

I am delighted to be writing the foreword to the first publication by Norstec; an initiative launched by the offshore renewables industry to spread the word about an extraordinary economic and environmental opportunity that lies in front of us - to access the renewable energy resources of the European northern seas. Developed with E3G - a not for profit environmental think-tank - this study seeks to highlight the opportunity ahead and argues that capturing this opportunity requires a long term vision to meet energy and climate objectives across Northern Europe.

The renewable resources of wind, wave and tide in the northern seas are created by a set of geographical circumstances that by coincidence finds adjacent large population centres crying out for more energy but without the CO₂ emissions of fossil fuels. As the study highlights, the economic, environmental and electricity supply opportunity is without parallel since North Sea oil and gas was discovered.

The nature of offshore renewables means that costs are driven by capital costs and maintenance costs - there is no fuel! For this reason offshore renewables bring a proportionately higher economic opportunity for jobs for every MWh produced. We must help communities to understand

that parity between sources of electricity should be measured by economic and environmental benefit as well as cost, and that as more offshore wind is built the costs drop further. Only then can the most informed choices on energy mix be made and this report seeks to help inform that debate.

In the current tough economic climate we should also be reminded that the findings below indicate the scale of the opportunity and not necessarily a forecast of what will happen. It requires co-ordinated political and investment 'buy in' across the region to enable this opportunity to be realized. Wider communities must be part of the fundamental decision that the renewable resources of the northern seas should be a significant part of the energy portfolio for our children and our children's children.

I do hope that prompted by some of the findings below you will join in spreading the word about the extraordinary opportunity of developing offshore renewables in Northern Europe.

Julian Brown
Chairman, Norstec

Offshore renewables offer an investment and economic growth opportunity on a par with North Sea oil and gas

The offshore renewables sector is maturing with significant growth and investment expectations over the next few decades. **Global investment in offshore wind power is estimated to reach €130 billion by 2020⁹.**

In 2013 alone offshore wind investments across Europe are expected to total over €6 billion¹⁰. In 2030, investment in offshore wind turbines is expected to triple to €17 billion per year across Europe¹¹. Cumulative investment in the overall European offshore wind energy market could reach €145.2 billion in total between 2021 and 2030¹² contributing to energy security, jobs and growth. On average, this **surpasses expected oil and gas investment forecasts** of £44 billion in the North Sea over the next five years¹³.

Delivering the scale of investment in the UK alone is on a par with the private investment undertaken during the peak development phase of UK North Sea oil and gas from the mid-70s to the mid-80s¹⁴.

Offshore wind can also create significant **gross value added for the overall economy**. If 2020 renewable energy targets are met, the gross value added from offshore wind in Denmark, Netherlands, Germany, Sweden and the UK could total €7.5 billion²¹.



Vast offshore renewables resource potential in Europe's northern seas can help to keep the lights on and decarbonise the energy sector

Europe needs to invest in renewing its ageing power infrastructure to meet future demand while also decarbonising its overall energy sector. Significant renewable energy potential in Europe's northern seas can provide **secure and clean power** at scale to meet these objectives.

North-West Europe is the global leader in offshore wind, adding capacity equivalent to a nuclear power station annually¹. **Europe accounted for over 90% of installed capacity globally in 2012**. UK, Denmark, Belgium and Germany are the global leaders with 84% share of the global offshore wind capacity².

By 2030, up to 150 GW of offshore wind capacity could be deployed in Europe, generating enough electricity to meet **14% of the EU's total electricity consumption**, and provide electricity to 145 million households³. The expected growth would be equivalent to adding more than a dozen nuclear power stations annually in 2030⁴.

By 2050, offshore wind could provide electricity equivalent to nearly 40% of EU's electricity demand⁵.

Large scale offshore wind deployment in Europe could avoid 315 million tonnes of CO₂ emissions in 2030⁶. This is equivalent to shutting down more than a third of Europe's coal and lignite power plants⁷, or to taking all transport off the roads in the UK, Germany and France⁸.



14% of the EU's electricity consumption by 2030

Investment in the offshore renewables will benefit coastal regions and create new highly skilled jobs

In Europe, about 20,000 people were working directly and indirectly in the offshore wind sector in 2009²⁰. By 2020, over 100,000 jobs could be directly created in the offshore wind industry across the North Seas region²¹.

By 2030, 300,000 people could be employed in the offshore wind industry overall²². In retrospect, the UK oil and gas sector in the North Sea generated 440,000 jobs in the last forty years²³.

The offshore renewables industry generally has a higher proportion of highly-skilled jobs as opposed to the economy at large, but also maintains the need for a **diverse skills base**²⁴.

Since auxiliary services in the offshore industry, including vessels and catering, tend to be located near the project sites, they also deliver **local**

and regional economic benefits. For instance, the construction of offshore wind farms has helped to regenerate some of Germany's coastal cities, with **thousands of jobs created** in the cities of Bremerhaven, Cuxhaven and Emden²⁶.

Esbjerg Harbour, Denmark's largest business harbour, has received €135 million of investment to improve its existing infrastructure further to **serve a growing offshore wind industry** in the North Seas²⁷.

By 2022, over **8000km of high voltage offshore transmission lines** could be laid across the northern seas, equivalent to the distance between London and Beijing. This would create thousands more jobs, linking electricity markets, boosting the potential for trade and connecting offshore energy to where the demand is²⁸.

The European countries in the North Seas are both very attractive investment hotspots for offshore renewables but also have the opportunity to export to growing global market

The countries around the North Seas are at the **top of the attractiveness index for investment in offshore wind**. The UK and Germany rank first and second, respectively, whereas Belgium, Denmark, France, Sweden and Ireland are all among the top 10, partly due to the scale of resource potential and supportive policy framework¹⁵.

Deep water offshore designs that are being developed constitute an **export opportunity**. As deep water offshore capacity increases, expertise, skills and technologies developed in Europe can be exported across the globe¹⁶.

By 2030, the UK offshore wind sector can deliver an increase in net exports of £18.8 billion to £22.5 billion of offshore wind investment, depending on the scale of deployment. This could **almost entirely plug the country's balance of trade deficit**¹⁷. Wind is already a key sector in Denmark and accounted for 8.5% of its total exports in 2012¹⁸.

In addition, based on central price assumptions, in the longer term the UK could become a net electricity exporter and gain £31 billion from **exporting offshore renewables-based electricity** to Europe in 2050¹⁹.

Technologies developed in Europe can be exported across the globe



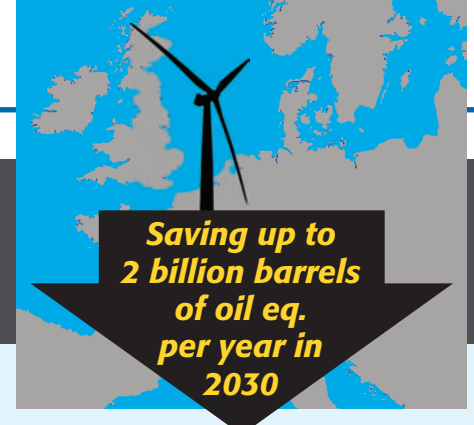
300,000 jobs by 2030

Offshore renewables can protect consumer bills from future prices and make the economy more resilient by reducing dependency on imported fossil fuels

Europe is becoming increasingly dependent on fossil fuel imports. Its dependency on coal, oil and natural gas increased from 46.7 % in 2000 to 52.7 % in 2010. Its dependency on oil imports reached 84% in 2010²⁹.

In the longer term, the total potential of economically-accessible offshore wind energy resources in Europe is larger than current European production of oil and gas put together³⁰.

Overall offshore wind resource potential in Europe could save up to **2 billion barrels of oil eq. per year** in 2030³¹, equivalent to almost half of EU's total net oil



import or total net gas import in 2010³². This is on par with North Sea oil and gas average annual production of 1 billion barrels of oil over the last 40 years in the UK³³.

In addition to increased physical security of supply, scaled up electricity generation from offshore wind can **avoid fuel costs** of €26.9 billion in 2020, and €32.8 to €55.8 billion in 2030³⁴, depending on fuel price assumptions.

Europe's northern seas can be the centre of excellence and innovation globally, and maintain European competitiveness on cutting-edge technology development

Europe already leads in many clean technology sectors with a market share of 30-50% globally³⁷.

European countries benefit from early mover advantages as over 9 out of every 10 MW of offshore wind installed capacity in 2012 was based in North-West Europe, with UK and Denmark as clear global leaders³⁸. European companies currently **dominate the global offshore wind turbine market** and are strong players in other offshore wind related technologies across the supply chain³⁹.

In addition to significant progress in offshore wind, **the largest European tidal energy project** in Scotland has been granted consent, which, if fully developed could provide half of Scotland's electricity annually⁴⁰.

Europe is a key location for inventive activities. Germany is in third place globally behind the United States and Japan in all wind related patents, mainly owing to two major European technology companies. All leading wind players are also active in **offshore innovation**, demonstrating their adaptive research and development abilities. In offshore wind related patents, three European companies are among top five patent owners globally⁴¹.

Further innovation in the European offshore renewables industry is underway and some expect significant **cost reductions** of around 35-55% to €70-90 per MWh by 2020⁴². Innovation and further cost reduction in these relatively new technologies will require continued support for research, development and demonstration, and, in addition, strong demand signals from the market to 'pull' them into full commercialisation.

Offshore wind is already moving into deeper waters with **bigger turbines**⁴³. Almost three-quarters of all new technology development announcements are for turbines of a rated capacity of 5 MW or more⁴⁴, with 10 MW turbines also under development⁴⁵. The longest wind turbine blade in operation in the world currently reaches 75 metres each, almost matching the wingspan of an Airbus jumbo jet A380. When the turbine blades rotate with a total rotor diameter of 154 metres, they sweep an area equivalent to 2.5 football fields (18,600 square metres)⁴⁶.



Image: Siemens press picture