotland (© REpower)

the lack of a crisis support structure between countries is factored in, the EU's growing vulnerability becomes evident.

Electricity infrastructure

There is an urgent need to increase capacity and make new investments in transmission and distribution grids. Electricity demand continues to increase by around 1.5% each year, but existing infrastructure and many electricity plants are reaching the end of their useful life. Over the next 25 years, around €900 billion will need to be invested in new power generating capacity and more than €560 billion of investments must be made in new transmission and distribution grids in the EU[6]. If we are to meet our climate targets it is essential that the large expansion in capacity be seen as an opportunity to turn the entire European electricity mix towards renewable energy sources.

Climate change

Global warming is no longer a contested phenomenon, and climate change is considered the greatest challenge Europe and the world will face during the 21st century. The energy sector is the largest source of greenhouse gas emissions. The EU has made a commitment to reduce its greenhouse gas emissions by 30% in 2020 if other nations follow its lead. That requires significant efforts to change the current energy supply mix and more effective climate policies at the EU level.

6 'World Energy Outlook 2006' – International Energy Agency (IEA).

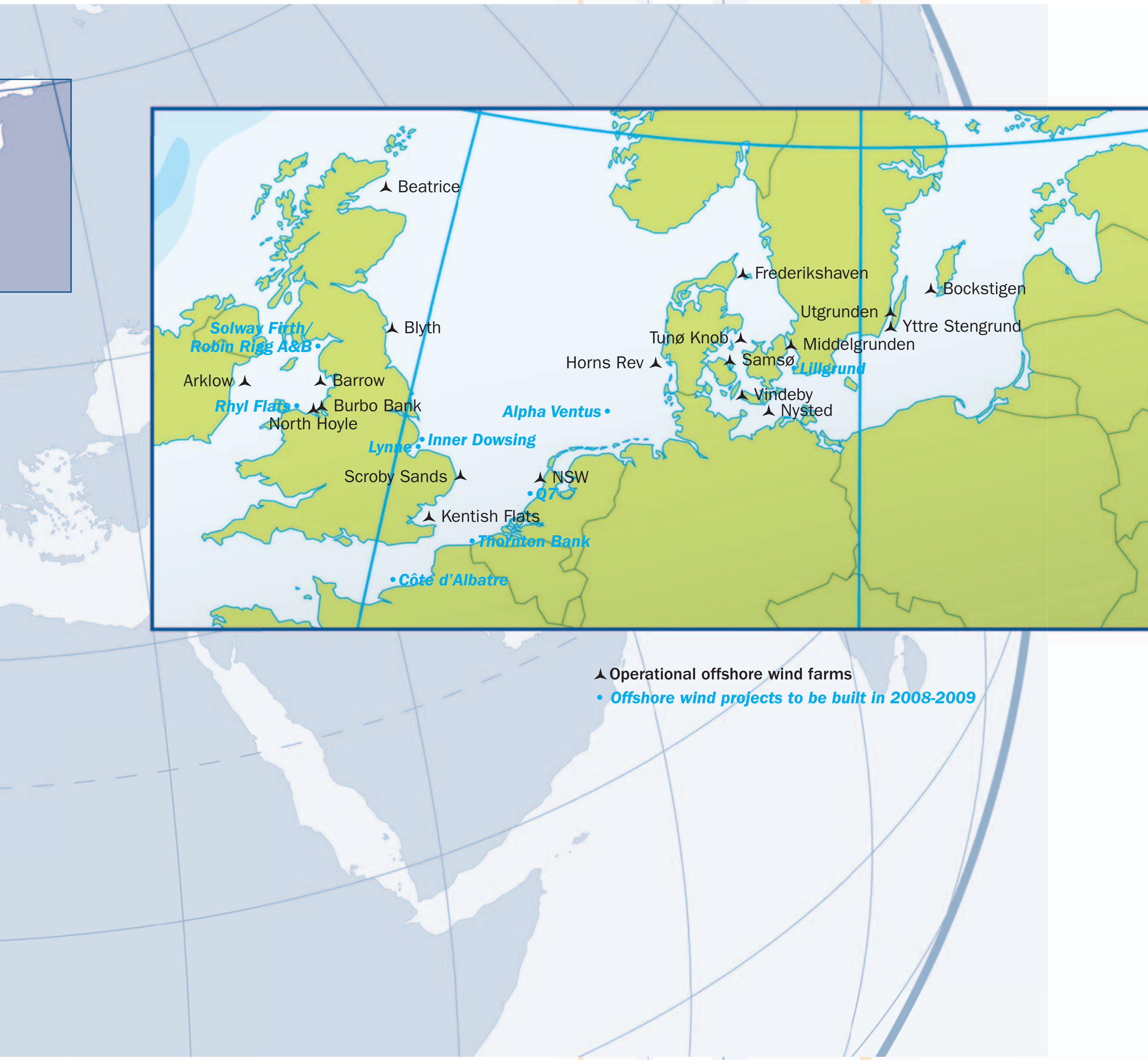
Global and internal energy markets

Conventional primary energies, such as coal, oil, gas and nuclear, have finite life expectancies. Simultaneously, global energy demand is growing. Developing countries, China and India in particular, are entering the energy-intensive phase of their development where people buy their first computer or car. Europe has to compete globally against the US, China and India for the use of these increasingly scarce resources.

Naturally, Europe should continue to engage in the global competition for the remaining energy resources. However, if Europe is to reduce its exposure to foreign control of fuels, it must follow a strategy of developing, deploying and exporting renewable energy technologies while increasing energy efficiency.

To respond to these challenges, the European Union has begun drawing up a common energy policy, which is built around the central aims of combating climate change, limiting dependency on imports, promoting jobs and growth in Europe, and providing secure and affordable energy to all consumers.

Offshore Wind Map: operational and planned farms in Europe


Beatrice
Solway Firth/
Robin Rigg A&B
Blyth
Arklow
Barrow
Rhyl Flats
Burbo Bank
North Hoyle
Lynne
Inner Dowsing
Scroby Sands
NSW
Q7
Kentish Flats
Thornton Bank
Côte d'Albatre
Alpha Ventus
Horns Rev
Frederikshaven
Utgrunden
Bockstigen
Yttre Stengrund
Tunø Knob
Middelgrunden
Samsø
Lillgrund
Vindeby
Nysted
Operational offshore wind farms
Offshore wind projects to be built in 2008-2009

Offshore wind power **benefits**

As a strategic, domestic and largely untapped resource, offshore wind is one of the key technologies for achieving the energy and climate goals of the EU. In particular, it will be one of the key components in helping the EU deliver its recently agreed target of 20% of its total energy consumption being provided by renewable sources by 2020[7]. Because of its scale and extra-territorial nature, offshore wind should be considered a project of European interest.

Security of supply

Offshore wind power could significantly reduce fossil fuel imports. An estimated capacity of 40 GW would produce 140 TWh[8], representing 13 MToe (tones of oil equivalent) of fossil fuels.

Offshore wind will play a crucial role in securing indigenous energy supply in the future and reducing our energy import dependence.

Burbo Bank wind farm, UK (© Siemens AG)

Internal energy market functioning

Despite its documented advantages, the EU has not so far succeeded in establishing a functioning and competitive internal electricity market that works. One of the concerns is the limited power exchange possibility between Member States due to lack of physical interconnection capacity and inefficient capacity allocation mechanisms. By its size and its extra-territorial nature, offshore wind power should create a demand for increased interconnection capacity and become a catalyst for improving the possibilities of power exchange.

Offshore wind power will contribute to a more secure supply of electricity beyond Member States with coastlines, and is a catalyst for the realisation of the internal electricity market in Europe.

Climate change

Sustainability is at the heart of European Union policies, and the energy sector is expected to play an important role in meeting the EU's Kyoto commitment. Wind energy is a cost-effective means of achieving future carbon reductions. The Kyoto target reduction in terms of CO_2 represents 355.8 Mt. Forty GW of offshore wind energy would save 105 Mt (around 30% of the target). Taking the price of CO_2 as 25 € /tonne[9], the additional total CO_2 benefit can be calculated at approximately 3 € billion.

Offshore wind can help the EU meet its commitment to CO_2 reduction.

7 http://www.consilium.europa.eu/ueDocs/cms_Data/docs/pressData/en/trans/92802.pdf
8 140 TWh are based on average estimated capacity factor of 40%
9 Actual market prices (for 2006 EU Allowances) have fluctuated between 7 and 30 €/t in the period January-July 2006, with averages fluctuating roughly between 15 and 20 €/t.

Lillgrund wind farm, Sweden
(© Hans Blomberg, Vattenfall)

Lisbon Strategy, knowledge-based economy and technological leadership

Offshore wind is at the cutting edge of technology. Europe has a globally strong position in the market sector: worldwide, the European wind turbine manufacturing industry has a market share of 80%, and for offshore this rises to 100%. Deploying offshore wind energy would increase the competitiveness of Europe by paving the way to a strong export position in a market with enormous global potential. The necessary technological development will also feed through to onshore wind, ensuring continued European leadership in the field.

Offshore wind has the potential to strengthen Europe's export position both with onshore and offshore technologies.

Regional development, creation of jobs

The potential for wind energy to boost economies and create jobs is well documented for onshore applications. For offshore wind, due to the limited number of projects, the impacts are not yet felt. However, offshore wind has already started to create jobs in areas which, due to declining shipyards, decreasing fishery activity or the slowing down of other industries, have high unemployment rates.

The deployment of offshore wind energy gives a strong impulse to job creation and regional development.

Maritime activities development

Europe is rich in marine resources which have a direct effect on the lives of the citizens: half of the continent's population lives less than 50 km away from the coastline and 40% of EU GDP is generated in maritime areas[10]. In many Member States, the recent growth of the maritime economy has been higher than that of the overall economy, in particular in regions active in maritime logistics.

The potential for European industries to develop cutting-edge maritime products that can lead in world markets, through the innovation 'push' of offshore wind technologies, is also large given Europe's considerable expertise in marine technology.

The offshore wind sector is in the rare position of being able to provide all of these benefits

A strong wind energy sector does not only mean reduced CO_2 emissions, but it is also synonymous with sustainable economic growth, reduced energy import dependence, and an overall increase in export opportunities, regional development, high quality jobs and European industrial leadership.

10 'An Integrated Maritime Policy for the European Union' – European Commission, October 2007

Offshore wind market
2007–2020

The development of offshore wind power holds many uncertainties. Different figures ranging from 20 to 80 GW by 2020 are being circulated and debated in different policy arenas. EWEA decided in 2007 to bring the industry together to get a clearer view and a larger degree of consensus about the likely path that offshore wind energy will take in the future. An EWEA Offshore Wind Industry Advisory Group was tasked by the EWEA Board with bringing forward delivery scenarios for 2020.

Horns Rev wind farm, Denmark (© DONG Energy A/S)

Back in 2003, EWEA published a scenario for wind energy, including a 2020 target for offshore wind energy of 70 GW. Recent industrial and policy developments[11] at EU level require a revision of the target. For various reasons, including a booming global onshore market, that target will be reached at a later stage. The EU market for onshore wind power grew by an average annual rate of 33.4% over a 14-year period (1992-2006). If the offshore wind market in the EU grows by the same rate over the next 14 years, 50 GW of offshore wind power will be operating in Europe by 2020.

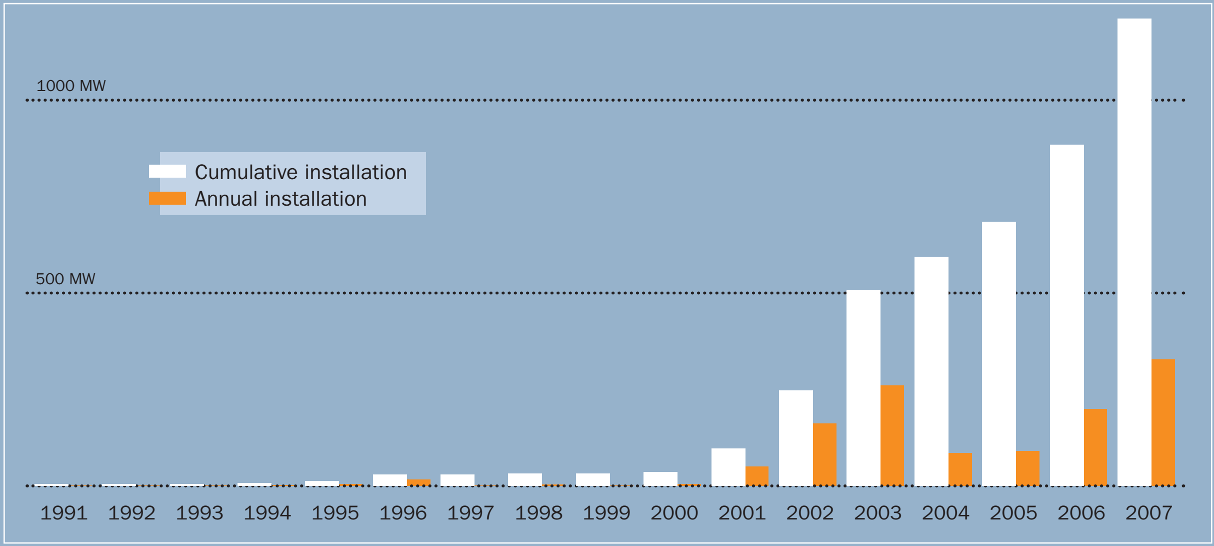
To respond to the new policy agenda, the industry will have to determine the potential contribution of offshore wind power to the agreed target of 20% by 2020 as Member States are preparing national actions plans for renewable energy.

This analysis aims to provide long-term scenarios to 2020 based on a sound understanding of the market trend in the offshore sector in Europe. Data is based on various sources of market estimates[12] and analysis collected during summer 2007. Information was cross-checked with industry estimates.

Due to the long lead times of offshore wind projects, their limited number and the increasing uncertainty of project completion over time, this document relies on a phased approach: an outlook for 2010, a forecast for 2015 and scenarios for 2020. Results and findings are presented in the following section.

11 Council meeting – 8/9 March 2007 (20% by 2020 binding target for Renewable Energy)
12 BTM Consult (2007), Emerging Energy Research (2007), Make consulting (2007), Douglas Westwood (2007), Wind power monthly.

FIGURE 1: **Offshore wind market development in Europe (1991-2007)**



Market status in 2007

By 2007, the industry had developed 25 projects, many of them large-scale and fully commercial, with a total capacity of around 1,100 MW in five countries. In terms of electricity production, at the end of 2006, offshore wind farm installations represented 1.8% of the total installed wind power capacity[13], but generated 3.3% of electricity from wind energy. Denmark, the United Kingdom, the Netherlands, Sweden and Ireland had operating offshore wind farms.

Market outlook by 2010

For the period 2007 to 2009, figures from the main market analysts do not diverge, given the limited number of planned projects and their long lead times. In 2008 and 2009, the offshore wind market will see projects being delivered in the UK (800 MW), Denmark (200 MW), Sweden (140 MW), the Netherlands (120 MW), France (105 MW), Germany (60 MW) and Belgium (30 MW). By the end of 2008, around 80% of the market will be concentrated in Denmark and the United Kingdom. For 2009 onwards a low and high estimate had to be developed, so as to reflect the increasing uncertainty over project delivery in this timescale. However, given the current limited distribution of offshore wind power in Europe, the historical growth rates, the wind potential of each country, the projects in the planning phase, the industry assessments and the policies and targets of each Member State, a total cumulative installed capacity of 3-4 GW by the end of 2010 can be expected, with a medium estimate of around 3.5 GW[14].

Market forecast by 2015

In the medium term up to 2015, based on a number of market estimates and on projects currently being planned, 10-15 GW of installed capacity in Europe can be forecast. In this period, development will be mainly driven by the United Kingdom, followed by Germany. The widening range of estimates is justified by the further increase in uncertainty over project completion. Therefore, three forecasts have been established: low, medium and high, with cu-

13 By the end of 2006 the total cumulative installed wind capacity reached 48 GW. In an average wind year 48 GW of wind produces approximately 100 TWh of electricity, equal to 3.3% of total EU electricity consumption. (See EWEA press release 1st February 2007 – http://www.ewea.org/fileadmin/ewea_documents/documents/press_releases/2007/070201_Statistics_2006_Press_Release.pdf)

14 These figures are consistent with the EWEA 80 GW forecast including 4 GW offshore by 2010.

Offshore research platform
FINO 1, Germany
(© BMU/transit/Härtrich)

mulative installed capacities by 2015 of 10 GW, 12 GW and 15 GW respectively.

Drivers of offshore wind vary from country to country. In some European markets, the move to offshore is driven by high resources, a desire to expand wind power capacity beyond the potential of onshore development, or by government pressure. Recently, there have been encouraging signs for future market growth, with a grid connection agreement and upgraded payment mechanism in Germany, three "Round 2"[15] approvals in the UK, a successful tender process for two large Danish wind farms, the adoption of a regulatory framework for Spain, and the first wind farm contracts in France and Belgium.

However, the deliverability of the projects remains strongly conditioned by wind turbine availability. Projects relying on 3–3.6 MW machines will not be able to get their wind turbines before 2009-2010, and the ones planning to use 5 MW wind turbines will have to await the serial production of today's prototypes and the results from the test facility in Germany.

Other assumptions considered in this forecast are:
- The German Alpha Ventus test site is fully commissioned in 2009 and delivers results for 5 MW machines by 2011
- In the UK, "Round 2" projects of 500 MW or greater are expected to go on-line from 2010. A "Round 3" will be fully launched in 2008/2009 with sites allocated from 2010 onwards
- Sweden sees the take-off of several large scale projects due to a more favourable regulatory framework
- Short term supply chain bottlenecks (skilled staff and specific vessels mainly) are progressively addressed through increased standardisation of practices and sector-specific high-level training capacities
- France, Belgium and the Netherlands see projects developed and completed (2008-2011)
- Spain is expected to begin its offshore development at the end of the forecast period (2012-2015) with one or two projects under development

Market scenario by 2020

As new actions always take time to implement and make their full impact on the market, decisions made today will shape the energy mix of tomorrow. The 2020 horizon is particularly relevant in relation to the political decisions taken in 2007: the agreement on binding targets of 20% renewable energy and 20% greenhouse gas reduction by 2020.

The underlying assumption in these scenarios is that the strong development of wind power to date

15 Rounds "1" and "2" refer to the UK government's process of allocating sites for wind development

can continue in the coming years as long as six complementary aspects are implemented:

- The clear and strong commitment of the European Union and its Member States to wind power development continues
- Strong and continued technological development and deployment to the marketplace from the wind industry
- Timely implementation of supply chain capabilities from manufacturing to project completion and maintenance
- Appropriate planning practices and technological achievements are translated into the construction of large scale commercial wind farms
- Grid infrastructures including interconnectors are designed, built and appropriately financed in time to accommodate large-scale wind power
- Implementation of more efficient power exchange mechanisms in the electricity market between Member States to ensure integration of renewable energy, including large-scale wind power.

Therefore, two scenarios have been established – low "minimal efforts" and high "policy impetus" – resulting in two cumulative installed capacities by 2020 of 20 GW and 40 GW respectively. If offshore wind energy grows at the same rate over the next 14 years as onshore wind energy has over the past 14 years in the EU, 50 GW of offshore wind will be reached in 2020. However, lead times for planning, lack of physical infrastructure, long project development times and short-term supply chain bottlenecks make this unlikely by 2020.

FIGURE 2: **Offshore wind development (Annual and cumulative in MW) 2010-2015**

		2007	2008	2009	2010	2015
Annual	Low*	205	645	500	1,000	1,700
	Medium					2,350
	High			900	1,500	3,000
Cumulative	Low	1,083	1,848	2,228	3,228	10,000
	Medium					12,000
	High			2,628	4,128	15,000

* For 2009 onwards a low and high estimate had to be developed, so as to reflect the increasing uncertainty over project delivery in this timescale.

FIGURE 3: **Offshore wind development 2006-2020 (Cumulative, GW)**

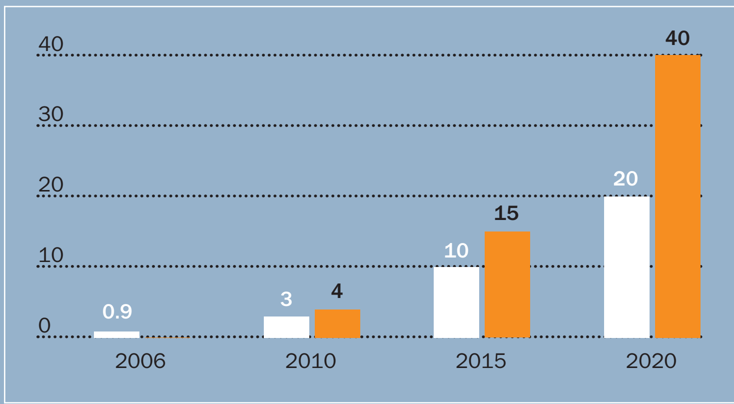


FIGURE 4: **Annual installation 2015-2020**

	Low	Medium	High
Installation 2015-2020 (GW/year)	2	3.6	5

Challenges and recommendations

Early results from the first offshore wind projects have been promising. In 15 years, wind farms with a total capacity of 1 GW have been erected in the waters of several EU Member States. But it is clear that several barriers remain in the way of a fuller development. If we are to develop offshore wind power at the level envisioned both by EWEA and some EU Member States, barriers must be removed in a timely fashion. Such barriers and risks include siting and licensing issues, whether projects can be financed, lack of skilled personnel, shortage of appropriate auxiliary services (e.g. crane vessels), grid infrastructure and management needs, technology development requirement, logistical, supply chain gaps and environmental issues.

Challenges have been sorted into five categories of issues:

- **Policy**
- **Market**
- **Research and technological development**
- **Grid integration: grid connection, network upgrade and power market design**
- **Environmental requirements and planning practices**

Today, the costs of offshore wind energy production are higher than those of onshore: expectations are that several factors working together will make the development of offshore wind energy sources more cost-effective, so that in the long term, costs will fall as more projects come on line, as has happened on land. However, in the short term, as future projects will be more complex to develop further out at sea (entailing longer cables) and in deeper waters, costs are likely to increase. Targeted R&D efforts and an adequate market deployment strategy are key to achieving economic and financial viability and thus to enabling a sustainable flow of projects to be developed commercially, which in turn will drive down costs further through a higher volume of business and increased competition.

Policy

According to the European Commission, the 20% binding target by 2020 implies 35% of electricity from renewables compared to 15% in 2005. In its strategic energy review, the European Commission estimated that wind could contribute 12% of EU electricity by 2020. One-third of this will come from offshore installations. EWEA estimates that wind power both onshore and offshore could contribute to 11-14% (180 GW) of wind power in 2020 (depending on 2020 demand) from a level of 3% (50 GW) at the end of 2006. The target cannot be met without large-scale offshore wind. Thirteen years is short notice. Strong policy measures must therefore be implemented rapidly.

RECOMMENDATIONS:

Establishing a European policy framework for offshore wind power

To guarantee investor confidence, and develop offshore wind farms on a sufficient scale, this sector needs a stable political framework. Legislation could be preceded by a European Commission Offshore Action Plan. This Action Plan should be formulated before the Swedish EU presidency in 2009, and be ready to be adopted during it.

Blade factory in Nakskov, Denmark (© Vestas)

The European framework should be based on four pillars: legislation and policy measures (including specific payment mechanisms), grid reinforcement measures, environmental measures and R&D measures. This framework should encourage EU Member States to develop national action plans containing sector targets and a quantification of the expected contribution of offshore wind power. This framework should integrate conclusions on how to develop offshore wind power effectively: work done by the Member States and contained in the Egmond Declaration (2004)[16], the Copenhagen Strategy (2005)[17] and the more recent Berlin Declaration (2007)[18].

Such conclusions include:

- The "one-stop shop office approach"
- The convenience of defining division of responsibility among different layers of the public administration in Member States
- The need for long-term and strategic grid planning
- The importance of more efficient consenting procedures which build on past experience and are in proportion to the scale of the project
- The need to ensure good quality assessments
- The establishment and use of marine spatial planning instruments to reach optimal site selection

In addition, there is a need for increased cooperation through working groups between public administration and wind industry to identify potential barriers, limitations and suggest measures to remove those barriers.

Increasing regional cooperation to maximise the synergies and complementarities of various regions with offshore wind ambition around the North Sea, the Baltic Sea, the Atlantic Ocean and the Mediterranean

None of the regions is able to bring the whole offshore wind supply chain to its predicted level of development on its own. Together, the regions can deliver a European supply chain that is capable of supporting projects in Europe and developments elsewhere in the world. Such a supply chain offers a unique opportunity to use and enlarge the market potential of these regions. Regional fund opportunities for the development of transregional projects should be explored.

16 Egmond Declaration, EU policy workshop Development of offshore Wind Energy (Egmond aan Zee, 30 September – 1 October 2004) – http://www.senternovem.nl/mmfiles/_%20Declaration%20OWE%2008-10-2004%20FINAL_tcm24-124637.pdf

17 Copenhagen Strategy: European Policy Seminar on Offshore Wind Power Copenhagen, Copenhagen 27 October 2005 – http://www.ens.dk/graphics/UK_Energy_Supply/Renewable_energy/Windpower/Copenhagen_Strategy.pdf

18 Berlin Declaration: European Policy workshop on Offshore Wind Power deployment, Berlin 23 February 2007 http://www.bmu.de/files/pdfs/allgemein/application/pdf/eupolicy_declaration.pdf

Nysted wind farm, Denmark
(© Jan Kofod Winther, DONG Energy A/S)

Clarifying roles for regulation, governmental and European policies

Achieving a cost-competitive offshore wind industry will require significant advances in the areas of technology and policy. Many of the challenges require an integrated approach. For example, public acceptance of offshore wind facilities will depend on the existence of a credible planning and permit-awarding process that ensures the recognition of public benefits from the use of the resource. Clear, stable regulations and transparent, predictable permit-awarding, underpinned by good knowledge of impacts and assessment of risks, will be essential.

Given the cross-border nature of offshore wind, its development will interact with European policies dealing with different aspects of the sea and its use. In particular, offshore wind's impact on the Common Fisheries Policy must be dealt with, and the priority given to each sector clearly established. Policies regarding shipping and navigation will also have to take offshore wind into account, and Member States will have to decide how they wish to manage the interaction between this new technology and their national security needs.

Market

Achieving 40 GW in 2020 means adding 39 GW – i.e. building 7,800 turbines of 5 MW – over 13 years. It represents the manufacture of 600 turbines per year, or 50 turbines per month, plus foundations and electrical infrastructure. Those turbines have to be assembled, transported and installed on sites. The industrial sector has to address this challenge.

RECOMMENDATIONS:

Establishing stable, coordinated long-term markets for offshore wind in Europe

Member States and the Commission must work together to ensure that the market for offshore wind in Europe is stable, long-term and grows smoothly. The coordination of policies to support the sector is necessary to allow investments to be made with confidence that markets will not be in excessive competition with each other. Ideally, the EU Member States with offshore wind ambitions should collaborate to provide a strategic interconnected grid system, with contributions from EU funds. Member States must coordinate the regulatory and market systems at each end of these grid links in order to facilitate the sale of the resulting power into the appropriate market at the time of generation.

Building and optimising the supply chain for a timely and sustainable flow of commercial projects

From initial site selection through to installation and operation, today's wind energy industry covers a wide range of disciplines, expertise and industrial sectors. Going offshore provides extra challenges due to the size of the projects, and the construction and maintenance work at sea that requires specialised equipment and expertise from sectors ranging from foundation manufacturers to operators of vessels. All these players have to plan and invest to meet the challenge of large-scale offshore wind deployment. However, EWEA is confident that the supply chain will undertake this activity so long as there is a clear and credible pipeline of project work for these companies to bid for.

Ensuring coordination and collaboration of the wind industry with the power infrastructure industry, the maritime industry and the oil and gas industry in order to integrate offshore wind power with established uses of the sea

While policies for other industrial uses of the sea (e.g. offshore oil and gas development, gravel extraction) are well established, offshore wind energy development is unprecedented and therefore is unfamiliar ground for the regulatory and policy arenas. Regulatory bodies have been using the existing regulatory frameworks to permit proposed offshore wind projects, but additional strategic planning and resource management strategies are needed to address the specific requirements of a robust offshore wind energy development. Timely involvement of the Transmission System Operators, health and safety bodies and environmental authorities are among the key elements for the success of future offshore wind. In addition, links must be established with the existing sea user industries, to minimise conflicts between them and offshore wind and to emphasise the synergies and opportunities for these players that offshore wind brings. These industries also have key experience and expertise that the offshore wind sector needs to develop cost effectively and safely.

Scroby Sands wind farm, UK (© Archant)

Encouraging the creation of a coherent offshore wind industry identity

The development of a coherent European offshore wind industry identity will require specific initiatives

to promote partnerships and to bring new actors from other sectors into the market who have the necessary skills and knowledge, for instance from the offshore oil and gas industry. One potential industry initiative could be to develop a 'supply chain code of practice'. Such a model was brought forward in the 1990s by the UK offshore oil and gas sector. This would set out the conditions of business in the sector, promote confidence in the business relationships and ensure fair profits for all.

Creating comparable European training and qualification standards to ensure sufficient workforce capacity and human resources, and to increase cross border cooperation

New requirements with regard to employee qualifications in the areas of project management, national and international law, quality assurance, occupational safety and health care and technical English are evident in almost all sectors of the value-added chain. A detailed analysis[19] of the European market recently revealed deficits which can be attributed to a lack of comparability and transferability of national professional qualifications, certificates and standards.

19 Qualification Requirement – Analysis Offshore Wind Energy Industry 2005

Research and Technological Development

Current offshore wind energy system designs have been adapted from onshore-based versions and deployed in shallow waters for more than a decade. Offshore wind energy technology is evolving toward larger-scale and fully marinised offshore systems that can be deployed in a range of water depths across a wider range of geographical areas. Today, a number of large wind turbine types primarily designed for offshore use are available: several manufacturers have developed turbines that range from 3 to 5 MW in capacity. Research is needed to enable a cost-effective large-scale deployment of the technology. As important as any of these technical issues is finance, in particular how easy it will be to raise the investment sums required for the new larger offshore projects of 100 MW and scheduled to be built over the next decade.

RECOMMENDATIONS:

Establishing credible cost benchmarks and targets for future offshore wind energy costs

The prime focus of all R&D efforts for offshore wind should be to increase the cost-effectiveness of the technology, without compromising on safety. For

Lillgrund wind farm, Sweden
(© Hans Blomberg, Vattenfall)

growth areas in Europe today. Both top down and bottom up approaches must be facilitated: top down through better EU and national coordination of research programmes, and bottom up through better cooperation between various stakeholders such as research institutes, universities, wind industry, consultancy firms, and so on.

example, the industry could establish the current cost base for the technology in order to set benchmarks for the various components of offshore wind projects, including the operation and maintenance phase. Once these have been determined, targets for reducing these costs in the period up to 2020 can and should be formed. This will give policymakers confidence that the overall cost of developing the sector is known and will go down over time, in the long term converging with the costs of alternative power investments.

Increasing and prioritising offshore wind R&D calls at EU and national level: the role of the Strategic Energy Technology Plan[20] and of the European Wind Energy Technology Platform[21]

Collaborative efforts and increasing targeted EU and national funds are crucial for advancing technology development that tailors offshore wind systems to the marine environment. It is vital that suitable resources are put into R&D and innovation at both EU and Member State levels. Failure to provide sufficient support for R&D in wind energy would risk the loss of one of the key energy technology

The Strategic Energy Technology Plan that the European Commission is preparing should guide R&D efforts in the key areas, with a view to decreasing the long term generation costs. The European Wind Energy Technology Platform (TPWind), which was launched in October 2006, must become central in defining the key R&D priorities. The European Commission must take into account the opinion of the sector representatives through TPWind when it comes to formulating its R&D priorities for offshore wind.

Increasing R&D cooperation between industries and with public authorities

The European Wind Energy Technology Platform enhances cooperation between the various stakeholders. An updated strategic research agenda and market deployment strategy will include the long-term priorities regarding wind resource assessment and forecasting, wind turbine optimisation, wind energy integration, offshore deployment and operations, wind and electricity market evolutions, policy recommendations, payment mechanisms and environmental impact assessment optimisation.

20 Towards a European Strategic Energy Technology Plan (SET-Plan) Communication COM(2006)847 http://ec.europa.eu/energy/res/setplan/communication_en.htm
21 European Technology Platform for Wind Energy (TPWind) http://www.windplatform.eu

Burbo Bank wind farm, UK
(© Siemens AG)

Increasing cooperation between national and European technology platforms

Several Member States have conducted comprehensive research programmes on offshore wind. Some of them have set up technology platforms[22]. The European Wind Energy Technology Platform is the place for coordination of these national initiatives.

Conducting research studies and programmes investigating the potential multiple use of the sea at the same location through dedicated FP7 joint calls organised by the EU

Encouraging demonstration programmes of full-scale projects, coastal onshore prototype test sites and facilities suitable for accommodating larger offshore prototype turbines

Exploring new approaches for accelerating innovation through:

- The contribution of the European Institute of Technology (proposed by the Commission) could help to fill the gaps between education, research and innovation

- A Joint Technology Initiative which could be of great interest for securing long-term public-private partnerships. The JTI for wind power could secure employment in Europe and reinforce the European industry's leading position in wind systems technology, thereby yielding both direct and indirect benefits to the European citizen.

This initiative could accelerate the pace of innovation and address the fragmentation of the market and of R&D efforts across Europe, private and public, by means of a common and compelling Strategic Research Agenda (SRA). One of the first steps of this initiative could be a pan-European test site with different turbines funded partly by the EU and interested Member States alongside companies.

Grid Integration

There are currently no electrical grids present at sea to connect large-scale offshore wind energy. In addition to the absence of offshore grids, current onshore transmission networks cannot accommodate some of the most ambitious plans for offshore wind farm deployment. The necessary redesigns of the grid infrastructure, system management, grid regulation and grid codes must be made to reflect the characteristics of renewable energy technologies. Increasingly, large offshore projects will be treated as "power plants" to be integrated in the same way as conventional power stations. This will certainly necessitate both national and cross border network upgrades, raising the need for infrastructure investment.

22 Denmark: Megavind – http://www.windpower.org/megavind, Spain: Reoltec – http://www.reoltec.net

There is no doubt that transmission and distribution infrastructure will need to be extended and reinforced in most EU countries when large amounts of wind power are connected. However, extensions and reinforcements are needed not only to accommodate wind power, but also to connect other power sources necessary to meet the rapidly growing European electricity demand. The present grid system, however, is not yet used to its full extent and in an optimal way.

A proper definition of the interfaces between the wind power plant itself (incl. the "internal" grid and the corresponding electrical equipment) and the "external" grid infrastructure (i.e. new grid connection and extension/reinforcement of the existing grid) has to be discussed, especially for remote wind farms and offshore wind energy. This does not necessarily mean that the additional grid tariff components due to wind power connection and grid extension/reinforcement have to be paid by the local/regional customers only. These costs could be socialised within a "grid infrastructure" component at national, or even EU level. Of course, corresponding accounting rules would need to be established for the grid operators.

RECOMMENDATIONS:

Cooperation between Member States and with grid-related stakeholders should be encouraged and intensified

One key opportunity to do so is through an effective and quick involvement of the coordinator for offshore/onshore wind projects in Northern Europe, appointed in 2007 for the implementation of the most critical identified priority projects.

Revising the guidelines for Trans-European Energy Networks according to the new commitments of the EU

This should be done along the lines set out in the Priority Interconnection Plan (COM(2006)846), and it should support the energy policy targets agreed by the European Council in March 2007. Future revisions of TEN-E guidelines should take into account results of dedicated studies at European level on large-scale integration of wind power (TradeWind).

Defining allocation of costs for grid infrastructure mechanisms to ensure that all players have a real incentive

Germany recently decided to put an obligation on the transmission grid operators to provide the offshore HV network infrastructure for the connections to the wind farms. The UK is developing a regulated transmission for offshore that is in line with the system that operates onshore. In general, grid expansions and reinforcements due to large scale wind developments should be approached and financed by Transmission Systems Operators in the same way as upgrades following increases in other forms of renewable electricity production or conventional power supply, and on the basis of long term integral system and grid planning.

Integrating future scenarios for offshore wind power development into strategic grid planning at national and EU level

EU grid operators should cooperate and develop common commercial and technical codes and se-

Egmond aan Zee, Netherlands
(© Shell WindEnergy)

curity standards, as well as plan and coordinate the investments needed at EU level. This would also promote cross border trade, increase competition in the EU internal energy market and create a more level playing field for operators. For any new initiatives, closer regulatory supervision is also necessary to guarantee price transparency, network access and clear investment incentives. Strengthening EU coordination of regulators and increasing the powers of national regulators as the European Commission proposed in 2007 should be encouraged.

Environment and Planning

Even before wind farms are constructed there are a considerable number of issues to be resolved over site selection, including legal rights and coastal zoning. Up to the traditional 12 mile (22.2 km) distance from a particular country's shore, approval for and negotiation over offshore development rights rest with the national authorities. Beyond this, although most countries have declared a further area as an EEZ (Economic Exclusive Zone), there is still some uncertainty as to exactly what this jurisdiction covers. There is also a need to avoid developers claiming rights for the exploitation of a particular sea area, but then not progressing with a project.

Beyond technical and economic issues, the sustainability of an offshore wind power industry will depend on focusing on environmental compatibility and impact mitigation as high design priorities, and on improving understanding of the interactions that will occur between offshore wind development and marine ecosystems. Demonstrating the compatibility of offshore wind energy systems with ecological systems and human uses of the ocean will be required for offshore wind energy development to proceed with the necessary public support. Knowledge of the intensity and scale of potential impacts on the local environment remains limited. First results of multi-annual monitoring studies are however, promising. The results of such studies should be widely promoted and the knowledge gained should impact the level and quantity of information requested for developers in their future applications. Generic research in cumulative effects and increased standardisation of environmental impacts assessment should also be encouraged.

RECOMMENDATIONS:

EU Member States should strive for one single regulatory regime and legislative framework applicable to both territorial waters and the Economic Exclusive Zone[23]

A stable and predictable policy framework is very important for a young industry, allowing it to mature. The sea knows no borders, and so the rules which are applied to allow projects to develop should be consistent wherever they are sited. Such consistency will promote the efficiency of development, and allow developers to predict with confi-

23 Exclusive Economic Zone (EEZ) is a seazone within which a state has special rights over the exploration and use of marine resources. Generally a state's EEZ extends to a distance of 200 nautical miles (370 km) out from its coast.

Bremerhaven wind farm, Germany
(© Multibrid)

dence whether a project can be developed in an environmentally acceptable manner and in what timeframe.

Encouraging efficient procedures which are based on past experiences and are in proportion to the scale and the impact of the project

The body of knowledge on the impacts of offshore wind on the marine environment is growing rapidly. It is important that the knowledge generated in different countries is shared efficiently so that research is not duplicated, and so that best practices can be disseminated quickly. In particular, evidence that establishes when precautionary approaches can be abandoned needs to be circulated rapidly so that developers are not burdened with unnecessarily onerous conditions before consent can be given.

Encouraging the establishment and implementation of marine spatial planning instruments

Suitable areas and locations for offshore wind power in the marine environment may compete with other uses of the sea such as nature conservation, fisheries, sea transport, tourism and military interest. The use of marine planning instruments is needed to help resolve potential conflicts, to regulate the competing uses of the seas via a transparent decision making process and to achieve optimal site selection.

Expanding existing cooperation on environmental research to more Member States

Bilateral initiatives already exist and the Danish-German cooperation on research into the impacts of offshore wind power in the marine environment works successfully. Such cooperation could be replicated or expanded; the possibilities of including other interested countries should be explored. The scope of the cooperation today, which includes environmental issues, could also be widened to include technologically-orientated aspects. Other projects of regional cooperation are in preparation. There is one such project between the United Kingdom, the Netherlands and Sweden, who plan to develop a proposal for a workshop of Member States' wind farm licensing authorities. This would allow them to share examples of consenting procedures and to identify opportunities for streamlining, as well as sharing examples for decision-making strategies under uncertain ecological baseline information. The impacts of such initiatives should be fully investigated and good practices must be encouraged.

Another approach has been the use of Strategic Environmental Impact Assessments to consider the likely environmental effects on sea areas before they are offered up for licensing to specific wind developers. This was the case, for instance, before the UK selected three large sea areas off its east and west coasts for up to 7,200 MW of wind capacity.

Policy recommendations: **summary**

Policy

- Establishing a European policy framework for offshore wind power
- Increasing regional cooperation to maximise the synergies and complementarities of various regions with offshore wind ambition around the North Sea, the Baltic sea, the Atlantic Ocean and the Mediterranean
- Clarifying roles for regulation, governmental and European policies

Market

- Establishing stable, coordinated long-term markets for offshore wind in Europe
- Building and optimising the supply chain for a timely and sustainable flow of commercial projects
- Establishing coordination and collaboration with the power infrastructure industry, the maritime industry and the oil and gas industry in order to integrate offshore wind power with established uses of the sea
- Encouraging the creation of a coherent offshore wind industry identity
- Creating comparable European training and qualification standards to ensure sufficient workforce capacity and human resources, and to increase cross-border cooperation.

Research and Technological Development

- Establishing credible cost benchmarks and targets for future offshore wind energy costs
- Increasing and prioritising offshore wind R&D calls at EU and national level
- Increasing R&D cooperation between industries and with public authorities
- Increasing cooperation between national and European technology platforms

Middelgrunden wind farm (© LM Glasfiber)

- Conducting research studies and programmes investigating the potential multiple uses of the sea at the same location through dedicated FP7 joint calls organised by the EU
- Encouraging demonstration programmes of full-scale projects and coastal onshore prototype test sites and facilities suitable for accommodating larger offshore prototype turbines
- Exploring new approaches for accelerating innovation through the contribution of the European Institute of Technology and/or a Joint Technology Initiative

Grid Integration

- Cooperation between Member States and with grid related stakeholders should be encouraged and intensified
- Revising the guidelines for Trans-European Energy Networks, according to the new commitments of the EU
- Defining allocation of costs for grid infrastructure mechanisms to ensure that all players have a real incentive
- Integrating future scenarios for offshore wind power development into strategic grid planning at national and EU level.

Environment and Planning

- EU Member States should strive for one single regulatory regime and legislative framework applicable both to territorial waters and the Economic Exclusive Zone.
- Encouraging efficient planning procedures which are based on past experiences and are in proportion to the scale and the impact of the project
- Encouraging the establishment and implementation of marine spatial planning instruments
- Expanding existing cooperation on environmental research to more Member States

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Middelgrunden wind farm, Denmark (© LM Glasfiber)

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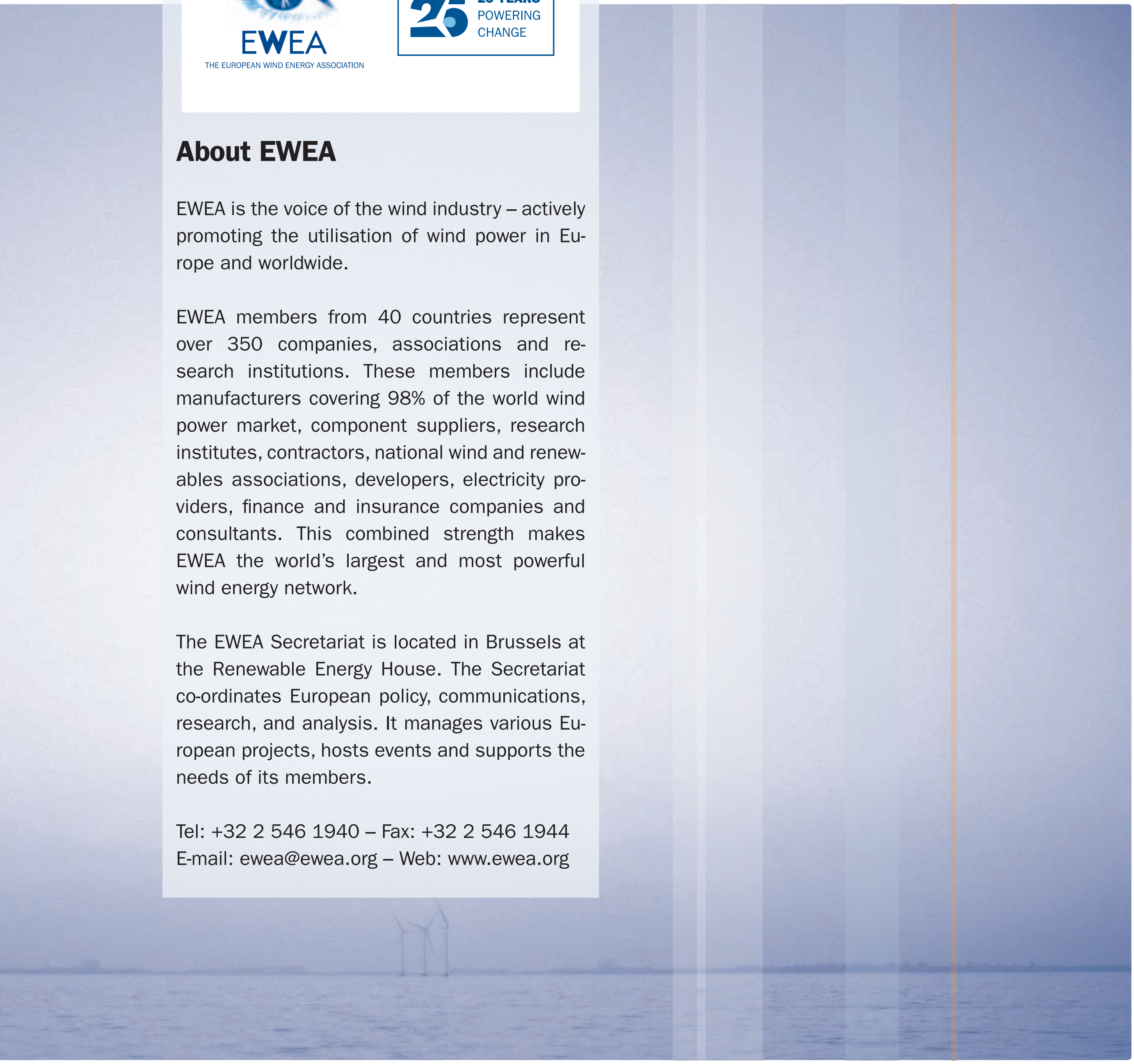

About EWEA

EWEA is the voice of the wind industry – actively promoting the utilisation of wind power in Europe and worldwide.

EWEA members from 40 countries represent over 350 companies, associations and research institutions. These members include manufacturers covering 98% of the world wind power market, component suppliers, research institutes, contractors, national wind and renewables associations, developers, electricity providers, finance and insurance companies and consultants. This combined strength makes EWEA the world's largest and most powerful wind energy network.

The EWEA Secretariat is located in Brussels at the Renewable Energy House. The Secretariat co-ordinates European policy, communications, research, and analysis. It manages various European projects, hosts events and supports the needs of its members.

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