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Accompanying the document

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMIITTEE OF THE REGIONS

An EU strategy to harness the potential of offshore renewable energy for a climate neutral future

{COM(2020) 741 final}

Guidance on electricity market arrangements: A future-proof market design for offshore renewable hybrid projects

I. Introduction

The European Union is set to become the first climate neutral continent by 2050, delivering on the commitment to achieve an inclusive, affordable and green transition. Offshore renewable energy will play a key role in transforming our energy sector and the Commission communication attached sets out the extent of the challenge this presents. A huge up-scale is needed to achieve the objective of a fivefold increase by 2030 and a 25-fold increase by 2050 to reach approximately 300 GW of installed capacity, and this is just for offshore wind. Other technologies at earlier stages of development also have a part to play. To achieve these ambitious objectives, there must be a significant step change in how we work to enable the cross-border cooperation required to deploy the levels of offshore renewable energy needed.

Today, offshore wind energy is deployed mainly through *national projects*, with offshore windfarms connected *radially* to the shore and cross-border interconnectors developed separately. Although a significant proportion of offshore projects is likely to continue to be developed in this way[1], some projects are expected to progress more efficiently and with significant welfare gains if they are developed as generation hubs connected to two or more Member States. These projects, known as hybrid projects because they combine energy generation and interconnection, can yield estimated cost savings of up to 10%[2] but also come with additional risks due to legal uncertainties related to regulatory treatment and other issues such as the distribution of costs and benefits among project partners. This moment in time represents a unique opportunity to prepare for a large up-scale of renewable energy and avoid sub-optimal growth due to fragmented national approaches in scarce maritime space.

The key challenge is how to deploy these projects in a way that achieves the least-cost transition for consumers and maintains social acceptance of the energy transition as a whole. Although there are clear benefits to a more integrated offshore grid for renewable energy production, these projects are complex to set up. In addition, the market rules governing the electricity system have been designed for a renewables-based future in a way that supports security of supply and the integration of large volumes of renewable energy over a wide area. However, they were not designed specifically with offshore hybrid projects in mind.

[1] "Progress on Meshed HVDC Offshore Transmission Networks" modelled a large scale up of offshore wind energy projects and energy hubs in the North Sea: www.promotion-offshore.net

[2] Roland Berger GmbH (2019), Hybrid projects: How to reduce costs and space of offshore developments, North Seas Offshore energy Clusters study: https://op.europa.eu/en/publication-detail/-/publication/59165f6d-802e-11e9-9f05-01aa75ed71a1

This paper focuses mainly on the specific category of offshore hybrid projects. These projects raise complex questions to be addressed to ensure that the regulatory framework is not a barrier to deployment. The objective of this guidance is to address some of the key questions facing Member States, regulatory authorities, TSOs and project promoters concerning the application of the electricity market legislation to offshore developments. In particular:

- It explains how to design offshore projects in line with the current rules, in particular unbundling, market dispatch and cross-border trading rules;
- It considers whether an adaptation of the current regulatory framework is needed to address the specific needs of investment incentives for hybrid projects;
- It examines the need for coordination on technical rules regarding connection to the electricity grid.

This guidance is technology-neutral, though it may be primarily of interest to offshore wind, which is currently the most mature offshore renewable energy technology. In addition, some of the elements outlined below can also be applied to more traditional offshore generation projects connected only to one market.

II. A market framework for offshore renewable energy

The EU rules governing the electricity market (namely Electricity Directive (EU) 944/2019 and Regulation (EU) 943/2019) aim to ensure that the integrated EU electricity market operates in a way that is fair and fit for renewable energy. In particular, the Regulation strengthens shorter-term markets, which will provide several benefits for renewable energy, enabling variable renewables to participate on a more equal footing as the markets close at the day-ahead and intraday stages when more accurate forecasting of generation is possible. This allows power generation using variable renewable sources to manage their risks and it also supports security of supply by allowing the full flexibility of our interconnected electricity system to integrate renewables over a wider area and respond to unforeseen events. The aim of these rules is to enable renewable energy to become the backbone of our electricity system.

This paper recognises that the electricity market rules were not designed with the specific needs of offshore hybrid projects in mind and therefore describes the current market framework. It sets out the Commission's view on certain areas where stakeholders have raised questions on complex topics such as market dispatch, unbundling, cross-border electricity trading and bidding zone configuration. It also analyses the rules on congestion income and the grid connection Network Codes to determine whether adaptations are needed to ensure that these rules are fit for purpose for a large scale-up of offshore renewable energy projects.

I. Explanation of the main market rules applicable

a) Market dispatch and balance responsibility

In the early days of renewable energy deployment, renewable energy was an emergent technology, protected from competition and market dynamics on the wholesale electricity market by support mechanisms, priority dispatch, priority access, and other types of specific frameworks. Nowadays, although not all renewable technologies are at the same stage of development, technologies such as wind and solar are highly competitive and renewable energy constitutes around one-third of all electricity generation in the EU[3]. The current market framework, in particular the recast Electricity Regulation, therefore takes account of the considerable progress made over recent years and recognises that renewable energy is becoming the foundation of our electricity system.

This is a significant change in the regulatory framework for producers of renewable energy because, in the past, they were often not exposed to market dynamics and obligations. The Electricity Regulation does not put an end to existing support schemes, indeed Article 12(6) provides a guarantee that producers on existing schemes may continue to benefit from priority dispatch granted under those schemes. However, though there are exemptions for small generation assets and demonstration projects[4] – especially important in the context of emerging offshore technologies – there are now clear rules on how large new investment projects should operate.

Article 12 of the Electricity Regulation sets out the rules on power generation dispatch. Large new renewable energy installations no longer benefit from priority dispatch, which means that future offshore wind generation will need to operate according to market based dispatch. Existing installations that already benefit from priority dispatch can continue to do so. Priority dispatch is also maintained for new small-scale installations up to 400 kW (decreasing to 200 kW from January 2026) and for demonstration projects for innovative technologies, therefore potentially for innovative tidal or wave offshore investments.

It is worth noting that, for hybrid projects, the issue of priority dispatch is not simply about access to a market. It is inherently linked to issues of third-party access and cross-border trade flows. In order to allow all generation to be able to compete for scarce interconnection capacity, fair and non-discriminatory treatment is critical. Article 12(7) of the Electricity Regulation states that priority dispatch must not be used to reduce cross-border capacities. This is to ensure that the cheapest sources of renewable energy will be dispatched and traded throughout the EU.

Article 5 of the Electricity Regulation sets out rules on balancing responsibility. In principle, all market participants must be responsible for the imbalances they cause in the system. For renewable energy producers active on the market, this means that they need to bear the risk of

[3] Source: Eurostat, 2018.

[4] Small generation assets and demonstration projects may be granted priority dispatch and an exemption from balancing responsibility under the Electricity Regulation.

incorrect predictions for production, e.g. due to incorrect wind forecasts. This creates incentives to improve forecasts or pay for better forecast services. Derogations from balancing responsibility may be maintained for small installations, demonstration projects and installations benefiting from support already approved under EU State aid rules commissioned before 4 July 2019.

These provisions mean that, as a starting point, electricity producers bear the responsibilities related to buying and selling the electricity they generate. The electricity producer can bear the responsibilities and complexities of operating in the wholesale market itself or delegate them contractually to a third party (an aggregator, a supplier, or another type of service provider). It would, of course, be a commercial decision to outsource to a third party service provider.

Another aspect of market operation crucial for offshore hybrid renewables is curtailment (or other forms of downward re-dispatch), especially as we achieve higher levels of renewable energy integration into our electricity systems. The Regulation distinguishes between market-based re-dispatch and non-market-based re-dispatch. Market-based redispatch will always require the agreement of the operator of the facility to be redispatched, e.g. by having made an offer for redispatch services (or using offers from other markets such as the balancing market). If however, exceptionally, non-market-based re-dispatch is used, the Regulation provides strong protection for renewables, which should only be subject to downward re-dispatching as a last resort once all other technologies that can reasonably respond have been exhausted first. Any such curtailment should also be suitably compensated pursuant to Article 13(7). It should be noted that compensation is linked to the price at the day-ahead level in the bidding zone of the renewable energy producer, and therefore impacted by the definition of bidding zones. It should also be noted that a renewable energy producer would not be remunerated if a commercial decision is made not to generate due to low or negative market prices.

In addition, one provision is especially relevant for large renewable energy installations with a significant impact on cross-border electricity trading. Article 12(7) expressly sets out that priority dispatch is no justification for reductions in cross-border capacity available for trade[5]. Therefore, where priority dispatch creates internal congestion, this does not allow deviation from the cross-border trading requirements under Article 16, which are explained further below in point c of this section.

Lastly, it is important to acknowledge that in a system based on market dispatch with full balancing responsibility, renewable energy producers are exposed to several types of risks. The main risks are price risks (if the market price is lower than expected, reducing revenue) and imbalance risks (if production is not as forecast and scheduled, thus creating imbalance costs). Producers can reduce those risks, and partly hedge against their impact, either themselves or through third-party service providers. Lower than expected prices on short-term

[5] Always with the caveat that system operators may take the measures that are necessary to maintain system security, in accordance with the Electricity Regulation.

markets can be hedged by trading electricity on long-term markets (e.g. either via specific power purchase agreements selling renewable electricity or on general forward markets). If the expected risks are due to price differences between different geographical areas (e.g. between an offshore bidding zone and a neighbouring market), they can be mitigated by trading forward transmission capacity (be it financial or physical transmission rights). To mitigate imbalance risks, producers of weather-dependent energy generation should use the best forecasting methods available as a basis for scheduling. Relevant national authorities should also consider providing clear explanations of how the market rules will affect producers[6] in their specific bidding zone and circumstances.

b) Unbundling

Unbundling, in application since the Third Energy Package of 2009[7] to ensure non-discriminatory system operation and third-party access, also applies to the offshore renewable electricity sector. That means that there must be a separation between electricity transmission on one hand, and electricity production, as well as storage or hydrogen production on the other hand. Therefore, although owners of offshore energy generation can also own and operate storage or electrolysers, for example, this is in principle not allowed for system operators.

Indeed, the fundamentals of third-party access and ensuring non-discriminatory treatment will become increasingly important as the offshore sector grows. Unbundling is crucial to create a level playing field and to set the right incentives for TSOs to take decisions independently, ensuring transparency and non-discrimination towards network users and as regards extending these grids where necessary. Importantly, even under a full ownership unbundling regime, it is not only the incumbent TSOs who are allowed to build networks, provided there is separate ownership and operation of generation and transmission assets once projects are operational. This separation requirement is due to the potential for distorting the market if the transmission owner operates generation assets in connecting markets or hampering competition by restricting third-party access to the transmission network.

There are alternatives to the traditional TSO model (where solely the TSO builds and operates the grid) that satisfy the unbundling rules as interpreted and applied by the Commission and that avoid conflicts of interest or incentives for discriminatory behaviour. The Commission

[6] For example, an industry guide to new market rules was provided in Ireland in 2017: https://www.sem-o.com/documents/general-publications/I-SEM-Industry-Guide.pdf

[7] In order to respond to the shortcomings identified in the 2007 Sector Inquiry and improve the functioning of the internal energy market, notably by addressing the problem of systematic network foreclosure through generator-owned grid operators, the operation of transmission networks was fully separated from the activities of energy supply and generation, thereby opening up European electricity markets to competition, innovative business models and increased transparency and oversight. System operators must apply for certification as an unbundled operator with their national regulatory authority and the Commission provides its opinion on the certification procedure.

has published a staff working paper[8] on "*Ownership Unbundling: The Commission's practice in assessing a conflict of interest including in the case of financial investors"* to set out these alternatives in more detail. One such example is the UK's Offshore Transmission Owner (OFTO) regime, which allows project developers to design, install and connect each project to shore with its own transmission link. The ownership of the finished cable is then tendered by the national regulatory authority (NRA) to a separate transmission operator (or OFTO), which can earn a regulated rate of return on the costs of operating these networks. The structure of this model works well and the UK has seen a reduction in the cost of building these transmission cables due to competitive downward pressure. Recent opinions issued by the Commission on certification have highlighted concerns about the tenders awarded to OFTO companies that also have a commercial interest in the electricity market and potentially an ability to exert their influence on that market[9]. It is important to note that offshore wind assets in particular are often considerable in size and could therefore have a significant market impact. This is something that the Commission continues to follow closely.

It is currently not clear whether the benefits of a model where the investor builds both the generation asset and the grid or the planned deployment undertaken by the national TSO is more conducive to the scale of the decarbonisation challenge. The former may result in a speedier build-out due to less of a need to coordinate between stakeholders, though the latter may result in better optimisation in a limited maritime space and potentially more deployment than a project-by-project approach. The Commission will continue to monitor the performance of all approaches, including the degree to which they help bring to market new solutions such as HVDC and digital services as well as storage and conversion investments.

In the longer term and looking ahead to the development of meshed and integrated offshore grids, models that work well in other sectors or geographic regions could also be considered. For example, a group of TSOs could plan, build and operate meshed assets, with support from the competent Regional Coordination Centre. They could propose the bidding zone configuration, including designating a TSO to manage the bidding zone(s), and relevant NRAs and Member States would approve the deployment plans. Today this way of working is established practice when Member States build interconnectors between countries, but it would be a more complex model, with more parties involved, additional responsibilities and operational tasks to be carried out by a designated TSO. Alternatively, a common model used often in the US is that of an Independent System Operator (ISO)[10]. In Europe, it would mean relevant Member States or relevant system operators setting up an ISO together to develop and operate offshore assets in a well-coordinated manner, including managing the bidding zone and ensuring operational security. Commercial parties would own the infrastructure and

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[8] https://ec.europa.eu/transparency/regdoc/rep/10102/2013/EN/10102-2013-177-EN-F1-1.PDF

[9] The Commission has remarked that, given the increasing share of renewable electricity production and the increasing importance of energy storage solutions, the accumulation of smaller generation capacities should be fully taken into account when assessing whether there is an incentive and ability for a shareholder in a TSO to influence the TSO's decision-making to the detriment of other network users.
https://ec.europa.eu/energy/sites/ener/files/documents/2019_157_walney_uk_en.pdf

[10] PJM, ISO New England, CAISO, for example. This should not be confused with the ISO model under the EU Electricity and Gas Directives.

receive a regulated return. Such a model is also used for gas infrastructure in the North Sea region. This model could be used on a multilateral basis in the electricity sector, in a way that is fully compliant with unbundling requirements.

c) Cross-border electricity trading through an offshore hybrid asset

The free flow of electricity across the European Union is key to achieving secure, affordable and clean energy for EU citizens and businesses. To support the integration of electricity markets, increase flexibility and ensure that larger volumes of renewable energy can be connected over wider areas, billions of euro are spent each year on cross-border interconnection projects. This is primarily paid for by European consumers through tariffs on their electricity bills, but also with significant EU funding.[11] It is important that, once built, interconnectors between EU Member States are used in the most efficient way possible to deliver the intended benefits to consumers, to support a greener electricity system and to ensure that all Member States can rely on imports to support security of supply when needed. This should also apply to interconnectors combined with renewable generation assets (hybrid projects).

In the EU, the schedules for cross-border trading are calculated through a joint process known as market coupling. Market coupling uses bidding zone prices, which have been calculated via marginal pricing, combined with cross-border grid constraints to determine the trade flows between transmission systems. These bidding zones (or price zones) are market areas within which electricity must be able to flow freely without encountering structural congestion. Therefore, there is a single wholesale electricity price within a bidding zone. When there are differences in prices in neighbouring bidding zones, the electricity trade flows from the lower to higher priced zone.

In the past, there have been problematic cases of TSOs closing their borders to electricity imports, even renewable electricity imports, in a structural way to manage congestion within their own control areas[12]. This runs counter to key principles of the Treaty on the Functioning of the European Union (TFEU) regarding electricity market design, which include the principles of the free movement of goods and non-discrimination between internal and cross-zonal exchanges. Any such action may also be considered contrary to the competition rules enshrined in the Treaty, in particular Article 102 TFEU. These principles and rules deriving from the TFEU apply to the electricity sector and are specifically set out in Article 16 of the Electricity Regulation, which obliges TSOs to maximise the available capacity for trade and to ensure non-discrimination between internal and cross-zonal exchanges.

[11] From the Commission alone, the total grant budget to support energy projects for the 2014-2020 period under the Connecting Europe Facility Energy programme was €4.7 billion.
[12] See, for example, the recent Commission Decision on case AT 40461 DE/DK Interconnector: https://ec.europa.eu/competition/antitrust/cases/dec_docs/40461/40461_462_3.pdf

Article 16 of the Electricity Regulation also sets an explicit target for cross-zonal trade. The rules state that TSOs can make no more than 30% of deductions from the interconnector capacities[13]. The rest (a minimum 70% of capacity) should be made available for trade. This gives TSOs the flexibility to make deductions for specific reasons, namely loop flows, internal flows and reliability margins, and ensures that there is a guaranteed minimum capacity available for trade applying to all Member States from January 2026 at the latest. These rules are crucial for the proper functioning of the EU electricity market, as electricity must be able to flow to where it is most needed without undue barriers.

Furthermore, all renewable energy projects, both offshore and onshore, should have fair and non-discriminatory access to the transmission network and electricity markets[14]. Therefore, in order to keep the transition affordable and to ensure fair competition, it is crucial that renewables are fully integrated into the electricity market in a non-discriminatory manner. The competition, trade and export of electricity generated from renewable sources, based on demand and supply rather than on pre-defined flow patterns, is crucial to the effective functioning of the internal energy market and to achieve the EU's decarbonisation goals.

2. Offshore bidding zones – a way forward

a) The concept of offshore bidding zones

The current approach to onshore renewable generation, where generation is considered part of an existing 'home' electricity market, is not well suited to offshore hybrid projects, and not conducive to the large scale-up necessary to achieve our climate objectives. This is because, in line with the principle of non-discrimination of cross-zonal flows, hybrid projects would either need to be curtailed to allow imports and exports over the interconnectors, or the cables would need to be oversized to make capacity available for trade. In principle, the integration of high volumes of offshore renewable energy generation will be difficult if hybrid projects need to rely on exemptions or derogations under EU law[15]. Long-term projects require a predictable and conducive legal and regulatory framework to allow them to expand and up-scale. However, individual projects may exceptionally qualify for exemptions or derogations, which require case-by-case approvals.

To achieve cost-effective decarbonisation and to provide a level playing field for all forms of energy generation and demand response, it is the Commission's view that establishing

[13] The capacity offered can be reduced for specific reasons, namely loop flows, internal flows and reliability margins up to a maximum of 30%. The rest of the capacity (minimum 70% of capacity) should be made available for trade by offering it to the Regional Coordination Centre for capacity calculation – where further deductions for the N-1 standard and transit flows are possible. See Article 16 of the Electricity Regulation.

[14] Non-discrimination and fair competition are fundamental market principles. See Article 3 of Regulation (EU) 943/2019.

[15] The Commission notes in this context that it has received a derogation request under Article 64 of the Electricity Regulation for the Kriegers Flak project, which is an offshore wind installation connected to both the German and Danish markets. A request was submitted in July 2020 for a derogation from certain articles in the Electricity Regulation.

offshore bidding zones[16] provides a good approach to ensure compliance with the cross-border trading rules. Modelling results and a detailed assessment of the available options[17] show that, from the models under discussion, offshore bidding zones achieve a higher degree of overall efficiency than the 'home zone' approach. This is because they lower costs to TSOs due to a reduced need for after-market corrective action, they support regional security of supply and system operation by ensuring that electricity flows to where it is most needed, and they are more future-proofed to cope with a large up-scale of offshore projects. The extent of the benefits depends on the degree to which lower priced trade is displaced and the extent of the resulting costs to TSOs and consumers for correcting inefficient market outcomes.

An offshore bidding zone ensures that generation from the offshore project is fully integrated into the market, that the total volume of energy generation can be exported from its own zone and dispatched according to market coupling schedules throughout Europe.

The offshore bidding zone approach is better suited to a large scale-up of offshore renewable energy as it ensures that renewables can be fully integrated into the market. In the short term, it ensures that offshore generation can flow to where it is needed, becoming part of the electricity schedules and supporting regional security of supply rather than becoming something for which TSOs have to correct, which limits how much can be deployed. This will become increasingly important as the share of renewable energy increases and becomes the backbone of our electricity system and we move towards climate neutrality by 2050. Furthermore, this model does not discriminate in favour of technology types, it is fully compliant with competition law and therefore provides the legal certainty needed for long-term and large-scale projects. In the medium to longer term, offshore bidding zones create locational incentives for the installation of new demand, e.g. for storage or green hydrogen production via electrolysis.

However, offshore bidding zones can result in a changed incentive structure. Modelling results indicate that a redistribution of parts of the revenue from offshore generation assets to transmission system operators can be expected. The extent of redistribution depends on the topology. Based on a recent study[18], for over half of the projects, the redistribution accounts for less than 1% of total revenue, but for a small share of projects, this can rise to 11% of revenue. This redistribution effect needs to be addressed to ensure that projects beneficial for society can be carried out. This is discussed in more detail further on in this paper in section III.

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[16] It should be noted that offshore bidding zones can also include near-shore onshore areas. Bidding zones should be based on where congestion occurs, so if the congestion occurs when transporting electricity further from the shore, the areas *before* the congestion could be seen as part of the offshore zone, thereby incentivising investment in electricity intensive demand in those areas.
[17] *Market Arrangements for Offshore Hybrid Projects in the North Sea* (Thema Report 2020-11) https://data.europa.eu/doi10.2833/36426
[18] *Market Arrangements for Offshore Hybrid Projects in the North Sea* (Thema Report 2020-11) https://data.europa.eu/doi10.2833/36426

Offshore bidding zones could also be an appropriate solution for NRAs and TSOs at national level, even when offshore projects are connected radially to the home market. This can happen, for example, if there is insufficient transmission capacity to take the electricity from the coast to cities further inland due to delays in permitting procedures or due to the practice of not building capacity for the few peak hours of wind. An offshore bidding zone would give the right price signal and can give incentives for demand such as power-to-gas technology to be located close to offshore generation. Without a separate bidding zone, a TSO may need to curtail offshore wind generation and re-dispatch power plants closer to the cities, which is not efficient. A separate bidding zone offshore could help ensure that the market only dispatches the required amount of electricity.

Offshore bidding zones are adaptable and can be scaled up over time. An important consideration is that the transmission network to connecting markets should be suitably sized to ensure that the electricity can flow to the onshore network. For example, if extra wind farms are added to an offshore bidding zone, the connected markets will only benefit if additional cables are laid to increase transmission capacity. Demonstration projects, either demand or generation, can also be situated in offshore bidding zones[19]. For generation projects, the importance of ensuring the right level of transmission capacity remains crucial. Demonstration projects that provide increased flexibility (via storage, for example) in offshore bidding zones can take full advantage of direct access to affordable offshore generation and contribute to an optimal usage of the offshore network.

Finally, in order to deliver the full benefits to consumers and to ensure that borders remain open for the import and export of renewable electricity, it is crucial (as explained in section I(c)) that TSOs make the maximum capacity, in line with the secure operation of the system, available to offshore energy producers for trade over the interconnectors.

b) Establishment and governance of offshore bidding zones

Bidding zones, as explained above, are market areas within which there is a single wholesale electricity price. The bidding zone price varies from zone to zone due to different patterns of energy generation and demand. These price differences are the signals for trade, determining the direction of power flows, i.e. if electricity is scarce in a zone, the price rises and imports follow. The 70% minimum target for trade, as described above, applies to bidding zone borders. Largely for historical reasons and the gradual integration of the EU electricity system over time, bidding zones have tended to follow country borders, rather than the underlying physical reality of the grid, although this is not always the case.

Establishing new offshore bidding zones for renewable energy projects connected to more than one market, potentially across national borders, raises questions about how these zones should be established and regulated and how system operation should be carried out. Although new in an offshore context, European TSOs and NRAs already have substantial

[19] A demonstration project in an offshore bidding zone may be granted priority dispatch and an exemption from balance responsibility in line with the Electricity Regulation.

experience in dealing with these issues and research conducted on behalf of the Commission indicates that suitable governance arrangements can be made under current legislation[20]. None of the options set out below, require making legislative changes.

At national level, offshore bidding zones that do not cross national boundaries can be governed under the current domestic arrangements. The Nordic countries and Italy have considerable experience where TSOs manage several bidding zones at national level. For a multinational zone, regulatory governance could be provided for through NRA cooperation, possibly institutionalised in a joint committee. Real-time system operation could be supported through the use of TSO service and cost-sharing agreements with action coordinated at regional level by the relevant Regional Coordination Centre. In both cases, these arrangements are possible under existing legislation and the experience of the Irish Single Electricity Market and other cross-border bidding zones is very useful.

A regulatory process to establish bidding zones already exists. It is the Commission's view that appropriate governance arrangements for offshore bidding zones can be made by applying existing legislation and procedures.

Establishment of a new bidding zone

For the establishment of a new bidding zone, two pieces of legislation are relevant: the Electricity Regulation (EU) 943/2019 and the Guideline on Capacity Allocation and Congestion Management 1222/2015 (CACM). The detailed procedures and requirements are set out in Articles 32 and 33 of CACM and, in all cases, the level of coordination and consultation with neighbouring TSOs depends on how big an impact reconfiguring the bidding zones is likely to have on their bidding zones. Following the entry into force of the Electricity Regulation, a pan-European bidding zone review was launched. Nonetheless, as clarified in Recital 19 of the Electricity Regulation, it is still possible to launch a national or regional bidding zone review in accordance with existing procedures in CACM.

At national level, if there is a negligible impact on a neighbouring TSO's control area, a single NRA or TSO with the approval of its competent NRA can launch a bidding zone review with a view to amending the existing configuration in its own control area. In this case, the relevant TSO and NRA must give prior notice of the planned review to neighbouring TSOs and be fully transparent on the reasons and conditions of the review. The results of the review must be published and if the result is a proposal to amend the bidding zone configuration, this must also be published. Given that each bidding zone is located in a Capacity Calculation Region (CCR), the next step is to update the list of borders in that CCR to account for the new offshore bidding zone. The TSOs of the CCR should update the list and then send it to the relevant NRAs for approval.

[20] *Market Arrangements for Offshore Hybrid Projects in the North Sea* (Thema Report 2020-11) https://data.europa.eu/doi10.2833/36426

For a bidding zone review with a regional impact, CACM also sets out how to launch the review and the detailed procedures to follow in Articles 32 and 33. Broadly speaking, the process is as follows:

- The participating TSOs must develop the methodology, assumptions and alternative bidding zone configurations and submit these to participating NRAs. Once approved by NRAs, the bidding zone review must be conducted in line with the criteria and process set out.

- The final proposal on whether to amend the bidding zone configuration is sent to the participating Member States (or designated competent authority) for an agreement within six months.

The Electricity Regulation (EU) 943/2019 adds the following points to the CACM process:

- the timeframe assessed in the bidding zone review should be three years;

- there are now strengthened governance arrangements and the EU Agency for the Cooperation of Energy Regulators (ACER) can decide if the NRAs do not agree on the methodology, assumptions and alternative bidding zone configurations as proposed by the TSOs;

- There are also strengthened governance arrangements for the decision-making process following the review. The Electricity Regulation requires the report to be submitted to 'relevant Member States or their designated competent authorities' for a decision. The relevant Member States are those participating in the review and those in the same CCR as the affected bidding zones.

Therefore, in order to establish an offshore bidding zone following a review, Member States in a CCR have six months to agree whether and how to proceed[21]. In addition, the TSOs must update the list of borders contained in a CCR and send it to NRAs for approval in line with established procedure. The Regional Coordination Centre coordinating TSO actions in the new offshore bidding zone will be the one responsible for that specific CCR.

Governance of a new bidding zone

…at national level

For new bidding zones established at national level in the exclusive economic zone of one Member State, the governance arrangements are relatively straightforward. Most EU Member States have one TSO responsible for system operation, and this TSO would be responsible for the new bidding zone. Many TSOs already have extensive experience of managing several

[21] In the event that Member States fail to reach agreement, the decision is automatically escalated to the Commission in line with the process set out in Article 14 of the Electricity Regulation.

bidding zones, for example, TERNA in Italy, Energinet in Denmark and Svenska Kraftnät in Sweden. The regulatory oversight flows directly from this arrangement. The NRA in that Member State would supervise the establishment and operation of new bidding zones by the TSO and issues such as market monitoring would fall under the remit of the competent NRA. Again, experience from Italy, Denmark and Sweden is a useful blueprint.

…at multinational level

At multinational level, various levels of cooperation and governance arrangements can be envisaged when exploring how to manage a cross-border bidding zone. Existing examples of multinational bidding zones in the EU today provide a good starting point. For example, the past German-Austrian-Luxembourgish bidding zone, the existing arrangements governing the German-Luxembourgish bidding zone and the experience of the all-island integrated Single Electricity Market in Ireland.

For an offshore bidding zone located in the exclusive economic zone or territorial waters of more than one Member State, Member States and their competent NRAs can decide on the most efficient arrangements and how close and how formal they would like the cooperation to be. For example, one option is to appoint a TSO (permanently or on a rotating basis) to perform the system operation for the bidding zone and take on all related responsibilities. This would be formalised in TSO service and cost-sharing agreements, under the supervision of the competent NRAs. Specifically for the offshore bidding zone, NRAs would also need to cooperate in order to take joint decisions, to the extent needed, on issues such as applicable tariffs and the grid connection regime. Austrian, German and Luxembourgish NRAs had a positive experience of informal cooperation in achieving coordination and cooperative decision making in relation to the regulation of the Austria-Germany-Luxembourg bidding zone. Their experience in the context of a larger and more complex bidding zone suggests that such informal cooperation can work successfully under existing EU law.

It is too soon to say whether more formal governance arrangements in an offshore bidding zone are needed but this will become apparent over time. For example, as offshore renewable projects expand, begin to include demand, and link up to other offshore hubs or additional Member States, the challenges might be better addressed through dedicated processes for decision making and governance. If this need arises, formalised arrangements for joint decision making could be arranged on the basis of delegated authority from the NRAs. This approach would not necessarily require transferring legal authority to a multilateral body.

One example of institutionalised NRA cooperation cited in the study by THEMA, is the Irish Single Electricity Market (SEM) Committee. The SEM Committee oversees the joint Irish electricity market (spanning two separate jurisdictions) and has formal regulatory responsibility for the following:

- management of the applicable Trading and Settlement Code;
- the Market Monitoring Unit (which monitors compliance, notably in relation to market power abuses);

- the Market Modelling Group; and
- Single Market Operator Regulation.

All regulatory matters that do not fall under the above scope remain the responsibility of each of the respective NRAs. The Committee consists of three members from the Republic's NRA, two members from Northern Ireland's NRA, and two independent members.

The NRAs work together through the Committee to harmonise transmission policy and define the systems and processes that constitute the high-level design of the integrated electricity market. The NRAs continue to be ultimately responsible for regional cooperation but specific functions have been transferred to the joint body, with the agreement of the national governments. Under EU legislation, ACER maintains responsibility[22] in the event of a dispute regarding relevant methodologies and can take a decision in the event of continued disagreement. However, the SEM Committee provides a more practical mechanism to undertake ongoing regulatory tasks that cover both NRAs, as well as to support cooperative regulatory development as needed.

The approach used in the Irish market could thus serve as a useful model for NRA cooperation as part of a multinational offshore bidding zone. Although the Committee's work is based on bilateral cooperation, the institutional arrangements that it embodies could be readily adapted to cover a multinational bidding zone.

…and for future offshore highly-meshed grids

As we look ahead to the scale of investment in renewable energy needed to achieve the 2050 climate neutrality target, and the ambitious plans of Member States to roll out offshore wind and other forms of tidal and ocean energy, there will naturally be some maritime areas that will become physically crowded, with large volumes of offshore energy generation. These areas will also experience very specific technical challenges in the types of system operation issues faced, from interacting with other renewable energy hubs to the difficult task of managing large volumes of non-synchronous generation. It is important to note that mechanisms to support TSO coordination already exist. Regional Coordination Centres could support coordination among onshore system operators and their tasks are sufficiently adaptable to be tailored over time to the needs of the offshore system. Article 37(2) of the Electricity Regulation (EU) 2019/943 also provides scope for assigning additional advisory tasks to Regional Coordination Centres.

However, where real-time system operation becomes increasingly complex and intricate, it could be warranted to take a more holistic approach to future system operation in offshore regions. The relevant group of TSOs could appoint one TSO to manage the entire offshore area (possibly consisting of several offshore bidding zones) or the TSOs and NRAs may

[22] ACER's powers in the Irish context are exclusively those afforded by the applicable European legislation, most notably in relation to regional methodologies in the CACM Guideline (2015/1222), the System Operation Guideline (2017/1485) and the Electricity Balancing Guideline (2017/2195).

decide to establish an independent system operator (ISO) for this purpose, potentially as a joint venture. An ISO established for this purpose would build up significant expertise in the technical challenges associated with offshore DC infrastructure and could become a global leader in managing a variable renewables-based electricity system.

Other benefits could flow from such an arrangement. One or more offshore ISOs would be a model case for regional cooperation. An ISO could function as a system architect to develop the long-term master plan for offshore meshed grid development, map locations for offshore wind, as well as undertake the required grid investments needed for Europe-wide grid optimisation. It would provide scope for the relevant NRAs to assess in a neutral and coordinated way the best type of incentive regime and tariff design for a variable renewables-based electricity system. It would also have the advantage of solving coordination challenges and could help de-risk anticipatory investments. At the same time, close cooperation between the ISO and onshore TSOs would remain necessary, e.g. to ensure sufficient transmission capacity onshore at the designated landing points for offshore cables.

It is highly likely that the governance arrangements for a multilateral ISO would need to be formalised, along the lines of the arrangements outlined above for multilateral bidding zones, or ACER, as the existing body for cooperation between European NRAs, could potentially take on the regulatory function. This structure could be complemented by a regional regulators' forum and, at governmental level, a high-level ministerial regional energy policy forum.

c) Conclusion on offshore bidding zones

Offshore bidding zones provide the long-term legal certainty required by hybrid projects and are currently considered the most efficient and affordable way for consumers to integrate large-scale offshore renewables into the system.

They also support system security and have additional benefits by ensuring reliable access to imports and potential incentives for efficient investments. It is already possible under the current regulatory framework of the Clean Energy Package to establish offshore bidding zones and to make suitable governance arrangements. Even more far-reaching solutions, such as the establishment of offshore ISOs, are in principle possible under the current legislative framework. Different approaches can, to a large extent, co-exist. However, in the long term, and with the significant build-up of offshore renewable generation expected and necessary to achieve the EU’s climate objectives, the offshore bidding zone approach appears well suited. This being said, it should also be acknowledged that this approach does have an impact on renewable energy developers, most notably in relation to price dynamics.

3) Price dynamics and links with support schemes

As explained in the section on offshore bidding zones, if the offshore zone contains only renewable energy generation and no demand, the price in that zone will depend on the level of demand from the markets to which it is connected. In addition, offshore generation will need to compete with connecting markets in order to ensure that it is in the merit order and dispatched, under the principle of marginal pricing and the market coupling process, which has worked well for onshore electricity markets for years.

However, this provides challenges for offshore electricity producers. Stakeholders have raised concerns, which have been recognised in supporting studies for the Commission, that since the offshore bidding zone price will be dependent on demand on connected markets, prices will be volatile, revenue may be lower and the volumes to be sold more uncertain. It is also true that these are significant long-term investments and additional risks, such as price volatility and uncertainty about the evolution of negative price periods can increase overall project costs and reduce the attractiveness of such projects for investors. Any support schemes for offshore hybrid projects should take this into account. It is necessary to address separately the rules for a functioning electricity market, which apply to all, and specific schemes to provide support for certain forms of energy production in the form of State aid.

4) Networks and connection regimes

It is important to emphasise that the points made above cannot be considered in isolation. The European market framework is a blend of rules set at EU and national level, the combination of which will shape the overall environment for renewable energy in that Member State. For offshore hybrid projects, network planning and the interaction of the tariff design with national support schemes are particularly important.

The social welfare benefits in developing hybrid projects and considerably scaling up offshore renewable energy with more meshed offshore grids may not be fully achieved unless onshore *network planning and deployment* can keep pace with offshore developments. It will be crucial to bring the electricity onshore to strong, well-connected parts of the grid and ensure that reinforcements to the onshore network allow the offshore renewable electricity to be transported from the coast to consumers. Well-designed onshore and offshore bidding zones that are aligned with structural congestion in the grid should be ensured and they can also provide investment signals for power-to-gas installations or incentives for major energy consumers to locate near the coast to benefit from lower electricity prices.

The *tariff design* and the charges applicable to producers, including for connection, are also essential for the overall business case. The tariff design should provide incentives for efficient network use but must also provide for the financing and cost recovery of the grid connection. Currently, there are significant differences between the applicable tariffs and charges, which could hamper cooperation between Member States in joint cross-border projects. There are broadly three types of connection-charging regimes: ‘deep’ connection charging (producers pay for the cost of their connection to the nearest grid and for the cost of reinforcements), 'shallow' connection charging (producers only pay for connection to the grid, while the TSO pays for reinforcements) and 'extra shallow' charging (the TSO pays for both connection and reinforcements). What is apparent is the strong link between the socialisation of certain costs through grid connection regimes and the clearing price of renewable energy auctions across Member States. Those with deep connection charging have higher bidding prices than those with shallow connection charging. This is because consumers do not pay for the connection and this cost is factored in by the developers in their bid.

The advantages of a deep charging regime could be a lower risk that the connection is not provided on time through better coordination and sequencing from the developer. In addition, for joint projects by Member States, a greater share of the total cost is factored into the project, which may make cost sharing easier. By contrast, a shallow charging regime has the benefit that the TSO can write off the network connection over a longer period and the cables can be reused for future projects.

Assuming that cost-sharing arrangements can be solved between NRAs, on balance, shallow charging may be better suited to areas that use pre-developed or clearly designated sites for offshore projects. Deep charging may be better suited to systems where developers have a choice of sites and it may be beneficial to provide incentives to factor in the network cost impact of different sites. What is clear is that close coordination of national policies on tariffs and charges by NRAs will be needed to enable these projects to come forward. Currently, the rules at EU level on these aspects are very limited, and harmonisation would require a voluntary alignment of national rules for the offshore bidding zone.

III. Possible adaptation of EU market rules

a) Congestion income

Congestion income is the price differential between markets that TSOs receive as income. This income must be spent on the priority objectives of reducing congestion by maintaining or increasing interconnection capacity, in line with Article 19 of the Electricity Regulation. For renewable electricity projects in offshore bidding zones, the value of a hybrid asset is split between the electricity market revenues and congestion income.

In a more integrated meshed grid that supports competition and price convergence, it is currently unclear how the levels of congestion rents will evolve. For example, there is a high correlation between wind generation in northern Europe and lower electricity prices. However, it is clear that in an offshore bidding zone configuration, there will be a redistribution of part of the revenue from offshore electricity producers to transmission system operators. The extent of this depends on the topology of the project. For over half of the projects, the redistribution effect is expected to account for less than 1% of total revenue, though for a small share of projects, this can be up to 11% of revenues[23]. This effect needs to be addressed to ensure that the total value of viable hybrid projects can be captured and to align the incentives to encourage these projects where they are beneficial to society.

A way to align these incentives could be an amendment to the rules on the use of congestion income. For example, by opening up the possibility for Member States and NRAs to allocate congestion income to renewable energy producers active in an offshore bidding zone, this could ensure that hybrid projects are no less attractive for a renewable energy investor. There are three main benefits to this approach: it could reduce the level of subsidies needed through support schemes, it could enable a transition for producers to market participation once the support scheme ends, and it could limit the need for support schemes entirely by enabling projects to come forward in a market-based way.

A further risk to note in the context of hybrid projects is that, if offshore energy generation is expanded but the corresponding interconnection cables are not built to schedule, it would result in limited interconnection capacity, and the offshore price could be close to zero until this congestion is relieved. In these cases, congestion income would be very high for a temporary period resulting in a form of redistribution from generation to TSOs. Where those congestion rents are used to increase the missing interconnector capacity, they address the core of the issue, thereby helping to integrate offshore wind. However, interconnection projects can also incur significant delays for multiple reasons.

For these reasons, the Commission will explore the scope to grant a degree of flexibility by carrying out a legal revision of the rules governing the allowed use of congestion rents, to enable a partial transfer of congestion income for hybrid projects. Possible approaches to this include making changes to financial transmission rights, auction revenue rights or support scheme design, as outlined in supporting studies for the Commission[24]. The Commission has not reached a conclusion on this issue. However, a partial transfer of congestion income could strike a good balance to encourage market-based investments and still ensure that TSOs are remunerated for making interconnection capacity available for trade. Therefore, the Commission will put forward a proposal for this purpose at the latest by 2022.

b) Technical connection requirements for offshore HVDC grids

The EU framework for connecting to the electricity grid is set out in three network codes: the Requirements for Generators (Commission Regulation (EU) 2016/631), the Demand Connection Code (Commission Regulation (EU) 2016/1388) and the Network Code on High

[23] *Market Arrangements for Offshore Hybrid Projects in the North Sea* (Thema Report 2020-11) https://data.europa.eu/doi10.2833/36426

[24] THEMA Consulting has suggested ways that this could be addressed in research conducted on behalf of the Commission. *Market Arrangements for Offshore Hybrid Projects in the North Sea* (Thema Report 2020-11) https://data.europa.eu/doi10.2833/36426

Voltage Direct Current Connections (Commission Regulation (EU) 2016/1447). One of the key findings from the PROMOTION study is that these codes were written with the onshore network mostly in mind. Even the HVDC Network Code focuses on supporting the onshore AC grid rather than an interface with an offshore DC electricity grid. Therefore, one of the recommendations of the study is to streamline the technical connection requirements for generators and HVDC cables in order to speed up the connection of offshore projects where multiple parties and Member States are concerned.

The current EU framework provides for a significant degree of national flexibility for TSOs to set requirements. In a study conducted on behalf of the Commission, Tractabel analysed these requirements with a view to creating best practice for technical connection requirements for offshore HVDC grids in the North Seas region[25]. Where justified, it proposed setting common requirements for certain aspects. This study can be a useful tool for Member States and TSOs when considering the specifications for common projects.

In addition, it would be beneficial to the deployment of offshore renewables projects across the EU to amend the network codes and set common EU standards for some technical aspects. Expert groups are currently working on amendments to the grid connection network codes[26] as part of the ongoing work in the Grid Connection European Stakeholder Committee. The Commission will share the results of this study with the relevant experts to ensure that the findings and recommendations of this report are taken on board in the amendment process.

IV. Conclusions

Offshore renewable energies can be scaled up in a way that is compatible with EU legislation. It is paramount to do so in line with existing EU legislation to achieve the goal of delivering a decarbonised electricity market that is flexible, integrated and secure, at least cost to consumers.

In the future, offshore renewable energy projects are expected to play a significant role in achieving our climate neutrality target. These projects are expected to be built using a blend of solutions – both single radial connections and hybrid projects that are connected to more than one market.

In the case of hybrid projects, establishing an offshore bidding zone is a suitable way to integrate these projects into the electricity system. In the short term, an offshore bidding zone ensures that electricity can flow to where it is most needed, ensuring that offshore renewable energy contributes to regional security of supply. In the medium to longer term, they also provide price signals to incentivise the development of storage and other offshore demand facilities. An offshore bidding zone is more efficient overall, as it reduces the need for costly

[25] *Technical requirements for connection to HVDC grids in the North Sea* (Tractabel Report 2020-11) https://data.europa.eu/doi10.2833/493628

[26] https://www.entsoe.eu/network_codes/cnc/expert-groups/

TSO corrective actions such as redispatching and countertrading and it keeps costs down for consumers.

However, it should also be acknowledged that although this model is more efficient, it affects the risk borne by project developers and trading revenue may be lower due to increased competition. This risk could be mitigated in well-designed support schemes for hybrid projects. Furthermore, hybrid projects can have a redistributive effect on incomes and, depending on the topology of the projects, can lower trading revenues while increasing congestion income. To ensure that incentives are aligned for viable hybrid projects coming forward in a market-based way, the Commission will consider amending the rules on the spending of congestion income.

The governance arrangements required for offshore bidding zones are possible under current EU law and would flow from the individual projects, ranging from a simple extension of national TSO and NRA tasks to more complex multilateral arrangements. Looking further ahead and beyond the deployment of the first hybrid projects, to complex meshed grids, the delegation of TSO tasks to one lead TSO (including bidding zone management and operational security) or the creation of an ISO could be an efficient and strategic regional initiative to ensure optimal planning and operation of the offshore grid. However, this is not a prerequisite. Multilateral governance arrangements setting out a clear allocation of tasks and supervision, agreed by the Member States, NRAs and TSOs concerned can be made under existing legislation. Experience in today's electricity market indicates that this can work well.

It is also important to highlight the links with aspects of national law and policy and note that the efficiency of network planning and the socialisation of project costs such as connection and site surveys all contribute significantly to the investment case for projects and to the overall cost of offshore renewable energy deployment. Furthermore, the Commission will work with the Grid Connection Electricity Stakeholder Committee to check that the grid connection network codes are suited to the rollout of more meshed and complex offshore projects.

In conclusion, the creation of offshore bidding zones for hybrid projects provides a suitable framework for a massive scaling up of offshore renewable energy, for it to become the backbone of our energy system as we move towards the EU's 2050 objective to achieve climate neutrality. It provides the certainty required for these long-term projects and strong investment incentives to further develop offshore demand, such as storage and the production of hydrogen from green electricity.