

ABOUT PROMOTioN

PROMOTioN seeks to develop meshed HVDC offshore grids on the basis of cost-effective and reliable technological innovation in combination with a sound political, financial and legal regulatory framework.

Background

The project 'PROgress on Meshed HVDC Offshore Transmission Networks' (PROMOTioN) applied in 2015 for funding under the EU Horizon 2020 (H2020) programme call 'Competitive Low-Carbon Energy' 5 (LCE 5). Within the framework of modernisation of the European electricity grid, this call focused on advancing innovation and technologies relevant to the deployment of meshed offshore grids. Its specific objective is to pursue an agreement between network operators and major equipment suppliers regarding a technical architecture and a set of multi-vendor interoperable technologies in order to accelerate HVDC grid development. PROMOTioN actively addresses the objectives that LCE 5 encompasses. Specifically, these are to:

- **Identify requirements for energy infrastructure priority corridors**
The requirements embrace a broad range of issues, such as the design, development and deployment of the energy infrastructure from a technical, financial, regulatory, managerial and policy perspective.
- **Facilitate agreement among operators and manufacturers**
Manufacturers and operators need to agree on architectures, control structures and interfaces in order to ensure interoperability and multi-vendor compatibility of equipment.
- **Demonstrate cost-effective HVDC grid technologies**
Full-scale and industrially relevant demonstrations will be carried out of novel & innovative components required to enable the realisation of meshed HVDC transmission grids:
 - HVDC circuit breakers
 - HVDC gas insulated switchgear
 - HVDC network protection systems
 - HVDC network control strategies
 - Harmonic performance of wind turbine generators
- **Prepare the first phase for deployment of innovative components...**
... of interoperable meshed offshore HVDC network technologies, services, tools and architectures.
- **Propose market rules and revenue streams...**
... to help establish a suitable package of financial resources.
- **Propose regulations for permitting and environmental compatibility**
PROMOTioN aims to set up a regulatory framework for the operation and management of meshed offshore grids governing legal, technical, and market-related aspects.

Context

A meshed European offshore transmission grid connecting offshore wind farms to shore could provide significant financial, technical and environmental benefits to the European electricity market. Launched in January 2016, PROMOTioN aims to explore and identify these potential benefits.

The main objective of PROMOTioN is the further development and demonstration of three key technologies: diode rectifier offshore converters, multi-vendor HVDC (high-voltage direct current) grid protection systems, and full power testing of HVDC circuit breakers. Complementary to this end, a regulatory and financial framework will be developed for the coordinated planning, construction and operation of integrated offshore infrastructures, including an offshore grid deployment plan (roadmap) for the future offshore grid system in Europe.

Currently, the high costs of converter technology, combined with a lack of experience with protection systems and fault clearance components, hamper the deployment of meshed HVDC offshore grids. In addition, deployment is hindered by limitations inherent to existing European regulations regarding the development of cross-border offshore infrastructures, national legal and regulatory barriers, and financing issues.

Timetable and Workpackages

The PROMOTioN project runs over a period of four years. The project is organised in a total of 16 work packages (WP's), which are closely interlinked. Laying the foundation by identifying the requirements for meshed offshore grids, WP 1 commenced with the project's kick-off. WP 2-7 built upon the findings of WP 1 with the implementation of requirements for the project and an examination of specific technological issues in detail. These range from grid topology to grid protection systems (WP 2-6) as well as regulatory aspects and financing (WP 7). The results of the work in WPs 2-6 provide the foundation for WPs 9-10, 15 & 16, who implement demonstrator and pilot facilities. WP 11 addresses questions of harmonization towards standardization. The results from WP 7 and 11 will jointly determine the development of a final deployment plan for the future meshed HVDC offshore grid. The project is flanked by WP 13 and 14, which have the task of dissemination (13) and overall project management (14).

Work package 8, that was meant to realise a full-scale demonstrator of a diode rectifier unit (DRU) based wind farm export solution at the Klim wind farm in Denmark, was prematurely terminated for technical reasons. Siemens is continuing to develop the concept towards technical maturity. PROMOTioN continues to consider the DRU as a potentially cost-saving technology for future offshore wind farm electricity export solutions. The grid integration and control of the concept is continued to be studied in work packages 2 and 3. A small-scale demonstrator is included in the MMC test bench in work package 16.

Goals

Based on the broad range of challenges involved, the PROMOTioN project partners set themselves a number of fundamental, non-negotiable goals that must be achieved. These goals are:

- To identify technical requirements and investigate possible topologies for meshed HVAC/DC offshore grids
- To develop protection components and schemes for offshore grids
- To establish interoperability of components and initiate standardisation
- To develop recommendations for a coherent EU and national regulatory framework regarding DC offshore grids
- To develop recommendations for financing mechanisms for offshore grid infrastructure deployment
- To demonstrate cost-effective offshore HVDC equipment
- To develop deployment plans for HVDC grid implementation

Challenges

As indicated in the figure below, the challenges facing deployment of meshed offshore HVDC grids in the European Union are manifold and encompass a variety of different aspects. For the PROMOTioN project, the following challenges have been identified:

- Cost effective and reliable converter technology
- Grid protection systems
- Financial framework for infrastructure development
- Regulations for deployment and operation
- Agreement between manufacturers, developers and grid operators

List of Participants

SHORT NAME	LEGAL NAME	COUNTRY
DNV GL	DNV GL Netherlands B.V.	Netherlands
ABB	ABB AB	Sweden
KU Leuven	KU Leuven	Belgium
KTH	KTH Royal Institute of Technology	Sweden
EirGrid	EirGrid plc	Ireland
SGI	SuperGrid Institute	France
DWG	Deutsche WindGuard GmbH	Germany
MEU	Mitsubishi Electric Europe B.V.	Netherlands
Svk	Affärsverket Svenska kraftnät	Sweden
GE	Alstom Grid UK Ltd (Trading as GE Grid Solutions)	United Kingdom
UniAbdn	University of Aberdeen	United Kingdom
RTE	Réseau de Transport d'Électricité	France
TU Delft	Technische Universiteit Delft	Netherlands
Equinor	Equinor	Norway
TenneT	TenneT TSO B.V.	Netherlands
SOW	Stiftung OFFSHORE-WINDENERGIE	Germany
Siemens	Siemens AG	Germany
DTU	Danmarks Tekniske Universitet	Denmark
RWTH Aachen	Rheinisch-Westfälische Technische Hochschule Aachen	Germany
UPV	Universitat Politècnica de València	Spain
FGH	Forschungsgemeinschaft für. Elektrische Anlagen und Stromwirtschaft e.V.	Germany
Ørsted	Ørsted Wind Power A/S	Denmark
Carbon Trust	The Carbon Trust	United Kingdom
Tractebel	Tractebel Engineering S.A.	Belgium
EUI	European University Institute	Italy
T&D Europe	European Association of the Electricity Transmission & Distribution Equipment and Services Industry	Belgium
USTRAT	University of Strathclyde	United Kingdom
Prysmian	Prysmian	Italy
RUG	Rijksuniversiteit Groningen	Netherlands



MVOW	MHI Vestas Offshore Wind AS	Denmark
Energinet	Energinet.dk	Denmark
SHE Transmission	Scottish Hydro Electric Transmission plc	United Kingdom
SCiBreak	SCiBreak AB	Sweden

