cerre Centre on Regulation in Europe

SCALING UP OFFSHORE WIND ENERGY IN EUROPE

Report

October 2023

Catherine Banet
Bert Willems

As provided for in CERRE's bylaws and procedural rules from its "Transparency & Independence Policy", all CERRE research projects and reports are completed in accordance with the strictest academic independence.
The project, within the framework of which this report has been prepared, received the support and/or input of the following CERRE member organisations: Ei, Norsk Hydro, Ofgem, Terna. However, they bear no responsibility for the contents of this report. The views expressed in this CERRE report are attributable only to the authors in a personal capacity and not to any institution with which they are associated. In addition, they do not necessarily correspond either to those of CERRE, or of any sponsor or of members of CERRE.

How to cite this Report:
Banet, C. and Willems, B. (2023), Scaling up Offshore Wind Energy in Europe, *Centre on Regulation in Europe (CERRE)*.

TABLE OF CONTENTS

TABLE OF FIGURES

ABOUT CERRE

Providing top quality studies and dissemination activities, the Centre on Regulation in Europe (CERRE) promotes robust and consistent regulation in Europe's network and digital industries. CERRE's members are regulatory authorities and operators in those industries as well as universities.
CERRE's added value is based on:

- its original, multidisciplinary and cross-sector approach;
- the widely acknowledged academic credentials and policy experience of its team and associated staff members;
- its scientific independence and impartiality;
- the direct relevance and timeliness of its contributions to the policy and regulatory development process applicable to network industries and the markets for their services.

CERRE's activities include contributions to the development of norms, standards and policy recommendations related to the regulation of service providers, to the specification of market rules and to improvements in the management of infrastructure in a changing political, economic, technological and social environment. CERRE's work also aims at clarifying the respective roles of market operators, governments and regulatory authorities, as well as at strengthening the expertise of the latter, since in many Member States, regulators are part of a relatively recent profession.

ABOUT THE AUTHORS

Catherine Banet
CERRE Research Fellow, University of Oslo

Catherine Banet is a Professor at the University of Oslo, Head of the Department for Energy and Resources Law at the Scandinavian Institute of Maritime Law, Norway. She is a member of the Advisory Academic Group (AAG) to the International Bar Association (IBA), Section for Energy, Environment and Natural Resources and Infrastructure Law (SEERIL), and Chair of the Board of the Norwegian Energy Law Association.

Bert Willems
CERRE Research Fellow, Université catholique de Louvain.

Professor Bert Willems, is a CERRE Research Fellow and a Professor of Economics at the Université catholique de Louvain where he studies and teaches energy management and environmental economics. He is affiliated with the Law and Economic Center at Tilburg University (TILEC), the Toulouse School of Economics and a board member of the Benelux Association for Energy Economics (BAEE).

LIST OF ABBREVIATIONS

ACER	EU Agency for the Cooperation of Energy Regulators
BEMIP	Baltic Energy Market Interconnection Plan
BZR	Bidding Zone Review
CACM	Capacity Allocation and Congestion Management
CBCS	cost-benefit and cost-sharing
CCR	Capacity Calculation Region
CEEAG	2022 State aid guidelines for climate, environmental protection and energy
CEER	Council of European Energy Regulators
CESED	Central and South Eastern European Energy Connectivity
CfD	Contract for Difference
EC	European Commission
ECA	European Court of Auditors
EEA	European Economic Area
EEZ	Exclusive Economic Zone
EGD	European Green Deal
ENTSO-E	European Network of Transmission System Operators for Electricity
ESC	European Stakeholders Committee
EU	European Union
GW	Gigawatt
IEA	International Energy Agency
IRENA	International Renewable Energy Agency
I-SEM	Integrated Single Electricity Market (Ireland and Northern Ireland)
ITRE	European Parliament Committee on Industry, Research and Energy
LCOE	Levelized Cost Of Electricity
MoU	Memorandum of Understanding
MSP	Maritime Spatial Planning
NECP	National Energy and Climate Plan
NRA	National Regulatory Authority
NSCOGI	North Seas Countries' Offshore Grid Initiative
NSEC	North Seas Energy Cooperation
OEM	Original Equipment Manufacturers
OFTO	Offshore Electricity Transmission (UK)
ONDP	Offshore Network Development Plan
ORE	Offshore Renewable Energy
OW	Offshore Wind
OWF	Offshore Wind Farm
PCI	Project of Common Interest
PMI	Project of Mutual Interest
PPA	Power Purchase Agreement

REDII	Renewable Energy Directive (EU) 2018/2001
REDIII	Proposal for a revision of Renewable Energy Directive (EU) 2018/2001
R&D	Research and Development
SB-ONDP	Sea-Basin related Offshore Network Development Plan
TAG	Transmission Access Guarantee
TCA	Trade and Cooperation Agreement
TEN-E	Trans-European energy infrastructure
TEU	Treaty on European Union
TFEU	Treaty on the Functioning of the European Union
TSO	Transmission System operator
TYNDP	Ten Year Network Development Plan
UNCLOS	United Nations Convention on the Law of the Sea

EXECUTIVE SUMMARY

This report analyses how EU regulatory action can help supporting the scaling up of offshore wind energy (ORE) in Europe. The offshore wind sector is currently facing great enthusiasm but also what has been described as 'the perfect storm', with a mix of strong demand, constrained supply, and inflationary pressures resulting in increased costs.

During the past few years, there has been a significant fall in offshore wind energy costs, making the technology one of the cheapest sources of renewable energy after solar PV and onshore wind. Offshore wind has become an essential pillar of the continent's trajectory towards net zero, while the EU offshore wind and related supply chains have developed a significant competitive advantage.
As a response to the energy market disruption caused by Russia's invasion of Ukraine, the European Commission presented the REpowerEU Plan that seeks to end the EU's dependence on fossil fuels imported from Russia and to ensure security of supply and sustainability by boosting further the share of renewable energy generation in the EU.

To achieve faster deployment of offshore wind generation capacity in the EU, rapid, targeted action is needed to accelerate the scale-up of ORE in generation, transmission/distribution, and market design in the EU and its Member States, or they will not be able to meet their climate commitments, increase their energy independence and deliver on industrial ambitions.

Key Areas for Targeted EU Action

The report identifies **four key areas** for targeted EU action to support scaling of offshore wind:

1. **Planning:** How can the development of offshore wind projects become part of an integrated plan for the Blue Economy (e.g., maritime/energy planning integration, in line with the National Energy and Climate Plans)?
2. **Permitting:** How to simplify and shorten permitting procedures for offshore wind generation and related infrastructures at the Member State level?
3. **Cross-border projects:** How can EU intervention spur the development of large, cross-border projects and related infrastructures (e.g., improved permitting, clustering) and support collaboration between EU Member States and neighbouring coastal states?
4. **Mutual and local benefits, including coexistence:** How to ensure co-existence between offshore activities such as energy production, shipping, aquaculture, tourism, defence, biodiversity protection (mutual benefits), and local benefits for developing offshore wind projects?

The report considers EU action from two lenses. First, it considers how EU intervention can assist Member States when scaling up offshore wind at the national level to reach EU targets and preserve cross-border trade on the internal energy market. Second, it studies how EU intervention can address the upcoming challenges when the large-scale deployment of offshore wind energy will result in more hybrid systems and gradually more meshed networks crossing Member States' borders.

Policy Recommendations

These policy recommendations aim to guide the EU's approach to offshore wind development, balancing economic, environmental, and social considerations, and to bring regulatory clarity.

Type of EU regulatory approach to be favoured to scale up offshore wind in Europe

- **EU Intervention and Subsidiarity:** The EU should carefully consider its role in offshore wind regulation, adhering to subsidiarity and proportionality principles.
- **Coexistence and Mutual Benefits**: Public intervention should ensure coexistence and address diverse interests in the maritime space.
- **Gradual Development of Rules:** Given the evolving nature of offshore wind technologies and grid designs, regulations should be developed incrementally to ensure legal certainty and avoid hindering investments.
- **Impact Assessments:** EU initiatives with significant economic, social, or environmental impacts should undergo impact assessments to inform legislative reforms.
- **Legal Certainty and Regulatory Sandbox:** Legal clarity and regulatory certainty are vital to attract investments. A gradual regulatory approach begins with defining market structure elements, with the option of a short-term regulatory sandbox for offshore hybrid assets.
- **Guidance on Regulatory Development:** The EC should provide guidance for a two-step approach to regulatory development, initially under existing legislation, followed by legislative reform if necessary.
- **Harmonisation and Multispeed Europe:** Balancing the pace of offshore wind development across different sea basins should not hinder the establishment of common EU rules or guidelines. Cross-border offshore projects should address the legal disparities in different sea basins. Bilateral or multilateral agreements may be needed for legal clarity. Packages of projects should be proposed within sea basins based on congestion management to optimise offshore wind development.
- **Alignment with Ongoing Reforms:** Offshore wind regulation should align with ongoing legislative reforms related to electricity market design, permitting acceleration, and the TEN-E Regulation.

1. Planning

- **Biodiversity and Ocean Protection:** Planning should prioritise environmental and social impacts and promote co-existence and local benefits, especially for emerging technologies like floating offshore wind installations.
- **Alignment of Maritime Spatial Plans and NECPs:** Regulatory bodies should ensure alignment between maritime spatial plans and national energy and climate plans.
- **Grid and Production Integration:** Grid and production planning should be integrated, promoting joint planning within sea basins to maximise offshore renewable energy projects.
- **Role Allocation and Clarity in Grid Planning:** Clear identification of responsibilities for offshore grid planning, considering various configurations, is necessary.
- **EU Governance System Use:** EU and regional governance systems should facilitate coordinated planning and cross-border projects. In addition, the EU should play a role in

steering national implementation plans and defining offshore wind generation targets per sea basin.

- **Space Allocation in Maritime Spatial Plans:** Allocating space for offshore wind in maritime spatial plans is essential for long-term planning.
- **Proactive Decommissioning and Reuse:** A proactive policy for decommissioning, re-using, and repurposing offshore installations should be promoted at the EU level.
- **TSO Coordination:** Coordination between Transmission System Operators (TSOs) should be strengthened, particularly in regional fora.

2. *Permitting*

- **Permitting Time-Limits and Streamlining:** Full implementation of existing EU legislation on permitting time limits and streamlining is essential.
- **Court Proceedings Duration:** Measures to address delays caused by prolonged court proceedings should be explored.
- **Merging Offshore Wind and Cable Permitting:** Best practices for merging permitting processes for offshore wind farms and cables should be developed.

3. *Cross-border projects*

- **Hybrid and Meshed Networks:** Future offshore networks should adopt hybrid and meshed configurations, with regulation adapting to this shift.
- **Offshore TSO Responsibility:** National TSOs should remain responsible for planning, owning, and operating offshore networks within their exclusive economic areas.
- **Integration with Onshore Markets:** Offshore assets must be closely integrated with onshore markets for efficient price formation.

4. *Mutual and local benefits, including co-existence*

- **Cost-Benefit Models:** A cost-benefit approach should be used to allocate costs and benefits of offshore networks among national TSOs.
- **Location-Specific Auctions:** Government-driven planning and centralisation should guide investment choices with location-specific auctions.
- **Market Organisation Focus:** The market organisation should provide regulatory certainty, reduce transaction costs, and support the long-term development of offshore networks.
- **Financial Transmission Access Guarantees:** should be created to hedge congestion price and volume risks for wind producers.
- **Local Benefits in Auctions:** EU legislation (REDII, state aid guidelines) allows for non-price criteria in offshore wind auctions. Further guidance on the definition of non-price criteria, in which non-price elements are accepted, the distinction between criteria related to innovation, environmental protection and, for example, circularity, and other criteria resembling local content requirements, should be provided to ensure consistency and fair competition.

1 Introduction

1.1 A common European approach to offshore wind development

On November 19 2020, the European Commission (EC) adopted an Offshore Renewable Energy (ORE) Strategy,[1] in line with the objective of the European Green Deal.[2] In parallel, political declarations have been signed among neighbouring countries of the five European Union (EU) sea basins[3] to announce joint targets for offshore wind, such as the April 2023 Ostend Declaration in the North Seas. The EU ORE Strategy calls for 300 GW of offshore wind and 40 GW of ocean energy installed capacity in the EU by 2050. The Ostend Declaration alone sets targets of at least 300 GW by 2050 in the North Seas, envisaging the latter sea basin as a 'green power plant of Europe'.[4]

Both visions, at EU and regional level, recognise the essential role of offshore wind in the energy transition, alongside other offshore renewable energy technologies such as floating solar, tidal and wave energy. With the ORE Strategy, the European Commission develops a new regulatory agenda for offshore renewable energy sources, and a new market framework for offshore wind energy in particular.

By proposing a series of measures at the EU level, the EC argues that there is a need for EU intervention and harmonisation to support and complete national measures. The EC strategy aims to address new challenges that arise from the large-scale deployment of offshore wind and from the development of hybrid offshore wind systems[5] gradually moving towards meshed offshore networks.[6] Indeed, the deployment of offshore wind energy has so far been primarily driven by national government strategies.[7] One can argue that national offshore wind ambitions have been spurred by the implementation of EU renewable policies, and notably the 2009 Renewable Energy Directive which defined mandatory national renewable energy targets.[8] Even if correct, the regulatory approach has

---

[1] Communication from the European Commission, An EU Strategy to harness the potential of offshore renewable energy for a climate neutral future, COM(2020)741 final, 19.11.2020. Hereafter referred to as the ORE Strategy.

[2] In its Communication on the European Green Deal, the European Commission states that 'increasing offshore wind production will be essential, building on regional cooperation between Member States'. The adoption of a strategy on offshore wind is listed as one of the key actions for implementation of the EGD (European Commission, Communication, The European Green Deal, COM(2019)640 final, 11.12.2019, p.16 and Annex to the Communication).

[3] The EU five sea basins are: Baltic Sea, North Sea, Mediterranean Sea, Black Sea, and North Eastern Atlantic. See Directive 2008/56/EC of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive).

[4] Ostend Declaration of Energy Ministers on the North Seas as Europe's Green Power Plant – Delivering cross-border projects and anchoring the renewable offshore industry in Europe, 24 April 2023

[5] Hybrid offshore grid refers to a situation where there is offshore production connected to the interconnector(s) between different bidding areas. See Section 4 of this report for a discussion on the definition of hybrids.

[6] Meshed grids refer to a situation where offshore hybrid projects are connected to each other, in a coordinated manner.

[7] This is recognised in the Impact Assessment Report accompanying the proposal for Directive amending the REDII Directive (EU) 2018/2001, SWD(2021)621 final, 14.07.2021, Part 1/2: 'Currently, deployment plans and targets for offshore renewable energy and respective support measures are generally set at national level, while regional cooperation takes place only to a limited extent and is mainly based on best practice exchange' (p.45).

[8] Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC, now repealed and replaced. The Directive established a European framework for the promotion of renewable energy, setting mandatory national renewable energy targets for achieving a 20% share of renewable energy in the final energy consumption and a 10% share of energy from renewable sources in transport by 2020.

been primarily defined at national level, with its shortcomings and divergences. This also results from the fact that offshore wind farms (OWFs) have been primarily developed with radial connections to shore within the same national jurisdiction.[9] Looking ahead, moving towards a higher level of ambition for offshore wind energy in Europe will require the development of both national and cross-boundary projects, developed in a coherent manner. Already in its 2013 Renewable Energy Progress Report, the EC called upon a 'common, European approach to offshore wind development', starting at the sea basin level.[10]

The main question raised in this report is to know how EU regulatory action can help supporting the scaling up of offshore wind energy in Europe.

The offshore wind sector is currently facing great enthusiasm but also what has been described as 'the perfect storm', with a mix of strong demand, constrained supply, and inflationary pressures resulting in increased costs. During the past few years, there has been a significant fall in offshore wind energy costs,[11] making the technology one of the cheapest sources of renewable energy after solar PV and onshore wind.[12] For this reason, offshore wind has become an essential pillar of the continent's trajectory towards net zero,[13] while the EU offshore wind industry and related supply chains have developed a significant competitive advantage over the last two decades, with promising export potentials.[14] As a response to the energy market disruption caused by Russia's invasion of Ukraine, the European Commission presented the REpowerEU Plan that seeks to end the EU's dependence on fossil fuels imported from Russia and to ensure security of supply and sustainability by boosting further the share of renewable energy generation in the EU. Offshore wind will again take an important share of the increase in added generation capacity, with some comparative advantages compared to onshore wind. For example, wind power generation has a higher power potential offshore than onshore. Access to area is challenging for both, but particularly acute for onshore wind. Offshore wind is perceived as a manner to counteract the decreasing social acceptance towards onshore wind projects, but does not avoid concerns around the coexistence between different activities at sea.

[9] A radial connection is a cable that links the offshore wind farm to a point on the mainland power grid.

[10] European Commission, Renewable energy progress report, COM(2013) 175 final, 27.3.2013, p. 10.

[11] The European Commission reports in the 2022 State of the Energy Union, that In the Offshore Wind Sector, the global weighted-average LCOE declined by 48% between 2010 and 2020, from USD 0.162 to USD 0.084/kWh, with a 9% reduction year-on-year in 2020. The main sources of costs reductions are technology improvements and industry related factors, such as growing developer experience and greater production standardisation. Source: European Commission, Report on the Achievement of the 2020 Renewable Energy Targets, COM(2022) 639 final, 15.11.2022, p.6.

[12] IRENA indicates that in the period 2010-2022, the global weighted-average LCOE of offshore wind went from being 258% more expensive than the cheapest fossil fuel option to being just 17% more expensive, as the cost fell from USD 0.197/kWh to USD 0.081/kWh, a reduction of 59%. International Renewable Energy Agency (IRENA), Renewable power generation costs in 2022 (2023), Table H.1 (Total installed cost, capacity factor and LCOE trends by technology, 2010 and 2022) and Figure S.1 (Change in competitiveness of solar and wind by country based on global weighted average LCOE, 2010-2022).

[13] European Commission, DG ENER, Member States agree new ambition for expanding offshore renewable energy, 19 January 2023.

[14] According to the Joint Research Centre of the European Commission, the European Original Equipment Manufacturers (OEMs) in the wind energy sector has held a leading position in the last few years. In 2021 they ranked second behind Chinese OEMs when analysing the Top10 OEMs in terms of market share. Among the top 10 OEMs, Chinese OEMs led with 43 % of market share, followed by the European (34 %) and North American (9 %) companies. JRC, Wind Energy in the European Union – Status report on technology development, trends, value chains and markets, 2022, Section 4 – EU position and global competitiveness, pp.122-131.

Despite these rapid market and technology developments and high policy ambitions, a faster deployment of offshore wind generation capacity in the EU is entering a critical phase where targeted, additional action is needed. Unless action is rapidly taken to accelerate the scale-up of ORE (in generation, transmission/distribution, and market design) and the cooperation between states, the EU and its Member States will not be able to meet their climate commitments, increase their energy independence and deliver on industrial ambitions. As highlighted by the European Parliament's Committee on Industry, Research and Energy's (ITRE) draft report on the offshore strategy published in June 2021, existing infrastructure must be improved and expanded to increase the volumes of electricity transmitted from offshore production sites to consumers on land.[15] Legal and regulatory frameworks must facilitate anticipation and long-term investments in infrastructure, encourage collaboration between Member States, and support investments in R&D.

1.2 Type of EU regulatory approach to be favoured to scale up offshore wind in Europe

The ORE strategy aims to enable and support the large-scale deployment of the necessary offshore wind generation and transport infrastructures as well as to facilitate new market solutions, but requires new legal and regulatory action to be implemented. **Some preliminary remarks are made below on the type of EU regulatory approach to be favoured to scale up offshore wind in Europe:**

- In line with the **subsidiarity[16] and proportionality[17] principles**, the need for EU action must be assessed as well as its content and form.[18] The objective of the EU measure (problem to be solved) will be decisive, also when considering its interaction with the principle of **national sovereignty over the energy mix**.[19] In the context of offshore wind energy, the EU is pursuing a technology specific approach, as a manner to achieve renewable energy targets.

- EU initiatives[20] expected to have a significant economic, social or environmental impact must be subject to an **impact assessment**,[21] the findings of which are summarised in an impact assessment report. During her State of the Union speech in September 2023, EC President von der Leyen announced an upcoming 'European Wind Power Package'. If this package is to be proposed within a few months before the end of her term, this raises the question of the ability of the EC to conduct an in-depth impact assessment of new legislative proposals or significant EU initiatives within this short timeframe. If time does not allow, the proposals under the package might be limited in nature and scope, for example to some soft law guiding principles (proposed by the EC, maybe in cooperation with ACER) and/or targeted new

[15] European Parliament, Committee on Industry, Research and Energy (ITRE), Draft report on a European strategy for offshore renewable energy, 2021/2012(INI), 9.6.2021.
[16] Art. 5(3) Treaty on European Union (TEU).
[17] Art. 5(4) TEU.
[18] As a reminder, energy is an area of shared competence between the EU and its Member States (Art. 4(1)(i), Treaty on the Functioning of the European Union (TFEU).
[19] Art. 194(2) TFEU.
[20] The impact assessment requirements apply to legislative proposals, and extend to non-legislative initiatives (such as financial programmes or recommendations for the negotiations of international agreements), and implementing and delegated acts.
[21] European Commission, Better Regulation Guidelines, Staff Working Document, SWD(2021) 305 final, November 2021.

requirements based on previous impact assessments.[22] The ORE Strategy itself was not accompanied by a full impact assessment, but a 'Guidance on electricity market arrangements'.[23]

- The fact that both technologies (e.g., floating and bottom-fixed installations, cable design) and grid solution designs are still evolving, argues in favour of a **gradual development of the rules**.[24] Notably, grid solutions are still in the making, with an evolution from radial to hybrids, and with the perspective of meshed grids, energy hubs/AC-hubs[25] and energy islands in the long-term. Offshore hybrid assets are expected to connect one or more offshore wind farms to more than one onshore bidding zone. However, many elements of grid and market design are still to be defined, and will only be set progressively. Due to changes in offshore grid configurations following the addition of production, conversion or storage assets, but also the connection of new grid segments, investment models may need to change along the way.

- The lack of certainty around the legal framework for offshore wind is a clear barrier to investments. **A gradual regulatory approach should not represent another barrier to investments. A gradual regulatory approach for hybrids should start in a targeted manner, clarifying first fundamental elements of market structure such as the legal definition of hybrids and cost-benefit sharing principles for these. It will then adjust along the way costs and benefits models for investors and the different actors while the grid design and market solutions mature**.

- Adjusting investment models along the way requires carefulness, not least to maintain foreseeability for project developers. **A gradual regulatory approach would therefore require a close regulatory monitoring** by national regulatory authorities (NRAs) alone, NRAs and stakeholders gathered at the European Stakeholders Committees (ESC),[26] and the EU Agency for the Cooperation of Energy Regulators (ACER). **A short-term regulatory sandbox for offshore hybrid assets could be on option. As part of this sandbox, the applicability of current legislation as well as temporary derogations to new hybrids projects – like for Kriegers Flak case[27] - should be tested, and the consequences of current market arrangements measured, with the objective of paving the way for changes to the EU legal framework, if proven necessary.** In their 2022 Reflection Note on the EC ORE Strategy, ACER

[22] See notably the Impact Assessment accompanying the Commission Communication on Stepping up Europe's 2030 climate ambition, SWD(2020) 176 final, 17.9.2020.

[23] Guidance on electricity market arrangements: A future-proof market design for offshore renewable hybrids projects, Commission Staff Working Document Accompanying the European Commission Communication An EU Strategy to harness the potential of offshore renewable energy for a climate neutral future, SWD(2020) 273 final, 19.11.2020.

[24] ACER and CEER Reflection on the EU Strategy to harness the potential of offshore renewable energy for a climate neutral future, 11 April 2022, paras. (12) and (84).

[25] AC-hubs are small/medium size offshore AC grids which connect offshore generation units (such as floating or bottom-fixed wind, floating photovoltaic assets), offshore storage units and offshore loads (e.g. renewable hydrogen from electrolysis). One of several AC-hubs could be interconnected via HVDC systems, connecting them to the networks of two or more Member States or synchronous areas. See ACER and CEER Reflection on the EU Strategy to harness the potential of offshore renewable energy for a climate neutral future, 11 April 2022, para. (53).

[26] https://www.entsoe.eu/network_codes/esc/

[27] See Section 4.3 below.

and the Council of European Energy Regulators (CEER) outlined several proposals for strengthening the legal framework for investments in offshore wind.[28] For example, they agree with the EC that congestion in hybrid offshore networks could best be managed through the establishment of offshore bidding zones (OBZs), at the same time that it ensures compliance with cross-border trading rules. The process for establishing OBZs (the bidding zone review (BZR) methodology) is defined in the Electricity Regulation and the Guideline on Capacity Allocation and Congestion Management (CACM Guideline), and perceived as 'complex, lengthy and burdensome'.[29] A group of TSOs concluded that the BZR process seems to be incompatible with the development of offshore hybrid projects under an OBZ.[30] To facilitate the development of hybrids, the approach could be gradual, starting with the possibility given in the Electricity Regulation that a TSO identifies itself long-term, structural congestion with a congestion report. The Member State can then establish a new OBZ without following the process of a BZR,[31] but based on guidance by the EC to streamline the process amongst Member States. EC guidance on cost-benefit sharing will also be needed. In light of the experience gained, the EC can later on propose legislative reforms to amend the Electricity Regulation and CACM Guidelines to adjust the OBZ procedure as well as the list of borders in the relevant Capacity Calculation Regions (CCR). In the long-term, the design of a legal regime enabling offshore hybrids may also force the adjustment of the general regime for interconnectors, notably on issues such as congestion management and balancing responsibilities. **To sum up, it is recommended that the fundamental elements of market structure, such as the legal definition for hybrids and cost-benefit sharing principles, are defined urgently. Therefore, and based on the feedback from regulatory monitoring, the EC should provide guidance as to the manner to proceed with a gradual development of the rules, around two consecutive steps: first, describe options to develop market-sound solutions within the framework of currently applicable legislation; and second, after a period of regulatory oversight, put forward proposals for legislative reform. The regulatory sandbox model could be used in support of this process.**

- **Multispeed Europe vs. harmonised rules** - Some sea basins, such as the North Sea and the Baltic Sea, are at the forefront of regulatory experiments, and urgently needs regulatory certainty to enable the required investments. Progressing at different speeds in the different sea basins can be part of a gradual approach, based on experiments and regulatory innovation. It can efficiently prepare the adoption of EU common rules in the long-term. The approach requires again regulatory monitoring and tight cooperation between the different NRAs to the same sea basin. Interinsitutional cooperation between NRAs can be promoted through established fora such the North Seas Energy Cooperation (NSEC) or the integrated Single Electricity Market (I-SEM) experience in Ireland. In certain sea basins, such as the North

[28] ACER and CEER Reflection on the EU Strategy to harness the potential of offshore renewable energy for a climate neutral future, 11 April 2022.
[29] ACER and CEER Reflection on the EU Strategy to harness the potential of offshore renewable energy for a climate neutral future, 11 April 2022, para (35).
[30] North Sea Wind Power Hub (NSWPH), A strategy to establish an offshore bidding zone for hybrid projects, Discussion Paper #3, May 2022.
[31] Ibid.

Sea, further legal clarifications will be needed when not all neighbouring countries are EU Member States (Norway, being an EEA country,[32] and the UK, having left the EU[33]). Legal clarity might be achieved by the signature of bilateral or multilateral MoUs or even bidding agreements.

- Additional EU action must **be coherent with other recent or ongoing legislative reforms on notably: (i) Electricity market design[34]; and (ii) permitting acceleration as part of REDIII revision**[35] **and the already revised TEN-E Regulation.**[36] **The future EU legal framework for offshore wind will also be shaped as part of these legislative reforms. This means that these reforms provide a timely opportunity to develop an EU regularoty framework for offshore wind.**

- Finally, and in addition to EU energy market legislation, compliance with existing biodiversity and ocean protection objectives must be ensured. This makes the need for good planning and coordinated development of the maritime space prerequisites on the way towards a sustainable blue economy in the EU.[37] Permitting procedures are also instrumental in assessing environmental and social impacts of offshore wind projects, as well as promoting co-existence and local benefits. However, **the sole implementation of current legal framework may not be sufficient to address the cumulative environmental and social impacts of offshore wind projects that are still to be fully understood**. This applies for example to the scope of environmental impacts of floating offshore wind installations, that is still under-researched.

While Member States have advanced at different paces and following different models, there is a need for better coordination among Member States within the same sea basin as well as clarity as to the common market design approach for offshore wind under EU law. **This calls for a reflection on the need and nature of further EU intervention, in addition to the suitability of already applicable legislation and policy instruments to enable novel types of projects, such as hybrids.** Coordination of action within the same sea basin for a safe, sustainable, and cost-efficient management of offshore resources and infrastructures should be a central consideration and a natural step in a gradual development of the common EU rules. EU guidance and targeted legislative intervention will be key along the way.

[32] Part to the European Energy Area Agreement.
[33] EU-UK Trade and Cooperation Agreement; UK/Norway Agreement on Cross-Border Trade in Electricity and Cooperation on Electricity Interconnection, 2021
[34] M. Pollitt, N.-H. von der Fehr, C. Banet, B. Willems, C. Le Coq, Recommendations for a Future-Proof Electricity Market Design, Centre on Regulation in Europe (CERRE) 2022.
[35] See upcoming CERRE report on speed-up permitting (2024).
[36] Regulation (EU) 2022/869 of the European Parliament and of the Council of 30 May 2022 on guidelines for trans-European energy infrastructure.
[37] European Commission, Communication on a new approach for a sustainable blue economy in the EU – Transforming the EU's Blue Economy for a Sustainable Future, COM(2021) 240 final, 17.5.2021.

1.3 Report structure and methodology

The present report identifies **four key areas** for targeted EU action in order to support the scaling of offshore wind in Europe. It analyses currently applicable legislation and ongoing EU legislative initiatives, it takes stock of current policies,[38] and formulates recommendations for improvement to tackle the below questions:

5. **Planning:** How can the development of offshore wind projects become part of an integrated plan for the blue economy (e.g., maritime/energy planning integration, in line with the National Energy and Climate Plans)?
6. **Permitting:** How to simplify and shorten permitting procedures for offshore wind generation and related infrastructures at Member State level?
7. **Cross-border projects:** How can EU intervention spur the development of large, cross-border projects and related infrastructures (e.g., improved permitting, clustering) and support collaboration between EU Member States and neighbouring coastal states?
8. **Mutual and local benefits, including coexistence:** How to ensure co-existence between offshore activities such as energy production, shipping, aquaculture, tourism, defence, and biodiversity protection (mutual benefits), and local benefits for the development of offshore wind projects?

These four key topics are addressed in Section 2 to 5 respectively.

The methodology applied in this report is based on desktop legal analysis (Sections 2, 3 and 5), combined with law and economics (Section 4). The scope is limited to EU law and policy, with some examples from national legislation. As concerns the North Sea, we acknowledge the specific issues raised by cross-boundary projects between the United Kingdom (UK), Norway and EU countries that are referred to in some places in the report. This stresses the need for a sea basin approach, taking into account the specificities of the legal framework for cooperation between the neighbouring countries of the same sea area.[39] However, the focus of this report remains on EU regulation. Further, the report takes a holistic approach, but recognises that in some instances the difference must be made between bottom-fixed and floating technologies. Finally, the report focuses on offshore wind energy, and does not address supply chain issues and supply risk for raw materials used in the offshore wind sector.

[38] The European Court of Auditors published in 2023 a report assessing the Commission and four selected Member States' actions to support the development of offshore renewable energy. European Court of Auditors, Offshore renewable energy in the EU, Special report 22, September 2023.

[39] I.e. the Trade and Cooperation Agreement (TCA) signed on 31 January 2020 between the UK and the EU, the Agreement on the European Economic Area signed on 1 January 1994 between the EU Member States and the three EEA EFTA States, and the Treaty establishing the Energy Community signed on 25 October 2005 between the EU and currently nine contracting parties (Albania, Bosnia and Herzegovina, Georgia, Kosovo, North Macedonia, Moldova, Montenegro, Serbia, and Ukraine.

2 Planning

In several policy documents, and notably the ORE Strategy, the European Commission has presented its vision in favour of a more integrated approach to activities planning in offshore areas, including for offshore wind (2.1). Based on this vision, two main questions are raised below: How can the development of offshore wind projects become part of an integrated grid plan (2.2), and more broadly of an integrated planning process for the Blue Economy (e.g., maritime, climate, energy planning integration (2.3).

2.1 The vision defended by the European Commission and parallel regional initiatives

In its ORE Strategy, the European Commission presents its vision for a more integrated approach to cross-sectoral planning in offshore areas, particularly at the sea basin level. With the view of scaling-up offshore renewable energy, the Commission identifies some key planning orientations that fall under two main categories:

- **More integrated planning processes at sea**

- Achieving the ambitious increase in offshore renewable energy will require identifying and using larger areas for offshore renewable energy production and related connection to power the transmission grid. This requires long-term planning by public authorities, not least to avoid conflict and therefore ensure coexistence;
- The development of offshore renewable energy must comply with EU environmental legislation and the integrated maritime policy;
- Maritime spatial planning (MSP) is a well-established tool to anticipate changes, prevent conflicts and find mitigation solutions;
- National maritime spatial planning should adopt a holistic, multi-use/multipurpose approach.[40]

[40] ORE Strategy, pp.7-8.

- **Offshore grid planning**
- The development and planning for an offshore grid needs to go beyond national borders;
- Offshore grid development has historically been limited to radial connections to shore. The development and planning for an offshore grid should increasingly consider the possibility of multi-functionality, in the form of hybrid projects or at a later stage a more meshed grid;
- Member States should together set ambitious targets for offshore renewables in each sea basin;
- Member States could sign a Memorandum of Understanding or an intergovernmental agreement between themselves, possibly assisted by the European Commission if needed;
- These commitments should be reflected in the updated National Energy and Climate Plans (NECPs) in 2023-2024;
- These ambitious targets will need to be taken into account in an integrated regional grid planning and development.[41]

Responding to the Commission's ORE Strategy, on 30 November 2021, the ITRE Committee of the European Parliament adopted an own-initiative report. The resolution supports the need to start with cooperation at sea basin level,[42] taking into account each basins specificities (no one-size-fits-all approach).

The resolution elaborates further on the need to develop infrastructure and grids as a matter of urgency.[43] It recalls that, to integrate more offshore wind power into energy markets, adequate infrastructure, such as transmission lines, must be developed. In that connection, the attainment of the interconnection targets defined in the legislation must be a priority, according to the ITRE Committee. Pursuant to the Energy Union Governance Regulation (EU) 2018/1999, the EU 2030 electricity interconnection target is of at least 15 % by 2030 (the electricity interconnection target for 2020 was 10 %).[44] In its resolution, the IRE Committee calls for the Commission to put forward a proposal that can 'speed up the deployment of the interconnection target'.[45]

Regional cooperation around offshore wind is happening in several sea basins in Europe. Among the most advanced initiatives can be mentioned the North Seas Energy Cooperation (NSEC),[46] that has a broad scope and includes offshore grid. Likewise, the Baltic Energy Market Interconnection Plan (BEMIP)[47] and the Central and South Eastern European Energy Connectivity (CESED) are important for developing regional offshore wind and grid initiatives. As a matter of example, the 2021 BEMIP Offshore Wind Work-programme covers the following action points: coordinated offshore grid;

[41] ORE Strategy, pp.11-12.
[42] European Parliament, A European strategy for offshore renewable energy, resolution of 16 February 2022, P9_TA(2022)0032, paras.D, 16.
[43] Ibid, paras. 11, 15.
[44] Energy Union Governance Regulation (EU) 2018/1999, Art. 2(11), Art. 4(d)(1).
[45] European Parliament, A European strategy for offshore renewable energy, resolution of 16 February 2022, P9_TA(2022)0032, para. 11.
[46] https://energy.ec.europa.eu/topics/infrastructure/high-level-groups/north-seas-energy-cooperation_en
[47] Examples of initiatives on offshore cross-border renewable energy and grid development under BEMIP: https://balticwind.eu/bemip-milestones-for-the-baltic-sea-offshore-development-countries-of-the-region-are-to-agree-capacity-goals-by-january-2023/

Maritime Spatial Planning focusing on offshore wind development; cooperation on enabling appropriate financing; acceleration of specific regional offshore projects and permitting.[48]
A series of political declarations has reiterated the desire of Member States, as well as associated countries (Norway, UK) to develop common initiatives for the offshore wind and possibly other renewable energy sources, in a cross-boundary manner within sea-basins.

On 30 August 2022, the Heads of Governments[49] and Energy Ministers[50] of the eight countries around the Baltic Sea signed a Joint Declaration of Intent to increase installed capacity in the Baltic see to at least 19.6 GW by 2030, and to consider a 2040 target at a later stage with the potential of reaching up to 93 GW. They also recognised the need to speed up permitting by a simplification of the permitting rules and procedures. They agreed to explore joint cross-border renewable energy projects and identify infrastructure needs to enable the integration of renewable energy.

In the Esbjerg Declaration of 18 May 2022, the signatory countries commit to jointly develop The North Sea as a Green Power Plant of Europe, an offshore renewable energy system connecting Belgium, Denmark, Germany and the Netherlands and possibly other North Sea partners, including the members of the NSEC.[51] The vision will consist of multiple connected offshore energy projects and hubs, offshore wind production at massive scale as well as electricity and green hydrogen interconnectors. The signatories set ambitious combined targets for offshore wind of at least 65 GW by 2030, and more than the signatories total capacity of offshore wind to at least 150 GW by 2050, delivering more than half of the capacity needed to reach EU climate neutrality according to the European Commission's ORE Strategy.

In the Ostend Declaration of 24 April 2024, energy ministries around the North Seas (Belgium, Denmark, Germany and the Netherlands joined by France, Ireland, Luxembourg, Norway and the United Kingdom) reiterated their common goal of developing infrastructure, production of offshore renewables and market design for the North Seas, setting a target for offshore wind of about 120 GW by 2030 in the North Seas and 300 GW by 2050. They expressed their support to on-going work to develop a high-level strategic integrated offshore network development plan for the North Seas, including by enhanced cross-border coordination of grid and maritime spatial planning.
The signatory countries commit to continue planning for 'multiple energy hubs and islands' as well as 'hybrid cooperation', 'multi-purpose projects' and 'increased connectivity by carrying out, where appropriate, a screening of the potential for offshore wind, and renewable hydrogen production,' in the North Seas.[52]

[48] BEMIP Offshore Wind Work Programme 2021, final_bemip_offshore.pdf (europa.eu)
[49] The Marienborg Declaration, 30 August 2022 The Marienborg Declaration - Regeringen.dk
[50] The Declartaion of Energy Ministers, 30 August 2022 Declaration of Energy Ministers_310822.pdf (kefm.dk)
[51] https://www.stm.dk/media/11345/esbjerg-declaration_170522_v3.pdf
[52] Ostend Declaration of energy ministries on the North Seas as a green power plant of Europe delivering cross-border projects and anchoring the renewable offshore industry in Europe, 24 April 2023

The adoption of this series of cooperation declarations by sea basin forms part of the implementation of the TEN-E Regulation[53] that requires Member States to conclude a non-binding agreement to cooperation on goals for offshore renewable generation to be developed within each sea basin by 2050, with intermediate steps in 2030 and 2040.[54]

One can observe a similar tendency to sign joint declarations and MoUs between TSOs. For example, in May 2023, the German TSO, 50Hertz, and Estonia's TSO, Elering, have signed a Letter of Intent (LoI) to jointly develop a 750 km, hybrid submarine interconnection project. The Baltic Wind Connector (2 GW) will connect Estonia's mainland coast to the Mecklenburg-Western Pomerania coast (north-eastern Germany) and will transport electricity generated from wind parks off Estonian Baltic Sea coast (hybrid connection).[55] Similarly, in December 2020, TSOs of the Baltic Sea Region signed the 'Baltic Offshore Grid Initiative', committing to develop common planning principles for Baltic Sea offshore energy network, and enable the consideration of the Baltic Sea offshore grid in the ENTSO-E Ten-Year Network Development Plan.[56]

To materialise, political declarations and Memoranda of Understanding must be accompanied by supportive legal frameworks and industrial initiatives. This is also true for offshore wind developments in the different European sea basins, in particular when not all neighbouring states are EU Member States (such as the UK and Norway in the North Sea).

2.2 Offshore grid planning requirements

To be both cost-efficient and sustainable, the increased targets for offshore wind developments at national and sea basin levels must be accompanied by a coordinated approach for grid planning. At national level, offshore grid planning needs to be coordinated with onshore grid planning. This applies to the first phase of development based on radial connections, but also to hybrids, offshore meshed grids or hubs. Connecting offshore assets, of any type, will require grid reinforcement onshore. At sea basin level, where hybrids and energy hubs will be developed, cross-border grid planning coordination will be necessary.

The call in favour of closer coordination of offshore grid planning between Member States of the same sea basin is common to all the visions described above. It builds on the grid planning requirements already defined in the EU legislation.

At EU level, the European TSOs for Electricity (ENTSO-E) are required to elaborate a ten-year network development plan (TYNDP), which is a pan-European electricity infrastructure development plan of

[53] Regulation (EU) 2022/869 of the European Parliament and the Council of 30 May 2022 on guidelines for trans-European energy infrastructure (TEN-E Regulation).
[54] TEN-E Regulation, Art. 14.1.
[55] With this hybrid interconnector project, wind parks will feed their power into a transmission system that can also be used for European electricity trading, fulfilling a dual function. This will require the construction of converter plants off Estonia, where the electricity can be accumulated, converted to direct current, and then transported to Germany.
[56] https://elering.ee/en/tsos-agreed-strengthen-cooperation-future-offshore-grid-baltic-sea

non-legally binding nature.[57] The TYNDP is based on scenarios (or visions) for the development of the European electricity network towards 2030-2040. Network development plans, including the TYNDP, are the basis for investments by grid operators.

A more integrated approach to grid planning is supported by other regional fora and grid operators. Several EU-funded research projects have investigated manners to promote it.[58]

Regional grid planning cooperation between Member States is already well established. In June 2016, the Political Declaration on energy cooperation between the North Seas Countries (North Seas Energy Cooperation, NSEC) was signed.[59] The Declaration follows up previous initiatives such as the Memorandum of Understanding of 3 December 2010 on the North Seas Countries' Offshore Grid Initiative (NSCOGI), which resulted in the development of concepts around a possible offshore electricity grid in the North Sea. The June 2016 Declaration already targeted offshore wind power as a potential to be exploited jointly through regional cooperation.[60]

In December 2021, a new political declaration was signed by NSEC countries, focusing primarily on offshore wind.[61] One of the objectives endorsed is to 'cooperate on maritime spatial plans that include offshore wind energy deployment and grid development' and to work towards 'a more coordinated offshore grid planning of the North Sea countries' in line with maritime spatial planning. Support Group 2 of the NSEC will develop concepts for a more coordinated offshore grid planning.[62]

Regional grid planning initiatives between TSOs have also developed, notably to support the development of offshore grids with offshore wind generation. For example, the Nordic TSOs stress in the Nordic Grid Development Perspective 2021 (NGDP2021) that offshore wind and the development of new hybrid offshore grids will require new methods and cooperation, including for planning.[63] Currently, Nordic countries apply different models with differing roles and responsibilities for TSOs and developers.

The choice of regime will impact the future development of meshed and integrated offshore grids as the connection regime, including associated costs, will impact the placement of future wind projects and the potential development of cross-border projects. National regulations have a direct impact on cost for offshore wind power.

---

[57] Electricity Directive, Art. 51.1. Electricity Regulation, Art. 30.1(b).
[58] E.g., OffshoreGrid, NorthSeaGrid, PROMOTioN, and several studies by Roland Berger studies and PWC/Tractebel.
[59] North Seas Energy Cooperation, Political Declaration on energy cooperation between the North Seas Countries, 2016, https://energy.ec.europa.eu/system/files/2016-06/Political%2520Declaration%2520on%2520Energy%2520Cooperation%2520between%2520the%2520North%2520Seas%2520Countries%2520FINAL_0.pdf
[60] It echoes the 2016 Manifesto 'Northern Seas as the Power House of North-Western Europe' signed by twenty Members of the European Parliament from countries neighboring the North Sea, and which called similarly for increased regional cooperation.
[61] North Seas Energy Cooperation, Political Declaration on energy cooperation between the North Seas Countries and the European Commission on behalf of the Union, 2 December 2021. https://energy.ec.europa.eu/system/files/2021-12/20211124-nsec_political_declaration.pdf
[62] Ibid, Annex 1 – Work programme.
[63] Energinet, Fingrid, Statnett, Svenska kraftnät 2021, Nordic Grid Development Perspective (NGDP2021), 4.3.2. https://www.fingrid.fi/globalassets/dokumentit/fi/tiedotteet/ajankohtaista/ngdp_2021_final_report_fixed3.pdf

According to the Nordic TSOs, the fact that differing national approaches are applied 'may lead to a skewed distribution of offshore wind power in a sea basin'. The risk is that 'offshore wind gets built not where it would be most cost-efficient on a Nordic level but where it is nationally subsidised most'.[64]

Thus, the Nordic TSOs take the view that the integration of offshore wind to the Nordic power system will 'challenge the current grid planning practices', and that a 'holistic and coordinated development of both on- and offshore grids' is essential to achieve a climate-neutral Nordic electricity system.

While planning radial grid connections to shore can be pursued at national level, deploying hybrid solutions with connections to several countries questions the validity of the current principles for grid planning, including dimensioning of the offshore grid, fault withstand, system operation and interoperability.[65] This calls for anticipation and regional coordination. As an example, the TSOs of the Baltic Sea Region established in 2020 the Baltic Sea Offshore Grid Initiative.[66] One of the intended purposes of the cooperation is to develop common planning principles for Baltic Sea offshore energy network.

In the context of its ORE Strategy and based on high offshore wind ambitions, the European Commission has announced a 'new approach to infrastructure planning', insisting on the need for a 'more rational grid planning' in terms of hybrid projects and 'integrated regional grid planning' at sea basin level.[67] As a first step, the revised TEN-E Regulation foresees reinforced cooperation around grid planning within the listed priority offshore grid corridors.[68]

Concretely, the revised TEN-E Regulation creates a new framework for the adoption of **Offshore Network Development Plans (ONDPs)**. These plans are closely linked to the adoption of the non-binding agreements between Member States - in the view to cooperate on goals for offshore renewable energy generation within each sea basin - and to the TYNDP.

Pursuant to Articles 14.2 of the TEN-E Regulation, ENTSO-E will have to develop and publish, for the first time by 24 January 2024, a separate document, part of the Union-wide TYNDP, called 'high-level strategic integrated offshore network plan' for each sea basin, in line with the priority grid corridors defined in Annex I to the TEN-E Regulation. ENTSO-E call these plans the **sea-basin (SB) related offshore network development plans (SB-ONDPs)**. The SB-ONDPs must be based on the goals developed by the Member States, as included in the joint non-binding agreements that the Member States must conclude by 24 January 2024, as referred to above. In terms of content, the SB-ONDPs

[64] Ibid.
[65] ENTSO-E website dedicated to offshore development and ENSTO-E position papers: <ENTSO-E's views on offshore development (entsoe.eu)>.
[66] Fingrid, 'TSOs agreed to strengthen cooperation for the future of offshore grid in the Baltic Sea', press release, 17 December 2020.
[67] European Commission, An EU Strategy to harness the potential of offshore renewable energy for a climate neutral future, COM(2020)741 final, 19.11.2020, 12-13.
[68] TEN-E Regulation, Art. 14 and Annex I.2 (Priority Offshore Grid Corridors).

must provide 'a high-level outlook on offshore generation capacities potential and resulting offshore grid needs, including the potential needs for interconnectors, hybrid projects, radial connections, reinforcements, and hydrogen infrastructure'.[69] The SB-ONDPs must also be consistent with the regional investment plans published in accordance with Article 34.1 of the Electricity Regulation.[70] ENTSO-E and the European Commission have developed a guidance document for the elaboration of the SB-ONDPs (adopted in September 2022).[71]

As a second step, this grid planning process will be completed by the elaboration (June 2024) and application (June 2025) of a specific cost-benefit and cost-sharing model for the deployment of the sea-basin integrated offshore network development plans.[72]

Grid planning processes onshore and offshore cannot be disconnected, for reasons linked to adequacy. Therefore, the integration of SB-ONDPs and high-level strategic offshore NDPs with the existing TYNDP, is to be pursued. Similarly, there will also be a growing need for an integrated planning across electricity and gas systems. The latest TYNDP already integrated an energy system perspective, but system integration offshore should also be taken into account.

2.3 Better integration of the planning processes to foster synergies across offshore activities

In the ORE Strategy, the European Commission is proposing to improve integration of the existing planning processes across the offshore sectors (energy, climate, maritime areas management, transport). The EC aims to **encourage cross-border cooperation between Member States** on long-term planning and deployment of offshore renewable energy by integrating offshore renewable energy development objectives in the National Maritime Spatial Plans (submitted by coastal states to the Commission). Beyond grid planning, the European Commission aims to reach better alignment, if not integration, between the existing planning processes (e.g., NECPs, national maritime plans).

The Maritime Spatial Planning Directive requires all coastal Member States to submit national maritime spatial plans to the Commission by 31 March 2021. The EC published a report on the implementation of the MSP Directive in May 2022, as it is requested to.[73] In the report, the EC concludes that the implementation of maritime spatial planning is a process that will stay and reinforce. It even foresees that the role of MSP for the sustainable development of the seas will take 'a step change', and will 'likely accelerated by the implementation of the European Green Deal and related legislation and strategies.'[74]

[69] TEN-E Regulation, Art. 14.2.
[70] TEN-E Regulation, Art. 14.3.
[71] Offshore Network Development Plans 2024 – Guidance Document, 6 September 2022.
[72] TEN-E Regulation, Art. 15.1 and 15.2.
[73] Report from the Commission to the European Parliament and the Council outlining the progress made in implementing Directive 2014/89/EU establishing a framework for maritime spatial planning, COM(2022)185 final, 3.5.2022.
[74] Ibid, section 5.1.

A first opportunity to reinforce the integration of planning processes is to integrate offshore renewable energy development objectives when developing the national maritime spatial plans. Consistency with the NECPs should also be checked, both at national and EC level, when reviewing the plans.

In its 2022 assessment of the national maritime spatial plans, the EC notes a series of positive outcomes. Notably:

- Several Member States have defined areas for future deployment of offshore wind parks, identifying potential for multi-use of the maritime space to support various objectives, such as low-carbon food production via aquaculture and fisheries;
- North Sea and Baltic Sea countries are the most experienced in MSP and in cooperating at sea basin level. Coastal Member States set up the North Seas Energy Cooperation to enable political and technical cooperation, including on MSP. In the Atlantic and the Mediterranean Sea, several national plans include zoning for possible deployment of offshore renewables.[75]

In terms of regional cooperation, both the Maritime Spatial Planning Directive and the Marine Strategy Framework Directive require Member States to cooperate across borders, at sea basin level. Joint maritime spatial planning would maximise benefits and promote co-existence between activities. At a minimum, this argues in favour of an alignment of the maritime spatial plans on the one hand and the national energy and climate plans (NECPs) on the other.

A similar integration of planning processes could also include transport planning, in line with the Commission's sustainable and smart mobility strategy, and the foreseen increased use of maritime transport (including short sea shipping).

The EC has been supporting actively national authorities in mapping and addressing conflicting spatial demands in the MSPs through guidance documents[76] and online platforms for exchange of good practices.[77] In these soft law documents, offshore wind farming and cables now appear among the relevant sectors, mostly from the respective of the offshore wind farms, less than operations connected to wind farms (installation, supervision, grid connection, etc.), which will increase over time.

In its 2023 special report on offshore renewable energy in the EU, the European Court of Auditors (ECA) has expressed criticisms as to the outcome of current maritime spatial planning processes for the purpose of integrating offshore wind energy. ECA praises efforts made by Member States sharing the same waters to consult each other when establishing their MSPs.

However, it concludes that the Member States have rarely used this opportunity to plan common offshore renewable energy projects, thus 'missing opportunities to use scarce sea space more efficiently'.[78]

---

[75] Ibid.
[76] E.g., European Commission, Addressing conflicting spatial demands in MSP – Considerations for MSP planners, Final Technical Study, 2019.
[77] See for instance the MSP platform: https://maritime-spatial-planning.ec.europa.eu/sectors
[78] European Court of Auditors, Offshore renewable energy in the EU – Ambitious plans for growth but sustainability remains a challenge, Special report 22/2023, p.5 and p.27.

3 Permitting

The question raised below is to know how to simplify and shorten permitting procedures for offshore wind generation and related infrastructures at Member State level, as a necessary step towards reaching the set production targets. The shortening of permitting procedures for cross-border infrastructure projects is already addressed in the TEN-E Regulation.

3.1 The public international law framework

Legislative frameworks that apply to offshore wind farms, including permitting, are dependent on the coastal state in whose waters they are installed. All states apply national regulation to activities on their exclusive economic zone (EEZ).

The extent to which coastal States have legislative powers offshore, is governed by the 1982 United Nations Convention on the Law of the Sea (UNCLOS), which distinguishes between several maritime zones. For offshore wind energy, the most important zones are the territorial sea and the EEZ. Within the territorial sea, the coastal States enjoy full sovereignty and have, thus, the same legislative powers as they have on land.

Next to that, coastal States may declare an EEZ, which is an area lying beyond and adjacent to the territorial sea and extending to a maximum of 200 nautical miles.[79] The coastal State does not have full sovereignty over its EEZ. Instead, it has 'sovereign rights' regarding its natural resources and with regard to 'other activities for the economic exploitation and exploration of the zone, such as the production of energy from the water, currents and winds'.[80]

Consequently, the coastal States may exercise a functional jurisdiction in the EEZ, i.e., a jurisdiction limited to specific activities. This functional jurisdiction entitles them to regulate the establishment and use of offshore wind turbines and the cables connected to them.[81] The activities must be undertaken with 'due regard to the rights and duties of other States' and with respect to other provisions of the UNCLOS.[82]UNCLOS entered into force in 1994. All EU Member States have signed the Convention and the EU itself signed the Convention following the adoption of Council Decision of 23 March 1998.[83]

---

[79] UNCLOS, Art. 55.

[80] UNCLOS, Art. 56(1)(a).

[81] With regard to the construction and operation of wind farms, Art. 56(1)(b)(i) UNCLOS in conjunction with art. 60 UNCLOS constitute a lex specialis compared to art. 56(1)(a) UNCLOS.

[82] UNCLOS, 56(2).

[83] Council Decision of 23 March 1998 concerning the conclusion by the European Community of the United Nations Convention of 10 December 1982 on the Law of the Sea and the Agreement of 28 July 1994 relating to the implementation of Part XI thereof, OJ L 179, 23.6.1998, p. 1–2.

3.2 The choice of national regulatory approach to offshore wind projects

Establishing an EEZ gives coastal states the exclusive right to generate electricity from offshore wind in- and outside the territorial sea. As laws need to be explicitly declared applicable to the EEZ, coastal States could either extend existing national laws to the EEZ or adopt a separate legal regime for offshore wind and the sub-sea cables, which bring electricity to the shore.[84] This means that offshore wind regulation falls under two main categories: extension of onshore legislation to offshore installations, structures and activities; or dedicated offshore legislation for wind energy specifically or renewable energy more generally (dedicated offshore wind legislation).
In addition, any offshore grid development with a connection to shore, directly or indirectly, will require a minimum of coordination with onshore grid reinforcement, including the related permitting for the onshore grid connection.

Some States like Denmark and Great Britain have decided to apply the relevant national electricity legislation to the EEZ and deploy a system of competitive licensing or tendering regime for the development of offshore wind energy. By contrast, historically, the Netherlands and Germany only classified offshore wind farms as installations requiring a ‘construction’ permit, which was granted on a ‘first come, first served’ basis.[85] However, with the increasing scale of offshore wind development, both States created a distinct legal regime governing offshore wind farms. These regimes are all based on a more centralised, government-led approach to the development of offshore wind farms.

3.3 Relevant EU legislation for permitting offshore wind projects and fast-tracking

In its Renewables 2022 report, the International Energy Agency (IEA), questions whether the European Union is on track to meet its REPowerEU goals. As concerns offshore wind, the EIA concludes that ‘long lead times and grid connection difficulties continue to be the main impediments to achieving faster growth by 2027’.

Despite a series of announcements by national governments to launch auction plans, ‘the pace of implementation hinges upon new site selection and increasing transmission capacity’. The IEA continues by targeting ‘excessive prerequisites for grid connection and for expanding transmission networks lengthen project’ for slowing processes and thus limiting the pace of deployment in the accelerated case.[86]

[84] Hannah K. Müller and Martha M. Roggenkamp, ‘Regulating Offshore Energy Sources in the North Sea: Reinventing the Wheel or a Need for More Coordination?’ (2014) 29 The International Journal of Marine and Coastal Law 716-737.
[85] The new Dutch law on Offshore Wind Energy (https://wetten.overheid.nl/jci1.3:c:BWBR0036752&z=2021-11-11&g=2021-11-11) allows for a tender, a comparative assessment, a comparative assessment with a financial component and a subsidy procedure, to be determined by the minister. The last procedure used a comparative test with a financial component. (See for instance Hollandse Kust (west) Wind Farm Zone | RVO.nl)
[86] International Energy Agency (IEA), Renewables 2022 – Analysis and forecast to 2027, revised version January 2023, https://www.iea.org/reports/renewables-2022

The permitting regime for development of offshore wind energy needs to be considered as part of the Renewable Energy Directive (EU) 2018/2001 (REDII), which sets binding EU targets, defines common rules for the promotion of renewable energy sources, as well as requirements in terms of administrative procedures. The organisation and duration of permit-granting procedures is covered by Article 16 of the Directive, that requests Member States to follow a 'one-stop shop approach for permit application and grating process. Pursuant to Article 16(1), the application shall not be required to contact more than one contact point for the entire process.

The permit-granting process shall cover the relevant administrative permits to build, repower and operate plants for the production of energy from renewable sources and assets necessary for their connection to the grid. The maximum deadline for the total permit-granting process shall not exceed two years for the power plans.

In practice, and as the date of this report, not all Member States have implemented this provisions, and permitting procedures vary widely among Member States on this point. In its 2023 special report on offshore wind, the European Court of Auditors studies four countries (France, Germany, the Netherlands and Spain).

It found out that Germany and the Netherlands have implemented a streamlined procedure based on the 'one-stop shop approach', where the Netherlands has one of the shortest permitting procedure, with a time of 4,5 years between site tender and commissioning. To compare, France has one of the longest procedure time that can extend up to 11 years. France has not either established a 'one-stop-shop- approach.[87]

In addition, other pieces of legislation will regulate the permitting procedure, notably for the completion of impact assessments (strategic impact assessment and environmental impact assessment, under the SEA and EIA Directives), for the integration to the energy system and the energy market (Electricity Directive and Electricity Regulation, and related networks codes and guidelines), and for the fast-tracking of permitting for cross-border grid infrastructures (TEN-E Regulation).

In relation to cross-border infrastructures, The TEN-E Regulation already opens for a stricter timeline for the permitting approval for projects on the Project of Common Interest (PCI) and Project of Mutual Interest (PMI) lists. The projects falling on the Union list are granted priority status, not only for permit granting and environment assessment procedures, but also for all dispute resolution procedures, litigation, appeals and juridical remedies.[88]
The permit granting process consist of two procedures that are subject to time limits: the pre-application procedure (shall not exceed 24 months) and the statutory permitting procedure (shall not

[87] European Court of Auditors, Offshore renewable energy in the EU – Ambitious plans for growth but sustainability remains a challenge, Special report 22/2023, pp.29-30
[88] Regulation (EU) 2022/869 of 30 May 2022 on guidelines for trans-European energy infrastructure, Art. 7.

exceed 18 months).[89] The national competent authority must ensure that the combined duration of the two procedures does not exceed 42 months.[90]

As part of the REpowerEU Plan, the European Commission adopted a Recommendation on 18 May 2022 on speeding-up permitting-granting procedures for renewable energy projects, which was accompanied by a Guidance document.[91] The Guidance presents good practices that exist in the Member States aimed at reducing the administrative burden and increasing planning certainty for renewable energy projects. The Commission recommendation was adopted alongside a proposal for a targeted amendment of REDII on permitting (see below).

The Council Regulation of 19 December 2022 offers another opportunity to fast-track renewable energy projects. In the context of temporary measures, the Regulation defines short deadlines for the approval of permits for renewable energy projects. Although the Regulation focuses on specific renewable energy technologies and types of projects which are capable of delivering a short-term acceleration, offshore wind projects might be eligible. The Regulation applies to all permit-granting processes that have a starting date within the period of application of the Regulation.[92]
Member States also have the possibility of applying the Regulation to ongoing permit granting processes that have not resulted in a final decision before 30 December 2022, as long as this will in concrete lead to shorten the permit granting process and that pre-existing third party legal rights are preserved.[93]

The Regulation provides the eligible project a status of 'overriding public interest' and applies to the planning, construction and operation of the plants and installations, but as well the grid connection.[94]
Building on the temporary measures of the Council Regulation, the European Commission put forward a proposal for targeted amendment of REDII on permitting notably on 14 July 2021.[95]

Further streamlining of the permitting deadlines is proposed, notably in renewables acceleration areas, although the particularities of offshore renewable energy projects should be taken into account when setting the deadlines. The streamlining of certain environmental-related aspects of the permit-granting procedures for renewable energy projects is also proposed. Finally, it is proposed to

[89] Ibid, Art. 10.1.
[90] Ibid, Art. 10.2.
[91] Commission Recommendation of 18.5.2022 on speeding up permit-granting procedures for renewable energy projects and facilitating Power Purchase Agreements, C/2022/3219 final. Accompanied by European Commission, Staff Working Document – Guidance to Member States on good practices to speed up permit-granting procedures for renewable energy projects and facilitating Power Purchase Agreements – Accompanying the Commission Recommendation on Speeding up permit-granting procedures for renewable energy projects and facilitating Power Purchase Agreements, SWD/2022/0149 final.
[92] Council Regulation (EU) 2022/2577 of 22 December 2022 laying down a framework to accelerate the deployment of renewable energy, Art. 1.
[93] Ibid.
[94] Council Regulation (EU) 2022/2577, Art. 3.
[95] European Commission, proposal for a directive of the European Parliament and of the Council amending Directive (EU) 2018/2001 of the European Parliament and of the Council, Regulation (EU) 2018/1999 of the European Parliament and of the Council and Directive 98/70/EC of the European Parliament and of the Council as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652, COM(2021) 557 final, 14.07.2021.

establishing a single contact point to facilitate permit-granting for joint offshore renewable energy projects between Member States (draft revised Art. 9(7)(a), REDII).[96]

The proposal for a Net Zero Industry Act contains provisions for shorter permit-granting process (draft Art. 6) and priority status for net-zero strategic projects (draft Art. 12-13).[97] Onshore and offshore renewable technologies are on the list of strategic net-zero technologies in Annex to the proposal.

This can be seen as a consolidation of the temporary rules (Council Regulation) on speeding up permitting for renewable energy generation and connection in general, including for offshore energy projects. This echoes the Commission's proposal (also repeated by the European Parliament in its Resolution of 16 February 2022) of having 'pre-approved licensing for offshore development sites', resembling the 'go-to-areas' for onshore renewable energy.

3.4 Separated or merged permitting procedures for production and connection

The first question is whether processes for offshore wind farm permitting and cable permitting should be decoupled or merged. The answer to this question has so far not been consensual,[98] and national practices differ. However, the idea of proposing a coupled process between wind farm and cable permits is getting increasingly popular, both in practice and as a policy recommendation.

Some countries, like the Netherlands, requires that the permitting for the connection and the offshore wind farm should be ready at the same time. In its resolution of 16 February 2022, the European Parliament notes the potential advantages of combining offshore production facilities and transmission assets in the same tender process. It therefore invites the Commission and the Member State to analyse the potential and possible challenges of a "full-scope tendering approach". The European Parliament also asks them to assess different set-ups to ensure sufficient incentives and optimal planning of offshore and onshore transmission grid.[99]

A second, related question is to address merged permitting approach under market design rules. Full scope projects refer to offshore wind projects that include production, grid connection and offshore transformer station 'full scope tendering'. This approach is currently enabled in the UK and in Denmark. In the Netherlands, the transmission investment is shared between different 'plots for windfarms'. Allowing for full scope projects will enable the development of merchant projects, including the grid connection part. This will offer an alternative to the regulated model with the involvement of grid operator.

---

[96] European Parliament, Provisional Agreement resulting from interinstitutional negotiations, proposal for revision of the Renewable Energy Directive, 16.06.2023.

[97] Proposal for a regulation of the European Parliament and of the Council on establishing a framework of measures for strengthening Europe's net-zero technology products manufacturing ecosystem (Net Zero Industry Act), COM(2023) 161 final, 16.3.2023.

[98] See e.g. the PROMOTioN project, D7.9 Regulatory and Financing principles for a Meshed HVDC Offshore Grid, 2019, p.39. Recommendation 10: 'National planning and permitting procedures should separate the process for the wind farm and cables but coordinate to align the projected commissioning dates'.

[99] European Parliament resolution of 16 February 2022 on a European strategy for offshore renewable energy, P9_TA(2022)0032, para.19.

Compliance with unbundling rules must however be assessed when the cable connection is used by more than one party, such as under hybrid projects or hub configuration (see Section 4 below). Merging procedures for production and grid can also raise issues under EU state aid rules.

4 Cross-Border Projects

4.1 Towards hybrid projects and meshed grids

To achieve the objective of 300 GW of offshore wind and 40 GW of ocean energy across all the Union's sea basins by 2050 (ORE Strategy), the Commission deems it necessary for Member States to work together across borders at sea-basin level. Furthermore, the Commission, as other Member States and stakeholders, believe that Member States should consider a more long-term vision combining offshore renewable energy generation with transmission lines interconnecting several Member States, also called 'hybrid projects' or, at a later stage, a more meshed grid. By allowing electricity flows for different use cases, this will ultimately maximise socio-economic welfare, optimise infrastructure expenditure and enable a more sustainable usage of the sea.[100] This vision is also reflected in the proposal for revision of the RED II Directive.[101]

To complete the picture of possible future offshore grid, five main configurations have been previously identified:

(1) Point-to-point interconnector,
(2) radial offshore park-to-shore;
(3) radial hub-to-shore;
(4) hybrid project; and
(5) multi-terminal offshore hubs.[102]

It is also notable that offshore wind projects can be connected as an electricity supply source to offshore demand installations, e.g., oil and gas installations on the UK or Norwegian continental shelf. These wind projects operate either in a completely isolated system, together with the relevant oil and gas platforms and/or have a connection to the mainland.

This list of different configurations for offshore assets and offshore grids, the urgency of the progress and uncertainty of future market structures, argues in favour of a progressive approach with gradual adjustment to the legislative framework and harmonisation when necessary.[103] This is also reflected in the statement of the European Commission's ORE Strategy, stating that '*hybrid projects will form an intermediate step between smaller-scale national projects and a fully meshed, offshore energy*

[100] Proposal for a Directive amending Directive (EU) 2018/2001 of the European Parliament and of the Council, Regulation (EU) 2018/1999 of the European Parliament and of the Council and Directive 98/70/EC of the European Parliament and of the Council as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652, COM(2021) 557 final, 14 July 2023

[101] Draft Recital 8 of the proposal for amendments of the REDII Directive reads as follows: 'Member States should increasingly consider the possibility of combining offshore renewable energy generation with transmission lines interconnecting several Member States, in the form of hybrid projects or, at a later stage, a more meshed grid. This would allow electricity to flow in different directions, thus maximising socioeconomic welfare, optimising infrastructure expenditure and enabling a more sustainable usage of the sea' COM(2021)557 final, 14.7.2021..

[102] NSCOGI, The North Seas Countries' Offshore Grid Initiative - Initial Findings, 2012, available at https://www.benelux.int/files/1414/0923/4478/North_Seas_Grid_Study.pdf. See as well the summary figure 2 in: ENTSO-E Position on Offshore Development – Market and Regulatory Issues, 15 October 2020, p.8.

[103] See Section 1 – Introduction.

system and grid'.[104] It follows that the interoperability of the different national offshore systems will need to be facilitated along the way,[105] notably through standardisation.[106]
The question treated in this section is to know how EU intervention can spur the development of large, cross-border projects and support the development of hybrid multi-purpose assets.

4.2 The Economics of hybrid multi-purpose assets

Most existing offshore network assets are either radial park-to-shore cables or interconnectors connecting two countries (see Figure 2). *Radial cables* fall under national legislation, which varies significantly. They can be owned by the wind park developer, the existing onshore TSO, or an offshore TSO (OFTO).[107] With joint ownership of wind park and the radial line, investment decisions and operational decisions can be coordinated. Great Britain started for instance with joint ownership, but then switched to an independent OFTO regime[108] for each wind development area.[109]

When only one wind park is connected to the radial cables, joint ownership does not distort competition, but once multiple parks are connected to the cable this likely goes against EU unbundling requirements.[110] These restrictions are reflected in the approach followed by ENTSO-E to exclude the offshore wind farm (i.e., generation asset) from the definition of offshore hybrid project.[111]

---

[104] ORE Strategy, p.12.
[105] Ibid.
[106] ENTSO-E Position on Offshore Development, Assessment of Roles and Responsibilities for Future Offshore Systems, Nov. 2022, p.31.
[107] As the term OFTO is often associated with a specific UK concept, we will use the term Offshore TSO for most of the text.
[108] Under the UK OFTO regime, OWF developers can select either OFTO-build or generator-build route. To date, all projects have gone through the generator-build route, through which the generator develops and builds their own transmission asset, which is then transferred by Ofgem to an OFTO through a competitive tender process. While this approach has contributed to de-risking OWF projects and cost reductions, it has also resulted in the multiplication of radial connections to shore.
[109] Green & Vasilakos, 2011.
[110] In (pre-Brexit) Great Britain, the regulator obliged wind farms to auction-off their transmission assets to an OFTO to satisfy EU unbundling requirements. (Green & Vasilakos, 2011)
[111] ENTSO-E Position on Offshore Development, Assessment of Roles and Responsibilities for Future Offshore Systems, November 2022, pp.6-7.

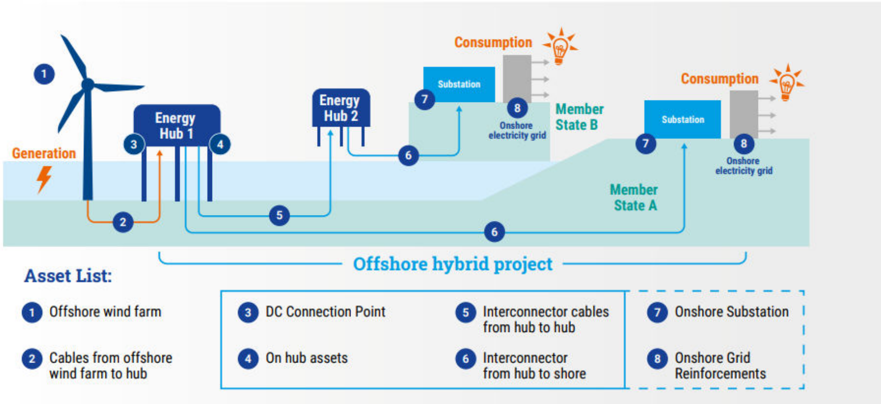

Figure 1: Offshore Hybrid Project – Distinction between transmission and generation assets (ENTSO-E, 2022)

Interconnectors are explicitly defined in EU legislation and, unless exempted, are subject to regulatory requirements in terms of ownership unbundling, regulated third party access, earmarking of congestion revenue, and availability for cross-border trade.[112]

Future wind parks will be located further away from shore and often in deeper sea waters. To connect them to the shore, *hybrid assets* are likely to be used, instead of radial lines (see Figure 2). These hybrid assets fulfil two roles: they connect windfarms to shore and they provide interconnection services. The Kriegers Flak, in the Baltic Sea, is the first European offshore wind location with a hybrid transmission asset.[113] Although hybrid assets are mentioned in EU policy documents (i.e., ORE Strategy), the Electricity Regulation (preamble) and TEN-E Regulation (preamble and Article 14), there is no specific definition or regulatory provision for hybrid assets in EU law yet, meaning that hybrids fall under the standard network regulation and the additional interconnection regulation, if not subject to yet another derogation.[114]

The legal literature highlights some of the problems of applying the interconnector regime for hybrid assets.[115] However, given the importance of hybrid assets, some stakeholders (like ENTSO-E) are in favour of using the existing legislation to move forward, adjust the definitions of the bidding zones by creating offshore bidding zones (OBZ), apply regulatory exemptions or derogations, and support available under TEN-E, instead of waiting for the adoption of the comprehensive regime of hybrids. A comprehensive regime remains desirable in the mid- to long-term, which might require an alternative

[112] See below Section 4.2.

[113] The Kriegers Flak area in the Baltic Sea consists of three parts dedicated to wind power development in Germany, Sweden, and Denmark. The German TSO 50Hertz and the Danish TSO Energinet collaborated in connecting the Danish wind park Kriegers Flak (604MW) with two German wind parks (Baltic I 48MW and Baltic II 288 MW) and so creating the first hybrid offshore transmission line (combines grid solution CGS) . Half of the costs for the interconnector have been paid by the EU. The Swedish Kriegers Flak windfarm of 640 MW will be commissioned in 2028, and a new cable connection to Sweden just received a permit. https://energinet.dk/om-nyheder/nyheder/2020/10/19/tyske-50hertz-og-danske-energinet-indviede-fyrtaarsprojekt-paa-kriegers-flak/ https://www.offshorewind.biz/2023/02/17/vattenfall-clears-final-permit-needed-to-build-swedish-kriegers-flak-offshore-wind-farm/

[114] See below Section 4.3.2.

[115] Nieuwenhout, C. T. (2022). Dividing the Sea into Small Bidding Zones? The Legal Challenges of Connecting Offshore Wind Farms to Multiple Countries. Journal of Energy and Natural Resources Law, 40(3), 315-335

framework to the interconnection regime, and guidelines on the configuration of bidding zones, joint planning and cost allocation.

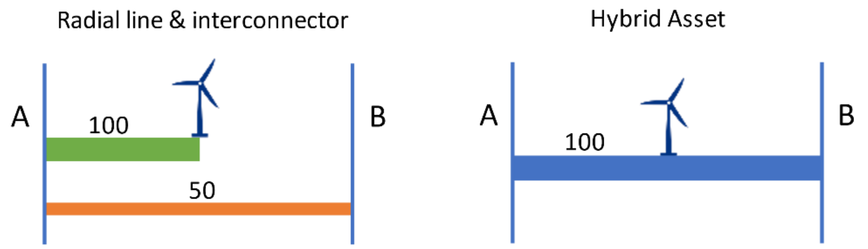

Figure 2: Replacing a radial line and an interconnector between country A and B with a hybrid asset with the same investment cost. The capacity of the cable is indicated next to the line (own work).

Green & Vasilakos discuss the economics of a hybrid network where one windfarm is connected to two countries, and compare it to a dedicated interconnector line between the two countries and a radial line connecting the windfarm to one of the countries, similar to Figure 2.[116] The total investment capacity (transmission capacity times distance) is the same in the left and right side of the figure. The windfarm is assumed to have a load factor of 40%. So, with a hybrid asset on the right, 60% of the transmission asset can be used to transport energy between the two regions. This transportation capacity is however only available when there is no wind output. On the left, the dedicated transmission line is always available but has a capacity of 50%. Hence the expected capacity is smaller with two dedicated assets.

With a hybrid project and an efficient market, the output of the windfarm will be transported to the price region with the highest price, which increases the social value of the wind output. So next to the higher (expected) transportation capacity, the output of the windfarm is used socially more efficiently.[117]

By analysing this simple example further, one can show (1) that the benefits of hybrid networks are larger for capacity which is further off-shore, (2) that the transportation benefits might be smallish with a single wind park (comparing 50 units of certain capacity and an uncertain 60 units), (3) that there might be additional allocative benefits of sending wind output to the highest price zone.

[116] Green & Vasilakos (2011).

[117] This does not mean that the windfarm receives the highest price when congestion on the cables is priced correctly. The part of transmission line that connects the windfarm to the high price zone will often become congested as it forms a bottleneck for both wind output and interconnection flows. The wind farm therefore receives the price of the lower priced export zone. As a result, the network operator collects additional congestion revenue on one part of the transmission lines which will be used to pay for network upgrades and which could lower the transmission tariffs for the network users.

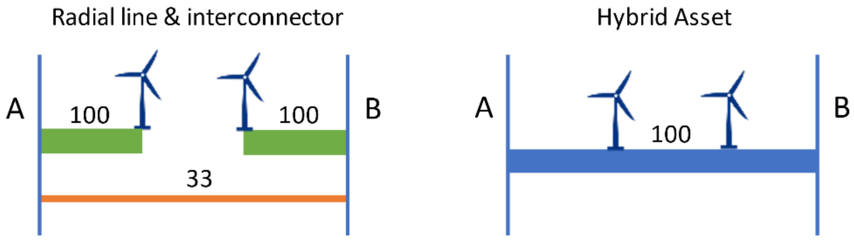

Figure 3: Replacing two radial lines and an interconnector with a single hybrid asset with the same investment cost.

Green and Vasilakos also indicate that interconnecting two separate windfarms that are located in two different territorial areas and each have their own radial network line, might be much more economical, as the additional cost for interconnecting the countries might be small (see Figure 3). Assume that the wind farms are located at one third and two thirds of the distance between the countries and the cost of a transmission lines is proportional to distance and capacity. For the cost of a certain transmission capacity of 33 (left side of figure) we can connect the two windfarms with a line of a capacity 100.
This hybrid asset will provide an expected interconnection capacity of 60; assuming that wind output is perfectly correlated in the two wind parks. Hence, the interconnection capacity almost doubled with the hybrid asset configuration. This second example shows that when there are multiple offshore windfarms, the value of a hybrid offshore grids becomes much more important.

This should not come as a surprise as it is well known that there are economies of scale in building a meshed network connecting several production and demand centres which have stochastic demand and production. A meshed network will also increase security of supply as the network can remain stable under contingencies (e.g., n-1 security constraints can be satisfied more easily).

In order to determine optimal transmission capacities and network topography, stochastic optimisation models with grid and generation expansion need to be used. The capacity of the transmission lines will depend on the correlation of wind output in the different production locations and onshore production locations. Simulation results show that an interconnected offshore network will have lower expected cost than one with radial lines and interconnectors. We highlight some of those studies below.

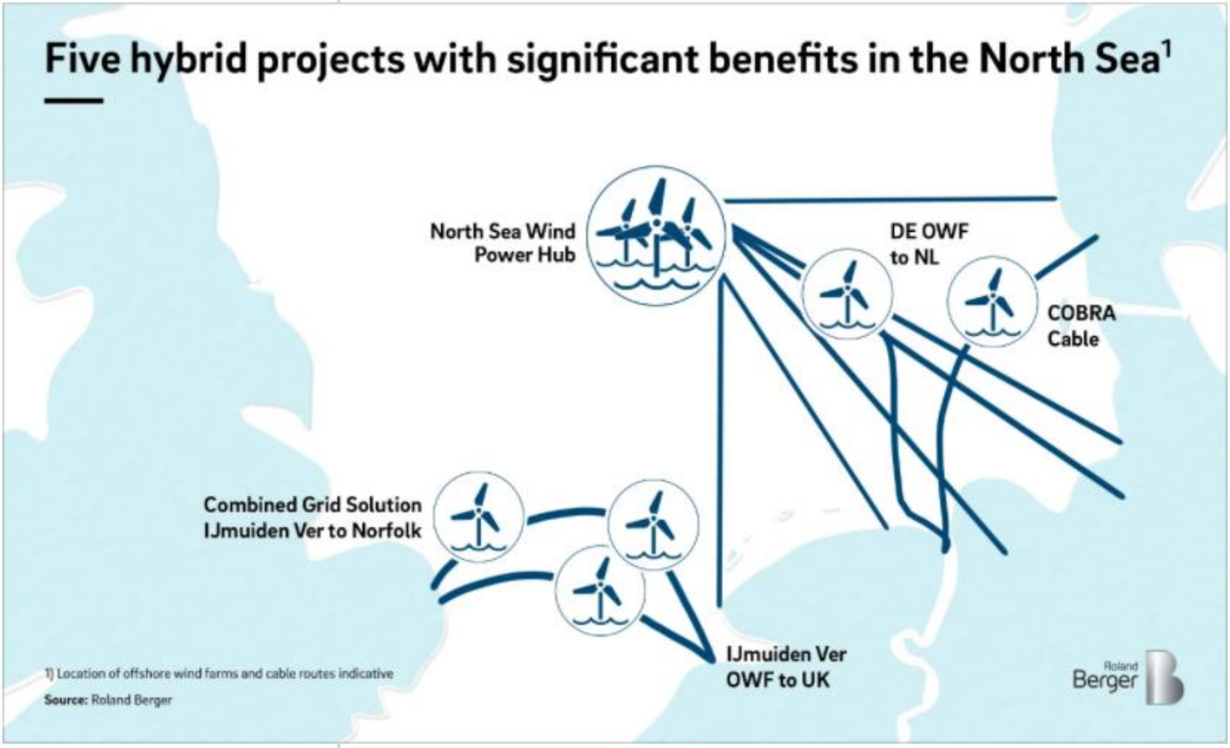

Figure 4: Examples of multi-purpose investment projects

Source: Roland Berger.

Several technological simulation models have studied the long-term infrastructure costs of offshore networks ranging from radial designs and hybrid networks, to the creation of offshore energy hubs in the form of an artificial island.

Earlier studies focus on energy hubs as an engineering solution where neighbouring windfarms connect to the same radial line. Such a "socket at sea" allows for cost savings in converter infrastructure.[118] In more recent studies, offshore energy hubs arise as part of a well-designed European-wide integrated infrastructure plan for generation, transport of power, storage and conversion to other energy carriers, such as hydrogen. Such hubs are well-connected off-shore network nodes where energy can be traded and hydrogen production can be located.

For instance, Durakovic et al. (2023) study the importance of offshore energy hubs which connect off-shore transmission lines and are potential hydrogen production locations.[119] They develop a capacity expansion model for the European power and hydrogen sector over the period 2020-2060, with a detailed description of offshore North Sea wind production locations. They show that an offshore energy hub enables more wind investments offshore. The 2060 investment will be 50GW higher than in the scenario without energy hub and includes now also floating wind. The energy hub also reduces the need for overall generation investment in Europe with almost 100GW. This leads to a reduction

[118] Jansen et al., 2022.
[119] Durakovic et al., 2023.

mainly in solar PV investments in the south. It requires also substantial investments in transmission capacity to limit wind production curtailment.

Figure 5 shows the simulated transmission capacities for 2050. The development of offshore wind and the energy hub will reduce interconnection capacity from Norway to the European continent, and will change trading patterns. More generally the study shows that large offshore infrastructure projects may have large impacts on the investment needs in onshore network and production locations by 2060, and that there are potentially large distributive aspects. By 2060, the offshore network can become the backbone of the energy system as shown in Figure 5, and investment in onshore and offshore will need to be centrally planned. With their cost parameters of they predict that most hydrogen production is produced onshore.[120]

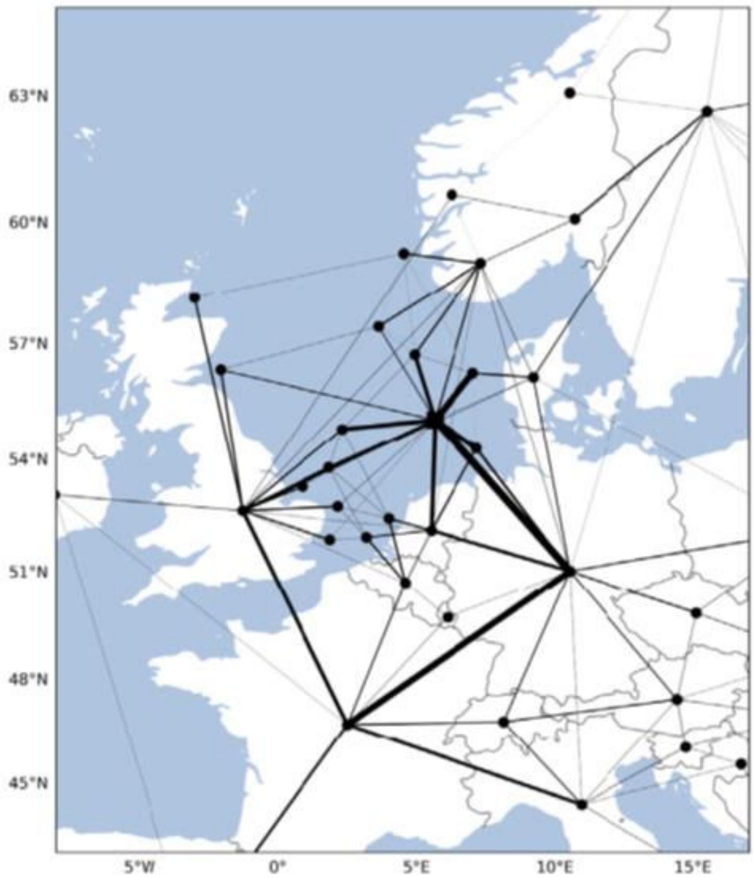

Figure 5: Transmission capacity in the North Sea region in 2050 with energy hub and a high hydrogen scenario Source: Durakovic et al., (2023).

[120] Note Sævareid et al (2023) use the same model to compare scenarios with radial networks and hybrid network assets without energy hub nor green hydrogen production, and find that prices in Norway are higher in the hybrid model as there is more interconnection capacity as a result of the hybrid assets. However, in this model direct connections are kept at the ENTSO-E development plans and not the long-term optimal investment paths, so those result might not be robust.

Those results are more-or-less in line with earlier studies. Gorenstein, Dedecca and Hakvoort review eighteen offshore networks models and conclude that although modelling assumptions and research questions vary widely, most models predict positive social benefits for more meshed network.[121] Benefits come in the form of more efficient dispatch, increases system flexibility and reliability, improved connection of wind power, more interconnection flows, reduced wind curtailment, and reduced network investments.[122] Note that the cost efficiency may not only include private costs, but also social costs with respect to spatial planning and the environmental impact. Although there are overall benefits, there are losers and winners and redistributing aspects matter.[123]

The limited role of offshore hydrogen depends on cost assumptions but is in line with earlier studies. For instance, Gea Bermúdez et al. (2021) find that it is generally cheaper to build onshore hydrogen production and storage than offshore.[124] Lüth et al. (2023), use an expansion planning model to determine offshore network size and the optimal location of electrolysers and show that some offshore hydrogen production might be built as it reduces the need for larger offshore network investments and reduces curtailments, although most hydrogen production takes place onshore.[125]

To sum up, the business model for large-scale offshore hydrogen production is limited and might depend on additional factors such as the conversion and reusing of existing natural gas pipelines and the creation of extra benefits for managing congestion and reliability in offshore grids. Moreover, the market arrangements influence the attractiveness of offshore conversion and storage projects: with offshore bidding zones, the incentive for offshore storage and conversion is larger than with larger (nationally based) bidding zones.

4.3 Regulation of interconnectors and hybrid projects

The transition from a single-purpose approach with radial connections to a dual-purpose approach with offshore hybrid projects requires legal clarity, not least in terms of planning, ownership, operatorship and revenue model. This raises the question of how to legally qualify hybrid projects compared to interconnectors, and the relationship between offshore hybrid project and generation assets, if the latter are to be excluded from the definition of hybrids.

4.3.1 Interconnector Regime

An interconnector is defined in the Electricity Regulation (Article 2) as ‘a transmission line which crosses or spans a border between Member States and which connects the national transmission systems of the Member States’.

[121] Gorenstein Dedecca & Hakvoort, (2016).
[122] The cost efficiency should not only include the private investment costs, but also the social cost
[123] Kristiansen et al., (2018) finds that for the North Sea an integrated energy hub compared to a radial network might lead to cost savings up to 52bn EUR. Egerer et al., (2013) nicely highlight the distributional effects of increased offshore transmission lines.
[124] Gea Bermúdez et al. (2021).
[125] Lüth et al. (2023).

Electricity interconnectors play a central role in the completion of the internal energy market, contributing to security of supply, cross-border trade, and the development of renewable energy generation. This is why the European legislation supports the development of interconnectors through a series of requirements such as faster permitting procedures, cross-border cost allocation (CBCA) methodologies,[126] maintenance or increase of interconnection capacities, harmonised principles on cross-border transmission charges, use of congestion rents or access to financing.[127] The 2014 European Council has also set interconnection targets, [128] later reflected in the Governance of the Energy Union Regulation (Article 4(d)(1)), of 10% electricity interconnection by 2020 and at least 15% by 2030.

Increasing the amount of interconnection capacity that is available to the market can be achieved not only by increasing the transmission capacity by introducing new transmission lines but also by improving market design by introducing for instance netting, flow-based market coupling, and intra-day cross-border trade and by increasing the available transmission capacity by not shifting internal congestion and relying more on ex-post counter-trading to manage congestion. The existing regulation prohibits the shifting of internal congestion to the border and requires that 70% of the transmission capacity is made available to the market.[129]

If counter trading becomes too costly, the 70%-rule provides the TSO with incentives to either manage national congestion by introducing extra price, or to build network investments that reduce cross-border congestion.

In case of network scarcity, TSOs collect congestion rents on the interconnectors. The TSOs cannot retain those congestion rents as profits, instead they should be used to increase or maintain cross-zonal capacity and guaranteeing the availability of the allocated capacity.[130] A secondary priority is to lower network tariffs. The goal is to prevent the TSO from benefiting from creating congestion on its network.[131]

4.3.2 Regulation of hybrid projects

Although policy documents such as the ORE Strategy refer increasingly to hybrid projects, there are few references to the latter ones in the current EU legislation. Hybrids are referred to in the Recitals

[126] Under TEN-E Regulation.
[127] Electricity Regulation, in particular Art. 1.
[128] European Council, Conclusions, 23-24 October 2014; and Communication from the Commission to the European Parliament and the Council, COM(2014) 330, 28.5.2014.
[129] Article 16 (8) in Regulation 2019/943, requires that 70% of the grid capacity is made available for trading. For an assessment of the 70% rule, see Christian Schneller, 'Cross-border electricity trade in Europe – Towards an 'electrical Schengen area'?, M. M. Roggenkamp and C. Banet (eds.), EELRXIV (Intersentia, 2021), Chapter VII, pp. 131-147
[130] See interpretation judgment in case C-454/18 – Baltic Cable v Energimarknadsinspektionen, on the principle of non-discrimination applied to the profit owned by a Swedish company owning and operating an electricity interconnectors.
[131] Art. 19.2-3, of Regulation 2019/943

of the Electricity Regulation, as '*offshore electricity infrastructure with dual functionality (so-called 'offshore hybrid assets') combining transport of offshore wind energy to shore and interconnectors*'.[132] There is no dedicated regime for hybrids in the current legislation, but some few provisions and requirements provide useful starting points:

- Recital 66 of Electricity Regulation 2019/943 supports the facilitation of hybrid projects. The Recital mentions that offshore hybrid assets 'should also be eligible for exemption such as under the rules applicable to new direct current interconnectors'.[133] Further, and 'when necessary, the regulatory framework should duly consider the specific situation of those assets to overcome barriers to the realisation of societally cost-efficient offshore hybrid assets.'
- The TEN-E Regulation include 'hybrid projects' in the list of subjects to measures to be assessed in the high-level strategic integrated offshore network development plans, to be developed and published as part of the Union-wide TYNP by 24 January 2024.[134]
- The TEN-E Regulation foresees the development by the Commission by 24 June 2024 (with the involvement of Member States, relevant TSOs, ACER and the NRAs), of a guidance document for a specific cost-benefit and cost-sharing (CBCS) for the deployment of the sea-basin integrated offshore network development plans.[135] By 24 June 2025, ENTSO-E shall present the results of the application of the CBCA/CBCS to the priority offshore corridors (Article 16).
- The Commission decision providing a derogation in favour of the Kriegers Flak combined grid solution project provides some useful elements as to how to develop a hybrid project under current legislation, while waiting for a consolidation of the regime.[136]

4.4 A thought experiment: a single offshore bidding zone and a single TSO per sea basin

In this sub-section we look at a thought experiment where a single supranational offshore TSO builds, owns, and operates the meshed offshore network in a sea basin and a single off-shore bidding zone is created.

We discuss the potential benefits of such a single TSO model, and conclude that those benefits are unlikely to be achieved in the short-run and that a system where national TSOs play a more important role is more likely. Furthermore, the creation of a single liquid offshore bidding zone may be overly ambitious and unlikely to achieve a level-playing field for wind producers.

[132] Electricity Regulation 2019/943, Recital (66).
[133] See Art. 63 of the Electricity Regulation (EU) 2019/943.
[134] TEN-E Regulation, Art. 14(2).
[135] TEN-E Regulation, Article 15.
[136] Commission Decision (EU) 2020/2123 of 11 November 2020 granting the Federal Republic of Germany and the Kingdom of Denmark a derogation of the Kriegers Flak combined grid solution pursuant to Article 64 of Regulation (EU) 2019/943 of the European Parliament and of the Council. The requested derogations aimed at allocating the capacity of the Kriegers Flak system at the bidding zone border between the Denmark 2 (DK2) and the German-Luxembourg (DE-LU) bidding zones with priority to the offshore wind farms directly connected to the KF system. The applicants request derogation for the Kriegers Flak system from a number of requirements described below, all relating to the minimum available capacity for trade under Article 16(8) of the Electricity Regulation.

We consider this thought-experiment as it might be a possible long-term outcome and is the furthest from the current situation, and might therefore be a useful hypothetical benchmark. The scenario of a single offshore TSO, although raised as an alternative in the ORE Strategy, is not consensual.[137]
The advantages of a single TSO is that a single player coordinates all investments and can trade-off capital and operating costs. It may increase interoperability, especially in HVDC situations.

If the offshore network has sufficient capacity and production assets are close to each other, a single liquid offshore regional bidding zone can be created that participates in the existing market coupling algorithm.[138] Electricity price differences between onshore and offshore price locations would then provide investment signals for extra transmission capacity and provide incentives for energy-intensive consumers to move production offshore as well. A liquid international forward price on the offshore energy hubs could provide long-term price signals for those offshore investments. The creation of a single price zone would, in theory, create a level playing field for all offshore windfarms. Competition between windfarm projects could then lead to efficient siting decisions.

However, the creation of level-playing offshore competition comes with several economic and legal challenges: It might be hard to create market liquidity, those price signals might play limited economic role, and the required harmonization might push the boundaries of the subsidiarity principle.
Windfarms can provide some ancillary services that help system stability.[139]

However they cannot provide much secondary response and balancing energy. So, for an offshore trading zone to function like a normal trading zone, there need to be sufficient controllable assets in the zone like offshore energy storage or large flexible demand; for instance, in the form of large-scale green hydrogen electrolysers to provide secondary reserve and balancing energy. In the medium term, this is unlikely to happen,[140] so balancing the offshore price zone will require onshore assets and active multi-lateral countertrading by all TSOs involved combined with some rationing of offshore wind power production.[141]

---

[137] It is outside the scope of the report to look at all possible scenarios. ENTSO-E (2022b) distinguish five different organizational structures for the development of offshore network facilities, and discuss their respective benefits and costs. It considers the role of four different market actors (offshore TSOs, onshore TSOs, ISO, and independent third parties), performing five different tasks (planning, building, owning, maintaining to operating). The report concludes that making the onshore network operators (TSOs) responsible for all offshore activities offers the greatest certainty and provides some suggestions to improve the existing regulatory framework. Sunila et al. (2019) discuss the regulatory implications of a single offshore bidding zone with an application for the Baltic Sea. The PROMOTioN project looks deeper into different types offshore bidding zone configurations: https://www.promotion-offshore.net/fileadmin/PDFs/D12.4_-_Final_Deployment_Plan_Distributed_Version.pdf

[138] There is little research on the definition of optimal price zones. Optimizing the zonal boundaries is a complicated integer optimization problem in the short-run (Bjorndal & Jornsten, 2001) and might give unforeseen investment incentives (Grimm et al., 2016). Intuitively, network nodes that are well connected and have similarly production technologies, should be bundled in one trading zone, as their optimal nodal prices would be similar, but this is not a precise prediction. Felling et al. (2019) suggest that optimal zonal boundaries in Europe are unlikely to follow country borders. Whether a single offshore price zone makes sense, requires more in-depth economic simulations, and some empirical evidence on the reorganization of onshore price-zones. However, cross-border price zones require extended legal harmonization on for instance international balancing responsible parties. With respect to the optimal sizes of offshore bidding zones see also Appendix V of the PROMOTioN report D12.4. https://www.promotion-offshore.net/fileadmin/PDFs/D12.4_-_Final_Deployment_Plan_Distributed_Version.pdf

[139] It can use three methods for this: kinetic energy extraction (adjusting the speed of the wind mills), controllable de-loading (producing below the maximal production rate) and integrated storage solutions (such as batteries) (Attya et al., 2018).

[140] Large-scale offshore green hydrogen production might only become reality by 2050 or 2060.

[141] This requires that the hybrid assets are tightly integrated in the market coupling process.

In the proposals for a reform of the market design, windfarms connected to a hybrid network will obtain the right to sell their output to the surrounding markets. "In order to reduce investment risk for these offshore project developers and to ensure that the projects in an offshore bidding zone have full market access to the surrounding markets, transmission system operators should guarantee access of the offshore project to the capacity of the respective hybrid interconnector for all market time units".[142] The details will be worked out in separate regulation.

One interpretation of this statement, and our preferred one, is that a windfarm receives a financial hedge for the price difference between the offshore price and its onshore home market price for its deemed production level. Such a guarantee has the benefit that it can be combined with a CfD contract indexed onshore home market price to fully hedge the price risk of the wind farm and the lost profit due output reduction caused by network outages. The price of the onshore market is more liquid than offshore and corresponds to the location of the main energy consumers so it makes sense to index CfDs to the onshore location than for the offshore one.[143]
This would however imply that the offshore zonal price becomes less relevant as it does not affect the profits of wind producers less.[144]

In order for a level playing field to arise for offshore wind energy production across EEZs, national policies need to be harmonised. As a starter, member states need to *harmonise transmission prices*. There still remain significant differences in connection charges, the initial payment to connect to the network, and the ongoing network usages fees. Principles for determining connection charges differ. With a shallow connection charge, the windfarm pays only for the direct costs of its connection, for instance for a new connection line to the high-voltage network. With a deep connection charge, a wind-farm pays not only for those direct costs, but also for other network upgrades that are necessary to avoid congestion, for instance in the onshore network. The connection charge could also be very shallow, where all connections costs are socialised in the transmission tariff structure. The tariff structure itself can have energy components (EUR/MWh) and capacity components (EUR/MW) which could be time, location and voltage level specific. [145]

Member states might also differ in the way they *allocate wind sites* (tendering, beauty contests, first-come-first-serve), the *support mechanism* they use for renewable energy and the *capacity market*

[142] Draft Recital 23, Proposal for a regulation of the European Parliament and of the Council amending Regulations (EU) 2019/943 and (EU) 2019/942 as well as Directives (EU) 2018/2001 and (EU) 2019/944 to improve the Union's electricity market design (COM(2023) 148 final), 14.03.2023.

[143] Laur et.al. (2022) propose using a market instrument, a transmission access guarantee (TAG) to hedge the congestion risk for offshore developers in a setting with offshore bidding zones, but the financial instrument seems to differ as it focusses mainly on the volume risk, but not on the price risk as well. Our proposed solution is more akin to a two-way FTR based on deemed production.

[144] Even if the wind farms would be exposed to the offshore bidding price, prices would have no effect on siting decisions as investment locations are often determined centrally and not by the investors.

[145] In order to obtain a level-playing field in Europe, EU regulation foresee that network costs should be cost reflective. In principle the infrastructure costs should not be paid by generators but by consumers. ACER (2014) states that "except for recovering the costs of system losses and the costs related to ancillary services, where cost reflective energy based G charges could provide efficient signals, energy based G charges should be set equal to 0€/MWh." but this does not lead to full harmonization, as for instance discussed by Sunila et al.(2019) for the Baltic sea basin. ENTSO-E (2022a) shows transmission costs differences across EU countries. (ACER, 2019) reviews the different methodologies used for setting transmission tariffs across member states.

design, if used at all. Also those mechanisms need to be harmonised, if we want to have a competitive offshore network which crosses national boundaries.[146] Such harmonisation may be achieved by adding new provisions in the Electricity Directive and Regulation and/or in the relevant network codes and guidelines. Even though there is room for some harmonisation on support schemes and capacity market design, this might touch upon subsidiarity and proportionality principles and is an issues which goes beyond the development of offshore wind.

A single supra-national TSO, will also require supra-national governance structure, for instance a single supra-national regulator which sets investment incentives and determines tariff levels (or tariff methodologies). A single monopoly TSO investor for connecting offshore wind to the onshore grids might not have the right incentives to minimise costs as it does not face competition. Some benchmark competition between offshore TSO investors in different sea basins might be possible, although costs differences across sea basins makes this hard. Benchmark competition works well for reducing operational costs, but not for capital cost and investments. Competition between national TSOs in connecting windfarms to their own national network (for instance Kriegers Flak will finally be connected to Sweden, Germany and Denmark) could create some competitive pressure but is unlikely to result in a cost efficient meshed grid and cooperation between TSOs. The best way to organise competition is probably in the procurement and construction phase for individual grid extension projects, where offshore TSOs could tender for construction companies and vendors of specific transmission infrastructure to build the cables and related infrastructure.[147]

Even if a supra-national TSO is not possible yet, coordinated forward looking planning for an offshore network infrastructure investment and wind parks is needed, taking into account interactions between projects and the existing onshore and offshore network.[148] It remains to be seen whether the current governance structure, with planning at national, regional and EU-wide level and voluntary development planning is up to the task.

In addition, to ensure compliance with unbundling requirements, TSOs which own the transmission system shall fulfil the requirements provided for in Chapter VI of the Electricity Directive (unbundling of TSOs) and be certified in accordance with Article 43 of the Electricity Directive. Applying certification requirements to a cross-border offshore TSO or offshore ISO will need further legislative clarity.

4.5 Allocating benefits and costs between Member States

In this sub-section we look at the allocation of benefits and costs of hybrid projects between member states. We assume that member states can use other instruments to distribute costs between the

[146] The proposed changes in market design require member states to use two-way contract for differences to support renewable energy, which could lead to a further harmonization of support schemes. The proposal also envisions international competition for CfDs, by allowing cross-border CfD transactions combined with long-term transmission access guarantees. One of the hurdles to the harmonization is the provision of those long-term network access guarantees, which are especially hard to define for intermittent generation.

[147] For radial transmission lines and close to shore wind parcs, competition between developers that build both the transmission and wind parcs might still be possible.

[148] Also suggested by Green and Vasilakos (2011).

different stakeholders within the country and focus on the allocation of benefits and costs between TSOs.

Side-payments and cost allocations can play two roles: (1) They can be used to ensure that the project is a win-win situation for all parties involved. They relax the "participation constraints" of parties who would otherwise block the project. Hence, those payments are redistributive. The cost allocation model under TEN-E belongs to this category. (2) Side-payments can also be used to ensure that TSOs internalize the effect of their decisions on other parties. Hence, they are to provide "incentives" and align the interests of each TSO with the broader EU-wide goals. If those incentives are in place, each individual TSO will act in the interest of the European Energy market. By design, those payments depend on the action of the TSO, as they would otherwise not provide any incentives. The existing inter-TSO compensation mechanism is an example of a payment scheme that is meant to provide incentives to TSOs not to create unnecessary costly loop-flows in other TSOs areas.[149]

This section will first discuss the issues of incentives and then look at the allocation of costs and benefits. We conclude that the alignment of incentives is important but that such payments will not provide strong enough signals to coordinate investments, and other tools need to be used, such as binding investment requirements. The (political) discussion on the allocation of costs and benefits will benefit from a social cost benefit study, but remains subject to multi-lateral bargaining.

If the offshore network is operated by a group of national TSOs who are responsible for the part of the grid in their EEZ, then coordination and aligning incentives of TSOs becomes necessary.[150] One issue is that there are maintenance and investment externalities between countries. For instance, Tangerås (2012) highlights how broken transmission lines in Southern Norway led to higher prices in Sweden and lower prices in Southern Norway without negatively affecting security of supply in Norway. The Norwegian TSO could have increased maintenance and avoided the break down, and might have repaired the line more quickly.[151]

A national TSO might not take into account the positive externalities it creates to neighbouring countries and its maintenance and investment decisions are therefore not aligned with the overall social optimum. So, left to their own individual decision making, TSOs may underinvest in maintenance and free ride on investments in neighbouring countries.[152]

The value of the interconnector is maximised if there is little congestion in the region where the cable connects to the existing onshore grid. So it is often socially optimal to do a deep reinforcement of the

[149] The inter-TSO compensation mechanism covers the allocation of costs between TSOs resulting from cross-border flows and is covered by Regulation (EU) 2019/943 Art. 49 and Regulation 838/2010. (Electricity in the EU — Inter-Transmission System Operator Compensation (ITC), 2010). The compensation is supposed to cover the cost of cross-border flows affecting a third country, in so-called loop flows, and is paid by the TSOs of the origin and destination of the cross-border flows. It gives TSOs incentives to limit those loop flows.

[150] Also with a supranational offshore TSO, coordination between each national TSO and the supranational TSO remains very important.

[151] TSOs are also sometimes accused of strategically adjusting cross-border transmission capacity, such as in the Svenska Kraftnat case (Sadowska & Willems, 2013), but this has become harder with additional regulation and transparency measures. However, strategic behavior on maintenance and investments is much harder to regulate.

[152] Investments can also create negative externalities for instance by shifting more flows towards neighboring grids.

onshore grid when a large new interconnector is built. However the cost of this reinforcement is paid for by one TSO, where the benefits of a more valuable interconnector are shared with other participating TSOs. So there are positive externalities and we would therefore expect underinvestment by individual TSOs.[153]

The externalities can be internalised by subjecting TSOs to monetary incentives schemes, where TSOs are paid for positive externalities that they cause; and pay when they cause negative externalities. There are two reasons why we believe that such a monetary incentive scheme will not work.
From the experiences with the inter-TSO compensation scheme, we learn that it provides some incentives for operational efficiency, but because it is ex-post and short-term it is insufficient to provide investment incentives. See also Buijs et al. (2010). Hence, they are not good in steering investment decisions. More fundamentally, in a meshed grid, investments are complementary to each other, i.e., there are positive network effects, and therefore the marginal value of an investment is larger than the average value of an investment. So the total market surplus is insufficient to provide incentives to all TSOs. In order to provide the correct monetary incentives, the government would need to step in and provide large subsidies to TSOs, which comes at a social cost, and might go against state-aid guidelines.

Alternative methods to align incentives for TSOs are minimal quality requirements, for instance for the maintenance or the procurement of ancillary services.[154] European technical grid codes are there exactly for this purpose. For investment projects broad minimal quality standards are hard to specify, as investments are often lumpy. However, the existing rules on making 70% of interconnector capacity available to the market, the prohibition of congestion shifting and requiring a certain degree of market openness are efforts to align incentives, even though they are somewhat ad-hoc and not based on explicit benefit and cost considerations.

Such general rules are insufficient for hybrid projects, as they might require project specific investments in onshore transmission capacity. Instead, project specific binding agreements on network enforcements and market organisation need to be part of hybrid project development. Note that the planned creation of multiple offshore bidding zones will reduce the effectiveness of existing rules for interconnectors, as it limits the applicability of the interconnector regulation, and alternative regulatory regimes to promote market integration, such as joint network optimisation might be necessary in the future.

Aside from providing incentives, side-payments between TSOs might be necessary if the allocation of the social benefits and cost of the full project (interconnector, and investments in grid reinforcement) does not create a situation where both countries gain from the project.

[153] This description assumes that the TSO will create a separate price zone in the coastal area to manage congestion deeper in its network. If creating such a coastal price zone is not possible, the TSO will likely reduce the capacity of the interconnection in order to avoid huge counter-trading costs to manage congestion. The lower capacity will hurt other countries, but this is not internalized by the TSO.

[154] Tangerås (2012) shows that with a single TSO those externalities are internalized by design, but another inefficiency might arise, a single level of supranational maintenance level might not be optimal, if member states have different preferences on for instance network reliability.

A cost benefit study should be used to calculate the social costs and benefits for each participant, and determine the size of those side-payments. If the overall project is welfare increasing for the contracting parties, side payments that make all member states better off should exist. Payments from the EU level might be required if there are wider positive externalities which are not captured by the contracting parties.

An example of an externality is the case where a third party, let's say Germany, benefits from an investment of other contracting parties, such as an interconnector between Norway and the Netherlands. The TEN-E regulation allocates responsibilities for setting up a framework for the cost-benefits analysis and cost allocation for the offshore networks to the Commission.

We make some general reflections with respect to the cost benefit studies: Ideally the cost benefit framework is already part of the planning process. Hence, the size, location and timing of onshore and offshore investments in new assets and the optimal configuration of offshore bidding zones are outcomes of such an analysis. This avoids the risk that the network is designed sub-optimally in order to influence future cost allocations.

The marginal benefit and costs of a series of projects that are implemented depends on the order of implementation. We want to avoid that the order in which projects are submitted for permitting, affects which projects are to be built and how TSOs are compensated. Ideally, a joint cost-benefit study is conducted on sea basin level, which includes all projects at once and is forward looking, so we do not decide on a piecemeal basis which projects are welfare improving.[155] A grant bargaining scheme, i.e., where all participants take part in the bargaining process several projects are considered, might be preferred to piecemeal negotiations on separate projects: all parties are likely to gain and fewer side-payments are necessary. This might be hard in practice, but bundling several investment projects has certainly some advantages. For a hybrid project, this means that at least the different functions of the assets are taken on board (interconnection facilities, local hub, and enabling wind energy development).

In order to determine the marginal effect of projects, we need to define benchmark scenarios, and attribute which costs and benefits are linked to the offshore project and which are not. Developing such a counterfactual scenario is a very difficult exercise, especially if TSOs use forward looking investment strategies, and over-invest in some parts of their network to deal with future demand. Some standardisation on the counter-factual market outcomes will be necessary. We do not want that the cost allocation model causes hold-up, where TSOs delay investments in order to ensure they can share those costs with neighbouring TSOs.

For interconnectors and hybrid networks, TSOs are likely to rely on different market configurations. For hybrid networks, multiple offshore bidding zones can be created, while this is of no use for an

[155] This has to do with the complementarity structure of the overall cost of the network, but also with the option value of irreversible investments decisions and the (unpriced) opportunity cost of using a location or spare network capacity. Stochastic optimization models might help us identify investment decisions that are robust to changes in market environment.

interconnector. With the creation of offshore bidding zones, some of the congestion will no longer occur on cross-border lines but rather on national offshore lines. This will affect the allocation of congestion revenues between the TSOs. When determining the cost allocation, we favour a wider project definition for the cost benefit analysis, which includes at least the full hybrid project and which explicitly takes into account the market organisation.

Even if hybrid projects and interconnectors increase the surplus in each Member State, there are distributional effects within each state. In the exporting country, prices increase which is good for electricity producers but not for consumers, and in the importing country prices will decrease with the opposite effect. Often consumers have a larger political cloud, especially during crisis periods with high prices; and the exporting region might try to restrict electricity outflows in order to keep energy prices low.

This export limitation will lower the value of the interconnector, which is inefficient, in order to solve a problem of redistribution and fairness concerns within the exporting country. Those redistributive concerns could have been solved with other means, for instance by making consumers the shareholders of domestic hydro plants, using a profit tax or reallocating the revenues of CfDs. Sufficiently independent national regulators might be less responsive to different national interests, but are probable not immune. Some guidance at a European level, with respect to joint planning processes and TSO independence might be useful here.

Summarising, we do not believe that incentive payments will be sufficient to coordinate efficient decentralised investment decisions by TSOs. Instead, we recommend that the TSOs sign binding agreements on the network reinforcements they will undertake, the allocation of costs, and the compensation mechanism if they deviate from investments plans.

A cross-country cost benefit study will be very useful in guiding the cost allocation between member states, but might be even more helpful in the initial planning phase. The final decision on cost allocation is likely to remain part of a wider political process, as the result of the analysis will depend on the project scope considered in the analysis and assumptions with respect to the counterfactual scenario.

4.6 Cost and Revenue model for Wind Energy

In this subsection we look at the cost and revenue models for wind energy producers in different market organisations, and look how the market design reform might interact with market outcomes.

Our main conclusions are that (1) if governments decide on investment location and the technologies used, we do not need to leave supra normal rents to firms, (2) strong competitive pressure will drive down wind farms' rents independent of market organization, (3) if any rents or costs are efficiently recycled to consumers, then consumers are indifferent in market organisation as well, (4) the choice of market organisation should therefore focus on reducing policy risk for investors, reducing transaction costs and providing price signals that are in line with long term market developments of a meshed offshore network.

Among many possible market organisations for creating a national offshore market we pick three representative ones, by varying network access charges, national RES support schemes and permit allocation and describe their impact on the profitability for the wind park producer and the cost for end-users. This is summarised in the Table 1.

Future support schemes for wind energy will have to be allocated in a competitive auction, and in the proposed market design take the form of two-way CfDs. Those CfDs might, or might not, be technology specific. Technology specific CfDs often reduce government expenses, but limit the role of markets in determining the technology mix. [156]

With a deep connection charge, the wind developer pays for upgrading the network, for instance connecting the wind farm to the onshore network. For a very shallow connection charge, the network costs are socialised and paid for by the end-users of the energy.

The **double tender**, organisation 1, has a national, technology neutral CfD market, a second tender for the production location permits, and a deep connection charge. The **single tender**, organisation 2, has a single technology and location specific tender which allocates the production location permit and provides a technology-specific CfD simultaneously. The wind farm does not pay for network charges. With **first come,** organisation 3, a national technology neutral CfD market exists, permits are allocated on a first come first serve basis and firms pay a deep connection charge.

[156] See also last year's CERRE report on the reform of the electricity market by Michael Pollitt et al. (2022). Fabra & Montero, (2022), discuss the rational of using technology specific auctions. Bichler et al., (2020) propose more complex auctions where different technologies compete in the auction, but are not treated equally. More generally see also the mechanism design settings by Maskin & Riley (2000) and Myerson, (1981).

	Organisation 1 Double Tender **(Figure 6)**	**Organisation 2** Single tender **(Figure 7)**	**Organisation 3** First Come **(Figure 8)**
RES Support	National CfD market	Technology & Location specific CFD	National CfD market
Network connection charge	Deep	Very Shallow	Deep
Permit for wind location	Tender	Allocation is part of the location specific CfD	First-come first-serve permit
Competition drives down profits of offshore producers, scarcity rents to government	Yes	Yes	No
Differentiated RES support	No	Yes	No
Who chooses location / technology?	Government & Market	Government	Market

Table 1: Three market organisations for offshore wind.

The focus of our analysis is on the wind park producer and end-users. We do *not consider the incentives of the TSO*, as we assume that the regulator allows investment cost and a fair return on capital to be recuperated from network users by appropriate tariffs in each scenario, and that the connection charges do not affect the investment incentives for the TSO. For simplicity, the *capacity market, congestion payments, and balancing charges are ignored* as those have similar effects in the three market organisations.

We assume *free entry* in the wind farm market and that competition drives down the profitability of the wind park, if a competitive process, such as a tender, is organised. The wind farm will then cover its investment costs and receive a risk-adjusted compensation for its capital costs, but will not make any additional profits.
The market organisation 1 and 2, double tender and single tender, achieve such rent extraction for offshore windfarms. In market organisation 3, the first-come organisation, there is no competition on price between offshore projects, and the project developers might obtain supra-normal profits.

Lastly, we assume that *auction revenues and network costs* are recycled to end users, without creating distortions, so it is a zero-sum game. The cost or benefits of the CfD contracts are assigned to end-users, as envisaged in the proposed regulation. End-users pay the spot price minus the financial payment of the CfD contract, and thus end up paying the CfD price for (part of) their energy consumption.[157] In market organisation 1, the double tender, the government collects an additional permit auction revenue, that it allocates back to energy consumers. If a shallow connection charge is used, the remaining unpaid network cost are paid for by consumers.

The figures below represent how the consumers and the producers share the market surplus and who pays for the respective costs. Here *R,* stands for the permit revenue, *T*, for the transmission cost and normal profit margin (dashed), and *W*, for the profit and normal profit margin (dashed) of the wind farm. The figures assume that the total average production costs (T + R) for offshore electricity is less than the long-run forward price for electricity. The difference between the forward price on the one hand and the total average production costs represents the scarcity rent for offshore production. The arrows on the left side of the figures represent the wind producer's income (CfD) and its costs (permits, and network charges). The arrows on the right represent the energy price for the contracted energy which is equal to the CfD price, the tax rebates and the extra costs due to the socialisation of investment costs.

Off-shore Permit Auction & National CfD market

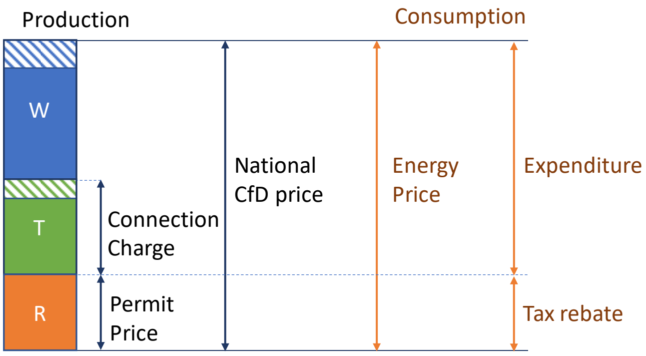

Figure 6: Market Organisation 1: Double tender National CfD market, deep connection charge and an off-shore permit market.

Technology-Specific CfD Auction

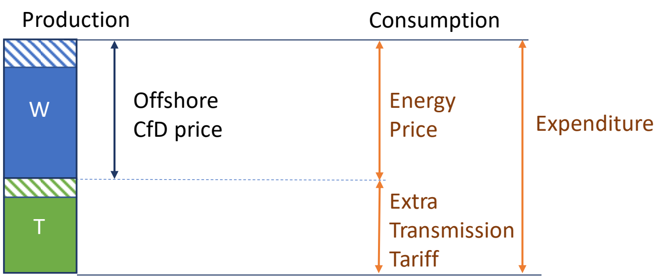

Figure 7: Market Organisation 2: Single Tender: Technology specific CfD and permit market, and a very shallow connection charge

[157] The CfD contract is likely going to cover only part of their consumption. We assume that the remaining expenses are unchanged in the scenarios, and can therefore be ignored.

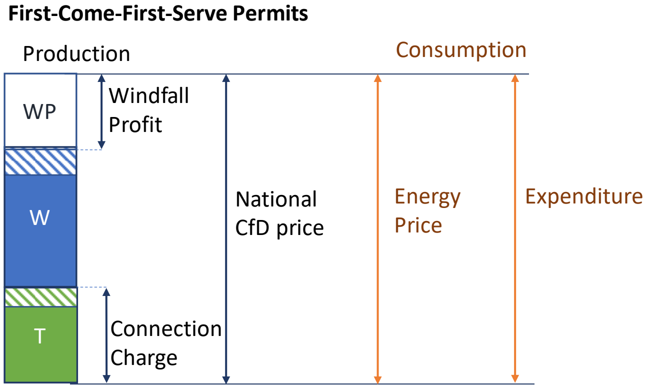

Figure 8: Market organisation 3: First-come: National technology neutral CfD market, deep connection charge and first-come-first-serve permit market

Scenario comparison – Discussion

The consumer expenditures are equal is market organisation 1 and 2, but are higher in Market Organisation 3. The reason for this is simple: free entry and competition drives away all the supra-normal profits for the wind park investors in market organisation 1 and 2. As this is a zero-sum game, the consumers pay the same in both market organisations.

In Organisation 1, double tender, there is a single national CfD price, which corresponds to the long-run forward price for renewable energy. This scenario is therefore compatible with a private firms contracting with the wind farms in parallel to government CfD contracts. For instance, the windfarm producer could sell part of its capacity under a PPA contract, and the rest under a government backed CfD contract. The scarcity rents are collected through the second tender, the permit auction, and are not affected by the PPA contract. The market provides some incentives for firms to choose the right investment location, but cut-throat competition in the permit market might reduce innovation incentives. Firms make similar profits in all locations, and different locations are competing with each other through the national CfD price.

In market organisation 2, the single tender, location specific CfDs are used to extract the surplus of location rents and provide support for wind energy. Participation in the CfDs market is therefore obligatory for the offshore wind parks. This model is therefore not compatible with private PPAs, as this would allow wind farms to circumvent the scarcity rent extraction. Offshore and onshore markets are separate which reduces competitive pressure. As the connection charges are very shallow, the wind farms do not pay for the transmission investments, which is reflected in low CFD prices.
However, consumers end-up paying higher transmission chargers and are therefore indifferent.
Participating in a single tender might be simpler for investors than the double tender, and lower transaction cost.

In market organisation 3, the offshore permit is allocated at a first-come-first-serve basis. The scarcity rents are not extracted, and the wind farm will make supernormal profits. The CfD market is compatible with a parallel PPA market. The advantage of market organisation 3 is that it provides windfarms with very strong incentives to invest in locations with low costs (and thus give higher profits). This is good for choosing efficient investment locations, but might reduce competition and interest for developing more difficult locations.

Whether we use deep or very shallow connection charges does not matter for consumer expenses as the full network costs need to be recouped from consumers. Consumers end up paying for it, one way or another. When production locations are scarce then deep connection charges do not provide locational signals in market organisation 1 or 2, as any price signal is competed away by firms. However, in market organisation 3, they can provide locational and technology signals to investors, which could increase efficiency.[158]

Designing the optimal market organisation requires a trade-off between providing incentives (for innovation, technology and location choice) and extracting rents by creating competition and differentiating firms' revenue streams.A more in-depth analysis is required to quantify the benefits and costs of possible organisational forms and is part of the wider ongoing market design debate.

The main message of our discussion so far, is that the differences between organisations 1 and 2 are relatively small due to competitive nature of the CfD and permitting process. Given the large role the government will play in designing and sizing off-shore production locations and incentivising those investments, market organisation 3, which leaves rent to the investors in the hope the markets decides on locations and technologies, is less appealing.

The choice of market organisation should therefore focus on processes that provide regulatory certainty to the investors and which are compatible with a long-term development of an offshore meshed network that is regulated in a similar manner as onshore networks. This means for instance that network charges should reflect some long-term forward looking average costs.

[158] In practice connection charges could affect the incentives of the TSO investments, but we assume here that the TSO is regulated optimally.

5 Co-existence and Local Benefits

The question raised in this section is to know how EU action can further ensure mutual benefits in the form of co-existence between offshore activities with other uses of the sea (5.1), as well as local benefits for the developments of offshore wind projects (5.2).

5.1 Ensuring mutual benefits by the co-existence of offshore installations with other uses of the sea space

As activities at seas multiply, so does the degree of potential conflicts in the use of sea areas. This raises concerns in terms of economic outcomes for affected activities, but also protection of the environment and biodiversity. In its ORE Strategy, the European Commission estimates that the proposed scale up goals for offshore wind will require less than 3% of the European maritime space and that it can therefore be compatible with the goals of the EU Biodiversity Strategy.[159] This statement has been criticised by the European Court of Auditor in a special report that concludes that the Commission did not correctly estimate the potential environmental effects when proposing the ORE Strategy.[160]More specifically, the ECA found that numerous environmental aspects linked to the planned offshore renewable energy deployment were still to be recognised.

This recalls the need for detailed impact assessment, including on environmental issues, when putting forward new EU initiatives in the field, as well as the respect of the "do no harm" principle.[161] The question becomes even more acute when the EU renewable energy targets are significantly increased and the length of permit-granting procedures inside and outside renewables acceleration areas are to be shorten down with derogations to environmental impact requirements.[162]

The same question of the need for detailed environmental impact assessment will appear again at the national level, in particular when Member States will need to follow-up with the EU's call for increased offshore wind capacity by the adoption of national measures. When developing activities offshore, Member States are bound by requirements on the protection of vulnerable marine ecosystems. This is notably based on the obligation to reach good environmental status enshrined in the Marine Strategy Framework Directive. They are also required to assess the cumulative effects from all human activities at sea, i.e., both from offshore wind development and other human activities.[163]

---

[159] ORE Strategy, p.1.

[160] European Court of Auditors, Offshore renewable energy in the EU – Ambitious plans for growth but sustainability remains a challenge, Special report 22/2023, pp.32-37, and para. 113 on p.40.

[161] See Section 1 – Introduction of this report concerning the need to conduct impact assessment when adopting new EU initiatives.

[162] These are among the measures adopted under Council Regulation (EU) 2022/2577 of 22 December 2022 laying down a framework to accelerate the deployment of renewable energy (definition as 'overriding public interest', acceleration of permit-granting, derogation to environmental impact assessment), and subject to temporary application. Some of these permit acceleration measures are reiterated in the compromise text of the REDIII revision (European Parliament, Provisional Agreement resulting from interinstitutional negotiations, 16.06.2023, draft Art. 16a and 16b).

[163] Art. 8(1)(b)(ii), Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive), of 17 June 2008. See as well: Commission Notice C(2020) 7730, Guidance document on wind energy development and EU nature legislation.

Likely, the interaction with other commercial activities - like fishing, aquaculture, tourism - and strategic activities - defence -, must be assessed and addressed. Some of these activities may even claim exclusive access. The interaction is not limited to subsurface areas, but expands to subsea and seafloor areas (use of seafloor, anchoring, grid connections). The mapping of these interactions happens primarily at the stages of the strategic impact assessment for maritime areas and offshore wind plans, and at the level environmental impact assessment for specific offshore wind projects.

How **to solve co-existence issues, including project design adjustment and compensatory measures, is managed ad hoc at national level, although rarely regulated in detail.**[164]
As mentioned in Section 2, EU action has on this matter primarily consisted in the development of guidance documents and publication of best practices. A list of preventive and mitigation solutions by sectors is proposed.[165]

In terms of co-existence with activities within the same sea basin, both the Maritime Spatial Planning Directive and the Marine Strategy Framework Directive require Member States to work together across borders, at sea basin level. In the ORE Strategy, the European Commission recalls that it is for the Member States to decide whether, where and to what extent to expand offshore renewable energies in their exclusive economic zone but some of the problems of identifying the best sites and coexistence with other uses can be best overcome by addressing them at regional level, in collaboration with neighbouring states.[166]
Co-existence issues could be better mapped and addressed already at the stage of cross-border consultation, offering a more holistic approach at sea basin level.

Tendering procedures are mostly an issue of national jurisdiction, but the EU legislation and Commission guidelines provide for some harmonisation requirements to ensure level playing field. Co-existence could be added to the list of non-price criteria to take into account, alongside sustainability and innovation. As example, co-existence could be promoted by the inclusion of **multi-use criteria in the tender and permitting procedures** as proposed in the ORE Strategy[167] and as already practiced in some countries.

[164] As a matter of example, and although not in an EU state, the Norwegian Renewable Offshore Energy Act (ORE Act) and ORE Regulations provide for a regime for compensation of negative interactions between offshore wind projects and fishermen.
[165] For interaction with offshore wind farms, the preventive measures include inter alia: the temporarily stop pile driving activities; choose technical solutions to prevent harm to fauna or reduce noise emissions; develop a Tourism Impact Statement and possibly include this as a standard in the SEA or EIA; consider the seasonality of shipping when planning offshore wind farm installations; acknowledge the special status of fishers in the MSP planning process; set up a liaison group for MSP at an early stage. Mitigation measures could include: establish multi-use of MPAs and offshore wind; develop a strategic ecological research programme; stimulate and facilitate innovation in the OWF sector to decrease potential conflicts with tourism; early application of a navigation risk assessment during the MSP process; allow some types of fishing in offshore wind farms under certain conditions. Source: European Commission, Addressing conflicting spatial demands in MSP – Considerations for MSP planners, Final Technical Study, 2019, pp.26-27.
[166] Nordic Energy Research, Coexistence and nature-inclusive design in Nordic offshore wind farms, March 2023.
[167] ORE Strategy, p.8

5.2 Promoting local benefits as part to non-price criteria

Despite the fact that local content requirements are prohibited under both the regime of the World Trade Organization (WTO) and EU internal market rules, **Member States have been increasingly using non-price criteria in offshore wind auctions or allocation of support (contract for difference mainly) to promote a series of local benefits in addition to other ones (e.g., innovation, system integration, sustainability and biodiversity, circularity, local supply chain, job training and local communities).[168] This marks a move from pure price-only auctions (single criteria auctions) where the focus was on price reduction, to an increasing weigh given to non-price criteria (in multi-criteria auctions), with the objective of promoting other types of objectives**.

The European legislation has progressively enabled the definition of non-price criteria into renewable energy auctions. The starting point is the Renewable Energy Directive that requires the use of tendering for the allocation of support schemes (Article 4). The same requirement is reiterated in the 2022 State aid guidelines for climate, environmental protection and energy (CEEAG), both for ranking bids and for the allocation of the aid as part of the competitive bidding process.[169] Then, as part of the tendering procedure for the allocation support scheme, **the CEEAG allow Member State to insert non-price criteria for up to 30% of the weighting of all the selection criteria**.[170] **It is therefore possible, under EU law, to define criteria in offshore wind tendering that can favour local benefits, such as environmental or local economic benefits, as part of the qualitative criteria.**

A similar move can be observed in more recent proposals from the European Commission in relation to procurement rules. In the Net Zero Industrial Plan and the proposal for a Net Zero Industry Act, the EC is proposing to promote the contribution to sustainability and resilience in public procurement procedures when awarding contracts for net-zero technologies, including offshore wind (definition and list in Annex to the proposal).[171]
One can argue that local benefits as defined above will contribute to both sustainability by promoting local supply chains, and resilience. The Commission proposes that the tender's sustainability and resilience contribution should be given a weight between 15 % and 30 % of the award criteria, without prejudice of the EU public procurement rules (Art. 41.1 Directive 2014/23/EU, Art. 67.5 Directive 2014/24/EU and Art. 82.5 Directive 2014/25/EU). [172]

Looking at some national examples, France, the Netherlands, Denmark and Poland are countries where non-price criteria have been introduced in offshore wind auctions, both for the award of market

[168] Energistyrelsen – Danish Energy Agency, Foreign Experiences for Awarding Offshore Wind, New concepts for awarding offshore wind licences in Denmark - Part 1, 2022.
[169] Communication from the Commission, Guidelines on State aid for climate, environmental protection and energy 2022, C/2022/481, of 18.02.2022, paras. 49.
[170] Ibid, para. 50.
[171] Proposal for a Net Zero Industry Act, draft Art. 19 and 20.
[172] Proposal for a Net Zero Industry Act, draft Art. 19 and 20.

premiums and zero bids.[173] Other countries, like Belgium and Germany, are also considering the definition of non-price criteria.
In a report for the Dutch government, van Damme et al. (2019) compare two models to tender production licenses for wind locations on sea: a comparative test with a price component[174] and an auction procedure.

The difference between both methods in the Dutch context is that with an auction firms compete on price only while they have to satisfy the same minimal quality criteria. With a comparative test with a price component the government can weigh both price and quality components of the bidders and select the firm which in relative terms requires the least financial support (price) provides the best societal values (quality).

The report indicates that the implicit assumption of the Dutch government that a comparative test would provide higher quality might be true, but has no strong empirical basis. However, the comparison of both methods required is not straightforward as there are several evaluation criteria: How effective are both methods in reaching the government's goals, how efficient are the market outcomes (is the best proposal accepted?), how complex is the procedure, what are the budgetary effects, and is the procedure transparent and does it stand up to legal scrutiny.

Comparative tests rely on ex-post subjective evaluation of quality. It is therefore hard for bidders to determine the quality that they should offer in the auction. Providing quality is costly and they are unsure about the quality evaluated by the government. This might hinder overall efficiency of the tendering process. The subjectivity of the evaluation might moreover lead to challenges in court, which could delay the roll out of the wind energy. If the relative weights of the price component is set too low, then the government might end up spending too much for the renewable energy support.

The report suggests that a comparative test should only be used when: (1) the quality levels cannot easily be contracted on ex-ante; (2) the preferences of the government and the project developer are not aligned;[175] (3) potential difference in the valuations of quality differences between projects is large.

When a comparative test with a price component is used, the report provides several recommendations: (1) The weights in the tests are expressed in monetary terms as this might clarify the trade-offs better for all bidders involved; (2) encourage bidders to submit multiple bids, with different combinations of quality and price (this is sometimes called package bidding; it reduces the risk that the bidders make the wrong price quality trade-off when submitting a bid); (3) provide ex-ante reference prices for hypothetical quality levels, such as the monetary value of an improvement

[173] For a review of the weighting of the criteria in the national auctions of these countries, see: WindEurope, WindEurope position on non-price criteria in auctions, April 2022, Annex.
[174] The comparative test with price component is the description under Dutch law. A more general term could be beauty contest with a price component.
[175] Improving the availability factors of a wind farm is an example of a dimension where the interest of the bidders and the government might be aligned. Market prices already signals which align private and social interests.

in environmental quality, the benefit being to improve the objectivity of the ex-post evaluation; (4) create a complementary market for stand-alone projects for sea quality improvements. For instance, an environmental organisation could provide sea conservation measures for a particular level of subsidy. Bidders could then indicate which additional services their offers are compatible with. The tendering process then chooses among all possible combinations of wind-farm offers and stand-alone quality projects based on ex-ante agreed weights.

6 Conclusions and recommendations

The main question raised in this report has been to know how EU regulatory action can help supporting the scaling up of offshore wind energy in Europe.

The report envisages EU action from a double angle. First, it considers how EU intervention can assist Member States when scaling up offshore wind at national level in order to reach EU targets and preserve cross-border trade on the internal energy market. Second, it studies how EU intervention can address the upcoming challenges when the large-scale deployment of offshore wind energy will result in more hybrid systems and gradually more meshed networks crossing Member States' borders.

The report discusses which type and form of EU regulatory intervention can be envisaged. The type of EU action will necessarily differ according to the time-frame considered, i.e., whether we consider measures in the short-term (within months or a year), mid-term (within one to two years) or long-term (as part of a broader legislative reform). This is notably justified by the need to perform detailed impact assessment for any EU initiative expected to have a significant economic, social or environmental impact, and by the fact that offshore wind systems are still evolving and will continue developing progressively. In practice, political realities may result in compromises that are difficult to predict.

The present report identifies **four key areas** for targeted EU action in order to support the scaling of offshore wind in Europe: planning, permitting, cross-border projects and mutual and local benefits.

1. Type of EU regulatory approach to be favoured to scale up offshore wind in Europe

- Given that energy is an area of shared competence between the EU and its Member States, the need for EU intervention, as well as its content and form, must be assessed pursuant to the **subsidiarity and proportionality principles**. The objective pursued by the EU measure (boosting offshore wind as way to address climate mitigation, reinforce security of supply and industrial competitiveness) will be key in this assessment. Compatibility with the principle of **national sovereignty over the energy mix** has been less of a concern when developing EU policies on renewable energy sources. In the context of offshore wind energy, the EU is pursuing a technology specific approach, as a manner to achieve renewable energy targets.

- EU initiatives expected to have a significant economic, social or environmental impact must be subject to an **impact assessment**. The lack of impact assessment will de facto limit the scope of action of the EC in proposing legislative reforms in the short run.

- The fact that technologies (e.g., floating and bottom-fixed installations, cable design) and grid designs are still evolving, argues in favour of a **gradual development of the rules, proceeding by steps and adjusting along the way**. Notably, grid solutions are evolving from radial to hybrids, with the long-term perspectives of meshed grids and energy/AC hubs or energy islands. However, many elements of grid and market design are still to be defined, and will only be set progressively. Due to changes in offshore grid configurations following the addition of production, conversion or storage assets, but also the connection of new grid segments, the business models may need to change along the way, and regulation adapted.

- The lack of legal certainty around offshore wind regime is a clear barrier to investments. **A gradual regulatory approach should not represent another barrier to investments. A gradual regulatory approach for hybrids should start in a targeted manner, clarifying first fundamental elements of market structure such as the legal definition of hybrids and cost-benefit sharing principles for these. It will then adjust along the way costs and benefits models for investors and the different actors while the grid design and market solutions mature**.

- Adjusting investment models along the way requires carefulness, not least to maintain foreseeability for project developers. **A gradual regulatory approach would therefore require a close regulatory monitoring** by national regulatory authorities (NRAs), alone and in cooperation with other NRAs and ACER. **A short-term regulatory sandbox for offshore hybrid assets could be on option.** As part of this sandbox, the applicability of current legislation as well as temporary derogations to new hybrids projects – like for Kriegers Flak case - should be tested, and the consequences of current market arrangements measured, with the objective of paving the way for changes to the EU legal framework, if proven necessary.

- In the long-term, the design of a legal regime of offshore hybrids may also require a rethinking of the general regime for interconnectors. **It is recommended that the fundamental elements of market structure, such as the legal definition for hybrids, are defined urgently (i.e., how to characterise the assets based on legal definitions). Therefore, and based on the feedback from regulatory monitoring, the EC should provide guidance as to the manner to proceed with a gradual development of the rules, around two consecutive steps: first, describe options to develop market-sound solutions within the framework of currently applicable legislation; and second, after a period of regulatory oversight, put forward proposals for legislative reform. While legal certainty is needed as to the characterisation of hybrid assets and allocation of costs and congestion rents in the short-term, there might not be a need for a dedicated regime for hybrids in the long run, as the market legislation may align.**

- **The need to strike a balance between multispeed Europe and harmonised rules reappears in the context of offshore wind developments.** Some sea basins, such as the North Sea and the Baltic Sea, are at the forefront of regulatory innovation, and urgently need regulatory certainty at the regional level to enable the ambitious investment goals. Progressing at different speeds in the different sea basins should not prevent advancing common EU rules, or at least guidelines, on a harmonised EU offshore wind regime in the short and mid-term. It can efficiently prepare the adoption of EU common rules in the long term. The approach requires again regulatory monitoring and tight cooperation between the different NRAs to the same sea basin. Interinstitutional cooperation between NRAs can be promoted through established fora, such as the North Seas Energy Cooperation. **In certain sea basins, such as the North Sea, further legal clarifications will be needed when not all neighbouring states are EU Member States (Norway, being an EEA country, and the UK, having left the EU). Legal clarity might be achieved by signing bilateral or multilateral MoUs or even bidding agreements.**

- **As part of a sea basin approach, it might be an efficient solution to propose packages of projects. Accordingly, it will probably not be one big bidding zone per sea basin but several ones based on congestion management.**

- Additional EU action must **be coherent with recent or ongoing legislative reforms on notably (i) electricity market design; and (ii) permitting acceleration as part of REDIII revision and the already revised TEN-E Regulation**. The future EU legal framework for offshore wind will also be shaped as part of these legislative reforms. This means that **these reforms provide a timely opportunity to develop a framework for offshore wind.**

- Compliance with biodiversity and ocean protection objectives must be ensured. This requires good planning and coordinated development of the maritime space on the way towards a sustainable blue economy. Permitting procedures are also instrumental in assessing the environmental and social impacts of offshore wind projects, as well as promoting co-existence and local benefits. However, **only relying on the current legal framework is likely not sufficient to address the cumulative environmental and social impacts of offshore wind projects. Those impacts are still to be fully understood, especially for new developments** such as floating offshore wind installations.

2. Planning

- The responsible bodies for ensuring an alignment of the maritime spatial plans on the one hand and the national energy and climate plans (NECPs) on the other hand should be clearly identified. One can consider amending the legislation to clearly define for these bodies **a duty to assess and report on the degree of alignment between objectives and plans**. **This calls for a clarification of the designation and competence of regulatory authorities offshore**.

- The EC should continue to provide **information on best practices and soft law guidance** as to integrated approaches in spatial maritime planning.

- Coordination throughout maritime spatial plans should be further encouraged and supported in order to **plan common offshore renewable energy projects among Member States sharing the same sea basin**. **Co-optimisation through joint planning in same sea basin will be necessary and can be requested at EU level.**

- Concerning grid planning, a more integrated planning approach between production and infrastructure and across Member States should be promoted. **Transmission needs and concrete projects should be aligned, also at sea basin level. The role of the network development plans is to identify needs, while project developers can provide input to the draft NDP and align therefore with them.**

- **Grid planning processes onshore and offshore cannot be disconnected**, for reasons linked to adequacy. Therefore, the integration of SB-ONDPs and high-level strategic offshore NDPs with the existing TYNDP, is to be pursued. Similarly, **there will be a growing need for an integrated planning across electricity and gas systems, also offshore.** The latest TYNDP already integrated an energy system perspective, but **system integration offshore should be taken into account**.

- There should be **more clarity as to role allocation and grid planning process offshore**. The responsibility for offshore grid planning should be clearly identified, taking into account the different types of grid configuration, and **clarity should be brought as to the scope of the planning process, i.e.: holistic, projects package or per project-approach**.

- **The use of existing mechanisms defined under the Governance system of the Energy Union and the TEN-E Regulation to advance coordinated planning and cross-border projects should be used at full and reinforced in the long term.** The absence of national mandatory RES targets under the Renewable Energy Directive makes the monitoring role of the Governance system of the Energy Union even more important to attain the joint EU targets. In its answer to the 2023 European Court of Auditors report, the Commission recognises that it should itself invite Member States to include their national offshore renewable energy targets, broken down by technology type (action to be implemented by the EC by end of 2024).[176] In the absence of national mandatory targets, this could be a pragmatic way of **steering cooperation for the joint fulfilment of EU targets for offshore wind capacity increase**.

- In general, **implementing EU and regional offshore wind objectives requires more steering and control through planning processes, including the definition of trajectories with set milestones**. An area for EU intervention should be the manner to steer national implementation plans towards compliance with EU targets, as well as the cooperation opportunities around common offshore wind projects. The proposal to set offshore wind generation targets per sea basin, as currently envisaged by the proposal for revision of the Renewable Energy Directive (REDIII) is a valid option. Similarly, the proposal to define joint projects between Member States (under REDIII) should be retained, as well as the need to make these joint projects coherent with the needs identified in the high-level strategic

[176] European Commission, Replies to the European Court of Auditors' Special Report – Offshore renewable energy in the EU, 2023, p.5. In its answer, the EC provides that it will 'guide the Member States in specifying their national offshore renewable energy targets, including a breakdown of technology type, when Member States have submitted their final updated national energy and climate plans in 2024. This will build on the guidance the Commission has provided to Member States for drafting their updated national energy and climate plans.'

integrated offshore network development plans for each sea-basin and the Ten Years Network Development Plan (draft revised Art. 9(7) of REDII).[177]

- **Allocating space for offshore renewable energy projects in maritime spatial plans (MSPs) is needed to enable long-term planning.** In addition, the definition of areas for future deployment of offshore wind parks in the national MSP should take into account the need to define 'renewables go-to areas', in accordance with the proposal for revision of the Renewable Energy Directive.[178] This could be made more explicit in EU legislation.

- **In order to optimise the re-use of existing offshore installations, a more pro-active policy in terms of decommissioning, re-use and repurposing should be promoted at EU-level (duty to assess, qualitative criteria in auctions).**

- **In the absence of or as an alternative to joint TSO or regulator offshore, regional fora (like the North Seas Energy Cooperation) should continue to be used to ensure grid coordination at regional level.** More transparency as to their work could be promoted, to further stimulate investment confidence.

3. Permitting

- The currently applicable European legislation defines precise requirements in terms of **time-limit and 'one-stop shop' approach** that not all Member States have yet implemented in their national legislation or applied. The European Commission should pursue a **full implementation of the current legislation as a starting point**.

- Following the adoption of emergency measures under the REpowerEU Plan, the EC has put forward new proposals to further speed-up permitting. In order to ensure legal consistency, it is important to have a consistent approach as to which legislative act to amend. For the requirements aimed as supporting the speed-up of administrative procedures, the Renewable Energy Directive is the relevant legal act. For the requirements related to cross-border energy infrastructures in priority corridors and areas, the TEN-E Regulation is the relevant legal act. For other general requirements related to renewable electricity projects permitting, consistency with Electricity Directive and Electricity Regulation must be considered, as it is already the case for its gas counterpart in the proposed hydrogen and gas markets decarbonisation package.[179] There is an underlying risk of seeing a multiplication of legal instruments defining different mechanisms for streamlining permitting procedures.

[177] Provisional Agreement resulting from interinstitutional negotiations, proposal for revision of the Renewable Energy Directive, 16.06.2023.
[178] Proposal for a Directive of the European Parliament and of the Council amending Directive (EU) 2018/2001 on the promotion of the use of energy from renewable sources, Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency, COM(2022) 222 final, 18.05.2022.
[179] Article 7 (3) on the proposal for a Directive on common rules for the internal markets in renewable and natural gases and in hydrogen.

- The **duration of court proceedings** fall outside the scope of the **time limit set for permitting approval** in REDII proposal. As this remains a major factor of delays, national best practices and new EU proposals aiming at addressing the problem of prolonged procedures due to challenges in courts should be explored further.

- **Further guidance is needed as to best practices when merging processes for offshore wind farm permitting and cable permitting**.

4. Cross-border projects

- In the long run, economic and engineering considerations push strongly for hybrid and meshed network configurations. Offshore networks will therefore obtain similar characteristics as onshore networks with large economies of scales. Regulation will need to follow suit: this requires unbundling of transmission and production also for offshore facilities and regulated network tariffs based on long-run investment costs.

- The business case for offshore windfarms depends crucially on accessing onshore consumption locations, as long-run energy scenarios predict only a limited role for instance for large scale offshore hydrogen production.

- **We recommend that national TSOs become (or remain) responsible for planning, owning and operating the offshore network in a country's exclusive economic area.** Creating one or more separate offshore TSOs will create additional coordination problems between on- and offshore TSOs. This may also be a politically difficult solution to agree on. The lack of a single offshore TSO is not the main hurdle for creating a European level playing field for offshore RES development, so there are only limited upsides.

- Offshore bidding zones will be less liquid than onshore bidding zones, by lack of local flexibility and consumption. The price formation will depend on good integration with onshore markets. **Hybrid assets should therefore be closely integrated within the market coupling algorithm.** Due to this lack of liquidity, offshore forward market are unlikely to develop, which complicates the risk management of offshore wind farms.

- **Coordination between national TSOs is crucial to maximize the value of offshore networks.** Aligning the interests of national TSOs with broader international goals will require binding investment targets, which go beyond joint planning and memoranda of understandings. National TSOs might otherwise favor national interest. The allocation of cross-border congestion revenues does not provide meaningful investment incentives.

- **Alternatives for the interconnector regulations are necessary.** The proposed creation of separate offshore bidding zones will reduce the role of current interconnector regulation as a means to promote market integration. This is not only the case for offshore bidding zones, but also when more national onshore bidding zones are created. The 70% rule is an ad-hoc rule that is not based on economic considerations, and we believe it needs to be gradually replaced with alternative metrics that measure the degree of market integration of the main energy trading hubs, combined with stronger coordinated planning.

- **The use of a cost-benefit model can provide guidance for the allocation of the costs and benefits of hybrid offshore networks between national TSOs.** They are often necessary to create win-win situations. We provide the following recommendations for the cost-benefit models:

  (a) **Use the cost-benefit approach already in the planning phase.** Interdependencies between infrastructure and projects, and among projects become clearer. It prevents the creation of locally optimised networks which are sub-optimal from an EU-level.

  (b) **Consider multiple investment projects simultaneously and avoid piecemeal developments.** Bargaining on multiple projects might be easier: "you win some and you lose some". It also prevents arbitrary cost-allocations based on the order in which projects are developed. For hybrid projects all functions have to be included, not only the role of the interconnector capacity. Also onshore investments related to the hybrid project need to be included.

  (c) **Be specific in determining base line scenarios.** We want to avoid hold-up problems where TSOs postpone onshore investments in order to claim larger costs in the cost allocation model. Therefore, a proactive TSO that upgrades network based on forward-looking demand estimates, should not be disadvantaged in the cost allocation phase.

- Investment choices, i.e. locations will be driven by government decision and centralised planning, and not by market forces. We therefore **favour location specific auctions as we do not want different locations to compete with each other.**

- Market organisation has little effect on profitability of projects or investment incentives with competitive location specific auctions. There is a water-bed effect: higher costs on one component will lead to lower auction revenues and vice-versa. Many specific elements in the market organisation affect the revenue and cost models of offshore wind farms (permit price, support scheme, connection charge, capacity market, congestion prices, balancing payments), but they might not be important in the short-run.

- **The market organisation should focus therefore on providing regulatory certainty to the investors, reduce transaction costs and be compatible with a long-term development of an offshore meshed network.** This means for instance that **network charges should reflect long-term forward looking average costs, which are likely to be lower than the short-term costs**.

- **We recommend the creation of financial transmission access guarantees (TAGs) that hedge both the congestion price risk and the volume risk of wind producers when selling in their**

home market. It reduces the risk for those investors, and because they are financial, they do not foreclose the market. **Combined with a Contract for Difference on the home market's liquid market price, they provide a perfect hedge for end-users.**

5. Mutual and local benefits

Mutual benefits in the form of coexistence

Co-existence is essential in the resolution of both the energy transition and the nature crisis. The focus should be on finding good mechanisms to ensure mutual benefits.

- The European Commission should take **due attention to carry out detailed impact assessment, including on environmental issues, when putting forward new policy and legislative initiatives**.

- **As actors, in the blue economy may have divergent interests in their use of sea areas, there is a need for public intervention in ensuring co-existence.** The role of the EU is justified for ensuring the promotion of joint EU goals in terms of nature protection, renewable energy developments, industrial policies and internal market.

- **EU action around best practices should continue, notably through the elaboration of good practices guidance and platform for exchange of best practices.** This applies to all stages of offshore wind projects development, from planning to tendering, award operation and decommissioning.

- **Minimum harmonisation measures for the mapping and solving of co-existence potentials could be reinforced** in the following ways: during spatial maritime planning, cross-border co-existence potentials should be better mapped and addressed, with the definition of an obligation to assess such potential and report on the result of the assessment; obligation to ensure early stakeholder engagement as part of the tender requirements for offshore wind tenders; inclusion of multi-use as a qualitative criteria in tendering and permitting processes.

The promotion of local benefits, as non-price criteria in offshore wind auctions

- The European legislation (REDII, state aid guidelines) now allows for giving weight to non-price criteria as part of offshore wind tendering. **In order to preserve the level playing field between actors and promote good practices, the European Commission should provide additional guidance as to the definition of non-price criteria in auctions**.

- **The need for alignment between non-price criteria in offshore wind auctions is particularly important in the perspective of cross-border projects and increasingly meshed grids**, where national tendering and support schemes will be juxtaposed. While Member States are responsible for the details of the design of the auction (including selection criteria), **further clarification to that respect could come as an amendment to the CEEAG**, that are binding on the European Commission when assessing notified state aid measures.

- Notably, **further clarification could be given as to the stage for allowing non-price criteria (pre-qualification, tendering or award).** This would enable a consistent interpretation of the state aid rules and avoid diverging national practices that may result in distortion of competition for OW product design.

- Similarly, **further clarification should be given as to which non-price elements are accepted in the tendering process, where a distinction might need to be made between criteria related to innovation, environmental protection and for example circularity, and other criteria resembling local content requirements** that may give unfair advantage to national champions or local companies, and so contradict competition law rules.

7 References

Treaties

EU-UK Trade and Cooperation Agreement

Treaty on the European Union

Treaty on the Functioning of the European Union

UK/Norway Agreement on Cross-Border Trade in Electricity and Cooperation on Electricity Interconnection, 2021

United Nations Convention on the Law of the Sea

Legislation

Council Regulation (EU) 2022/2577 of 22 December 2022 laying down a framework to accelerate the deployment of renewable energy http://data.europa.eu/eli/reg/2022/2577/oj

Regulation (EU) 2022/869 of the European Parliament and of the Council of 30 May 2022 on guidelines for trans-European energy infrastructure, amending Regulations (EC) No 715/2009, (EU) 2019/942 and (EU) 2019/943 and Directives 2009/73/EC and (EU) 2019/944, and repealing Regulation (EU) No 347/2013 (TEN-E Regulation) 152 OJ L (2022). http://data.europa.eu/eli/reg/2022/869/oj/eng

Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU (recast) http://data.europa.eu/eli/dir/2019/944/oj

Regulation (EU) 2019/943 of the European Parliament and of the Council of 5 June 2019 on the internal market for electricity (recast), 158 OJ L (2019). http://data.europa.eu/eli/reg/2019/943/oj/eng

Regulation (EU) No 838/2010 of 23 September 2010 on laying down guidelines relating to the inter transmission system operator compensation mechanism and a common regulatory approach to transmission charging. 250 OJ L (2010). http://data.europa.eu/eli/reg/2010/838/oj

Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC, now repealed and replaced.
ELI: http://data.europa.eu/eli/dir/2009/28/oj

Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive), of 17 June 2008. http://data.europa.eu/eli/dir/2008/56/2017-06-07

Europen Commission decisions

Commission Decision (EU) 2020/2123 of 11 November 2020 granting the Federal Republic of Germany and the Kingdom of Denmark a derogation of the Kriegers Flak combined grid solution pursuant to Article 64 of Regulation (EU) 2019/943 of the European Parliament and of the Council

Academic References

Attya, A. B., Dominguez-Garcia, J. L., & Anaya-Lara, O. (2018). A review on frequency support provision by wind power plants: Current and future challenges. *Renewable and Sustainable Energy Reviews*, 81, 2071–2087. https://doi.org/10.1016/j.rser.2017.06.016

Bichler, M., Grimm, V., Kretschmer, S., & Sutterer, P. (2020). Market design for renewable energy auctions: An analysis of alternative auction formats. *Energy Economics*, 92, 104904. https://doi.org/10.1016/j.eneco.2020.104904

Bjorndal, M., & Jornsten, K. (2001). Zonal pricing in a deregulated electricity market. *The Energy Journal*, 22(1). https://doi.org/10.5547/ISSN0195-6574-EJ-Vol22-No1-3

Buijs, P., Bekaert, D., & Belmans, R. (2010). Seams Issues in European Transmission Investments. *The Electricity Journal*, 23(10), 18–26. https://doi.org/10.1016/j.tej.2010.10.014

Cole, S., Martinot, P., Rapoport, S., & Papaefthymiou, G. (2015). Cost-benefit analysis of a coordinated grid development in the North Sea. 2015 *IEEE Eindhoven PowerTech*, 1–5. https://doi.org/10.1109/PTC.2015.7232385

Durakovic, G., del Granado, P. C., & Tomasgard, A. (2023). Powering Europe with North Sea offshore wind: The impact of hydrogen investments on grid infrastructure and power prices. *Energy*, *263*, 125654. https://doi.org/10.1016/j.energy.2022.125654

Egerer, J., Kunz, F., & Hirschhausen, C. von. (2013). Development scenarios for the North and Baltic Seas Grid – A welfare economic analysis. *Utilities Policy*, *27*, 123–134. https://doi.org/10.1016/j.jup.2013.10.002

Fabra, N., & Montero, J.-P. (2022). Technology Neutral vs. Technology Specific Procurement (*CEEPR WP* 2022-005; p. 48). https://ceepr.mit.edu/workingpaper/technology-neutral-vs-technology-specific-procurement/,

Felling, T., Felten, B., Osinski, P., & Weber, C. (2019). Flow-based market coupling revised-Part II: Assessing improved price zones in Central Western Europe. https://doi.org/10.2139/ssrn.3404046

Gea Bermúdez, J., Pedersen, R. B. B., Koivisto, M. J., Kitzing, L., & Ramos, A. (2021). Going offshore or not: Where to generate hydrogen in future integrated energy systems? *TechRxiv*. https://doi.org/10.36227/techrxiv.14806647.v2

Gorenstein Dedecca, J., & Hakvoort, R. A. (2016). A review of the North Seas offshore grid modeling: Current and future research. *Renewable and Sustainable Energy Reviews*, *60*, 129–143. https://doi.org/10.1016/j.rser.2016.01.112

Gorenstein Dedecca, J., Hakvoort, R. A., & Herder, P. M. (2017). Transmission expansion simulation for the European Northern Seas offshore grid. *Energy*, 125, 805–824. https://doi.org/10.1016/j.energy.2017.02.111

Green, R., & Vasilakos, N. (2011). The economics of offshore wind. *Energy Policy*, 39(2), 496–502. https://doi.org/10.1016/j.enpol.2010.10.011

Grimm, V., Martin, A., Weibelzahl, M., & Zöttl, G. (2016). On the long run effects of market splitting: Why more price zones might decrease welfare. *Energy Policy*, 94, 453–467. https://doi.org/10.1016/j.enpol.2015.11.010

Konstantelos, I., Pudjianto, D., Strbac, G., De Decker, J., Joseph, P., Flament, A., Kreutzkamp, P., Genoese, F., Rehfeldt, L., Wallasch, A.-K., Gerdes, G., Jafar, M., Yang, Y., Tidemand, N., Jansen, J., Nieuwenhout, F., van der Welle, A., & Veum, K. (2017). Integrated North Sea grids: The costs, the benefits and their distribution between countries. *Energy Policy*, 101, 28–41. https://doi.org/10.1016/j.enpol.2016.11.024

Kristiansen, M., Korpås, M., & Farahmand, H. (2018). Towards a fully integrated North Sea offshore grid: An engineering-economic assessment of a power link island. *WIREs Energy and Environment*, *7*(4), e296. https://doi.org/10.1002/wene.296

Lüth, A., Seifert, P. E., Egging-Bratseth, R., & Weibezahn, J. (2023). How to connect energy islands: Trade-offs between hydrogen and electricity infrastructure. *Applied Energy*, *341*, 121045. https://doi.org/10.1016/j.apenergy.2023.121045

Maskin, E., & Riley, J. (2000). Asymmetric Auctions. *The Review of Economic Studies*, 67(3), 413–438. https://doi.org/10.1111/1467-937X.00137

Pollitt, M. M von der Fehr, N.H. Willems,B. Banet,C. Le Coq,C. Navia, D. & Bennato, A.R.(2022). Recommendations for a Future-Proof Electricity Market Design (p. 215). *Centre on Regulation in Europe (CERRE)*. https://cerre.eu/publications/recommendations-for-a-future-proof-electricity-market-design/

Myerson, R. B. (1981). Optimal Auction Design. *Mathematics of Operations Research*, 6(1), 58–73. https://doi.org/10.1287/moor.6.1.58

Nieuwenhout, C. T. (2022). Dividing the Sea into Small Bidding Zones? The Legal Challenges of Connecting Offshore Wind Farms to Multiple Countries. *Journal of Energy and Natural Resources Law*, 40(3), 315-335. https://doi.org/10.1080/02646811.2021.2011034

Sadowska, M., & Willems, B. (2013). Power Markets Shaped by Antitrust. *European Competition Journal*, 9(1), 131–173. https://doi.org/10.5235/17441056.9.1.131

Schneller, Christian, 'Cross-border electricity trade in Europe – Towards an 'electrical Schengen area'?, M. M. Roggenkamp and C. Banet (eds.), *EELRXIV* (Intersentia, 2021), Chapter VII, pp. 131-147
Sunila, K., Bergaentzlé, C., Martin, B., & Ekroos, A. (2019). A supra-national TSO to enhance offshore wind power development in the Baltic Sea? A legal and regulatory analysis. *Energy Policy*, 128, 775 782. https://doi.org/10.1016/j.enpol.2019.01.047

Tangerås, T. P. (2012). Optimal transmission regulation of an integrated energy market. *Energy Economics*, 34(5), 1644–1655. https://doi.org/10.1016/j.eneco.2012.01.007

Van Damme, E., Gerlagh, R., Heijmans, R., & Willems, B. (2019). Veilen of Vergelijken Voor Het Winnen Van Windenergie Op Zee? *Tilburg University*.

Policy Documents

ACER-CEER, Reaction to the European Commission's public consultation on electricity market design, 14 February 2023.
https://www.ceer.eu/documents/104400/-/-/2bf4fff4-b32b-9b00-c2e2-c039101ad39c

ACER and CEER Reflection on the EU Strategy to harness the potential of offshore renewable energy for a climate neutral future, 11 April 2022.
https://www.ceer.eu/documents/104400/-/-/0ee9681b-fbc9-d367-9099-ad9b258088a7

ACER (2019). ACER Practice report on transmission tariff methodologies in Europe.pdf (p. 71).
https://acer.europa.eu/Official_documents/Acts_of_the_Agency/Publication/ACER%20Practice%20report%20on%20transmission%20tariff%20methodologies%20in%20Europe.pdf

ACER (2014). Opinion of the Agency for the Cooperation of Energy Regulators No09/2014, 15 April 2014 on the Appropriate Range of Transmission Charges Paid by Electricity Producers (p. 22).
https://www.acer.europa.eu/Official_documents/Acts_of_the_Agency/Opinions/Opinions/ACER%20Opinion%2009-2014.pdf

BEMIP Offshore Wind Work Programme (2021), final_bemip_offshore.pdf (europa.eu)

Energistyrelsen – Danish Energy Agency, Foreign Experiences for Awarding Offshore Wind, New concepts for awarding offshore wind licences in Denmark - Part 1, 2022.
https://ens.dk/sites/ens.dk/files/Vindmoller_hav/part_1_-_foreign_experiences_for_awarding_offshore_wind.pdf

European Commission, Replies to the European Court of Auditors' Special Report – Offshore renewable energy in the EU, 2023.
https://www.eca.europa.eu/Lists/ECAReplies/COM-Replies-SR-2023-22/COM-Replies-SR-2023-22_EN.pdf

Proposal for a regulation of the European Parliament and of the Council amending Regulations (EU) 2019/943 and (EU) 2019/942 as well as Directives (EU) 2018/2001 and (EU) 2019/944 to improve the Union's electricity market design (COM(2023) 148 final), 14.03.2023.
https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52023PC0148&qid=1679410882233

European Commission, Report on the Achievement of the 2020 Renewable Energy Targets, COM(2022) 639 final, 15.11.2022.

European Commission, Better Regulation Guidelines, Staff Working Document, SWD(2021) 305 final, November 2021. https://commission.europa.eu/system/files/2021-11/swd2021_305_en.pdf

European Commission, Communication, Guidelines on State aid for climate, environmental protection and energy 2022, C/2022/481, of 18.02.2022.

European Commission, proposal for a directive of the European Parliament and of the Council amending Directive (EU) 2018/2001 of the European Parliament and of the Council, Regulation (EU) 2018/1999 of the European Parliament and of the Council and Directive 98/70/EC of the European Parliament and of the Council as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652, COM(2021) 557 final, 14.07.2021. https://www.europarl.europa.eu/RegData/docs_autres_institutions/commission_europeenne/com/2021/0557/COM_COM(2021)0557_EN.pdf

European Commission, Impact Assessment Report accompanying the proposal for a Directive for of the European Parliament and the Council amending Directive (EU) 2018/2001 of the European Parliament and of the Council, Regulation (EU) 2018/1999 of the European Parliament and of the Council and Directive 98/70/EC of the European Parliament and of the Council as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652, SWD(2021) 621 final, 14.07.2021.

European Commission, An EU Strategy to harness the potential of offshore renewable energy for a climate neutral future, COM(2020) 741 Final 27 (2020). https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020DC0741

European Commission, Guidance on electricity market arrangements: A future-proof market design for offshore renewable hybrids projects, Commission Staff Working Document Accompanying the Communication An EU Strategy to harness the potential of offshore renewable energy for a climate neutral future, SWD(2020) 273 final, 19.11.2020. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=SWD:2020:273:FIN&qid=1605792817427

European Commission, Impact Assessment accompanying the Commission Communication on Stepping up Europe’s 2030 climate ambition, SWD(2020) 176 final, 17.9.2020. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020SC0176#footnoteref302

European Commission, Addressing conflicting spatial demands in MSP – Considerations for MSP planners, Final Technical Study, 2019. https://op.europa.eu/en/publication-detail/-/publication/8971ab22-8285-11e9-9f05-01aa75ed71a1/language-en/format-PDF/source-98582084

European Commission, Renewable energy progress report, COM(2013) 175 final, 27.3.2013

European Court of Auditors, Offshore renewable energy in the EU – Ambitious plans for growth but

sustainability remains a challenge, Special report 22/2023.
https://www.eca.europa.eu/en/publications/SR-2023-22
European Council, Conclusions, 23-24 October 2014
European Parliament, Provisional Agreement resulting from interinstitutional negotiations, proposal for revision of the Renewable Energy Directive, 16.06.2023.
https://www.europarl.europa.eu/RegData/commissions/itre/inag/2023/06-16/ITRE_AG(2023)751617_EN.pdf

European Parliament, Committee on Industry, Research and Energy (ITRE), Draft report on a European strategy for offshore renewbale energy, 2021/2012(INI), 9.6.2021.
https://www.europarl.europa.eu/doceo/document/ITRE-PR-693604_EN.pdf

ENTSO-E Position on Offshore Development, Assessment of Roles and Responsibilities for Future Offshore Systems, November 2022 https://www.entsoe.eu/outlooks/offshore-development/

ENTSO-E (2002c), Offshore Network Development Plans 2024 – Guidance Document, 6 September 2022 https://eepublicdownloads.blob.core.windows.net/public-cdn-container/tyndp-documents/ONDP2024/220906_ENTSO-E_Guidance_ENER_ENTSO-E_clean.pdf

ENTSO-E (2022a). Overview of Transmission Tariffs in Europe: Synthesis 2020 (p. 70). https://eepublicdownloads.entsoe.eu/clean-documents/mc-documents/l_entso-e_TTO-Report_2020_03.pdf

ENTSO-E. (2022a). Overview of Transmission Tariffs in Europe: Synthesis 2020 (p. 70). https://eepublicdownloads.entsoe.eu/clean-documents/mc-documents/l_entso-e_TTO-Report_2020_03.pdf

ENTSO-E. (2022b). ENTSO-E Position on Offshore Development: Assessment of Roles and Responsibilities for Future Offshore Systems (p. 34). https://eepublicdownloads.blob.core.windows.net/public-cdn-container/clean-documents/Publications/2022/entso-e_pp_Offshore_Development_Assessment_roles_responsibilities_221118.pdf

Esbjerg Declaration on the North Sea as a Green Power Plant of Europe, 18 May 2022. https://www.stm.dk/media/11345/esbjerg-declaration_170522_v3.pdf

European Commission, DG ENER, Member States agree new ambition for expanding offshore renewable energy, 19 January 2023
https://energy.ec.europa.eu/news/member-states-agree-new-ambition-expanding-offshore-renewable-energy-2023-01-19_en

European Commission, Commission Notice – Guidance on Cost-Benefit Sharing in Cross-border Renewable Energy Cooperation Projects, C(2022) 9284 final, 15.12.2022.

https://energy.ec.europa.eu/system/files/2022-12/C_2022_9284_F1_OTHER_AUTONOMOUS_ACT_EN_V2_P1_2356829.PDF

European Commission, Recommendation of 18.5.2022 on speeding up permit-granting procedures for renewable energy projects and facilitating Power Purchase Agreements, C/2022/3219 final. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=PI_COM%3AC%282022%293219

European Commission, Staff Working Document – Guidance to Member States on good practices to speed up permit-granting procedures for renewable energy projects and facilitating Power Purchase Agreements – Accompanying the Commission Recommendation on Speeding up permit-granting procedures for renewable energy projects and facilitating Power Purchase Agreements, SWD/2022/0149 final, 18 May 2022.
https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52022SC0149

European Commission, An EU Strategy to harness the potential of offshore renewable energy for a climate neutral future, COM(2020) 741 Final 27 (2020).
https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020DC0741

European Commission, Communication on a new approach for a sustainable blue economy in the EU Transforming the EU's Blue Economy for a Sustainable Future, COM(2021) 240 final, 17.5.2021.
https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52021DC0240

European Commission, Communication, The European Green Deal, COM(2019)640 final, 11.12.2019.

European Commission, Directorate-General for Energy, Roland Berger GmbH, Kern, S., Zorn, T., Weichenhain, U., & Elsen, S. (2019). Hybrid projects: How to reduce costs and space of offshore development : North Seas offshore energy clusters study. Publications Office of the European Union.
https://data.europa.eu/doi/10.2833/416539

European Commission, Proposal for a regulation of the European Parliament and of the Council on establishing a framework of measures for strengthening Europe's net-zero technology products manufacturing ecosystem (Net Zero Industry Act), COM(2023) 161 final, 16.3.2023

European Court of Auditors, Offshore renewable energy in the EU, Special report 22, September 2023

European Commission, Proposal for a Directive of the European Parliament and of the Council amending Directive (EU) 2018/2001 on the promotion of the use of energy from renewable sources, Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency, COM(2022) 222 final, 18.05.2022.

European Parliament, 'A European strategy for offshore renewable energy', Resolution of 16 February 2022, P9_TA(2022)032.
https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2022:222:FIN

International Energy Agency (IEA), Renewables 2022 – Analysis and forecast to 2027, revised version January 2023, https://www.iea.org/reports/renewables-2022

International Energy Agency, Tracking Offshore Wind 2020, available at: https://www.iea.org/reports/tracking-offshore-wind-2020

International Renewable Energy Agency (IRENA), Renewable power generation costs in 2022, 2023, ISBN 978-92-9260-544-5. https://www.irena.org/Publications/2023/Aug/Renewable-Power-Generation-Costs-in-2022

Joint Research Center (JRC) of the European Commission, Wind Energy in the European Union – Status report on technology development, trends, value chains and markets, 2022. https://publications.jrc.ec.europa.eu/repository/handle/JRC130582

Nordic Energy Research, Coexistence and nature-inclusive design in Nordic offshore wind farms, March 2023. https://www.norden.org/en/publication/coexistence-and-nature-inclusive-design-nordic-offshore-wind-farms

The North Seas Countries' Offshore Grid Initiative (NSCOGI) - Initial Findings, 2012, available at https://www.benelux.int/files/1414/0923/4478/North_Seas_Grid_Study.pdf.

North Sea Wind Power Hub (NSWPH), A strategy to establish an offshore bidding zone for hybrid projects, Discussion Paper #3, May 2022. https://northseawindpowerhub.eu/knowledge/discussion-paper-a-strategy-to-establish-an-offshore-bidding-zone-hybrid-projects

OFGEM. (2020, August 12). Open letter: Notification to interested stakeholders of our interconnector policy review. https://www.ofgem.gov.uk/sites/default/files/docs/2020/08/open_letter_-interconnector_policy_review.pdf

Ostend Declaration of energy ministries on the North Seas as a green power plant of Europe delivering cross-border projects and anchoring the renewable offshore industry in Europe, 24 April 2023. https://www.regjeringen.no/contentassets/78bfc87bb04044c0933002ad7dd6e0f1/erklaring-energiministere.pdf

Progress on Meshed HVDC Offshore Transmission Networks (PROMOTioN), Work Package 7.5: Final Deliverable (D7.9) D7.9 Regulatory and Financing principles for a Meshed HVDC Offshore Grid, 2019. https://www.promotionoffshore.net/fileadmin/PDFs/D7.9_Regulatory_and_Financing_principles_for_Meshed_HVDC_Offshore_Grid_2_.pdf

Roland Berger GmbH, Kern, S., Zorn, T., Weichenhain, U., & Elsen, S. (2019). Hybrid projects: How to reduce costs and space of offshore development : North Seas offshore energy clusters study. Publications Office of the European Union. https://data.europa.eu/doi/10.2833/416539

WindEurope, WindEurope position on non-price criteria in auctions, April 2022, Annex. https://windeurope.org/policy/position-papers/windeurope-position-on-non-price-criteria-in-auctions/

cerre Centre on Regulation in Europe

Avenue Louise 475 (box 10)
1050 Brussels, Belgium
+32 2 230 83 60
info@cerre.eu
www.cerre.eu
@CERRE_ThinkTank
Centre on Regulation in Europe (CERRE)
CERRE Think Tank