

EUROBAR

Scoping paper – December 2022

The goal of the Eurobar initiative is to establish a platform for exchange between TSOs and expedite discussions and solutions with major relevance in the development of offshore interlinked systems, which are a key enabler to realize an efficient offshore grid.

An interconnected offshore grid allows a more efficient integration of CO₂-free wind power into the markets while facilitating lower power prices. This measure also allows a more efficient grid infrastructure by reducing the overall impact on the environment. The creation of redundancies (n-1 criteria) reduces losses of RES power generation in case of failure. Furthermore, grid bottlenecks and costly congestion management measures can be reduced or avoided.

Eurobar will be a facilitator to enhance efficiency and identify possible harmonisations between offshore TSOs. As the members of the initiative represent all European sea basins and deep-water seas, we bring together a broad set of practical experience.

The final objective is to ensure evolution of technical development, system integration of offshore wind connections, reducing the overall financial burden via e.g. CAPEX, OPEX and risk profile of offshore wind connections to the transmission grid and the environmental impact of the infrastructure.

Today, open questions lie in the field of 1) technical challenges for the infrastructure needs and the benefits of further technical standardisation and 2) an adequate regulatory framework, which supports investors' confidence in the development of interlinked systems (TSOs as well as market parties).

The Eurobar initiative works complementary with other initiatives and associations. Our work and experience will support relevant European and national bodies to take the necessary decisions in the coming months and years.

Furthermore, we will develop best practises of national frameworks currently applied to enhance the ramp-up of offshore wind and a secure, efficient and future-proof system integration in new offshore countries.

In the following chapters we describe the topics that Eurobar has identified as key challenges and therefore will focus on.

1. Technical solutions

Most work of the Eurobar initiative will be done in the field of engineering and technical solutions. We founded dedicated groups to focus on four major fields.

1.1. Deep-water infrastructure

Offshore wind generation in deep water is becoming a promising solution to connect the vast renewable energy potential from wind in areas not seen as viable in the recent past. Although some technical solutions have not yet reached the level of maturity for large-scale deployment of deep-water wind generation, some early projects are already connected to the transmission grid and others are presently under project or construction development. Additionally, the manifestations of interest from project promoters are becoming more and more frequent. The number of projects and installed capacity is expected to have a significant increase in the coming years.

It becomes important for TSOs to build a platform of shared experience & knowledge, state-of-the-art and best practices to promote an efficient planning and infrastructure project development regarding the integration of deep-water offshore wind production to the onshore transmission network. Eurobar is following a stepwise approach.

1. Gather a general picture on the available information regarding deep-water infrastructure and TSOs interests in order to identify the most relevant aspects, information gaps or areas requiring further detailed analysis. This systematic organisation will include, e.g., a perspective on deep-water capacity goals, existing and projected installations, design and cost estimation of infrastructure, technical challenges or limitations, standardization needs.
2. Build a TSO perspective on the major short and medium-term trends regarding deep-water offshore wind installed capacity and technology needs.
3. From the results of Step 1 and 2, topics which should be discussed in more detail with wider industry and stakeholders will be identified.

As a final step, the sub-group will summarise the findings and give possible recommendations.

1.2. Connection schemes and technical requirements

For offshore wind power plants, ENTSO-E has developed the common codes which form a basis for interconnection requirements within EU. The most important codes are “the network code on requirements for grid connection of generators (RfG NC)” and “the requirements for grid connection of high voltage direct current systems and direct current-connected power park modules network code (HVDC NC)” – published respectively on 14 April 2016 and 8 September 2016. The RfG NC covers the requirements for generators to be connected while HVDC NC covers the

requirements for long distance direct current (DC) connections and Offshore Wind Power Plants (OWPP) connected to the shore via HVDC transmission system. These codes are key for the robustness of the European electricity network.

The work in Eurobar has different objectives:

1. Discuss the most relevant issues related to the offshore wind production integration to the onshore transmission network.
2. Share the best practices at European level in grid code implementation.
3. Define the desired standards of security, reliability and power quality at the connection points, considering the relevant average rated power of OWPP and the unpredictability of the primary source.

To reach these goals, a questionnaire towards TSOs for the purpose of collecting information on EU Grid Code implementation will be designed. The information provided will form the basis to analyse and share differences among TSOs' implementation strategies.

Moreover, we assess sharing experiences with designs of OWPP connection schemes (e.g. Single Line Diagrams (SLD)), to discuss technical characteristics related to Grid Code requirements fulfilment, which could form a basis to define a standard connection scheme (e.g. 2GW OWPP).

1.3. High Voltage Cables

The Cable industry is currently being overwhelmed – demand is greater than supply – and cable suppliers are less eager to accept the terms of the clients during tender process. Latest technical brochures did often not fully consider TSO's interests, leading to individual definitions of own requirements in the technical specifications.

This is particularly the case for cable system qualifications, which are both time and resources consuming, that cable suppliers tend to minimize, despite all the recent evolutions either in products and/or manufacturing assets.

It is in the TSOs interest to align on minimum requirements, and jointly enter qualification process. This would allow savings of costs and time for both sides, all the while keeping adequate technical requirements.

First, we will focus on the qualification of new extrusion lines. These are the most critical assets involved in the manufacturing process of a cable system. It is of the utmost importance that they are properly qualified in order to ensure appropriate quality throughout the course of the project. As a second step, we will establish a roadmap for new lines that will seek qualification, both for AC and DC applications, onshore and offshore.

Eurobar members will share their qualification practices and aim to define minimal technical requirements and extension of qualifications that would suit all members. The results of our assessment will be introduced to the wider industry.

1.4. HVDC offshore infrastructure

DC technology is expected to play an important role for the integration of offshore wind energy into the electrical power grid. It is state of the art to execute this kind of connection as point-to-point connections. Under certain conditions the benefit of such point-to-point systems can be increased by connecting them to a multi-terminal DC (MTDC) system. To reduce the risks related to such MTDC projects these can be designed as offshore-grid-ready from the start. Our possible contribution has three dimensions:

1. Providing a platform for exchange on technical approaches in context of MTDC-offshore-systems (including hybrid Interconnectors) and point to point systems. This includes discussions about general technical aspects like system ratings (e.g. voltage, power) and system topologies (e.g. converter topology, system grounding). Joint recommendations for harmonisation will be shared.
2. Discuss and analyse technical aspects especially related to the offshore-grid-ready approach. A subsequent interconnection of point to point connections to a MTDC-system, brings technical issues like i.e. different grounding conditions, additional space demand. We will be a forum for exchange of knowledge and bundle intellectual resources among TSOs.
3. Monitoring of current developments and best practices. The outcome and experience of already existing projects, research projects and other initiatives shall be spread among the members. This refers to topics related to MTDC systems as well as point-to-point connections.

2. Regulatory Framework

The current policies, regulatory framework and energy market design facilitate the deployment of offshore wind via national radial projects. The focus is rather short-term (generally not more than 10 years ahead) to ensure projects can be realized quickly, at lowest direct cost and lowest cost of capital. A good step forwards states the new TEN-E regulation, which stipulates the Member States to detail out their individual planning in the Maritime Spatial Planning of a sea basin.

The concept of hybrid assets or interlinked offshore system is shifting the paradigm for energy infrastructure development as interlinked offshore system in the long-term allow for higher efficiency. It may require reconsideration of dedicated policies, regulatory frameworks and market design to ensure stable market conditions and thereby long-term benefits. However, interventions should only be done,

where necessary. ENTSO-E¹ has identified the gaps and needs for amendments to ensure a robust and beneficial scheme for offshore wind developers as well as for TSOs. The current legal framework places opportunities for improvement, which needs to be approached as soon as possible so that further build-out of offshore systems is not hampered.

Eurobar will provide proposals based on practical experiences and elaborate projects needs considering the specific requirements of all sea basins. The following aspects are deemed relevant for further analysis.

2.1. Cost recovery and role of anticipatory investments

Achieving the European Union's ambitious offshore targets by 2050 is highly challenging and requires new and innovative solutions.

The development of offshore generation and grid assets create a need to define new sets of project categories and classifications of the assets, involving multiple countries, developers and technologies. The classifications of assets will be the basis for assessment of ownership structures, distribution of responsibilities and financing.

A regulatory framework, which allows and enables for innovative solutions and cooperation between TSOs and project promoters.

Long project lead times of grid connection project (ten years or more) can delay the integration of green offshore energy if TSOs can only start the planning of the project, once the detailed connection needs for offshore wind farms are identified. Anticipatory investment would allow to start early on and avoid delays.

New technical solutions will be necessary. Currently the regulatory framework does not support the exploratory and innovative character sufficiently. Higher risk profiles and flexibility must be allowed for where the risk of a stranded investment is relatively low.

Within Eurobar, we want to identify well working flexible solutions and adequate frameworks, which allow TSOs to act fast and in a future-robust manner.

2.2. Contractual arrangements with developers and liability issues

The current regulatory framework is not developed for integrated infrastructure projects such as Multi-Terminal / Multi-Vendor systems, and these are not market standard. Today, most HVDC systems are designed by EU HVDC suppliers as point-to-point transmission systems and are provided by a single vendor. Looking at an interlinked system, all actors need a legal framework, which defines the method of

¹ENTSO-E (10/2020): Market design – European markets across land and sea https://eepublicdownloads.azureedge.net/clean-documents/Publications/Position%20papers%20and%20reports/2021/entso-e_pp_Offshore_Development_02_Market_Reg_Issues_201014.pdf

cooperation and exchange of general information (use of (generic) models, technical parameters, etc.) between involved TSOs, OWP operators and HVDC manufacturers. This i.a. includes contractual framework conditions and NDAs.

An important part of the collaboration with different manufacturers would also be the issue of liability. In an interconnected system, it would be more promising to define these contractual frameworks in a coordinated approach and in close cooperation with Member States and regulators.

2.3. “Cable Gates” (Maritime Spatial Planning)

Project promoters of offshore interlinked systems would benefit from a good overview of possible grid connection points and "cable gates". It would give project promoters the necessary information to start project planning. This implies that national dedicated authorities (together with the TSOs) identify geographical areas within their EEZ where offshore connections are feasible and indicate further potential development aiming at reaching the set national and EU build-out targets.

Eurobar will promote a sustainable planning approach by identifying a set of guiding principles resulting from member TSOs' experience.

3. Complementarity with other initiatives and associations

In various fields, we use the TSOs work under the **ENTSO-E** umbrella as our basis.

- A **holistic system planning** of multi-purpose solutions based on sea basins is crucial to identify the most effective approaches which interlink with the on-shore grid.
- Recent work has been conducted on **multi-terminal and multi-vendor interoperability for HVDC-applications**, but various questions on the corresponding technology are still open.
- The **market design**, i.e. the potential sizing of offshore bidding zones and its methodological basis as well as potential compensation mechanisms for offshore wind farm developers are discussed within ENTSO-E, which Eurobar deems as the adequate forum. Also, the availability of transmission capacities for cross-border trading under the target model of advanced hybrid coupling are outside of the scope of Eurobar.
- The **secure operation** of a future offshore grid comes with challenges for TSOs and the need for further R&D. Also, the RCCs needs to be fit for purpose based on the already established framework to help TSOs with the performance of operational services.

- Furthermore, the various actors in the offshore space and their conceivable combinations of **roles and responsibilities** between them - which differ between Member States – have been addressed within ENTSO-E. Eurobar will investigate especially the suggestions by the European Commission and stress the important role of TSOs in holistic system planning.

The outcomes of Eurobar stem from practise experience and learnings. Hence, we are aiming that Eurobar findings can complement and support ENTSO-E dedicated workstreams, creating a larger and more comprehensive perspective.

Eurobar will share the gained insights transparently and aims at contributing to existing as well as upcoming proposals with the experience and insights of the members.

Eurobar will benefit from additional members and welcomes all TSOs that wish to cooperate within the initiative.

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