

# PROMOTioN – EXECUTIVE SUMMARY OF PROJECT INTERIM REPORT

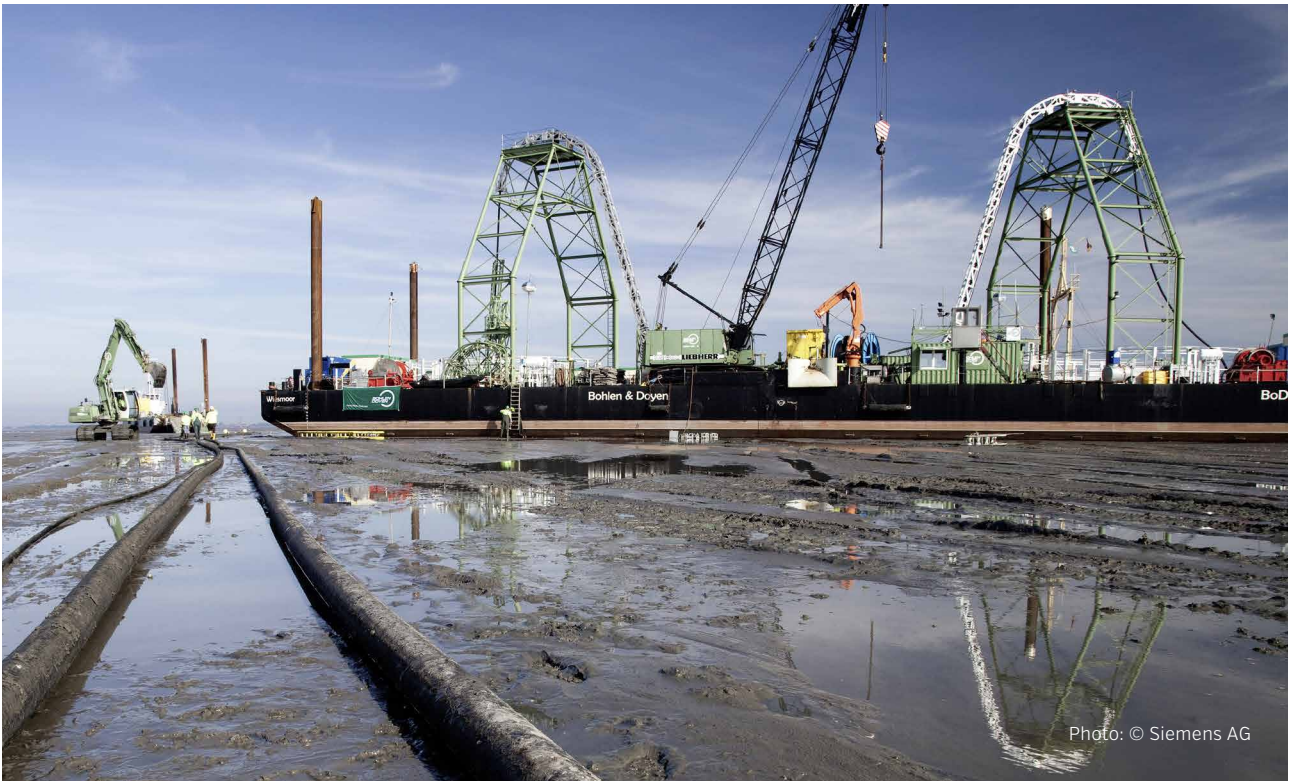
Meshed high-voltage, direct current (HVDC) network technology is a potential candidate for the future electrical power infrastructure required to enable Europe to transition to a clean, reliable and affordable energy future. It enables the optimal exploitation of geographically spread renewable energy sources by enabling countries to efficiently and cost-effectively trade the electrical energy. Particularly, the rapid development of offshore wind power in the Northern Seas, which requires transporting large amounts of electrical power over long distances via submarine cables, is a key application. Traditionally, European companies have pioneered the application of offshore wind and HVDC technology through innovation, and applying this to meshed networks is the next logical step to maintain the competitive advantage.

In the past, several studies have shown the socio-economic benefits and technical implications of such a meshed HVDC network. The studies often assumed that the technology required to build a meshed HVDC network would be ready and available, and that regulatory hurdles could be overcome. PROMOTioN, Progress on Meshed Offshore HVDC Transmission Networks, aims to advance on those studies, by determining all technical, regulatory, legal and financial actions that are to be taken in order to implement a meshed HVDC grid, using the Northern Seas as an example case.

In PROMOTioN, the technical and operational requirements for meshed HVDC networks are developed to a deeper and realistic level of detail, and the key technical choices to be made are identified and supported. The technology maturity of key components, such as DC circuit breakers and DC protection schemes, is demonstrated, and recommendations for standardization, improving both technology and vendor interoperability, are provided. Current member state and EU level regulations and methodologies for cost-benefit analysis concerning the development of transnational transmission infrastructure are analysed to identify hurdles towards the implementation of a meshed offshore HVDC network. Based on this, changes are proposed to the existing EU financial and regulatory frameworks, to foster a healthy investment climate.

- Firstly, a project identity and dissemination plan has been developed.
- In the first year, PROMOTioN has created a sound basis for future work.
- A qualitative and quantitative description of the requirements of a meshed offshore HVDC network, its subparts, connected wind farms and their operational characteristics have been defined.





- A comprehensive literature review of previous studies on meshed HVDC networks and the required technology has been carried out, selecting suitable scenarios and reference network topologies for use as a basis for future work.
- Models of cables, converters and the reference network topologies in various levels of detail have been developed and made available. Detailed modelling of DC circuit breaker technologies and an analysis of their behaviour within HVDC networks during faults has been started, with the aim of developing standardized models for network studies, test procedures and test circuits.
- Recommendations have been made to make the current ENTSO-E cost benefit analysis methodology suitable for meshed HVDC network development.
- At the end of the first year, a thorough understanding of the state-of-the-art meshed HVDC network development has been achieved, gaps in knowledge and challenges have been identified, and a clear idea of the required next steps to address these challenges has been gained, serving as a solid basis for further work.

During investigations in the first year, the technical maturity of the complex control and protection technology for a new type of diode-rectifier based offshore converter for offshore wind integration was determined to be insufficient to enable meaningful full scale demonstration within the project's timeframe. Investigations into gaining a deeper understanding of this technology and its implications continue.

The results have been reported in several deliverables, including journal papers, conference papers and workshops, which have been published on the project website. A stakeholder and reference group meeting has been organized, and two half-yearly internal project conventions were held. The results of which were exchanged and consultations with various project stakeholder groups were held.

