North Sea
Wind Power Hub

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REQUIREMENTS TO DEVELOP

Ensure industry can progress

NSWPH | June 2019

The Consortium

The North Sea Wind Power Hub consortium has joined forces to realise climate goals. The consortium her work is based on research, stakeholder interaction and experience from earlier projects.

Port of Rotterdam

Biggest port in Europe with a strong ambition to become the most sustainable port in the world

ENERGINET

Danish transmission system operator working for a green, reliable and sustainable energy supply of tomorrow

gasunie

European energy infrastructure company serving the public interest and facilitating the energy transition by providing integrated infrastructure services

TenneT

TenneT is a Dutch-German electricity TSO and is one of Europe's major investors in national and cross-border grid connections on land and at sea in order to enable the energy transition.

Executive Summary

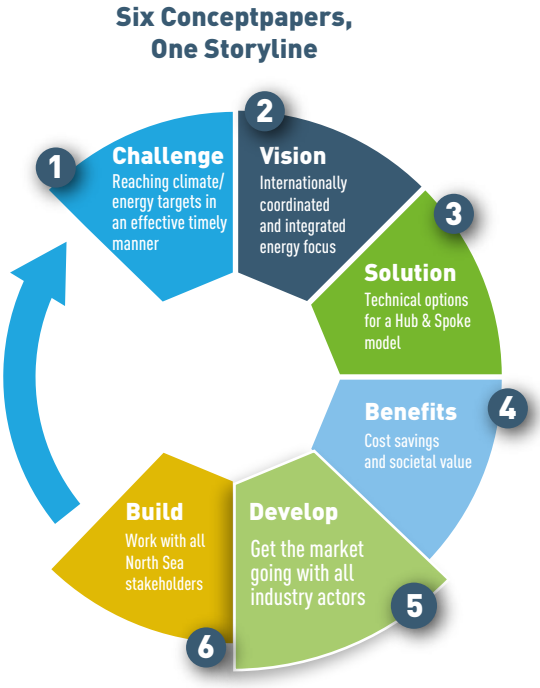
The current regulatory framework and market design is not developed for integrated infrastructure projects such as the modular Hub-and-Spoke concept.

It is conceivable to develop a first Hub-and-Spoke project within the current regulatory framework and market design, but reconsideration is required soon to properly incentivise stakeholders in the long-term and to facilitate a large-scale roll-out of offshore wind through subsequent Hub & Spoke projects.

Key players in industry call for urgent and coordinated action to realise large scale roll-out and integration of offshore wind in the North Sea.

Six concept papers, one storyline

The goal of the concept papers is to inform North Sea stakeholders, and the general public, of the results the NSWPH has obtained working on the modular Hub-and-Spoke concept over the last two years. The six concept papers tell one story: from the challenge to meet the Paris Agreement, through the solution building on the modular Hub-and-Spoke concept, to the next steps required to meet the Paris Agreement timely and in a cost-effective manner.



The Hub-and-Spoke concept with combined wind farm connection and interconnection functionality and likely with P2X conversion is shifting the paradigm for energy infrastructure development.

The current policies, regulatory framework and energy market design are not developed for integrated infrastructure projects such as the modular Hub-and-Spoke concept

The present 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) and with limited scope, to ensure projects can be realised quickly, at lowest direct cost and with lowest cost of capital. This approach has facilitated the scale up of offshore wind energy capacity in the North Sea up to now (13 GW installed in 2018). The regulatory framework for interconnection capacity is different from wind farm connections, as interconnector development is triggered by socioeconomic welfare increase due to price differentials between markets and interconnection targets (10% of national generation capacity by 2020).

The Hub-and-Spoke concept with combined wind farm connection and interconnection functionality and likely with P2X[1] conversion is shifting the paradigm for energy infrastructure development. It requires a reconsideration of policies, regulatory framework and market design to ensure stable market conditions, and enable anticipatory investments and timely development of supply chains and innovation. Also, practical standardisation issues such as DC voltage levels require alignment. The current limitations of the regulatory framework for Hub-and-Spoke type of projects are related to:

- **Time horizon** – typically 10 year for binding grid planning processes, while large infrastructure projects require at least 10 year to develop and construct, will show benefits only in decades after and require anticipatory investment (beyond the first module) to bring value.
- **Cost benefit analysis framework** to assess the value of these projects are not (yet) equipped to handle hybrid assets (wind farm connection + interconnection), or strongly sector coupled projects
- **Assessment** is largely project based, with only assessing value of isolated projects on a (reference) system.

The appropriate boundary conditions for the successful scale up of offshore wind and interconnection capacity should include a supporting regulatory framework and market design that properly incentivises all stakeholders involved to ensure assets will be developed, constructed and operated at lowest cost and highest value for society. The energy transition to meet the Paris Agreement must be completed within 30 years, but more than 10 years of development and construction time is likely needed for Hub-and-Spoke projects to become operational. Therefore, the current policies, market design and regulatory framework should be urgently reconsidered to enable the successful development of multiple Hub-and-Spoke projects towards 2050, as building blocks in an international coordinated roll-out.

It is conceivable to develop a first Hub-and-Spoke project within the current regulatory framework and market design, but reconsideration is required to properly incentivise stakeholders in the long-term

The consortium considers it conceivable to develop a first Hub-and-Spoke project within the current regulatory and market frameworks, but key decisions need to be made. The consortium is not aware of any fundamental mismatch with existing regulations as no legal assessment has yet clearly indicated that an

[1] *P2X includes power-to-gas (mainly H2 as well as methane) and other options (such as fuels, feedstock, food, oxygen, residual heat, etc.)*

Reshaping the regulatory framework and market design such that it properly incentivises all involved stakeholders in the longer term throughout the energy transition

amendment of e.g. the Electricity Regulation is needed to enable the development of a first project. Note that the "barriers" to be addressed for a Hub-and-Spoke project are also discussed in a separate study by Roland Berger[i], commissioned by the European Commission to identify barriers and mitigation options for hybrid projects. The consortium was consulted in this study through questionnaires and direct feedback.

Although a first project is deemed conceivable within the current regulatory framework and market design, it is vital that the following key decisions are taken, preferably in close consultation with stakeholders. Main areas that need decision making are market arrangements and e.g. if a hub should be setup as a separate bidding zone under the existing market regulation. Decisions are required on how revenue models for generators and transmission infrastructure operators should be structured. First discussions with the offshore wind farm (OWF) industry have started on which models could potentially work best; this however requires careful consideration and further interaction with industry.

As a next step towards facilitating the first Hub-and-Spoke project, decisions need to be made soon on the aspects as mentioned above. A thorough engagement process is required that addresses and defines actions with key stakeholders. Also, focus should be on reshaping the regulatory framework and market design such that it properly incentivises all involved stakeholders in the longer term throughout the energy transition. This process could result in voluntary agreements between stakeholders, or memoranda of understanding, but most likely intergovernmental agreements are required to conclude on these decisions for a first Hub-and-Spoke project.

Key players in industry call for urgent and coordinated action to realise large scale roll-out and integration of offshore wind in the North Sea

The consortium seeks to facilitate the development of a business model that provides a viable route to market for OWF developers, while balancing the benefits for all stakeholders and society in general. The business model of the Hub-and-Spoke projects will strive to support the business case for OWF developers through minimised costs, access to an interconnected energy market and enhanced long-term revenue stability. To achieve this ambition, early input from OWF developers has been a key priority for the consortium as it is essential to create a successful business model and advance the first Hub-and-Spoke project.

In early 2019, the consortium has engaged with more than 10 leading and influential OWF developers to get feedback and input on a successful business model for a first-of-a-kind project, combining grid connection of offshore wind power with interconnectors. During the discussions with industry, a number of principles regarding a viable business model of the Hub-and-Spoke concept were commonly agreed upon. The agreed principles included:

- *Developers from different jurisdictions should join the hub under harmonised regulatory and / or subsidy parameters*
- *Hydrogen solutions should be further considered as a means to enhance the business case for developers and TSOs*
- *Alignment of the timing is key in ensuring that the sizing of the cables is commensurate to the capacity which is connecting*
- *Roles and responsibilities have to be defined early and clearly, for example who is operating the grid infrastructure, who is responsible for balancing the power, etc.*

Taking a regional approach to planning new offshore wind assets across the North Sea would have considerable benefits, including to the North Sea Wind Power Hub concept.

Reaching a common understanding on these principles is a key milestone for the consortium in the maturation of the Hub-and-Spoke project and the development of a viable business model.

The consortium and developers recognise that a number of additional areas have to be further discussed and analysed before reaching a consensus regarding a viable business model. During our dialogue with the industry, the consortium and OWF developers agreed that the following areas should be further investigated in the next phase:

- An optimal governance structure covering, amongst other things, the hub operator, grid operator, and the allocation of ownership.
- An optimal revenue model: for transmission cables and how the hub/generators capture revenues.
- An optimal model for sharing of socio-economic benefits with the connected markets.

Key messages from the industry:

Whilst Europe is on a long-term trajectory towards becoming a single energy market, co-ordinated jurisdictional planning of the energy system is not currently a reality. Taking a regional approach to planning new offshore wind assets across the North Sea would have considerable benefits, including to the North Sea Wind Power Hub concept. We see multiple key advantages of a co-ordinated approach:

1. **Efficient use of infrastructure is needed to integrate large scale of offshore wind.**
   Our OWF developer discussions show that the industry agrees that efficient utilisation of international, cross-border transmission infrastructure is required to successfully integrate large-scale offshore wind energy into the energy system. The network of transmission cables, directly connecting hubs with European energy markets, will provide interconnection functionality. This will support the integration of European energy markets, increase security of supply and yield socio-economic benefits from increased energy market coupling.

2. **Combined Spatial Planning is required to achieve the ambitions of Paris Agreement.**
   Given the current and planned use of space in the North Sea, a co-utilisation approach is necessary in the future to reach the required installed capacity of offshore wind. A recent study concluded that if all the currently utilised areas are excluded, only 14,000 km^2 or 3% of the suitable space in the North Sea remains available for OWFs which is only sufficient to host 50-90 GW, depending on the power density[ii]. In addition, this space is highly fragmented limiting the potential to benefit from scale effects. A concerted action and cooperation across all stakeholders are required to enable further cross-border coordination in spatial planning of the North Sea, which is pivotal in reaching the Paris Agreement. The approach must consider co-utilisation with other sectors such as nature, shipping and fisheries and take a long-term, international and multi-stakeholder perspective. This is supported by the industry and in line with the message from the Political Declaration on energy cooperation between the North Seas Countries.

3. **The OWF developers show support to the further examination of techno-economic feasibility of the Hub and the conceptual design of the first project**.
   The discussions with OWF developers show that there is common understanding of the challenges facing the industry and that there is an urgent need for increasing the installation pace to meet the Paris Agreement. The offshore wind industry recognises that various technical, operational and commercial aspects have to be further matured in

the next stage of the project. It is recommended by the industry that the further maturation of the Hub-and-Spoke projects is done in close collaboration between OWF developers, TSOs, policy makers and regulators.

As a final remark, the industry would like to ask the European policy makers to consider the importance of:

- Taking a holistic view in regional planning of seabed across jurisdictions;
- Planning for a coordinated rollout of offshore wind projects across the North Sea;
- Delivering efficient use of infrastructure that can accommodate the required level of offshore wind resource; and
- Providing a long-term outlook and commitment for offshore wind developments

The consortium and industry invite the Dutch, Danish and German governments to consider setting up a cross-governmental consultation to find solutions for the issues highlighted in this report in order to enable the offshore wind potential of the North Sea to contribute to achieve the ambitions of the Paris Agreement. We are also keen to open up the discussion for participation from other North Sea countries such as the United Kingdom and Norway.

Sources

[i] *Roland Berger, 2019. Cost-efficient offshore development through hybrid projects. Commissioned by the European Commission. https://publications.europa.eu/en/publication-detail/-/publication/59165f6d-802e-11e9-9f05-01aa75ed71a1/language-en/format-PDF/source-98244663*

[ii] *Witteveen + Bos & ECN/TNO, 2018. Cost Evaluation of North Sea Offshore Wind Post 2030 https://northseawindpowerhub.eu/wp-content/uploads/2019/02/112522-19-001.830-rapd-report-Cost-Evaluation-of-North-Sea-Offshore-Wind....pdf*

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