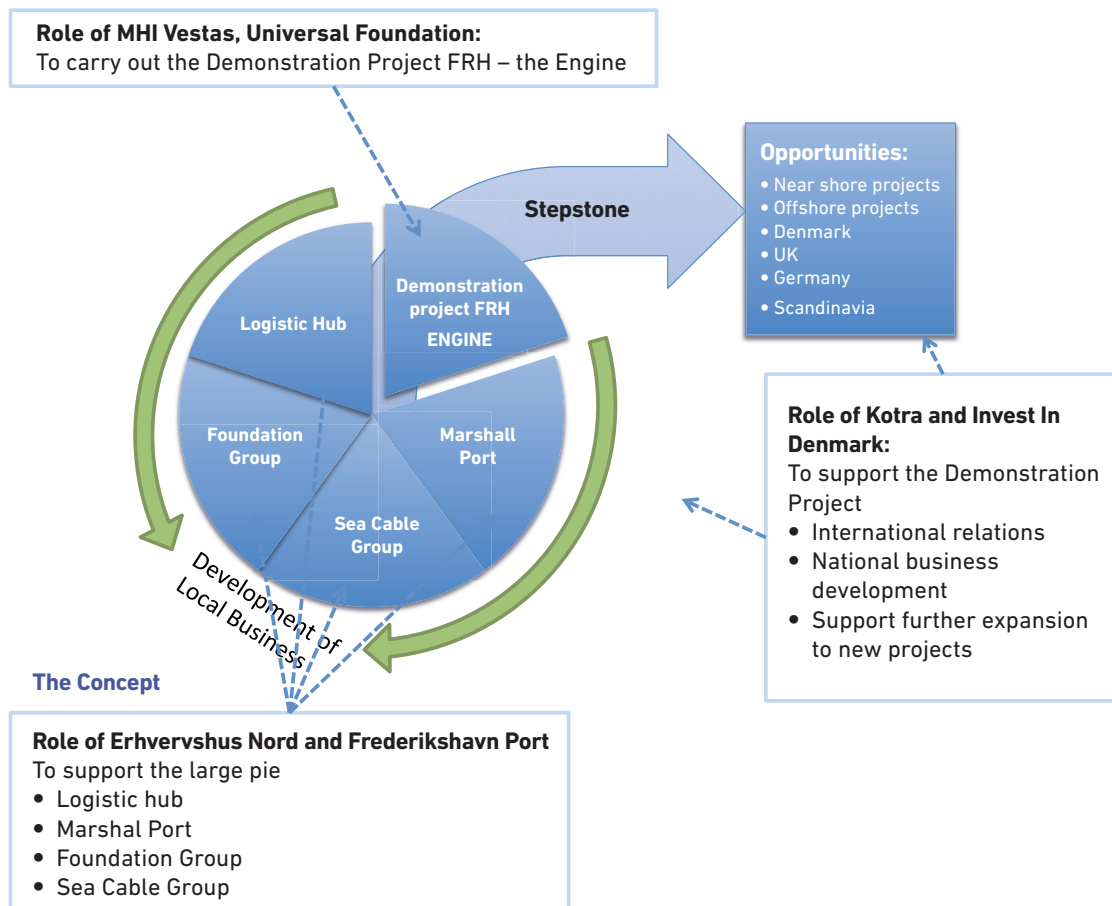


Promising concept for turnkey deliveries of major complex facilities

Since November 2013 a concept for turnkey deliveries of off shore wind farms has been developed in a joint effort between Frederikshavn, MHI Vestas Offshore Wind and Universal Foundation. This concept results in lower prices per installed MW and greater competitiveness for those enterprises taking part. Greater competitiveness and the accumulation of knowledge have taken place and will continue to be realized via collaboration between major international enterprises and small and mediumsized regional and local businesses in North Jutland, with the major enterprises' capabilities (technology, organisation, etc.) contributing to knowledge building and job creation amongst the small and mediumsized businesses.

In collaboration with enterprises such as DONG Energy, the Danish Energy Agency, major EU utilities, 3F, MHI Vestas Offshore, Fred. Olsen wind companies, Taihan Electric Wire, Daewoo International, Kuehne + Nagel, Spar Nord Bank, Arbejdernes Landsbank, Nordea and selected small and mediumsized businesses, Frederikshavn (the municipal authority, utility company, port and Erhvervshus Nord business development), Invest In Denmark and Kotra have developed the concept in line with the following roles and distribution of responsibilities.

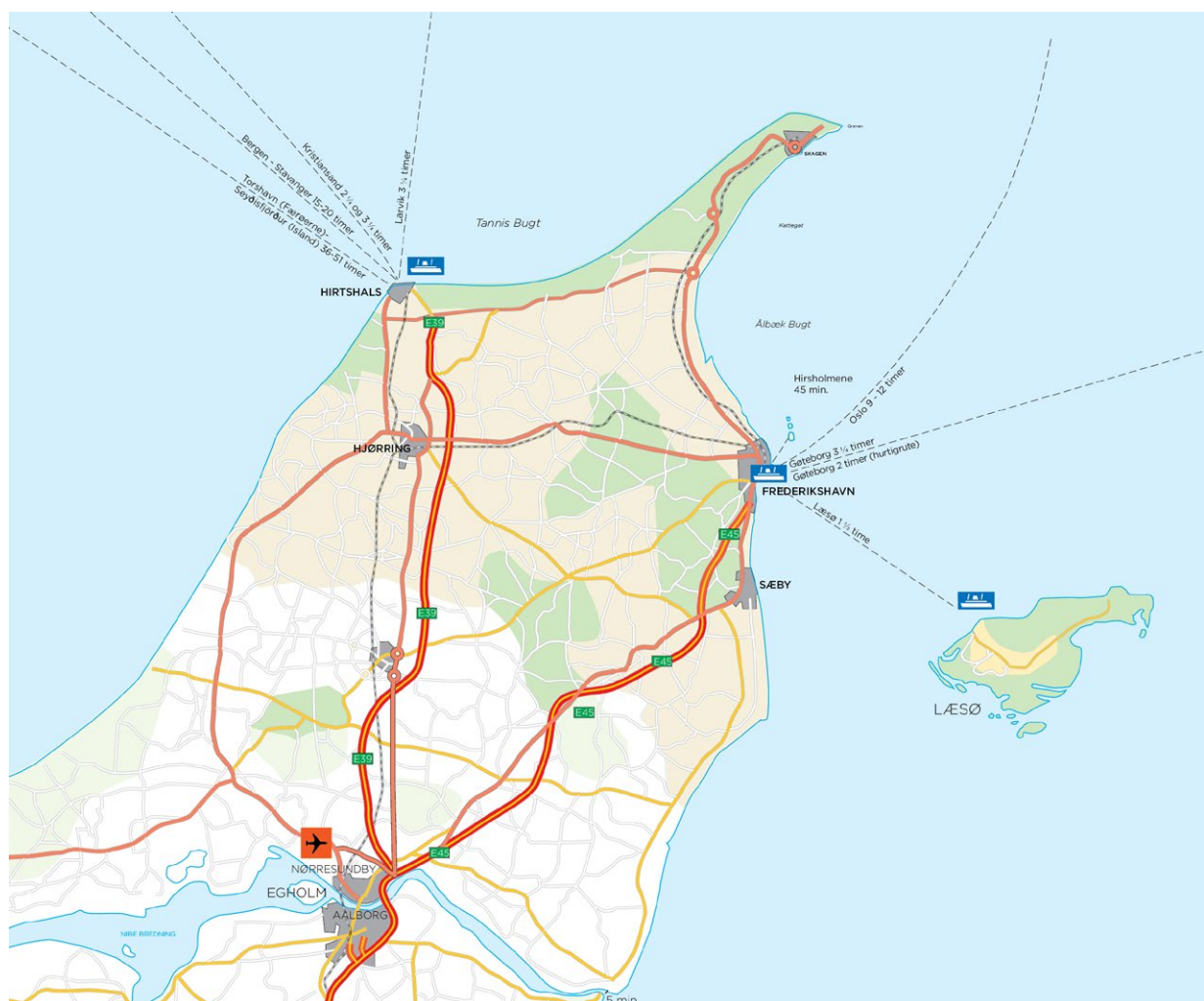


The concept is demonstrated in practice within offshore wind via the implementation of Demonstration Project Frederikshavn, where the project's success criteria are being realised with visibly good results.

- 1. "Ready quayside 15 November 2015 – DKK XX mill. per MW"**
- 2. "Frederikshavn as Marshalling Port for offshore wind"**
- 3. "Two Korean companies established in Frederikshavn"**
- 4. "The Concept is applied to the sale of 450 MW nearshore wind farms"**

The scalable concept that is being implemented in a straightforward manner and at high speed in Demonstration Project Frederikshavn, which is described in more detail below, will realize the objectives that poli-

ticians, ministries, agencies, the wind industry and pension funds have been calling for: "Lower prices per installed MW and job creation".



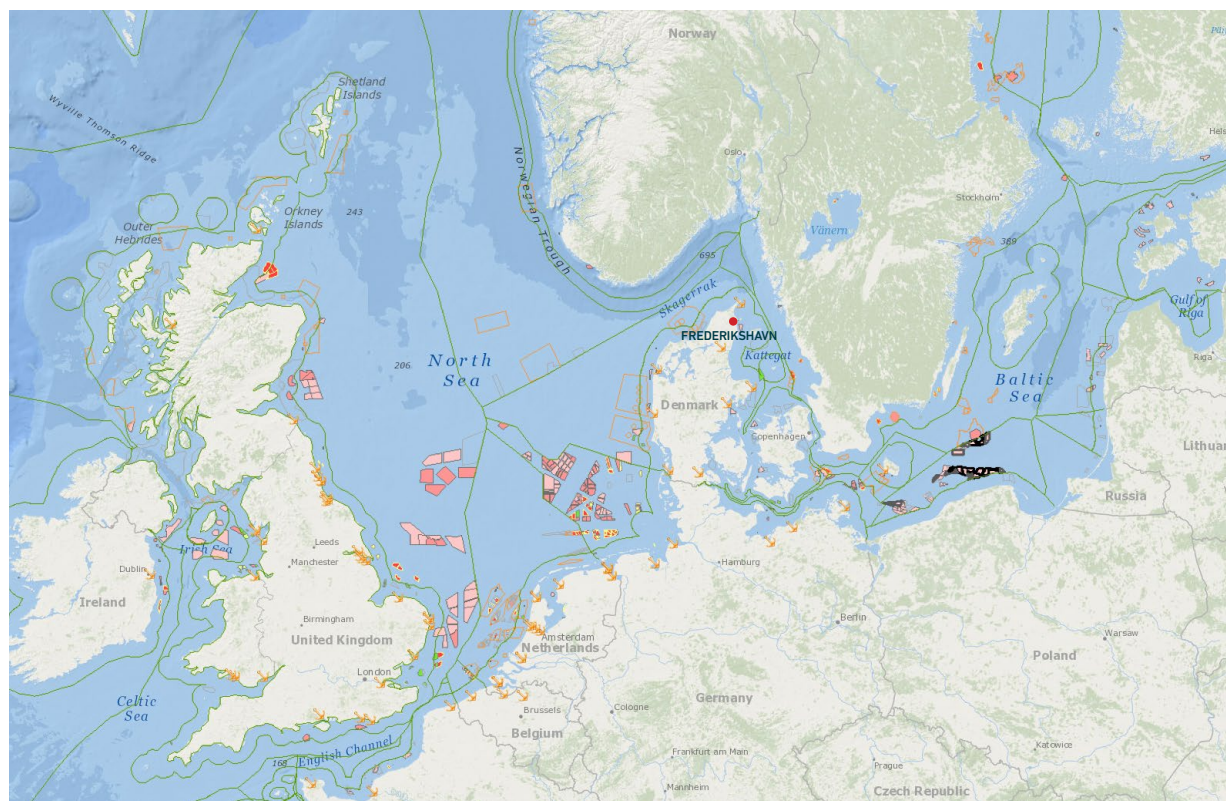
The project exploits Region North Denmark's skills, location and the extension of the Port of Frederikshavn, combined with excellent and well-established infrastructure to/from Norway and Sweden via Color Line and Stena Line and motorways to/from continental Europe, with the objective being to encourage the wind industry to establish final assembly and logistics hubs.

Working with major international enterprises involved in an extensive array of energy sources (oil/gas, hydro-power, wave power, biogas, etc.) and with major construction tasks will enable business relationships to be created and thereby opportunities to exploit the concept, in which the line-up will be put together in a way similar to that at Demonstration Project Frederikshavn.

Demonstration project Frederikshavn and the European market for offshore wind

Demonstration Project Frederikshavn (The Project) is based on the development of up to six next-generation multi-megawatt offshore wind turbines with related foundations and sea cables. The Project and concept for turnkey delivery of offshore wind farms will act as the gateway to the huge market for offshore wind power in the North Sea in immediate continuation of the project in Frederikshavn. The Project provides the participating parties, including interested Korean com-

panies, with the opportunity to promote skills, products, ability to supply and commitment to the growing offshore market with respect to – amongst others – the 9 leading energy companies that control 75% of all UK Round 3 projects, and to act as a partner on future offshore tenders. The prerequisite for involvement is a common interest in developing a best practice example to the industry at unprecedented cost levels of 20-30% below current levels.



40 GW offshore wind turbines in Northern Europe by 2020

The political goal within the EU is to provide 40 GW of offshore wind power by 2020. With only around 7 GW provided to date, there is a huge potential of 33 GW by 2020, which corresponds to 5-6,000 wind turbines and a total investment well in excess of 100 billion EUR. Denmark is contributing to this positive development by means of the proposed developments at Horns Rev 3 (400 MW), Kriegers Flak (600 MW) and 400 MW in near-shore projects. The realisation of these goals will con-

tribute to the development of an energy source that reduces CO₂ for the benefit of the environment, and which will ensure Europe's energy security and independence from the politically driven gas and oil supplies. At the same time, there is increasing political pressure to reduce costs by a considerable amount in the industry in order to ensure that offshore wind power is competitive in relation to fossil fuels.

Industrialisation and increased competition will boost the competitiveness of offshore wind power

Leading industrial players such as DONG Energy Wind Power, MHI Vestas Offshore Wind and Siemens Wind Power are targeting cost reductions of 30-50% in relation to current levels.

Reductions of this magnitude have proved to be very difficult to achieve when based on current technology. Wind turbine manufacturers such as Siemens and Vestas have therefore begun to focus on developing the wind turbines of the future in which capacity is increased to 8-10 MW per wind turbine (as opposed to today's preferred wind turbine capacity of 3.6 MW). This will result in more efficient high-performance wind turbines, which will in turn have considerable impact on the so-called Levelized Cost of Energy. Similarly, con-

siderable savings have to be found on the Balance of Plant (BoP) components – including foundations, substations, cables and installation. At present, the turbine represents approx. 40-45% of CAPEX, whereas the foundation represents approx. 20-30%. Due to the fact that wind turbines will increase in size and capacity, and offshore projects will be located in deeper water (up to 50 m against approx. 20 m today) further from the shore (30 km today as opposed to more than 200 km in the future), current BoP component technology will have great difficulty in realising significant cost cuts. There is therefore a pressing need for smarter and cheaper methods of developing offshore wind projects – innovation and greater competition are both ways of ensuring this.

Technologies of the future and innovative concepts are being tested in Frederikshavn

Demonstration Project Frederikshavn is all about testing the technology of tomorrow and using an innovative method of collaboration to bring a new concept for turnkey delivery of offshore wind farms to the market, whereby suppliers of approx. 85-90% of the wind farm (turbines, foundations, sea cables and installation) will see significant reductions in construction price. The Visible short-term result hereof will be the up to six offshore wind turbines on the approved site in the waters off the coast of Frederikshavn.

The Project is unique in a European perspective, as it is currently the only approved site without performance

limitations and with broad local political support. This will enable new technology to be trialled as early as 2015/2016, resulting in lifetime costs for offshore wind power being reduced by 30-50% and being done so prior to the development of the 1,400 MW wind farms at Horns Rev 3, Kriegers Flak and nearshore projects by 2020, thus underpinning Denmark's energy vision. In addition, it will pave the way for the provision of technology for 33,000 MW in the North Sea, where Frederikshavn is aiming to act as a manufacturing base and discharge port for the entire supply chain.

Frederikshavn as marshal port

The Port of Frederikshavn is perfectly located at close proximity to major offshore wind developments in Denmark, Germany and the UK. Furthermore, the strategic location also makes it of interest to the oil and gas industry. The Port of Frederikshavn is a municipally-owned limited liability company with a healthy and robust financial status. The port has a strong interest in carrying out Demonstration Project Frederikshavn, since this activity can accelerate the phases of the port's expansion for the benefit of all companies at the port. Key areas of interest include:

Marshal Port wind energy activities:

- Logistics hub, where wind energy components (blades, nacelles, towers, foundations, sea cables, etc.) are received, stored, reloaded and distributed to sites to be installed.
- Final assembly hub, where wind energy components undergo preparation, "final assembly" and accommodation.

Future potential

The Project is set to be a best practice example for delivery of a turnkey model for offshore wind farms based on the strong involvement of local, national and international stakeholders. The Project is perfectly timed in advance of the major offshore wind projects in the North Sea set to go forward from 2017 onwards.

The lessons learned from the Project and the innovative cooperation model can easily be transferred to inter-

- Installation and service hub, where the wind energy industry – in collaboration with local and regional businesses – delivers installation and service concepts to sites as alternatives to already existing hubs.

The Port of Frederikshavn is preparing the tender for expansion of the port of the order of DKK 600-700 million this autumn. With the municipal authority as its owner, it goes without saying that the Port of Frederikshavn has an interest in terms of jobs and the positive spill-over effect on the local community that will result from higher levels of activity within the offshore wind power sector. The expansion of the port will meet the requirements of the offshore wind power sector such that favourable establishment conditions can be offered with long-term perspectives.

national offshore markets, including – but not limited to – the USA, Japan and Korea to develop sustainable offshore wind energy based on best practice experience from Frederikshavn and the North Sea project zones. The concept holds the potential to be easily duplicated to other major energy infrastructure projects, including biogas, solar, tidal and wave energy. The resulting potential is huge!

Building on strong Korean relations

Building on the strong relation to and support of KOTRA Denmark and Invest in Denmark the Concept has already produced a supply chain consortium for deliveries of onshore and offshore cables in Denmark and Norway including Daewoo International Corporation, Taihan Electric Wire Co., Kühne + Nagel and Delpro Wind. Efforts are made to form similar supply chain consortiums re-

garding foundation fabrication. The Project will provide Korean participants with a stepping stone along with Danish partners to a growing European offshore wind industry with limited risk and high exposure towards key industry stakeholders, including leading European utilities and developers. Successful participation will be the first step towards a potential market of 33 GW!

The Concept with job creation and accumulation of knowledge

The technical, economic and organizational capabilities of major consortia are necessary in order to carry out Danish nearshore and offshore projects. Technical requirements and forms of procurement do not allow small and medium-sized businesses in the selected areas to be involved until the winners of the projects have been identified. Recommendations have been made to the Danish Energy Agency that the award criteria should

include the criteria below, such that weighting/grading takes into account innovative solutions that maintain the primary objective of "Job creation and lower price per MW", as well as the ability to involve local authorities and their subsidiaries (port, utility supply, business development, etc.) without any risks to the public enterprises concerned.

- **Price**
- **Organization**
- **Creation of added value locally and regionally**

The concept that is to be demonstrated in Frederikshavn will be rolled out on nearshore projects in which the Concept's primary objective is guaranteed by the participating municipal authorities and MHI Vestas and Universal Foundation respectively. The Concept can give Denmark a leading position and guarantee approx. 7,000 – 8,000 full-time equivalents in connection with planned and approved nearshore and offshore projects. In collaboration with other nearshore municipal authorities, Frederikshavn will be leading the way through the establishment of the marshalling port, production of foundations and the sea cable logistics hub. The nearshore projects can be implemented more quickly than the Danish Energy Agency's current timetable. The creation of added value in the Concept is a catalogue in which, through performance of the project, major in-

ternational enterprises can prove that they have lived up to their promises, at the same time as which all parties are able to earn money. A crucial factor is that small and medium-sized businesses will benefit from the fact that they will receive training in offshore requirements (technology, organization, quality, etc.) from the major enterprises, which thus act as locomotives. This ensures the creation of jobs and accumulation of knowledge which can be exploited by small and medium-sized businesses in public invitations to tender, for example with regard to so-called super hospitals, the Fehmarnbelt Fixed Link and Danish Rail Network tenders. Major tenders – both public and private – should ideally lead to the creation of jobs – and not to losses for banks or disappointed company owners and local communities.