Baltic Offshore Grid Initiative

Expert paper 2025

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SVENSKA KRAFTNÄT

Content

Executive summary

The Baltic Offshore Grid Initiative (BOGI) is led by the transmission system operators (TSOs) from the Baltic Sea region and is aimed at enhancing the development of offshore wind energy and related grid infrastructure. This expert paper explores the strategic development of offshore wind energy and emphasises the necessity for regional cooperation and innovative solutions.

The Vilnius Declaration signed on 10 April 2024 during the high-level Energy Security Meeting organised by the Baltic Sea governments and the Baltic Energy Market Interconnection Plan (BEMIP) high-level Group, called for enhanced regional cooperation amongst TSOs to explore the development of new hybrid interconnector projects and offshore energy multi-purpose hubs. Building upon this established collaboration and considering the joint planning work undertaken by the European Network of Transmission System Operators for Electricity (ENTSO-E), this paper analyses the potential of projects of high-importance at the sea basin level, including hybrid projects, cross-border radial offshore connections, and direct interconnectors, with regards to exploiting the region's offshore potential efficiently.[1]

- The Baltic Sea grid map provides a comprehensive overview of the currently known cross-border electricity and hydrogen projects in the region for the time horizon up to around 2040.

- The Baltic Sea, with its diverse wind profiles and the envisaged placement of offshore wind farms in greater distance to each other, presents a favourable environment for offshore RES development and related infrastructure. As a result, wake effects are expected to be low and long-distance (hybrid) interconnectors level out local variations in wind power generation.

- TSOs across the region are exploring innovative approaches that can reduce grid investment needs and optimise resource utilisation, such as cross-border radial connections and the co-location of offshore wind energy production with energy demand, such as onshore hydrogen production via electrolysis.

- With rising project costs and more dispersed project benefits across Member States, the financing and cost sharing of offshore hybrid infrastructure projects in particular could be aided by regional planning and new funding mechanisms. Historical success stories, such as the Nordel cooperation, provide valuable insights into effective regional collaboration and the importance of strong political buy-in.

- The Baltic Sea TSOs could address supply chain challenges by collaborating with manufacturers and suppliers, by providing clear asset need forecasts, standardising technical requirements, and enabling early engagement to streamline processes. Meeting the future demand for assets and services has the potential to generate the creation of jobs across the value chain.

- The security of critical undersea and offshore energy infrastructure is paramount. Strategies to enhance its resilience against hybrid threats as well as robust cooperation between TSOs, security authorities, and private operators are necessary.

This expert paper offers a roadmap for enabling offshore wind development in the Baltic Sea, fostering regional cooperation, and ensuring an innovative and secure energy future.

1 Discussions on offshore wind in the Baltic Sea focus on infrastructure development and security - Lietuvos Respublikos energetikos ministerija

Grid map – overview of ongoing project initiatives

The Baltic Sea region is experiencing growth in both onshore and offshore renewable energy sources. This growth, coupled with the synchronisation of the Baltic States' energy system with Continental Europe´s, the need for better market integration between internal and cross-border bidding zones, and ensuring the physical security of critical infrastructure, calls for increased attention to be placed on the region's offshore infrastructure.

While the principle of prioritising electrification is widely accepted as the most efficient approach, it is essential to consider a system of systems approach and better cross-sectoral integration. Therefore, although this expert paper is dedicated to offshore infrastructure development, it cannot be fully elaborated without understanding regional onshore grid development needs and cross-border hydrogen infrastructure development projects.

Offshore Hybrid Projects

Bornholm Energy Island
- TYNDP project ID: 1106
- 3GW offshore wind
- 2GW connection to DE
- 1.2 GW connection to DK

Baltic WindConnector
- TYNDP project ID: 1211
- 2 GW offshore wind
- 2 GW interconnector EE/LV-DE

Baltic Hub
- 2 GW offshore wind
- 2 GW interconnector
  - DE-HUB – 2000 MW
  - LT – HUB – 2000 MW
  - LV – HUB – 2000 MW

EE-LV 4th Interconnector
- TYNDP project ID: 1088
- 1 GW offshore wind
- 1 GW interconnector LV-EE

Offshore interconnectors

Estlink 3
- TYNDP project ID: 1094
- 700MW interconnector EE-FI

Fenno-Skan 3
- TYNDP project ID: 239 Analysis to be kicked-off. Development of hybrid project might become option.

Konti-Skan Reinvestment
- TYNDP project ID: 1097
- Minus 700 MW => plus 1000...1400 MW (tbd)

LaSGo Link
- TYNDP project ID: 1068
- 700MW interconnector SE-Gotland
- 500 MW interconnector Gotland-LV

Onshore interconnectors

Harmony Link
- TYNDP project ID: 170
- 700 MW interconnector LT-PL

Cross-border strengthening project
- TYNDP project ID: 1209
- Up to 1000 MW cross-border increase

Aurora line
- TYNDP project ID: 111
- 800MW SE->FI; 900MW FI->SE interconnector

Aurora line 2
- TYNDP project ID: 1095
- 800MW SE->FI, 800MW FI->SE interconnector (under planning)

Cross-border hydrogen projects

Nordic Hydrogen Route
- Under consideration/ in planning
- Hydrogen corridor between SE and FI

Nordic-Baltic Hydrogen Corridor
- Under consideration/ in planning
- Onshore corridor between FI, EE, LV, LT, PL and DE

Baltic Sea Hydrogen Collector
- Under consideration/ in planning
- Offshore corridor between SE, FI and DE

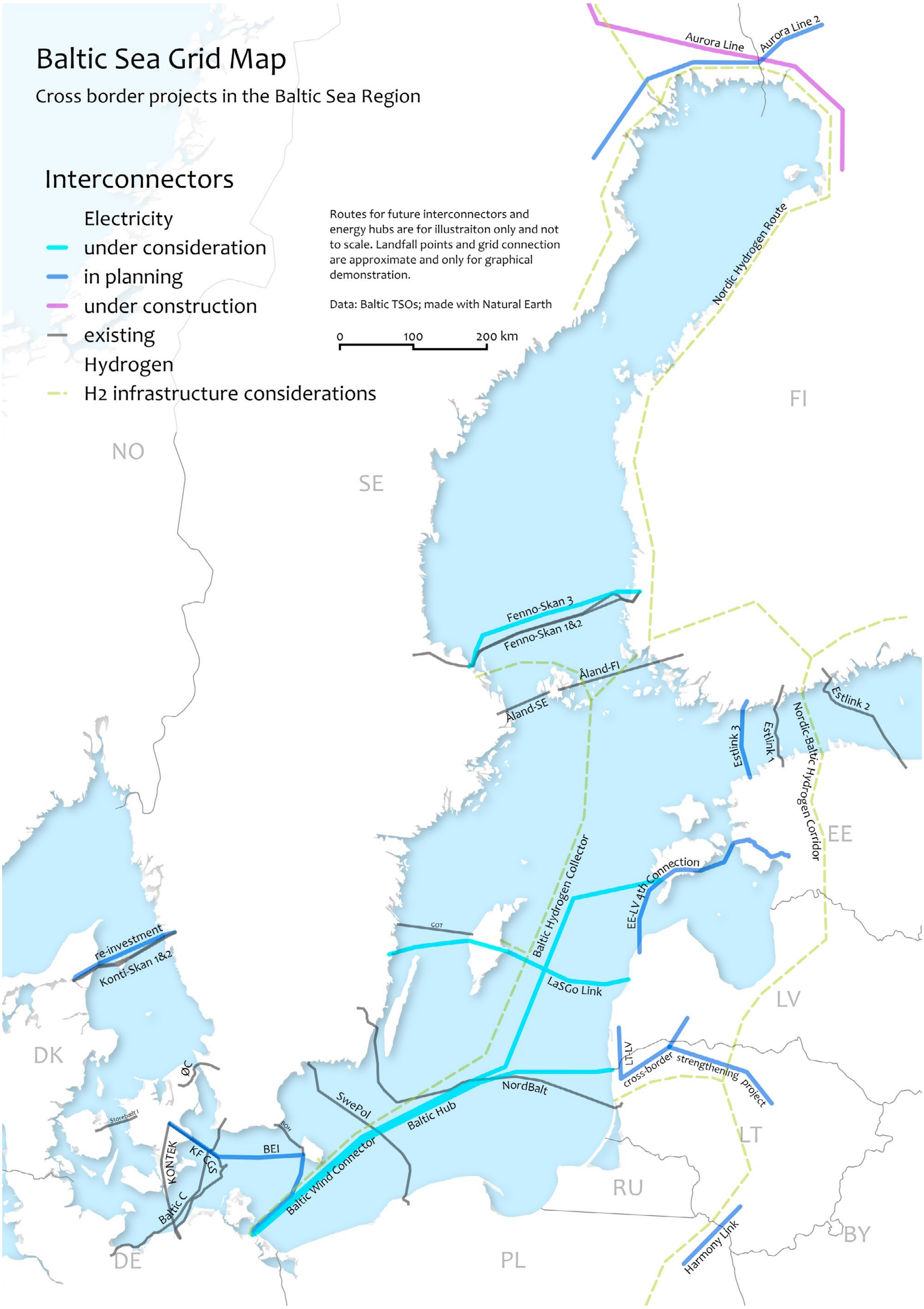


Figure 1: grid map outlining the ongoing projects in the Baltic Sea region, covering hybrid, offshore point-to-point, onshore interconnection, and H2 projects.

Efficient placement of offshore wind connections in the Baltic Sea

The Baltic Sea TSOs are eager to contribute to the discussion on the potential for further offshore infrastructure projects and their benefits in the Baltic Sea. The feasibility of offshore infrastructure projects is contingent upon the efficient connections of offshore renewable energy sources (RES) and their economic viability. The efficiency of the offshore RES connections can be improved at sea basin, regional and local levels.

- At sea basin level benefits can be unlocked if two issues are properly being considered: wind speed correlations across the Baltic Sea and avoidance of wake effects.
- At the regional level, we examine cross-border radial connections.
- At the local level, we look at the co-location of offshore wind and energy consumption such as the production and utilisation of green hydrogen.

Solving efficiency questions across these three levels could enable better harvesting output of offshore RES and bringing benefits to the Baltic Sea. Whether connecting offshore wind assets through hybrid or radial connections, we can optimise performance and ensure efficient energy production.

Sea basin level – correlation of wind speeds in the Baltic Sea

Long-distance (hybrid) interconnectors level out local variations in wind power generation. This reduces (but does not eliminate) the need for countries to invest in dispatchable capacity within their own borders.

The map on the next page (**figure 3**) shows how strongly the wind speeds in different regions of the Baltic Sea are correlated with each other – in other words, how often similar wind patterns occur across different regions. The map demonstrates that the further away two areas are from each other, the less likely they are to experience the same wind occurrences. By using the Danish Krieger´s Flak wind farm as an example, it shows that the further one moves away from it, the lower the number of hours of simultaneous wind occurrences is (see darker colour shading).

This illustrates that offshore wind infeed into the grid from diverse and distant locations is more 'valuable' for the energy system than connecting a huge amount in one place. Both the variability of the resulting energy mix and flexibility needs are reduced. This makes the development of offshore wind across larger regions – and, indeed, across sea basins such as the Baltic and Northern Seas or the Atlantic Ocean and Mediterranean Sea – so important for Europe's power system.

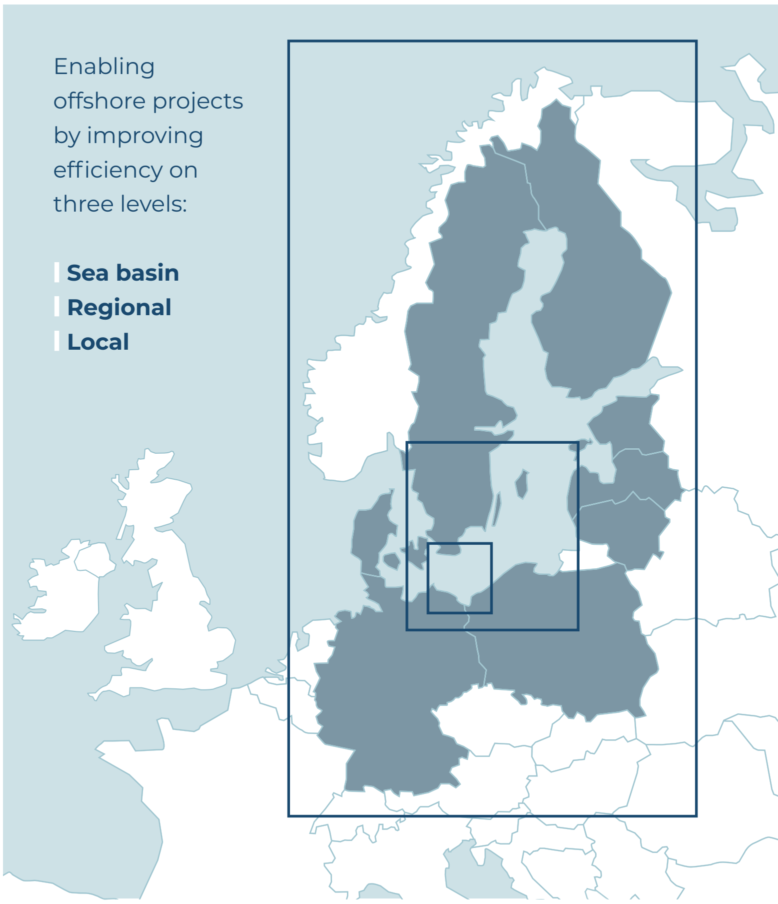


Figure 2: Different levels of improving offshore RES connections

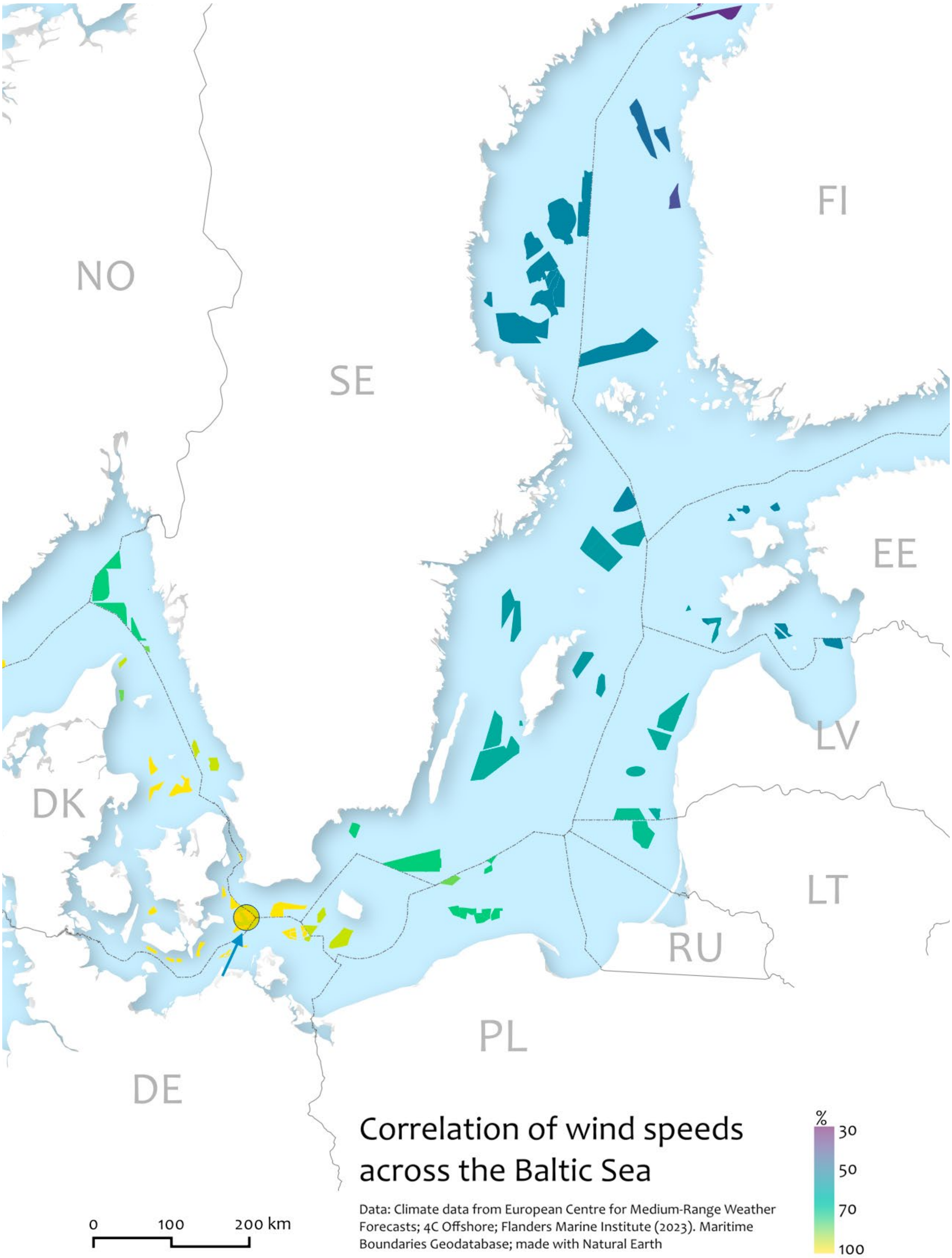


Figure 3: Weekly correlation of wind speeds across the Baltic Sea, with the Danish Krieger´s Flak wind farm as the reference region

Sea basin level – reducing wake effects

The economic case for the development of offshore wind power is based on having access to a strong and stable wind resource. High amounts of full-load hours (over 4,000 FLH per year) can be achieved by modern wind farms which are situated in good locations. With larger and more numerous wind farms in the future, clusters will emerge where wind farms are located close to each other. This proximity can lead to wake effects that reduce the efficiency of individual wind farms, ultimately significantly reducing their annual electricity output.

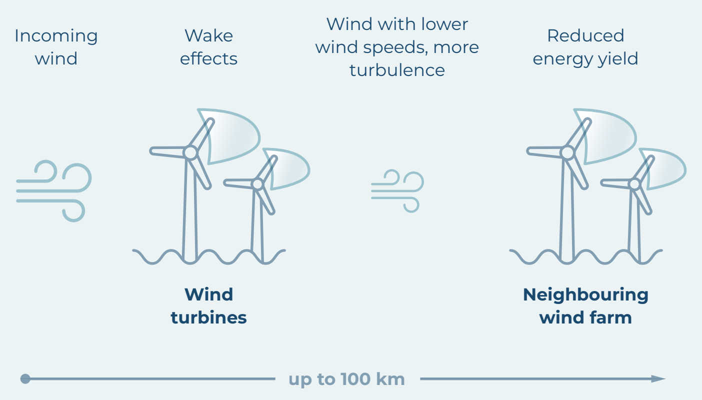


Figure 4: Understanding wake effects

- **Reduced energy yields:** Wake effects can lead to reductions in the amount of electrical energy produced by downstream offshore wind farms (OWFs): their overall energy output can be decreased by between 10 to 30%.

- **Turbulence and fatigue:** Increased turbulence in wake regions can accelerate turbine component fatigue, affecting maintenance schedules and operational costs.

- **Reducing wake effects:** The layout and spacing of offshore wind parks need to be efficiently designed to mitigate wake effects by:

  - spreading of OWFs to achieve lower power densities and less shading within different exclusive economic zones

  - displacing OWF to other countries to achieve greater distances for more efficient refreshment between OWF clusters. Doing so would require strong cross-border cooperation related to the maritime spatial planning between countries

While the Northern Sea provides a good example for this phenomenon (losses are found to lead to an average FLH reduction of 23% in the region, with reduction peaks in Germany reaching almost 30% due to wake effects), the Baltic Sea, with its diverse wind profiles and strategic and less dense OWF placement presents a favourable environment where wake effects are expected to be considerably smaller.[2]

The map in **figure 5** on the next page displays the potential wind farm areas and main wind directions in the Baltic Sea. The predominant wind direction is westerly. However, the sea basin stretches out in a north-south direction, meaning that most wind farms in the area do not share the same wind corridor. The wind blows from the sea towards the coastline usually without other wind farms being in the way (the area between Germany and Denmark is an exception here). Moreover, current maritime spatial plans in the Baltic foresee lower power densities ompared to the Northern Seas as not all offshore wind potentials are expected to be fully exploited. This leaves more space for a refreshment of wind resources between wind farms which will reduce the cross-border accumulation of wake effects.

The above observations imply that the Baltic Sea carries more significant benefits compared with the more densely utilized (higher power densities) North Sea basin, where more offshore wind farms share the same wind corridor. From an efficiency perspective, the Baltic Sea is therefore a promising sea basin with relatively small wake losses, although wake losses will still occur.

2 Fraunhofer IWES (2022). 'Offshore Flächenpotenziale: Analyse der Energieerzeugungseffizienz in der deutschen AWZ'. https://bwo-offshorewind.de/uberarbeitete-flachenpotenzialstudie-des-fraunhofer-iwes/ and Fraunhofer IWES (2024). Ad-Hoc Analyse: Ertragsmodellierung der Ausbauszenarien 16 bis 21', Adhoc_Analyse_Ertragsmodellg_22_23.pdf (bsh.de)

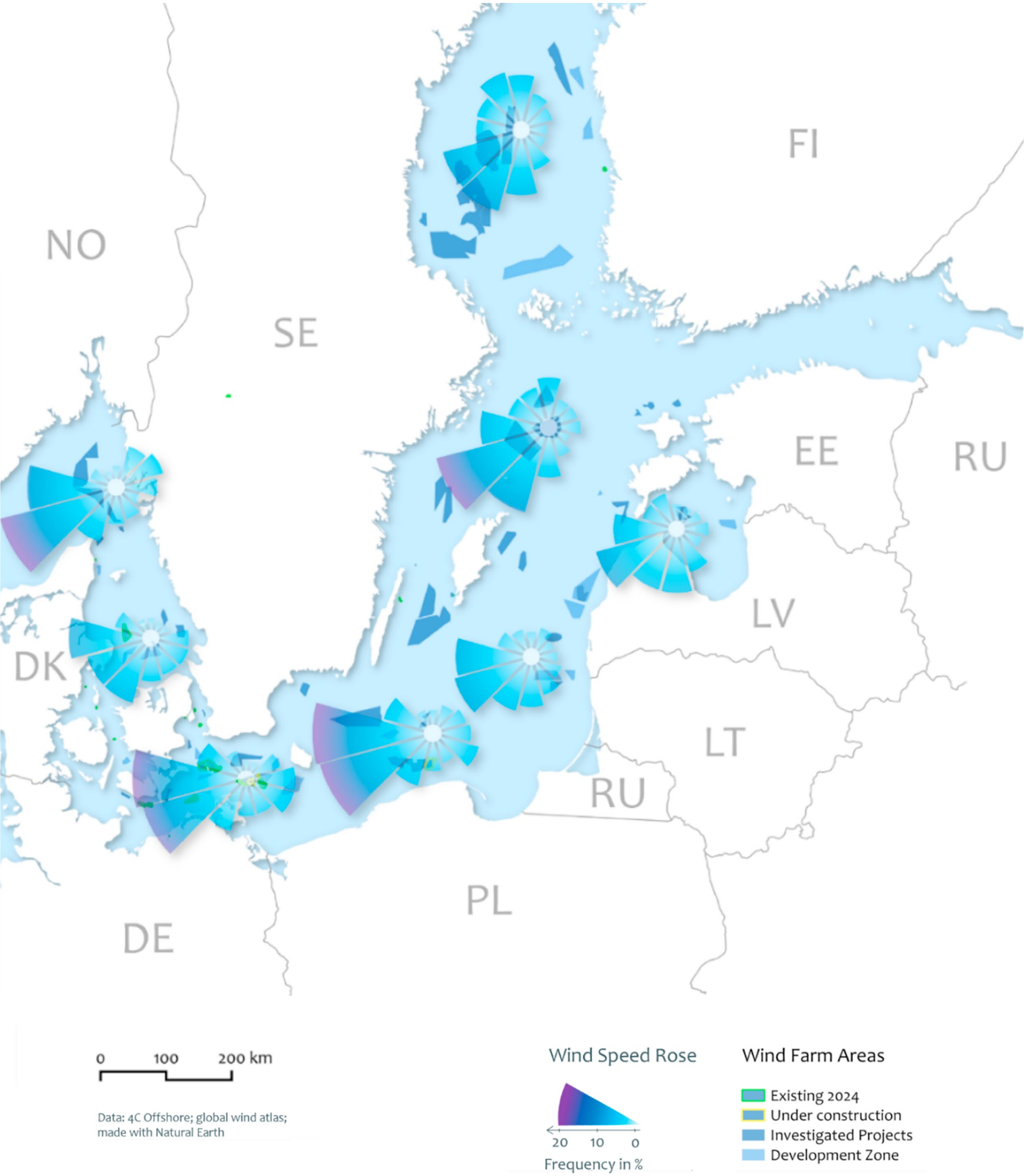


Figure 5: Main wind directions in the Baltic Sea

Regional level – bilateral agreements on cross border radial connections

To meet Europe's net-zero targets and optimize socioeconomic welfare, a significant part of offshore wind capacity needs to be developed within 'offshore energy exporting countries' that have more offshore wind energy potential than they need to meet their domestic demand. By contrast, there are countries whose levels of domestic offshore energy generation fall short of meeting their needs.

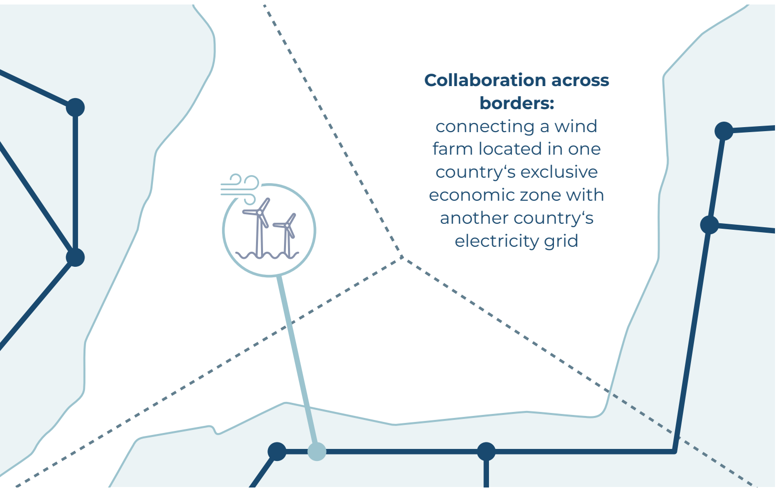


Figure 6: Cross border radial connections

Unlike domestic radial connections, cross-border radial connections directly link one or more offshore wind farms located in the exclusive economic zone of one country to the onshore electricity grid of another country. Just like their domestic counterparts, these connections serve a single purpose and do not link two separate energy systems together. Although no cross-border radial connections currently exist, they could prove to be a valuable option for countries that are struggling to expand their domestic production of renewable energy. Cross border radial connections could help to increase offshore wind capacity in Europe's seas, thereby promoting greater energy cooperation across borders while keeping technical solutions simple. One essential requirement for a cross-border radial connection is that the initiatives and agreements need to be agreed upon by the governments and responsible ministries and national regulators.

This requires both types of countries to collaborate as part of the planning, development, financing and funding of different projects, and requires the costs and benefits of such projects to be shared out in a fair manner. By promoting cross border radials between countries that carry limited and abundant amounts of offshore wind potential, efficient projects will be unlocked. Moreover, long-term planning across borders will help to mitigate wake losses and reduce the environmental impact of offshore projects on protected areas.

While this concept might not be a suitable solution for all Baltic Sea countries, countries like Denmark and Germany are already actively looking into the possibility of realising cross border radial connections between them. Potential legal and regulatory questions will be investigated by the hosting countries.

Local level – enabling the co-location of offshore wind and energy demand

At the local level, co-locating offshore wind energy production and consumption behind a single onshore connection point can significantly lower the required grid connection capacity. This reduction can, in turn, enable more offshore wind projects and connections, optimising both the available offshore wind capacity and the onshore transmission infrastructure.

We are observing the innovative integration of co-located technologies, which can help balance grid load, lower network charges, diversify income streams, and mitigate risks for generators. The co-location of supply and demand can enable the efficient coupling of offshore wind and onshore hydrogen production. Known as overplanting in Denmark or 'hybrid connections' in Finland, this practice offers several benefits for offshore wind and hydrogen projects. It can significantly reduce the need for grid investments and reinforcements. By integrating onshore hydrogen production into offshore wind farms behind one main grid connection point, the energy generated can be used on-site, reducing the need for extensive grid infrastructure expansion and reducing transmission losses. This approach allows offshore wind farms to be larger than the dimensioning fault, optimising the use of available resources and enhancing overall efficiency. While the approach is promising, it should be highlighted that technical and regulatory challenges will need to be further addressed.

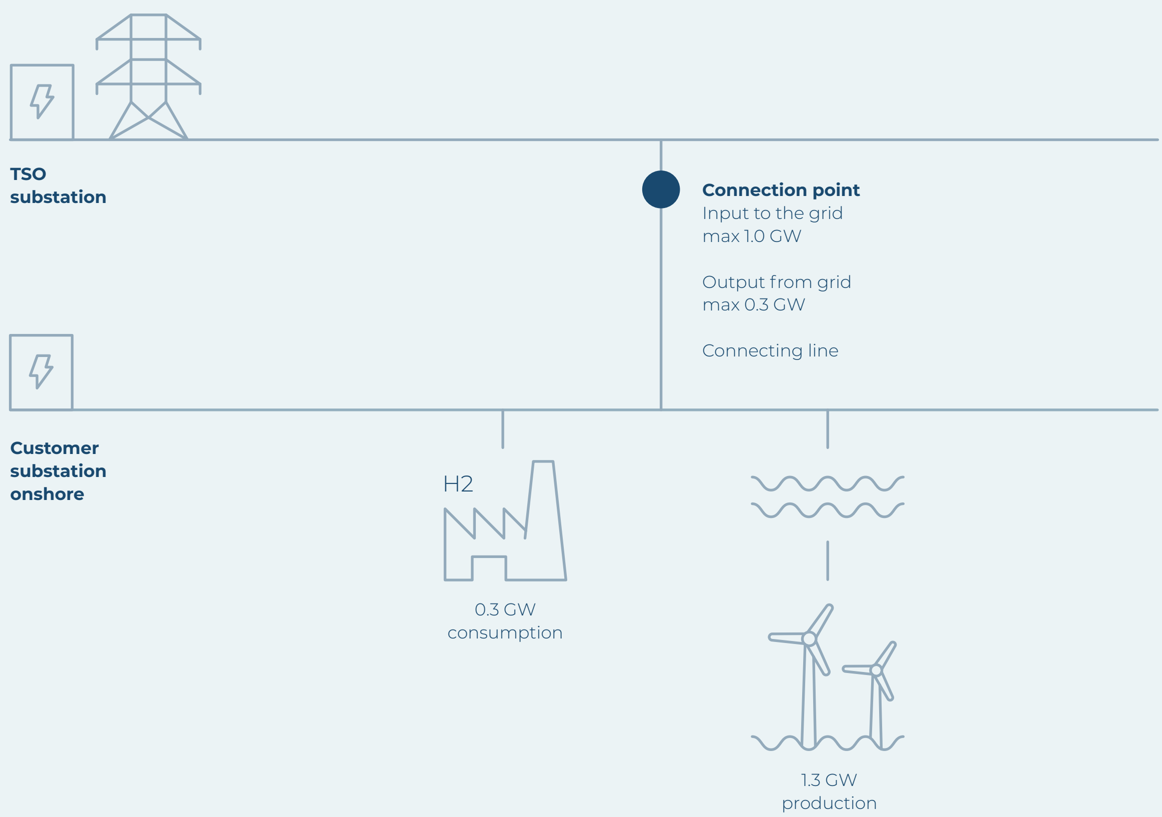
Differences can arise between countries due to differences regarding the responsibility for building the grid connections for offshore wind farms. In some countries, such as Germany, the Transmission System Operator is responsible for this task. In other countries, like Denmark, Sweden, Lithuania, and Latvia, the wind farm developer is responsible for the grid connection of the offshore wind farm.

We want to highlight best practice and recent developments in the deployment of offshore wind energy and the corresponding grid infrastructure in the Baltic Sea region. Currently, the region's practices are developing at various stages.

Energinet – outlining technical requirements
Energinet has outlined the technical requirements for co-location and overplanting, emphasising the need for alignment in 28 subject areas, including power system technical performance, reactive power capability and exchange limitation at the point of connection. These requirements ensure the power system's technical performance at the point of connection and allow developers to choose which individual plant or ancillary equipment satisfies the requirements.

Fingrid – examining hybrid connections
Fingrid is currently exploring the possibility of hybrid connections as an alternative to traditional connections. In this approach, similar to the Danish concept, electricity production and consumption would occur at the same transmission grid connection point, thereby reducing the need for grid reinforcements. This method would also enable the connection of more, faster, and larger customer projects, because the connection method reduces the total connection capacity. The concept involves technical and reliability challenges due to the interdependence of production and consumption resulting from the connection method. Additionally, its utilisation is currently limited by legislation. The legislative feasibility of the concept will be reviewed as part of reforms to the electricity market law starting in spring 2025.

Figure 7: Co-location of offshore wind and energy demand



Cost sharing, funding and financing

With rising costs and more dispersed benefits across Member States, the financing and cost sharing of offshore projects, and hybrid projects in particular, is becoming increasingly challenging. The BEMIP Offshore Network Development Plans (ONDP) report provides cost estimates for offshore network infrastructure needs for 2050 (with intermediate steps in 2030 and 2040) of up to €90 billion. These estimates highlight the significant investment required for developing the offshore network infrastructure needed for exploiting the sea basin's potential.[3]

The Baltic Sea region faces additional challenges in terms of connecting potential RES generation areas in the north-east (Finland and Baltics) to consumption regions in central Europe. Due to the long distances involved, project investment needs are intensified even further while countries behind the connection landing points may have different levels of economic readiness with regard to implementing the project.

Cost-sharing has become a contentious issue due to the substantial expenses involved in the development of offshore wind infrastructure. The high costs necessitate the equitable distribution of costs amongst stakeholders to ensure a project´s financial feasibility and success. Effective cost-sharing mechanisms are seen as essential to balance the financial burden and promote sustainable energy development.

Current cost sharing and funding mechanisms have reached their limits

The default process for the cross-country sharing of costs related to electricity transmission infrastructure at EU level is the cross-border cost allocation (CBCA) for Projects of Common Interest (PCIs), as defined in the TEN-E Regulation (EU 2022/869). So far, it has worked as a catalyst to unlock projects of wider European value in particular through providing a gateway to European funding in the framework of the Connecting Europe Facility (CEF) for Energy, as recently demonstrated in the Baltic Synchronisation project. Moreover, the Danish-German Bornholm Energy Island project was recently awarded a significant funding budget as part of the latest CEF call, which could help the project to further advance.

The triangle of PCI selection, CBCA and CEF funding has created transparency for European public authorities in the assessment of particularly valuable projects from a European perspective. It has helped to provide a framework for project promoters and Member States to come to an agreement on the sharing of costs, while ultimately leading to enhanced support including through funding.

However, it must be acknowledged that until now, the mechanism has not led to the allocation of actual costs to Member States beyond the asset hosting countries. Considering that this very process has nevertheless shown that significant benefits may lie outside the territories of the hosting countries, new mechanisms are needed to facilitate offshore wind projects and the potential corresponding cross-border transmission infrastructure. It should also be noted that the current administrative burden behind the CBCA is very high, involving many stakeholders at both European and national level.

Finally, after the revision of the TEN-E regulation in 2022, new energy infrastructure categories eligible for CEF financing were introduced. While this acknowledged the need for offshore infrastructure, the budget allocated to cross-border energy infrastructure was not increased adequately and has stagnated throughout the last Multi-Annual Financial Frameworks (MFF), with less than €1 billion being available in the CEF for Energy each year for the whole of the EU. In comparison, the transport sector has received more than four times the budget in the last MFF.

3 ENTSO-E TYNDP 2024 Sea-Basin ONDP Report – BEMIP Offshore Grids

Against this background, to ensure that the infrastructure which is needed to reach the region's energy and climate targets will indeed be developed eventually, we as Baltic Sea TSOs propose the following considerations for a future cost sharing and funding framework:

- **Regional planning** should be strengthened from the start. Examples such as the bundling of projects as part of the voluntary Nordel initiative (see info box below) show that enhanced collaboration between system operators and Member States in terms of the exploitation of a region's energy potential can yield significant efficiency gains, including for security of supply and overall system security. Projects require stable and long-term political support to ensure their timely delivery.

- Regarding concrete tools, **we support the latest efforts to enhance the cost sharing framework**, including through the non-binding sea basin cross-border cost sharing (CBCS) guidance introduced by the European Commission in summer 2024, as this can help to inform cost-sharing discussions at European level, among other sources. However, it must be borne in mind that CBCS divides the costs for the identified infrastructure needs of a sea basin between the countries of the respective offshore corridors and does not refer to specific projects or project portfolios.

- For **concrete cost-sharing negotiations related to a set of projects**, market simulations and cost-benefit analyses play an important role, as they have in bilateral negotiations to date. However, as these may not be able to cover all relevant aspects and thus arrive at an acceptable cost-sharing proposal for all countries involved, other factors can also be included and accompanying measures taken. This could involve, as in the case of the project Bornholm Energy Island, statistical RES transfers (Germany and Denmark are sharing out the 3 GW of offshore wind in an equal manner between themselves) and the sharing of congestion income.[4]

- In addition, we support calls from Member States for the European Commission to **assess remaining challenges and gaps regarding the coordination of cost and risk sharing** between relevant countries, and, if deemed necessary, put forward further proposals in this regard.[5]

- We support efforts by the European Commission along with Member States and industry, to **help mobilising private investments and sharing costs and benefits in a broader perspective**. Current restrictions in EU-law restrict the setting of cost-reflective tariffs to promote the efficient development and use of the grid. For example, the generation charge should be adjusted to reflect the costs associated with grid reinforcements caused by variable generation.

- Furthermore, as access to capital will become increasingly challenging within the given project pipeline, we are counting on the implementation of the **Commission's Grid Action Plan**. In this context, Action 9 is particularly important as it aims to identify tailored financing models to address obstacles to private financing. This includes further instruments by the European Investment Bank, such as loans, guarantees, or similar funding mechanisms that catalyse private financing for net-zero grid projects.

- In this regard, direct **European funding** for energy projects should be substantially strengthened. The track record shows that funding can be the decisive factor with regard to realising projects that carry value for the EU as a whole. Ensuring that there is unified European political agreement is crucial to prevent fragmented negotiations, particularly for non-hosting countries that may lack incentives to participate. The Commission, Member States, and national regulatory authorities should either increase the funding for CEF or establish new, equivalent European funding mechanisms. These mechanisms must be founded on a political agreement at the Member State level and supported by appropriate and fair governance rules. Also, the European Commission and Member States should seek less burdensome and faster access to such funds, potentially through decoupling the funding from lengthy formal processes such as CBCA.

4 BMWK – Joint Project Bornholm Energy Island for the Generation and Transmission of Offshore Renewable Energy

5 Council Conclusions 30 May 2024

- **Regulation models should enable TSOs to invest** in these assets. Currently there are variations between national regulation models which might hinder cost sharing, especially if asset costs cannot be included in TSO regulated these bases.

- At the national and European levels, the principles establishing which offshore wind farms could connect to a hybrid asset and on what terms should be clarified.

Figure 8: Transmission projects from the 2004 Nordic Grid Master Plan

Analysis of historical success stories of regional cooperation

Nordel was the cooperative organisation of the Nordic TSOs that focused on the development and operation of the Nordic electricity grid before the establishment of ENTSO-E. Nordel's efforts resulted in the creation of several common Nordic grid master plans and the successful implementation of various grid reinforcement projects without cost-sharing negotiations ending up being a blocker for the projects. During the 2000s, the planning process of Nordel proceeded towards integrated Nordic cooperation concerning grid reinforcements and expansions. This regional cooperation was unique in Europe and demonstrated that Nordel was a front-runner in ensuring a well-functioning regional electricity market. The successful Nordel cooperation on joint system planning aimed to develop the grid from a Nordic perspective, considering international aspects and paying attention to environmental impacts. This work resulted in three common Nordic grid master plans over the course of ten years.

In 2004, a comprehensive analysis was conducted of the potential for new investments in the Nordic electricity transmission infrastructure. The results were published in the Nordic Grid Master Plan (NSUP2004), with proposals for grid reinforcement in five prioritised cross-sections, as shown in **figure 8**.

Although a high level of political agreement would be needed to implement a similar package of projects on a voluntary basis within the Baltic Sea region, historical evidence indicates that it is possible.

The success of the Nordel master plan can be attributed to several key factors.

- Strong political buy-in, which ensured that all stakeholders were committed to the plan's objectives.

- Additionally, a compelling narrative was established prior to reaching agreements, which helped align the interests of various parties and facilitated smoother negotiations.

- This combination of political support and a clear, shared vision was crucial in making the Nordel master plan effective.

- The reinforcements constituted a single, agreed entity with no mutual prioritisation or project-by-project cost-benefit analysis. The aim was to seek the highest possible total benefit for the region.

- Sense of urgency due to droughts in the hydropower reliant system and increased inter-regional transmission. Parallels exist with the current wind dominated electricity system.

Scaling-up the offshore wind supply chain in the Baltic Sea

Europe has been accelerating the pace at which it carries out offshore wind development. To meet the ambitious targets of the Baltic Sea region and Europe as a whole and to ensure that the energy transition is fast and affordable, scaling up manufacturing capacities is essential. By capitalising on the growth potential of offshore wind development, Europe can secure its energy future while boosting its economy and workforce, including in countries that are about to scale up their offshore activities.

To date, almost no offshore wind farm has been developed, built, and operated by companies from one single country alone: until now, European and global players together have driven the development of offshore wind, and this is likely to continue in future. The European Commission's Wind Power Package is already producing its first effects, with recent investment decisions being taken or announced across the continent.

The Baltic Sea region TSOs can address supply chain challenges by collaborating with manufacturers and suppliers. By providing clear forecasts of their asset needs, TSOs can help suppliers plan and allocate resources effectively. Standardising technical requirements and components can streamline the manufacturing process and reduce costs. Furthermore, contract models from TSOs that enable early engagement can further help to scale and speed up processes.

The map in **figure 9** on the next page depicts the sites belonging to different parts of the Baltic Sea´s wind development supply chains. In addition to manufacturing sites for wind turbine components (such as towers, blades and nacelles) and service hubs for the assembly of parts, logistics, and operation and maintenance activities, the map also includes information about (offshore) transmission grid asset manufacturers and shipyards. Recent decisions that have been taken about investments in new facilities are represented by the yellow icons.

The map also demonstrates how the development of offshore wind is becoming an increasingly pan-European quest that involves activities around the whole Baltic Sea. Both traditional leaders in offshore wind development (Denmark and Germany) and an increasing number of non-traditional players are driving this.

Given the increasing number of expected offshore wind projects it seems possible that the Baltic Sea region will become more attractive for manufacturing sites. Positive developments in this direction are, for example, the Vestas blade manufacturing site in Poland and the NKT investments in a high-voltage subsea cables production site in Sweden.[6]

To date, the market for onshore and offshore wind energy development has largely been a European one. Europe has demonstrated strong technological leadership through its manufacturing of assets and has played a leading role regarding innovative ways of connecting countries and offshore wind farms together. Meeting the future demand for assets and services has the potential to generate the creation of jobs across the value chain. Some of these jobs will be created in countries that are only just about to embark on their offshore development journeys.[7]

6 Vestas plans to establish a second offshore factory in Poland to meet growing demand for offshore wind in Europe & NKT will invest EUR 1bn in high-voltage capabilities and capacity at Swedish factory | NKT

7 Standpunkt' by Bärbel Heidebroek, President of the German Wind Energy Association (BWE) from 19.08.2024: https://background.tagesspiegel.de/energie-und-klima/briefing/warum-sich-europa-vor-chinas-windturbinen-hueten-sollte

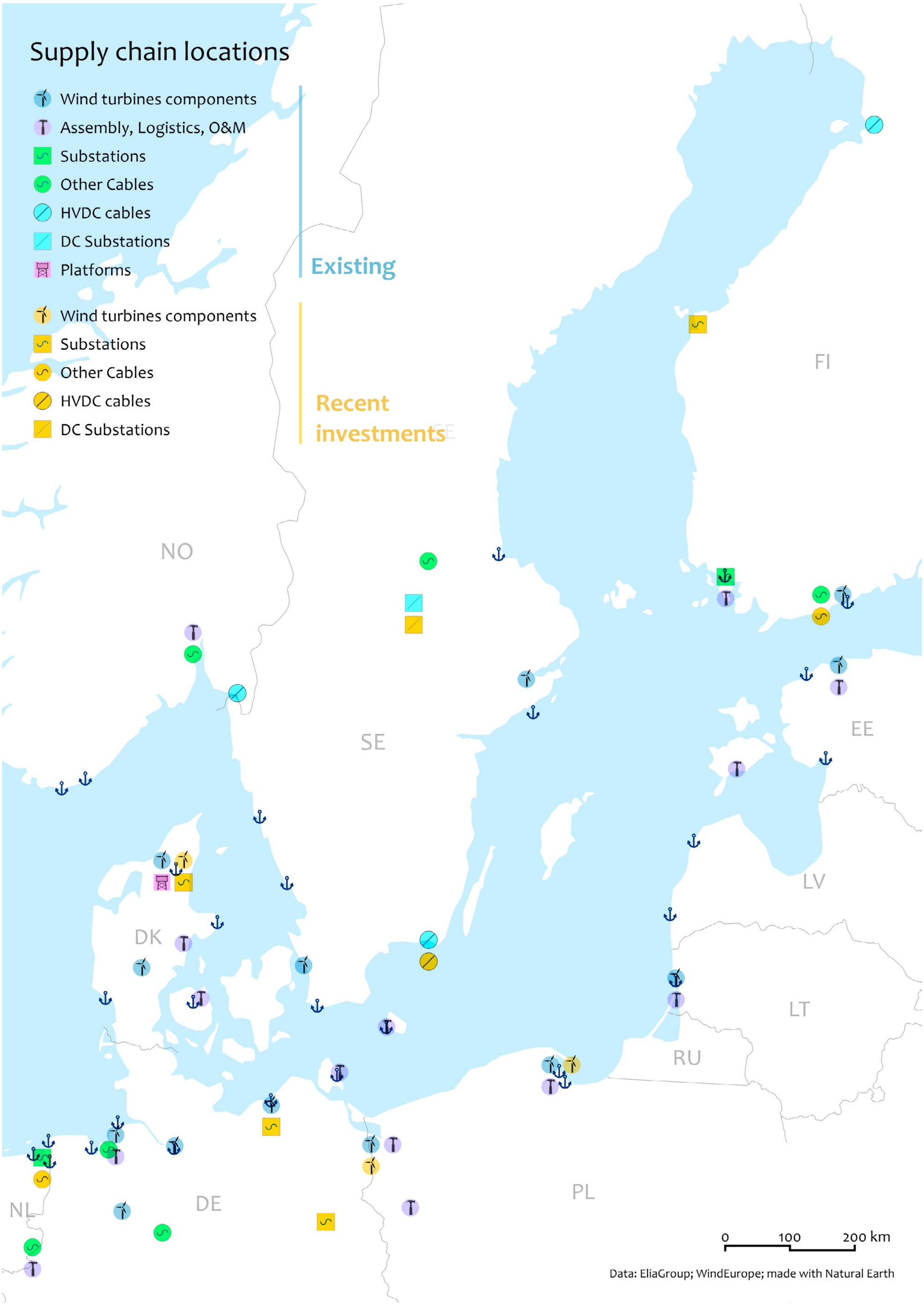


Figure 9: Offshore wind supply chain in the Baltic Sea

TSOs and security cooperation in the Baltic Sea

The security of critical undersea and offshore energy infrastructure in the Baltic Sea is crucial for Europe´s energy sovereignty. This is even more true for a European electricity system which increasingly relies on offshore wind and cross border interconnectors that link the electricity markets of countries across the Baltic Sea together. Recent incidents have resulted in damages to critical undersea infrastructure, be they negligent or malicious, and the complex geopolitical situation underlines the importance to reevaluate the current security architecture to protect maritime and offshore energy installations in the Baltic Sea against grey-zone attacks, hybrid warfare and terrorism. The following section is therefore aimed at enhancing the resilience of energy systems in an era of hybrid threats.

The Baltic Sea TSOs have a long-standing history of collaborating on system security, which has been essential for maintaining the stability and reliability of the region's power system. A recent milestone was reached when the Baltic States' power systems were synchronised with the Continental Europe Synchronous Area. Operating within both EU and NATO member countries, the Baltic Sea TSOs benefit from even stronger cooperation and collaboration opportunities since Finland and Sweden joined NATO.

Against this background, the TSOs welcome the Joint Statement of the Baltic Sea NATO Allies Summit released on 14 January 2025, which was signed by the heads of state or Government of Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland and Sweden, in the presence of the Secretary General of NATO and the Executive Vice President of the European Commission. The statement aims to address the recent increase in serious incidents that are damaging critical undersea infrastructure in the Baltic Sea. Furthermore, the TSOs welcome the joint work by the Baltic Sea NATO Allies towards a Memorandum of Understanding on Critical Infrastructure Protection in the region.[8]

At the same time, TSOs welcome NATO´s launch of "Baltic Sentry" to increase the security of critical infrastructure by enhancing NATO's military presence in the Baltic Sea and improve the ability of its allies to respond to destabilising acts.[9]

For the current security architecture to be further enhanced and developed, the Baltic Sea TSOs propose the following:

- In the short and medium term, the responsibilities of and expectations towards security authorities and private actors in the maritime sphere must be clearly defined and delineated. Responsibilities should be based on the most effective use of assets and capabilities to protect critical infrastructure. The necessary legal framework should be designed accordingly.
- In order to decisively and effectively counter threats, the private sector and state authorities must continue cooperating closely while maintaining a joint situational awareness.
- The aim should be to maintain and improve communication channels for the mutual exchange of data, information and best practices, both from private operators to security authorities and vice versa. This should include cross-border communication, especially within the framework of defense alliances and including private operators, to ensure the most effective protection possible.

8 2025-01-14-joint-statement-baltic-sea-nato-allies-summit-data.pdf

9 NATO – News: NATO launches 'Baltic Sentry' to increase critical infrastructure security, 14-Jan.-2025

- Operational communications should be tested regularly and cooperatively, for example as a multinational crisis management exercise. The "Coherent Resilience Baltic 2023" (CORE 23-B) tabletop exercise could serve as an example of this. This will facilitate the operationalisation and implementation of tasks by clearly predetermining responsibilities and maintaining effective communication channels. This ensures swift cooperation and enables necessary repairs to be completed as quickly as possible.[10]

- In line with the Joint Statement of the Baltic Sea NATO Allies, the TSOs are open to discuss the deployment of innovative solutions, as well as the development of new technologies for surveillance, the tracking of suspicious vessels and undersea monitoring. This could include enhanced partnerships with the private sector, in particular infrastructure operators and technology companies.

- The TSOs welcome the EU Action Plan on Cable Security and its whole resilience cycle approach of prevention, detection, response and deterrence. In light of recent damages caused to offshore infrastructure, the European Union should continue to implement strategies to reduce the attractiveness of maritime and undersea infrastructure as a target for sabotage. The TSOs agree on the necessity to explore the establishment of common repair capacities for scarce or highly specialised equipment in case damage occurs, as well as the implementation of deterrent mechanisms to facilitate damage claims against those who negligently or maliciously harm offshore infrastructure.[11]

- Initiatives to enhance security, particularly those involving asset-related solutions, are likely to incur additional costs. It is necessary that the regulated revenues of the TSOs are adjusted to consider any additional security investments and cooperation efforts. TSOs should be given certainty regarding the recouping of these costs, enabling them to select the most effective solutions while continuing to uphold the security and reliability of the power system.

Against this background, the Baltic Sea TSOs are ready to engage in further discussions with all other relevant players to further contribute to a robust security architecture in the Baltic Sea.

10 TX CORE 23-Baltic Final Exercise Report - NATO ENSEC COE

11 https://digital-strategy.ec.europa.eu/en/library/joint-communication-strengthen-security-and-resilience-submarine-cables

Next Steps: Enabling Offshore Wind Development in the Baltic Sea

Offshore wind power has the potential to become a key part of the Baltic Sea countries' energy future in the coming decades. Enhancing regional cooperation among Member States and TSOs is crucial. By fostering collaboration, we can effectively develop hybrid interconnector projects and offshore energy hubs to harness the sea basin's potential more efficiently. Moreover, collaboration unlocks efficiencies in offshore gird security with regard to prevention, resilience and repairs which is especially important in the Baltic Sea.

Looking to 2025 and beyond, the Baltic Sea TSOs will continue to jointly engage in the development of offshore wind power projects, work closely with project developers, respond to the progress made on customer projects, and derive key success factors to further advance the European energy transition via the offshore sector.

We will continue to provide updates on the progress made in offshore development in the Baltic Sea and stand ready to share them in appropriate formats and via appropriate fora.

Impressum

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