# Offshore Coordination Gap Analysis

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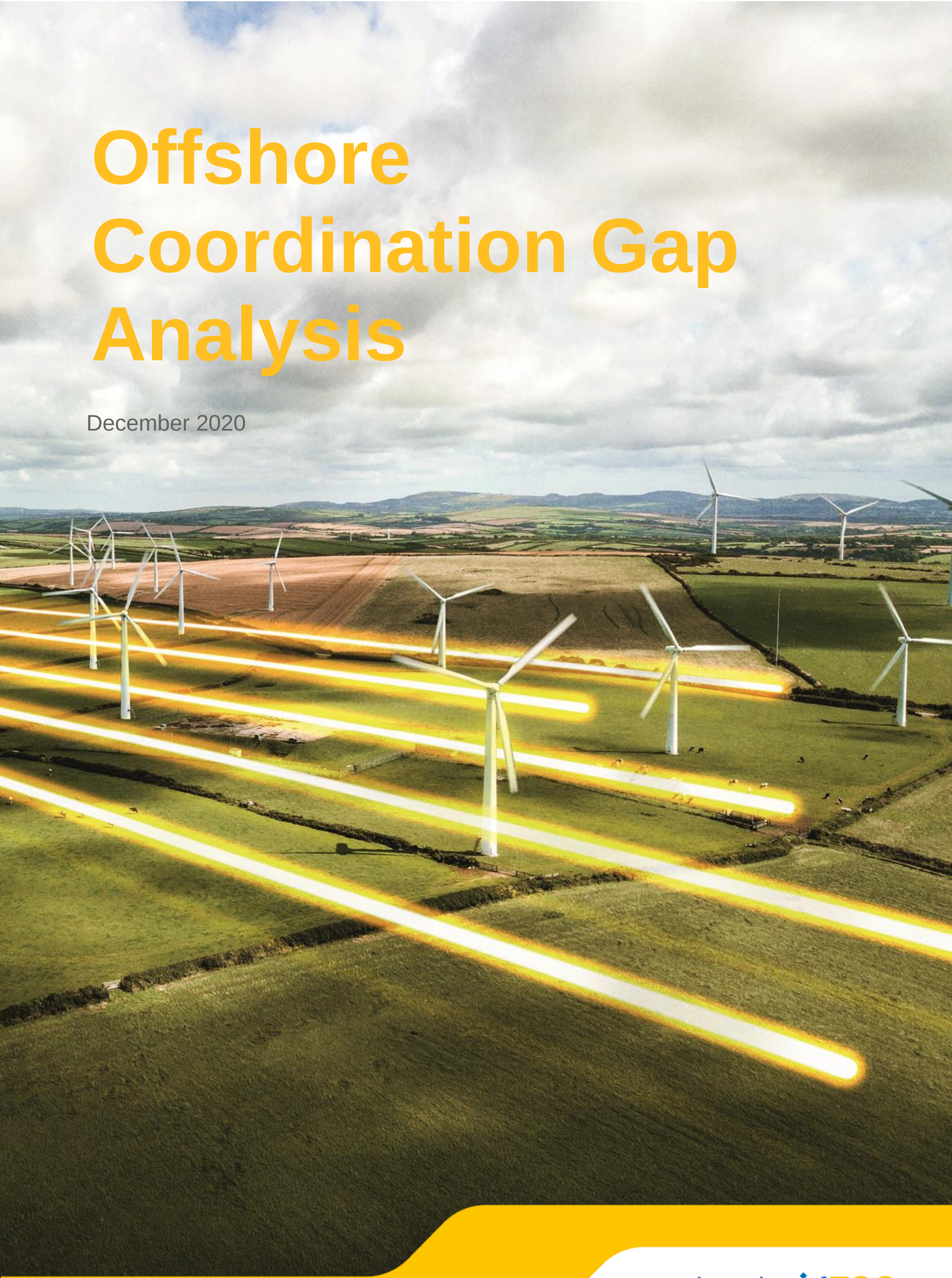

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# Executive summary

## Context

The Offshore Coordination project is assessing whether the levels of offshore wind required to meet net zero targets can be connected in a more beneficial way for consumers and coastal communities. A phased approach is being taken, with Phase 1 assessing technology readiness and costs for a more coordinated offshore network, the impact on the onshore network and the costs and benefits of different conceptual network designs. As part of Phase 1 we have undertaken a Gap Analysis to understand what research had already been completed that may offer solutions to known problems, to ensure we build upon previous work and to inform our priorities for a potential Phase 2.

The Gap Analysis was conducted using several academic and industry reports that had been published relating to offshore wind. We considered the reports we felt were most relevant and have used best endeavours to analyse them but it should not be taken as exhaustive. We used our analysis to map against a number of ESO identified priorities: Stakeholder engagement, Commercial, Environmental, Technology, System requirements, System design and Delivery Model. We are not proposing the gaps below are necessarily for the ESO to fill, with some such as environmental considerations falling beyond our expertise.

## Summary/Key Messages of findings

The papers named or identified in this section have been detailed further in the sections ‘Sources used’.

1. **Stakeholder engagement** - There has been very little discussion of stakeholder engagement in the papers and discussion has been limited to the need to consider community views and the support for a collaborative approach.

   **Gap identified**:

   A commitment to a collaborative approach and a jointly owned roadmap

   Extensive stakeholder engagement with communities and wider industry about the work.

2. **Environmental** - Increased levels of offshore wind are necessary for the UK to meet the commitments the government has made to deliver net zero greenhouse gas emissions across all sectors by 2050. Offshore networks will be an important factor in facilitating offshore wind’s contribution to that. However, there is very little discussion on environmental factors, including visual amenity. Some papers provide high-level commentary on how different technologies impact visual amenity (e.g. onshore v offshore converter stations). One paper outlined wider environmental views (e.g. consideration of the impact of marine life).

   **Gap identified:**

   A clear view of the key environmental considerations, including visual amenity

   An agreed process across industry for how environmental factors are considered in the network designs, cost-benefit analysis and planning process (including network planning and planning permission).

3. **Commercial** – A coordinated approach is seen as more efficient than a radial counterfactual, although few reports provide a detailed cost-benefit analysis (CBA). The Integrated Offshore Transmission Planning East (IOTPE) paper conducted CBA on a range of offshore network designs, but the paper is five-years old and the levels of wind, government policy and technology have moved on. Encouraging anticipatory investment is deemed important but no practical solutions or recommendations are offered. The Offshore Wind Industry Council (OWIC) Transmission review short-term solutions paper discussed developer risk and financing and offered potential short-term solutions. Taken together, the papers potentially highlight most of the challenges and what must / should change (commercial frameworks, codes, charging arrangement) but often do not offer detailed recommendations.

   **Gap identified:**

   Combine the commercial challenges into a master list and agree it with industry.

Developer risk and financing solutions should be built on

Agree a jointly owned work-plan that focuses on solving the issues with tangible actions, including for the ESO. This should emerge from the BEIS-led Offshore Transmission Network Review[1].

4. **Technology** - Papers, including IOTPE and those produced by OWIC provided an overview of the current technology available, and the benefits/challenges associated with it. This focuses particularly on High Voltage Direct Current (HVDC), High Voltage Alternating Current (HVAC), and Voltage Direct Current (VDC). Some reports (IOTPE and Crown Estate) are very detailed but dated, others are high-level. In summary, there does not appear to be a major technological barrier. There is no discussion of technology over the next 10-15 years and there is no discussion of how first of a kind risk can be reduced. Interoperability is mentioned as being an important factor, but there are limited recommendations on how to achieve it.

   **Gap identified:**

   Our technology availability workstream in Phase 1 of the project should provide an overview of current and future technologies, this can build on the more detailed reports considered here.

   A work-plan on first of a kind risk and interoperability standards should be agreed with industry. A first step is defining the challenge / problem statement.

5. **System requirements** - There was a general view that frameworks and standards, in particular the Security and Quality of Supply Standard (SQSS) and Grid Code, were not developed with an integrated offshore network in mind. Where this is discussed, papers generally recommend they are at least reviewed. Some papers highlight that they will need changing, but often do not provide detailed recommendations. There was no commentary or methodology for how offshore integration is treated in relation to onshore boundary capacity.

   **Gap identified:**

   Combine the issues into a master list for each code or framework and agree it with industry. Our conceptual network designs and analysis of the impact on the offshore network in Phase 1 can feed into this.

   Agree a jointly owned work-plan that focuses on solving the issues with tangible actions, including for the ESO.

   Consider how changes can be made flexibly as the network evolves.

6. **Network design** - Overall, there was little view on detailed network designs and their CBAs. Some papers presented high-level designs, but often these were for example only, or to highlight other points (e.g. OWIC consenting and leasing paper). The IOTPE paper was the most comprehensive in this area, although it was dated and based on old targets. It also does not consider interconnectors.

   **Gap identified:**

   This should be a clear output of our work in Phase 1 to develop conceptual network designs.

   A clear plan for next steps should be developed and agreed with industry.

7. **Delivery Model** - Overall, no report brings together all the outputs and makes recommendations on next steps. However, taken together, the papers provide a starting point for various topics, especially commercial, technology and standards/frameworks.

   **Gap identified:**

   A coherent strategy across relevant parties involved in the frameworks relevant for the offshore transmission network should be developed. It Is anticipated this will come from the BEIS-led Offshore Transmission Network Review. This should help turn the vision of our conceptual network designs into a plan and reality.

[1] https://www.gov.uk/government/publications/offshore-transmission-network-review

## Next Steps

The Gap Analysis has helped inform our thinking for Phase 2 of the project and three of our main areas of focus: commercial aspects, system requirements and changes needed to ESO processes. We will continue to work with stakeholders on the scope and proposals for a potential second phase of work to deliver the overall objectives of the Offshore Transmission Network Review.

## Sources Used

| Papers | Summary |
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| Crown Estate, East Coast Transmission Network Technical Feasibility Study (2008)[2] | This paper considers the technical and economic feasibility of using the east coast seabed for an offshore transmission network. It creates a conceptual design for an offshore network along the east coast of England, with a focus on using it to move power from north to south and bypassing the onshore grid, and for connecting offshore generation. In addition, the paper explicitly lists out of scope topics as: commercial justification, revenue mechanisms and the regulatory environment. |
| National Grid, supergrid submission to the Energy and Climate Change Select Committee (2012) | This paper was a submission by National Grid to the Energy and Climate Change Select Committee, dated 19 May 2011. It discusses the benefits of a European supergrid – an integrated offshore network combined with interaction with other European countries. It also discusses risks and uncertainties. |
| European Commission, meshed grid report (2014)[3] | The purpose of this report was to review 8+ other reports to develop relevant scenarios for the analysis of the benefits of the different network configurations that could be used. The goal of the study is to assess the full suite of potential benefits of a meshed offshore electricity grid in the North Sea, the Irish Sea and the English Channel at horizon 2030 for a comprehensive range of scenarios. A key objective was to estimate the benefits of the meshed grid as compared to those for radial offshore generation connection. |
| Considerations in design of an offshore network, University of Strathclyde (2015) | The paper discusses various engineering, regulatory and economic issues associated with Offshore networks. It compares AC and HVDC options for simple connections, considers the benefits of coordinated offshore network development and asks whether, in an offshore context, conventions on secure operation that are customary in design and operation of onshore transmission networks are still relevant. |
| Integrated Offshore Transmission Project (East) – Final Report + Appendix 1 Technology, Appendix 2 System Requirements, Appendix 3 Cost-benefit analysis (2015) | This report details the initial conclusions of using a coordinate design approach to provide connections for Round 3 offshore wind farms. It concludes that there are consumer benefits of £2.4bn to £5.6bn, there are no major technical barriers and a number of system reinforcement strategies are considered. The commercial and regulatory arrangements are concluded to (at the time) be inadequate. The report concludes that the levels of offshore wind at the time did not merit an integrated approach or delivery of anticipated investment. This basis of the report was 17.2GW of offshore wind by 2030. |
| OWIC Transmission review short-term solutions[4] (2019) | The paper focusses on short-term solutions on how offshore transmission can evolve in the current regime in a pragmatic way. The questions the paper seeks to address are: 1) How can current processes be optimised to improve allocation of risk and ensure a more efficient divestment process? 2) How can offshore transmission's regulatory framework support innovation and optimisation? 3) How can overall asset health be improved, and how does the framework account for the later life of projects? The paper looks at the rigidity of current OFTO arrangements and how they have become a barrier to optimisation and innovation as well as presenting an unbalanced apportioning of risks between generators and OFTOs. |
| OWIC - Consenting & Leasing Legislation Assessment (2019) | The paper considers whether the UK's planning and leasing related legislation, regulations and conventions enable offshore transmission infrastructure to be delivered under various scenarios. The paper considers six scenarios with co-ordinated assets, and four involving interconnectors, but only to assess |

[2] https://archive.uea.ac.uk/~e680/energy/energy_links/transmission/east_coast_transmission_network_technical_feasibility_study.pdf
[3] https://ec.europa.eu/energy/sites/ener/files/documents/2014_nsog_report.pdf
[4] https://wixlabs-pdf-dev.appspot.com/assets/pdfjs/web/viewer.html?file=%2Fpdfproxy%3Finstance%3DATWtofypdwKND322ID-sMQ7gNYCJYIOf-xOlhLtOhdo.eyJpbnN0YW5jZUlkIjoiMmM1YmJiNDctNzNmMy00MTgwLTlmMTctOGJjZGQ5ODIwY2Y0IiwiYXBwRGVmSWQiOiIxM2VlMTBhMy1lY2I5LTdlZmYtNDI5OC1kMmY5ZjM0YWNmMGQiLCJtZXRhU2l0ZUlkIjoiM2M1ODgxMTUtNTU2Yy00MDc4LTk1NDctMzQ0YjliZjY2NjViIiwic2lnbkRhdGUiOiIyMDIwLTA5LTI4VDEzOjI3OjMzLjY1OVoiLCJkZW1vTW9kZSI6ZmFsc2UsImFpZCI6Ijg1MzMzYzc0LWY3ZDUtNDEzNy04MzE2LWVmYzQzZTc0ODUxOSIsImJpVG9rZW4iOiIxMDAzM2E1Mi0yNjlmLTAxZjgtMGE1MC1iZjg2NDI3NDZhYWYiLCJzaXRlT3duZXJJZCI6IjFjMDUyMWRjLWNjY2YtNDc1OC05YmUwLWExYTBiMjI1ZDE1ZSJ9%26compId%3Dcomp-k4b9k997%26url%3Dhttps%3A%2F%2Fdocs.wixstatic.com%2Fugd%2F1c0521_c95af18ace06489eaa2295e8d63e3a83.pdf#page=1&links=true&originalFileName=OWIC_Transmission_Review_Short_Term_Solu&locale=en&allowDownload=true&allowPrinting=true

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| | whether the current consenting and leasing legislation is suitable. It concludes that it is. |
| OWIC – Funding and financing models for the Green Net (2019) | 'Green Net' is interpreted as the offshore transmission system required to deliver onshore grid connections to offshore electrical power generation from offshore wind farms, in a fashion that is more complex than the current radial connection status quo. To achieve a Green Net the report argues that 1) there should be a Network Master Planner 2) anticipatory investment should be allowed and 3) developer funding should be on a RIIO-type model. |
| OWIC – Enabling efficient development of transmission networks for offshore wind targets [5](2019) | The report reviews and sets out the emerging grid related barriers to delivering the offshore wind Sector Deal target of 30GW by 2030, and the national net zero greenhouse gas emission 2050 target, which the Committee on Climate scenarios show will require at least 75GW of offshore wind. Nine key challenges are discussed, and recommendations are proposed. |
| OWIC – Grid-access technologies for GB Offshore Wind Industry (2020) | The report analyses three issues. 1) Integrated electricity transmission planning – coordinated planning can facilitate economic and efficient development of future offshore and onshore transmission networks, based HVAC or HVDC technologies; 2) Key enabling infrastructures – shared transmission assets such as coastal HVAC grid hubs, offshore HVDC hubs, and demonstration and innovation hubs, would be required to realise the full potential of GB's offshore wind resource; and 3) Design authority and system operator – there is a need to plan appropriate enabling infrastructures and funding of the future offshore transmission systems. |
| OWIC – Integrated offshore transmission – regulatory issues (2020) | This paper is a second draft, published on 12 March 2020. It has been produced for the OWIC Offshore Transmission Group to identify gaps, failings and barriers in the regulatory frameworks which are currently hindering the development of integrated offshore transmission. |
| The Grid Cooperative - Integrated offshore transmission regulatory issues (PowerPoint) (2020) | Paper summarises issues with the current anticipatory investment and connections processes, but offers no solutions. |
| ENTSO-E Position on Offshore Development (2020)[6] | The paper sets out, at a high-level, the challenges and opportunities of offshore wind development. It does not, however, offer solutions for how these opportunities could be realised. There is a strong focus on standardisation, which is consistent with ENTSO-E's remit. The paper takes a pan-European view, evidenced by figures for potential offshore wind capacity as high as 450 GW by 2050. Given a GB offshore network would be more local / regional, some of these challenges may be less of an issue. |

[5] https://wixlabs-pdf-dev.appspot.com/assets/pdfjs/web/viewer.html?file=%2Fpdfproxy%3Finstance%3DATWtofypdwKND322ID-sMQ7gNYCJYIOf-xOlhLtOhdo.eyJpbnN0YW5jZUlkIjoiMmM1YmJiNDctNzNmMy00MTgwLTlmMTctOGJjZGQ5ODIwY2Y0IiwiYXBwRGVmSWQiOiIxM2VlMTBhMy1lY2I5LTdlZmYtNDI5OC1kMmY5ZjM0YWNmMGQiLCJtZXRhU2l0ZUlkIjoiM2M1ODgxMTUtNTU2Yy00MDc4LTk1NDctMzQ0YjliZjY2NjViIiwic2lnbkRhdGUiOiIyMDIwLTA5LTI4VDEzOjI3OjMzLjY1OVoiLCJkZW1vTW9kZSI6ZmFsc2UsImFpZCI6Ijg1MzMzYzc0LWY3ZDUtNDEzNy04MzE2LWVmYzQzZTc0ODUxOSIsImJpVG9rZW4iOiIxMDAzM2E1Mi0yNjlmLTAxZjgtMGE1MC1iZjg2NDI3NDZhYWYiLCJzaXRlT3duZXJJZCI6IjFjMDUyMWRjLWNjY2YtNDc1OC05YmUwLWExYTBiMjI1ZDE1ZSJ9%26compId%3Dcomp-k4ba69ul%26url%3Dhttps%3A%2F%2Fdocs.wixstatic.com%2Fugd%2F1c0521_fee99f6c108140ac8880c385863067ce.pdf#page=1&links=true&originalFileName=OWIC_Enabling_Efficient_Development_of_T&locale=en&allowDownload=true&allowPrinting=true

[6] https://www.entsoe.eu/2020/05/29/entso-e-position-on-offshore-development/