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Offshore oil and gas infrastructure electrification and offshore wind: a legal exploration

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ABSTRACT

The oil and gas and renewable energy sectors are increasingly coming together as traditional hydrocarbon producers are exploring the large-scale integration of renewables in fossil-fuel projects. One option is the electrification of oil and gas production platforms in the offshore environment utilizing offshore wind energy to power the asset's operations. This article assesses the rationale for such a shift as well as regulatory avenues and barriers to the electrification of offshore oil and gas assets through offshore wind energy technology. While the article's explorations are of a general conceptual nature, this article studies existing and planned developments in Norway and Atlantic Canada.

This article discusses key factors to determine the legal nature of different electrification project models and proposes solutions to identify the likely legislative and regulatory regime(s) which will govern. The article concludes that reforms for a forward-thinking legal and regulatory environment for the offshore space will have to re-examine the role of existing (platform) and new (wind but also oil and gas) offshore infrastructure and the associated regime that applies to these projects. Currently, in the Norwegian and Canadian contexts, these discussions are somewhat exploratory. They do, however, underline the importance of planning the co-development of offshore wind energy projects with existing and future oil and gas projects and to highlight the need for greater clarity in the evolving design of legal and regulatory frameworks to support the future of the global offshore energy sector.

INTRODUCTION AND BACKGROUND

The triple challenges of climate change, the need to balance sustainability with a growing global population, and renewed energy security concerns, are pushing the global energy sector in ever-new directions. Europe's unprecedented energy crisis, prompted by the 2022 invasion of Ukraine,[1] further exacerbates transformative shifts in the energy industry. Demand for low-carbon energy is increasing at an accelerating pace, as noted by the International Energy Agency's World Energy Outlook update of October 2023.[2] At the same time, oil demand is predicted to increase

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1 International Energy Agency, *World Energy Outlook 2022*, p 29.
2 International Energy Agency, *World Energy Outlook 2023, Pathways for the energy mix* (2023).

by 2.25 million barrels per day in 2023 compared to 2022, due to post-pandemic economic recovery.[3] Oil is set to peak in 2030.[4] Global energy demand structures, and with it, the utilization of existing energy infrastructure, are rapidly changing. While fossil fuels remain, by far, the primary energy source in the global energy mix, at about 80 per cent of the global primary energy consumption,[5] renewable energy growth is expanding at an accelerated rate. A revolution in renewable energy growth, however, does not mean an immediate cut-off from fossil fuels. As oil and gas-producing countries and energy companies are further committed to reducing their greenhouse gases (GHG) emissions, some of them drastically, like Norway, Canada, or the UK,[6] the role of renewables and GHG mitigation solutions (such as carbon capture, use and storage projects) in the oil and gas sector will take on even more importance. As explored in this article, the oil and gas and renewable energy sectors are coming together as traditional oil and gas producers, petro-economies, and private fossil industry actors are increasingly looking at the large-scale integration of renewables in (traditional) fossil-fuel projects. The big-picture question is how renewables can be integrated within existing and future fossil-fuel projects, and what legal and regulatory challenges need to be addressed to drive the large-scale uptake and deployment of renewables, such as offshore wind energy, in traditional oil and gas projects?

One of these options is the electrification of oil and gas production platform infrastructure in the offshore environment, which entails utilizing offshore wind energy to generate renewable electricity to power (and to decarbonize) the operation of oil and gas extraction assets offshore. In various degrees, renewable energy will substitute fossil fuels (typically natural gas) to generate power in oil and gas extraction operations. Electrification and sector coupling, understood as a co-production and combined use of different energy supply and demand forms,[7] is already being deployed to reduce GHG emissions from the extraction and production of oil and gas in selected jurisdictions, typically in near-shore scenarios. Offshore wind-led electrification, as proposed in this article, takes this concept one step further, offering new decarbonization opportunities for the oil and gas sector and potentially opening new commercial opportunities for the global offshore wind energy sector, which at the time of writing, has been suffering from a series of challenges.[8] At the same time, new and complex practical and regulatory challenges are raised by the very idea of offshore wind energy-driven electrification.

This article assesses the legal and regulatory incentives and barriers for the electrification of offshore oil and gas assets through offshore wind energy technology as a form of 'greenification' of the global fossil fuel industry.[9] It focuses on integrating *offshore* renewable energy generation assets with existing (or even future) oil and gas production platforms. While the overall offshore electrification discussion will necessarily draw upon technological aspects, maritime spatial planning, energy policy, and even broader energy and climate change law and policy, this article focuses on the regulatory consequences of offshore electrification.

[3] Reuters, 'OPEC sees robust global oil demand growth in 2023 after 2022 Chinese contraction' (13 December 2022) <https://www.reuters.com/business/energy/opec-sticks-2022-2023-oil-demand-growth-forecasts-after-downgrades-2022-12-13/> accessed 15 November 2023. For a discussion related to the functioning of the international petroleum market and OPEC's policy see, in this same issue: Volker Roeben, 'What Drives OPEC Production Policy? [2024] Journal of World Energy Law & Business.

[4] Fatih Birol, Executive Director of the International Energy Agency, 'Peak fossil fuel demand will happen this decade' (*Financial Times*, 12 September 2023); International Energy Agency (n 2), p 21.

[5] bp, *bp Energy Outlook 2022 Edition* (2022), p 29.

[6] Norwegian Ministry of Climate and Environment, *Norway's Climate Action Plan for 2021–2030*, Meld. St 13 (2020–2021) Report to the Storting (8 January 2021); Norwegian Government, *Norway's New Climate Target: Emissions to be Cut by at Least 55%* (Press release, 3 November 2022); Government of Canada, Oil and gas emissions cap, October 2022, <https://www.canada.ca/en/services/environment/weather/climatechange/climate-plan/oil-gas-emissions-cap.html> accessed 15 November 2023; Government of Canada, Options to cap and cut oil and gas sector greenhouse gas emissions to achieve 2030 goals and net-zero by 2050—discussion document, August 2022, <https://www.canada.ca/en/services/environment/weather/climatechange/climate-plan/oil-gas-emissions-cap/options-discussion-paper.html> accessed 15 November 2023; see also, UK Crown Commercial Service, *Carbon Reduction Policy (Policy Paper)* (23 March 2022, last updated 20 February 2023).

[7] IRENA, *Renewable Energy Policies in a Time of Transition* (2018), p 93.

[8] Reuters, 'U.S. Offshore Wind Energy Sector "fundamentally" Broken—BP exec' (November 2023), <https://www.reuters.com/business/energy/bp-low-carbon-boss-calls-us-offshore-wind-industry-fundamentally-broken-2023-11-01/> accessed 15 November 2023.

[9] Ignacio Herrera Anchustegui and Aleksander Glapiak, 'Wind of Change: A Scandinavian Perspective on Energy Transition and the "greenification" of the Oil and Gas Sector' in Katarzyna Gromek-Broc (ed), *Regional Approaches to the Energy Transition: A Multidisciplinary Perspective* (Springer 2023).

The analysis centres on the nature of offshore electrification projects and their reflection in regulatory frameworks, how they affect existing or planned oil and gas extraction operations, and on the discussion as to whether they are a single project or two interlinked but autonomous projects. This article focuses on offshore oil and gas platforms and on offshore wind turbine assets, which share important commonalities but also raise critical new legal issues, examined below. The overall objective of this article, therefore, is to explore the alignment, in regulatory and legal contexts, of the offshore wind energy industry with the traditional offshore oil and gas sector. While the discussions are of a general conceptual nature and could be applied to any jurisdiction, this article studies existing and planned developments in Norway and Atlantic Canada to guide the analysis.

Norway is a jurisdiction that already counts a high proliferation of offshore electrification, such as the running Hywind Tampen project electrifying already existing oil and gas turbines through an offshore wind farm and the announced (but recently halted) Trollvind development electrification project.[10] Additionally, two other tentative projects have been mentioned but have also not progressed. These are Wintershall's project regarding the electrification of the Brage field with two floating wind turbines of February 2021[11] and ConocoPhillips' efforts to develop wind turbines for the Ekofisk field.[12] In Canada, offshore oil and gas electrification is a possibility for existing and proposed oil and gas extraction operations. For example, the Bay du Nord Project, which has been approved by the Government of Canada in 2022 subject to stringent environmental and emission conditions, is currently awaiting a final investment decision, now expected by 2026 at the earliest.[13] Although no formal announcements have been made that an offshore wind energy project will be developed to power the Bay du Nord Project, this article discusses the scenario as a strict hypothetical, with a view to evaluating the different project scenarios and the function of the applicable regulatory regime(s).

This article proceeds as follows: the section 'Incentives and side effects for reducing greenhouse gas intensity of oil and gas production through electrification of offshore assets' sets the critical context for the offshore electrification discussion; the section 'Electrification of offshore assets: the question of which regulatory framework applies to the project design' introduces electrification in the offshore energy transition, using selected project scenarios to identify and discuss regulatory models and to advance practical legal responses. The section 'Conclusions and looking ahead' concludes that industry and policymakers must work to align priorities and develop regulatory strategies to advance an overall build-out of the offshore wind energy sector to decarbonize strategic offshore oil and gas assets through wind energy electrification.

INCENTIVES AND SIDE EFFECTS FOR REDUCING GREENHOUSE GAS INTENSITY OF OIL AND GAS PRODUCTION THROUGH ELECTRIFICATION OF OFFSHORE ASSETS

Electrification of oil and gas assets has the potential to significantly reduce GHG emissions from the hydrocarbon extraction cycle.[14] This is especially so in light of increased regulatory and voluntary scrutiny of Scope 1 and Scope 2 emissions in oil and gas operations (ie emissions from the

[10] Equinor, 'Equinor put Trollvind on Hold' (22 May 2023) <https://www.equinor.com/news/20230522-trollvind-on-hold> accessed 15 November 2023.

[11] Wintershall dea, *Brage Vindkraft Forslag til utredningsprogram for konsekvensutredning* (February 2022).

[12] ConocoPhillips and others, *Endret Plan for utbygging og drift av Ekofisk Sør: Ekofisk Vind* (July 2022). On 13 October 2022, Stavanger Aftenblad reported the closure of the initiative: Stavanger Aftenblad, *Skrinlegg havvind-prosjekt på Ekofisk: – Dobbelt så høge prisar* (13 October 2022).

[13] On 31 May 2023, Equinor announced that it will postpone the development of the Bay du Nord project based on rising costs and the need to re-evaluate the concept and strategies. See: Reuters, 'Equinor delays Bay du Nord Canada oil project up to 3 years over rising costs' (31 May 2023) <https://www.reuters.com/business/energy/equinor-delays-bay-du-nord-canada-oil-project-up-3-years-over-rising-costs-2023-05-31/> accessed 15 November 2023.

[14] For some literature highlight this, see: Steinar Birkeland and others, 'Electrification and other Measures to Minimise Carbon Emissions from the Johan Sverdrup Field' in *Offshore Technology Conference*. OnePetro, 2020; Tuong-Van Nguyen and others, 'CO2-mitigation Options for the Offshore Oil and Gas Sector' [2016] Applied Energy 161, 673; Mohamed Elgenedy and others, 'Unlocking the UK Continental Shelf Electrification Potential for Offshore Oil and Gas Installations: A Power Grid Architecture Perspective' (2021) 14 Energies 7096; Ekaterina Gavenas and others, 'CO2-emissions from Norwegian Oil and Gas Extraction' (2015) 90 Energy 1956.

production, transport and procession of oil and gas).[15] Typically, offshore oil and gas production assets are powered by a local electricity supply generated by natural gas turbines. The challenge is that these gas turbines have low-efficiency ratios compared to onshore gas-fired power plants, which reach 78 per cent efficiency.[16] They waste about 70 per cent of energy, mainly in the form of heat, emitting considerable amounts of GHGs.[17] These GHG emissions 'are directly related to the fuel combustion and therefore are primarily caused by the use of [natural gas] in gas turbines to drive compressors'.[18]

In the oil and gas sector, extraction-related GHG emissions are more important than may at first appear. For example, DNV has reported that around 4 per cent of the total global CO_2 emissions related to hydrocarbon usage are linked to oil and gas extraction from the ground.[19] Emissions are generated from incomplete flaring (4 per cent), fugitive releases (28 per cent), and venting (68 per cent).[20] National inventory numbers provide further arguments concerning the volume and importance of these extraction-related emissions. In Norway, where 160 gas turbines operated at 93 active oil and gas fields on the Norwegian Continental Shelf, GHG emissions from petroleum extraction reached 12.1 million tonnes of CO_2 equivalent.[21] This was the country's single largest source of CO_2 emissions, accounting for 24.7 per cent of the total emissions in 2022.[22] Furthermore, the Canada Energy Regulator has noted that Newfoundland and Labrador's greenhouse gas emissions 'from the oil and gas sector in 2020 were 2.1 MT CO_2e. Of this total, 1.8 MT were attributable to offshore oil production and 0.3 MT were attributable to petroleum refining'.[23] The oil and gas sector is Labrador and Newfoundland's second largest emitting sector at 22 per cent of total greenhouse gas emissions, second only to the transportation sector at 41 per cent and the industry and manufacturing sector at 10 per cent of total emissions.[24] For additional comparison, in the UK, Offshore Energies UK (OEUK) reported that emissions from oil and gas production in the UK Continental Shelf were equivalent to 15.03 mn tonnes of CO_2 equivalent in 2021, a 12 per cent reduction compared to 2020.[25] It is estimated that the power needed to operate the UK's oil and gas fields represents about 70 per cent of all the offshore oil and gas-related emissions.[26]

How does electrification work and what precedents are there?

Because of increased scrutiny of high GHG emissions from their operations, oil and gas producers have sought ways to reduce them, including by electrifying operations. This phenomenon is not new in the case of electrification from onshore. The novelty, as proposed in this article, lies in the use of offshore wind to achieve electrification of assets offshore, which is therefore of particular relevance to projects located far away from the shore.

Onshore electrification, for the sake of simplicity, involves the connection of the asset with a sub-sea electricity transport cable connected to the local electricity grid (or directly from a generation point) onshore. The technical operation of onshore electrification depends on the distance of the platform to the shore. For shorter distances, high voltage alternate current is used, while for

15 International Energy Agency, *Emissions from Oil and Gas Operations in Net Zero Transitions* (May 2023).

16 Jorun I Marvik, Eirik V Øyslebø and Magnus Korpås, 'Electrification of Offshore Petroleum Installations with Offshore Wind Integration' (2013) 50 Renewable Energy 558.

17 Marvik, Øyslebø and Korpås, ibid; Elgenedy and others (n 14).

18 TNO and PBL Netherlands Environmental Assessment Agency, *Decarbonisation Options for the Dutch Offshore Natural Gas Industry*, April 2020, p 20.

19 DNV, 'Routes to Reduce Emissions from Oil and Gas Production' (6 October 2020) <https://www.dnv.com/oilgas/perspectives/routes-to-reduce-emissions-from-oil-and-gas-production.html> accessed 15 November 2023.

20 International Energy Agency, *'Methane Tracker 2020', IEA, Fuel report* (March 2020).

21 Norwegian Petroleum, 'Emissions to Air' <https://www.norskpetroleum.no/en/environment-and-technology/emissions-to-air/> 15 November 2023; Statistisk sentralbyrå, 'Emissions to Air' <https://www.ssb.no/en/natur-og-miljo/forurensning-og-klima/statistikk/utslipp-til-luft> accessed 15 November 2023.

22 Statistisk sentralbyrå, ibid.

23 Canada Energy Regulator, 'Provincial and Territorial Energy Profiles—Newfoundland and Labrador' <https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/provincial-territorial-energy-profiles/provincial-territorial-energy-profiles-newfoundland-labrador.html> accessed 15 November 2023.

24 ibid.

25 Offshore Energies UK, *Emissions Report 2022*, p 16.

26 UK Oil and Gas Authority, *UKCS Energy Integration. Final report. Annex 1 Offshore Electrification* (August 2020).

longer distances, high voltage direct current (HVDC) cables are required, which are typically significantly more expensive.[27] Transporting electricity over long distances also results in efficiency losses as energy is dissipated as heat, making onshore electrification expensive.

For example, Norway has developed onshore electrification projects over the past three decades. The first one was the Troll East (A) platform in 1996, followed by other Equinor-operated fields: Ormen Lange, Troll A, Gjøa, and Valhall.[28] In 2020, eight fields received power from onshore. Some of them are electrified with HVDC cables as long as 292 km for the Valhall field; others are powered through cables using high voltage alternating current, with Goliat having the longest cable at 105.5 km from shore.[29] In 2020, it was approved to expand electrification to eight other fields within 2023. The Norwegian Petroleum Directorate estimated in 2020 that with 16 fields electrified, 3.2 million tonnes of CO_2 emissions a year (a quarter of the total CO_2 oil and gas extraction emissions) will be reduced.[30] This downward trajectory is expected to continue, with further electrification announcements (due to policy and regulatory incentives to electrify operations) anticipated. For example, the Norwegian Oil and Gas Ministry requires that operators 'submit an overview of the energy volume and costs of supplying the facility with power from shore instead of using offshore gas turbines. Partial electrification with mobile wind turbines should be considered if this is a suitable measure'.[31]

The Hywind Tampen project is a good example of partial electrification using wind energy. In this project, 11 floating offshore wind turbines are directly connected to the Gullfaks and Snorre oil and gas fields and are planned to provide 35 per cent of all the annual electricity power demand for the extraction operations.[32] Total decoupling from fossil fuels to power operations is unlikely, as backup gas turbines are critical to platform operations 'to provide complementary power, and [these] must be available to ramp up quickly when the wind drops'.[33] Therefore, the electrification discussion does not consist of an outright objective of total elimination of fossil fuel sources. This would be unrealistic, but electrification does 'offer a reduction … of fuel consumption and emissions'.[34]

As noted, electrification of oil and gas assets becomes a potentially attractive alternative to reducing direct GHG emissions linked to the extraction of hydrocarbons. By substituting wellhead natural gas or diesel with offshore renewable electricity to power up the platforms, there is significant potential to reduce overall operational emissions. In addition to reducing GHG emissions with resulting positive environmental and climate impacts, electrification lowers operating costs, improves energy efficiency, reduces critical health and operational safety risks such as on-platform ignitions, and provides a degree of stability in offshore operations.[35] Reducing the dependence on gas turbines, which cause more noise and vibration, may also positively impact platform workers and the marine environment, thus underscoring the overall benefits of platform electrification.[36]

Incentives for platform electrification using offshore wind energy follow a broader trend of GHG emission reductions in offshore oil and gas operations. The offshore oil and gas sector will increasingly be tasked to respond to national action on climate change, including carbon pricing mechanisms and will view the electrification of operations as a critical step (and response to climate action) as part of a wider industry transition.

27 Marvik, Øyslebø and Korpås (n 16).

28 Henrik Bjørnebye and Catherine Banet, 'Licensing Regime: Norway' in Eduardo G Pereira and Henrik Bjørnebye (eds), *Regulating Offshore Petroleum Resources* (Edward Elgar 2019) 124; Herrera Anchustegui and Glapiak (n 9) 67.

29 Elgenedy and others (n 14).

30 Norwegian Petroleum Directorate, *PowerFromShore to the Norwegian shelf* (Summary of report 2020), p 2.

31 Norwegian Petroleum Directorate, *Guidelines for plan for development and operation of a petroleum deposit (PDO) and plan for installation and operation of facilities for transport and utilisation of petroleum (PIO)* (2022), p 27.

32 Equinor, 'Hywind Tampen' <https://www.equinor.com/energy/hywind-tampen> accessed 15 November 2023.

33 David Grainger, 'Reducing CO 2 Emissions from Offshore Oil and Gas Production', *Proceedings of the 15th Greenhouse Gas Control Technologies Conference* (March 2021), p 5.

34 TNO and PBL Netherlands Environmental Assessment Agency (n 18), p 30.

35 Håvard Devold, 'Electrification and Energy Efficiency in Oil and Gas Upstream' in Abu Dhabi International Petroleum Conference and Exhibition. OnePetro, 2012; Marvik, Øyslebø and Korpås (n 16).

36 ABB, *Electrification of Petroleum Installations: Commercial Justifiable and Necessary for the Climate* (2014), pp 3 and 5.

National action on climate change

A background of binding and non-binding governmental obligations to reduce GHG emissions provides powerful incentives to reduce the carbon intensity of oil and gas extraction projects through electrification. These are derived from instruments such as the Paris Agreement, national climate targets, constitutional provisions protecting the environment and/or human health, and carbon pricing mechanisms such as the European Union/European Economic Area Emissions Trading System (EU ETS)[37] or the Canadian provincial or territorial systems.[38]

Norway, for example, announced a revision of its climate ambitions at the 2022 United Nations Climate Change Conference (COP 27—Conference of the Parties of the UNFCCC), raising its national emission reduction target to 55 per cent by 2030.[39] By 2050, Norway has pledged to become 'a low-emission society (…). Achieving this target will involve reductions in GHG emissions of the order of 90–95 per cent by 2050 from the level in the reference year 1990'.[40] At the same time, Norway's economy depends on the oil and gas industry. In 2022, Norway produced 232 million Sm^3 of marketable oil equivalents (Sm^3 o.e.), slightly more than in 2021 (230.6 million Sm^3), and close to the record, 264.2 million Sm^3 o.e.[41] About 53 per cent of this total production is natural gas with the remainder consisting of petroleum. Production is forecasted to increase until at least 2025, as reported by the Norwegian Petroleum Directorate in January 2023.[42] An increase in production to respond to the European energy crisis means that Norway is now the main exporter of natural gas to the European Union.[43]

On the other side of the Atlantic, climate change is also forcing changes in the Canadian oil and gas industry and driving broader energy policies. The Canadian Net-Zero Emissions Accountability Act, together with the 2030 Emissions Reduction Plan, sets out an overall emissions reduction target of 40–45 per cent below 2005 levels by 2030 for the Canadian economy, with the legislated goal of 'net-zero' by 2050. Canada's latest National Inventory Report submitted annually to the UNFCCC (April 2023) shows an overall decline of 8.4 per cent of emissions from 2005 levels. While this is encouraging, there are three notable sectors where emissions have actually increased: buildings, agriculture, *and oil and gas*. Emissions from Canada's oil and gas sector remain 'problematic as emissions continue to rise … [pointing] to the need for more rules to reduce emissions in this sector'. Discussions of a so-called 'oil and gas emissions cap' to achieve 2030 sustainability goals and Net-Zero by 2050 are ongoing in Canada at the Federal government level. In response to this proposal, the Canadian Association of Petroleum Producers (CAPP) noted that Atlantic Canada is 'already producing some of the lowest emitting oil production in the world' and that new projects in Newfoundland and Labrador's offshore 'will include new technology, further reducing the environmental footprint of future projects'. Electrification from offshore renewable sources would fit this. Furthermore, it was noted that the offshore sector 'is a vital part of the Newfound and Labrador economy, and the proposed emission cap has the potential to dramatically impact the province's economic health'.[44]

Despite national pledges to drastically reduce GHG emissions and to become a low-emission society by 2050, Norway (and Canada) have made no political statements or regulatory changes that would indicate the end of high hydrocarbon extraction activity in the decades to come. In

37 Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC (OJ [2023] 02003L0087—consolidated version).

38 Government of Canada, 'Carbon Pollution Pricing Systems Across Canada' <https://www.canada.ca/en/environment-climate-change/services/climate-change/pricing-pollution-how-it-will-work.html> accessed 15 November 2023.

39 Norwegian Government, 'Norway's New Climate Target: Emissions to be Cut by at Least 55%' (3 November 2022) <https://www.regjeringen.no/en/aktuelt/norways-new-climate-target-emissions-to-be-cut-by-at-least-55-/id2944876/> accessed 15 November 2023.

40 Norwegian Ministry of Climate and Environment (n 6), p 37.

41 Norwegian Petroleum, 'Production forecasts' <https://www.norskpetroleum.no/en/production-and-exports/production-forecasts/> accessed 15 November 2023.

42 ibid.

43 European Council, 'Infographic—Where Does the EU's Gas Come From?' <https://www.consilium.europa.eu/en/infographics/eu-gas-supply/> accessed 15 November 2023.

44 Canada's Oil and natural Gas Producers, 'CAPP Response—Proposed Federal Options to Cap and Cut Oil and Gas Sector Greenhouse Gas Emissions to Achieve 2030 Goals and Net-Zero by 2050' (22 September 2022) <https://www.capp.ca/wp-content/uploads/2022/09/Emission-Cap-Letter-Sept-29-2022.pdf> accessed 15 November 2023.

fact, the opposite is true, with plans and ambitions to continue petroleum extraction.[45] In January 2023, the Norwegian Government announced the results of the 2022 licensing rounds in the awards in predefined areas, where 47 production licenses were granted.[46] Later that same month, the Government sent a proposal for publication consultation on whether up to 92 areas will be offered for exploration licenses in the Barent and Norwegian Seas.[47] If additional oil and gas extraction activity is to be undertaken, GHG emissions must be reduced through technological alternatives to comply with action on climate change and, as examined below, the increased cost of carbon as a result of pricing mechanisms.

Carbon pricing as an additional incentive for the oil and gas sector

Increasingly stringent carbon pricing mechanisms in both Norway and Canada may act as additional incentives for the oil and gas sector to electrify.[48] Equinor, for example, has committed to reducing net group-wide operational emissions by 50 per cent by 2030 and becoming a net-zero company by 2050.[49] In the UK, the North Sea Transition Deal of 2021 between the state and oil and gas producers aims to reduce 50 per cent of the sector emissions compared to 2018 and reach net-zero by 2050.[50] Duties, levies, and taxes on GHG emissions generate direct incentives to reduce them.[51] Both Norway and Canada apply national, provincial, and territorial measures that 'price' emissions. This is not a common case among oil and gas producing nations, where countries such as Saudi Arabia, Russia, Iraq, the United Arab Emirates, Brazil, Iran, or Kuwait have not implemented specific measures pricing GHG emissions related to the oil and gas industry through a carbon tax system.[52]

In Norway, stringent national rules related to environmental and climate considerations and air quality are combined with the EU Emission Trading System carbon market, with GHG emissions linked to hydrocarbon extractions are covered by the EU ETS.[53] Current carbon prices under the EU ETS have remained relatively high after several months of all-time record in late 2022. In late April 2023, EU Allowances under the December 2023 contract were trading at €86.42/mtCO2e.[54]

Measures addressing GHG emissions and polluting discharges in Norway apply through, among others, the CO_2 Tax Act on Petroleum Activities,[55] the Sales Tax Act, the Greenhouse Gas Emission Trading Act,[56] and the Pollution Control Act.[57] Since 1991, a carbon tax has been levied on the combustion of gas, oil, and diesel in petroleum operations on the continental shelf and the release of CO_2 and natural gas.[58] This levy is imposed in addition to the EU ETS. In 2022, each producer of a cubic metre of gas or a litre of oil had to pay ca. €0.165. In the case of natural gas, this is equivalent to about €70 per tonne of CO_2. In 2023, this tax was increased to about €75 per

45 Norwegian Petroleum, 'Production forecasts' (n 41).
46 Norwegian Petroleum Directorate, 'APA 2022: 25 Companies Offered Ownership Interests' (10 January 2023) <https://www.npd.no/en/whats-new/news/general-news/2023/apa-2022-25-companies-offered-ownership-interests/> accessed 15 November 2023.
47 Norwegian Government, 'Høring—Tildeling i forhåndsdefinerte områder 2023 (TFO 2023)' <https://www.regjeringen.no/no/dokumenter/horing-tildeling-i-forhandsdefinerte-omrader-2023-tfo-2023/id2960226/> accessed 15 November 2023.
48 See in this same special issue discussing the topic of carbon pricing mechanisms in its mandatory and voluntary forms: Vassiliki Koumpli, 'EU ETS and Voluntary Carbon Markets: Key Features and Current Challenges' [2024] Journal of World Energy Law & Business.
49 Equinor, *2022 Energy Transition Plan* (22 March 2022), p 4.
50 UK Department for Business, Energy & Industrial Strategy and OGUK, *North Sea Transition Deal* (March 2021), p 10 <https://assets.publishing.service.gov.uk/media/605b148ce90e0724c7d30c2b/north-sea-transition-deal_A_FINAL.pdf> accessed 15 November 2023.
51 Herrera Anchustegui and Glapiak (n 9).
52 The World Bank, 'Carbon Pricing Dashboard' <https://carbonpricingdashboard.worldbank.org/> accessed 15 November 2023; Earth.Org, 'What Countries Have a Carbon Tax' (10 September 2021), <https://earth.org/what-countries-have-a-carbon-tax/> accessed 15 November 2023
53 Thema Consulting Group, *Elektrifisering av olje- og gassektoren—har det global klimaeffekt?* (January 2023), p 9; Herrera Anchustegui and Glapiak (n 9).
54 S&P Global Commodity Insights, 'Weak Compliance Demand Drags EU Carbon Prices to Three-month Low' (28 April 2023) <https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/electric-power/042823-weak-compliance-demand-drags-eu-carbon-prices-to-three-month-low> accessed 15 November 2023.
55 Lov om avgift på utslipp av CO2 i petroleumsvirksomhet på kontinentalsokkelen, LOV-1990-12-21-72.
56 Lov om kvoteplikt og handel med kvoter for utslipp av klimagasser, LOV-2004-12-17-99.
57 Lov om vern mot forurensninger og om avfall, LOV-1981-03-13-6.
58 Lov om avgift på utslipp av CO2 i petroleumsvirksomhet på kontinentalsokkelen, LOV-1990-12-21-72.

tonne of CO_2.[59] In 2007, the Norwegian government introduced an additional tax scheme per kilogram of oxides of nitrogen, NO and NO_2, emissions applying to all sectors of the economy, and which currently is 23.48 NOK (about €2) per kg.[60] However, the Norwegian government has implemented a Participant Agreement scheme that grants a temporary full exemption from paying the nitrogen emissions charges to undertakings part to it. This has been declared compatible state aid by the European Free Trade Association Surveillance Authority on two occasions, with the latest waiver applying between 2018 and 2025.[61]

These charges impose significant financial burdens on the oil and gas sector active on the Norwegian Continental Shelf. For example, Equinor, responsible for 70 per cent of Norway's oil and gas production,[62] incurred a total cost of $978 million US in 2021 related to the payment of EU ETS quotas, the Norwegian CO_2 tax.[63] This is a substantial increase compared to the same cost in 2016 when total environmental costs amounted to $604 million US.

In Canada, in January 2023, the federal carbon price increased from $50 to $65 Canadian per tonne of GHG emissions. It will continue to grow 'at a rate of $15 per tonne from 2023-2030'.[64] By 2030, the federal carbon price will be $170 Canadian per tonne of GHG emissions. The federal regime for GHG pollution pricing survived a vigorous challenge by several provinces (including the key oil and gas-producing province of Alberta) and was deemed constitutional by the Supreme Court of Canada in March 2021 in its *References re Greenhouse Gas Pollution Pricing Act* decision.[65]

Despite the challenges of operating in jurisdictions with high carbon pricing mechanisms such as in Norway and Canada, a low-carbon oil and gas production offers lucrative prospectives, especially at a point in time when the global energy transition is beginning to accelerate. Furthermore, within a wider energy security discussion, the 'futureproofing' of the respective oil and gas sectors in Norway and Canada through offshore electrification, as advanced in this article, will take on an even more significant role. At the risk of stating the obvious, offshore electrification will provide important impulses to the emerging offshore wind energy sector and the traditional oil and gas industry. For example, Wood Mackenzie discusses the concept of 'energy super basins' in a recent report, geographic regions where the upstream industry is 'co-located with both plentiful clean electricity and CCS potential'.[66] Norway's North Sea region and Atlantic Canada have the potential to develop as energy super basins, not least since the world will need oil and gas for many decades to come, with an increased focus on low-carbon production. Thus, the role of electrifying oil and gas operations using renewable energy such as offshore wind energy may soon become 'one of the fastest and best ways to eliminate emissions … [meaning that the] co-location of low-cost renewables with low-cost oil and gas is key'.[67]

Advancing offshore wind energy and the electrification of offshore oil and gas

As noted, the electrification of offshore oil and gas infrastructure may be a key driver for offshore wind technology and advance the development of new renewable energy solutions. The offshore wind sector is still in the initial stages of development in Norway and Canada, but aligning the traditional offshore oil and gas sector with a relatively new wind energy industry will advance an overall energy transition in the offshore fossil fuel sector. It will do this by generating new projects that will lead to further economies of scale, knowledge gathering, and the development of innovative solutions related to sector-coupled assets. Offshore wind electrification offers avenues for oil

59 Norwegian Petroleum, 'Emissions to Air' (n 21).
60 Lov om særavgifter, LOV-1933-05-19-11.
61 EFTA Surveillance Authority, *NOx tax exemption for 2018–2025*, Decision No 027/18/COL (2018).
62 Equinor, 'Field and Platforms' <https://www.equinor.com/energy/fields-and-platforms> accessed 15 November 2023.
63 Equinor, 'Climate—table CO2 Costs and Environmental fees' <https://sustainability.equinor.com/climate-tables> accessed 15 November 2023. These numbers include fees in Brazil, too.
64 Canada, 'The Federal Carbon Pollution Pricing Benchmark' <https://www.canada.ca/en/environment-climate-change/services/climate-change/pricing-pollution-how-it-will-work/carbon-pollution-pricing-federal-benchmark-information.html#> accessed 15 November 2023.
65 Canada: *References re Greenhouse Gas Pollution Pricing Act*, 2021 SCC 11.
66 Wood Mackenzie, *Energy Super Basins: Where the Renewable, CCS and Upstream Stars Align* (July 2022) 2.
67 Mackenzie (n 66) 5.

and gas producers to expand their renewable energy portfolios and explore new technical solutions to optimize oil and gas extraction, all while gaining expertise in a novel sector. Several supermajors in oil and gas, such as Equinor, BP, Chevron, Total, Eni, Shell, and ExxonMobil, are operating independent offshore wind projects or are in the advanced stages of expanding into the market.

Electrification of existing (or future) oil and gas assets may also provide investors in offshore renewable energy projects with the requisite short-to-medium term investor security, at a time when the offshore wind energy sector is still relatively novel, particularly in emerging jurisdictions such as Norway and Canada. Critical lessons still need to be learnt, and expertise from the oil and gas sector will be vital to build-up and establish an entirely new economic activity in challenging geographic and environmental conditions. Thus, electrification will also serve to accelerate an economic and social transition towards low-carbon economic activities in Norway and Canada. Integrating renewables in offshore oil and gas infrastructure will thus require complex processes and operating models, not to mention implications for operations, safety, project participants, and regulators.

Drastic reductions in GHG emissions are critical to the future of the oil and gas sector globally, including in Norway and Canada. What is new for the renewable energy sector, the offshore oil and gas sector, and national regulators alike in both Norway and Canada, however, is the departure from the development of onshore wind energy projects built solely to generate electricity to decarbonize the electricity grid, and instead to shift the focus to offshore wind energy projects built expressly to electrify oil and gas platforms offshore. In 2022, for example, the most ambitious and innovative Trollvind electrification project was announced through which Equinor, Petoro, TotalEnergies, Shell, and ConocoPhillips are seeking to develop a 1 GW wind park to electrify the Troll and Oseberg offshore fields on the Norwegian Continental Shelf, through an onshore connection point.[68] Unfortunately, in May 2023, the project was put on hold due to technological and financial complexities, along with an unclear and absent regulatory framework in Norwegian law.[69]

ELECTRIFICATION OF OFFSHORE ASSETS: THE QUESTION OF WHICH REGULATORY FRAMEWORK APPLIES TO THE PROJECT DESIGN

Offshore wind electrification's first steps

Until 2022, oil and gas electrification came from energy sources generated onshore. In Norway and other jurisdictions, electrified oil and gas fields were powered by electricity supplied by the existing grid and connected to the offshore platform assets. The electricity came from the national grid, meaning that the electricity production and the oil and gas fields were seen as separate activities connected by an electricity transmission cable and handled separately in legislative and regulatory frameworks.[70] Secondly, the electrification occurred after the offshore oil and gas asset had been constructed. So-called upgrades or retrofits to offshore assets have been typically handled either as a modification of the gas field, as is the case in the UK, where modifications fall under a modification of the Field Development Plan.[71] In Norway, this is also the case. Any modifications typically are approved as modifications of the main development project by a plan for the development and operation of petroleum deposits (PDO), or as a plan for the installation and operation of facilities for the transport and utilization of petroleum (PIO).[72]

[68] Equinor, 'Equinor and Partners Consider 1 GW Offshore Wind Farm off the Coast of Wester Norway' (17 June 2022) <https://www.equinor.com/news/20220617-considering-1gw-offshore-wind-farm-off-western-norway> accessed 15 November 2023.

[69] Equinor, 'Equinor put Trollvind on Hold' (n 10).

[70] See clarifying this, eg when stressing that the authorization related to the construction of new electricity generation and transmission facilities require an independent license under the Energy Act: Norwegian Petroleum Directorate (n 31) 31.

[71] For more on this see, North Sea Transition Authority, *Requirements for the planning of and consent to UKCS Field Developments* (last updated October 2021).

[72] Norwegian Petroleum Directorate (n 31)12.

However, offshore oil and gas electrification changed in November 2022 when Hywind Tampen, the Norwegian offshore wind farm that currently provides about 35 per cent of the electricity to the Gullfaks and Snorre fields, started to produce electricity exclusively for these fields. The regulatory process for the Hywind Tampen project, which concluded with approval in April 2020,[73] was markedly different from previous projects for two reasons. First, the power produced was not drawn from existing onshore generation capacity but from a new generation facility located offshore and built with the sole objective of electrifying the facility. Secondly, this project was handled as a modification of the oil and gas fields to which it supplies power, not as an independent project. The regulatory procedure for the Hywind Tampen project, therefore, exposes several critical questions in law and regulatory processes, not least the key issue of which applicable rules are to apply to future electrification projects on the Norwegian Continental Shelf.

Electrification by offshore wind parks offers important technical and practical benefits compared to electrification from onshore-generated electricity. For example, the utilization of offshore wind parks would resolve the issue of transporting electricity over long distances, thus avoiding (or at least minimizing) the need for costly long-distance sub-sea cables and associated interconnector infrastructure.[74] It is understood that alternate current solutions could be used, thereby substantially reducing project costs. Secondly, the offshore wind energy project option will address geographic constraints, especially where onshore electrification is not technically feasible due to lack of capacity or distance from shore. Thirdly, electrification from offshore wind energy projects will prevent the reliance on onshore electricity from non-renewable fossil fuel sources such as coal, thereby promoting climate mitigation strategies (while paradoxically, electrifying hydrocarbon extraction projects) and preventing the offshore wind energy projects from competing with onshore electricity generation. Fourthly, offshore wind electrification will add new electricity generation capacity and is unlikely (depending on the applicable electricity market regimes) to have a negative impact on onshore electricity prices. Fifthly, developing offshore wind assets in the North Sea will have the added effect of expanding the growing offshore grid network, which may be used to connect different projects and/or countries, promoting aspects related to the security of and variability of supply.[75]

While offering an attractive option to decarbonize the oil and gas sector, the electrification of offshore oil and gas assets using offshore wind energy is in its infancy. Few projects have been devised, and engineering and cost factors may become a significant hurdle. Additionally, these initiatives are highly susceptible to regulatory risks (as well as economic and technological challenges), not least due to the relatively undeveloped nature of legislative and regulatory frameworks. The design of the offshore project also directly impacts which legislative and regulatory framework applies to it, as analysed below, keeping in mind that it may be more than one framework (either offshore wind energy, offshore oil and gas, or a hybrid version). For example, classifying a project as an oil and gas or offshore wind project (independent from each other or ancillary to each other) will directly influence the legislative and regulatory regimes applying to the proposed facilities. Technological developments have the potential to complicate these processes even further. A 2021 UK government report identified some of these risks[76] and, as noted, in May 2023, the Trollvind project in Norway was put on hold.[77] Key regulatory barriers persist in the (future) offshore electrification using wind energy, linked in part to a lack of certainty as to the nature of the projects at hand and clarity on the applicable regulatory, permitting, and applicable law regimes.

73 Equinor, 'Hywind Tampen Approved by Norwegian Authorities' (8 April 2020) <https://www.equinor.com/no/news/archive/2020-04-08-hywind-tampen-approved> accessed 15 November 2023.

74 Marvik, Øyslebø and Korpås (n 16).

75 North Seas Energy Cooperation, 'Joint Statement on the North Seas Energy Cooperation' (12 September 2022) <https://energy.ec.europa.eu/system/files/2022-09/220912_NSEC_Joint_Statement_Dublin_Ministerial.pdf> accessed 15 November 2023; see also: Rudiger Tscherning, 'The European Offshore Supergrid and the Expansion of Offshore Wind Energy in Germany, Ireland and the United Kingdom—Legal, Political and Practical Challenges, Part I' (2011) 20 European Energy and Environmental Law Review 76; Volker Roeben, 'Governing Shared Offshore Electricity Infrastructure in Northern Seas' (2013) 62 International and Comparative Law Quarterly 839.

76 UK Department for Business, Energy & Industrial Strategy and OGUK (n 50) 27.

77 Equinor, 'Equinor put Trollvind on Hold' (n 10).

Offshore wind electrification: design decisions and regulatory challenges

The design, approval, and development of offshore wind energy projects to electrify offshore platforms involve discussions around accessory infrastructure, retrofitting of existing (principal) oil and gas platform assets, and the broader question of how to align (in regulatory and legal contexts) a new wind energy industry with the traditional oil and gas sector. Stand-alone offshore wind energy projects differ from offshore oil and gas projects. While both project scenarios share certain commonalities, such as being located at sea and being used to extract resources or gather the power of nature to generate energy, they are not alike in any broader sense. For example, offshore wind energy projects require large sea spaces, occupying several hundred square kilometers. In contrast, offshore oil and gas projects occupy much less space, even when a platform operates several wells. Unlike oil and gas projects, no resources are formally 'extracted' or consumed from the seabed; wind is harnessed but never exhausted. Offshore wind parks have the production of electricity as their ultimate function, which is generated by the movement of the wind turbine blades. This electricity is produced *in situ* and transported in its same form to its final destination, where it will be consumed as another activity is conducted. Oil and gas projects, on the other hand, extract a resource but in the extraction process, no new product is created. The extracted oil and gas must be transformed for further refinement and manufactured into different gasoline, diesel, or plastic industrial streams. This is a critical conclusion at the outset and leads to the thinking that there is limited scope to include offshore wind projects within the existing (and established) regulatory framework for offshore oil and gas assets.

As stressed, unlike the electrification of offshore oil and gas infrastructure by onshore electricity cable connections, the electrification of offshore oil and gas platforms through direct wind energy offshore is still a novel concept. These projects differ from the stand-alone model discussed above as they co-exist and complement each other. The offshore wind park will generate electricity that will power the oil and gas field, being this its sole or primary function. Furthermore, the offshore wind may be built concurrently with the oil and gas assets, creating an even closer link between the infrastructure. Could this mean that this is one project composed of different assets? If so, may this have implications for the applicable law and necessary steps to approve the electrification of an oil and gas field and the construction of a wind park?

To explore likely project models and applicable regulatory options for offshore wind energy and offshore platform electrification, three parameters are used to evaluate actual or planned projects. These are: the applicable project design and resulting regulatory taxonomy, the intended function of the proposed offshore wind energy project, and the timing of the offshore wind project. The Norwegian and Canadian scenarios are used to illustrate these alternatives based on existing and anticipated future developments.

Towards a regulatory taxonomy based on the applicable project design

As noted, the question of the applicable legal and regulatory framework (or frameworks) is critical to the continued electrification of the oil and gas sector. This section discusses the likely practical scenarios in terms of project design models for the electrification of oil and gas assets using offshore wind energy projects not connected to the onshore by way of electricity cables. The onshore connection to existing electricity grid infrastructure is omitted in this article, predominantly due to the regulatory particularities which are different from those related to the authorization and development of offshore infrastructure and the vast and complex topic of grid connection of oil and gas assets, which is outside of the scope of our article.

In the quest to identify a regulatory taxonomy for offshore project types, this article identifies two likely scenarios based on the technological possibilities and a temporal consideration as to when the different project entities (the oil and gas platform, the offshore wind energy project) are built and connected to electrify the oil and gas platform. The first (existing) scenario may be called the 'Hywind Tampen project design', which considers the offshore wind energy project as a new asset designed to electrify an existing oil and gas platform. The second scenario assumes the development of an offshore wind energy project and a new offshore oil and gas project simultaneously and as one single project, which may be called the (hypothetical) Bay du Nord project design for discussion purposes.

In short, the core consideration relevant to offshore electrification can be narrowed down to the following: what type of project is before the regulator(s) and which legal regime should apply to it?[78] For example, is the project an oil and gas project with an offshore energy project that is part of it? Are there two separate and different projects, one an oil and gas project and the other an offshore wind project, autonomous and independent from each other? If deemed ancillary or independent, on what basis is this decided and what legislative and regulatory determinations form part of the consideration? Who decides? If seen as a modification or part of an oil and gas project, could standard licensing steps be bypassed to accelerate project permitting? Or will an integrated/hybrid regime apply to both the offshore wind project and the offshore oil and gas project due to the accessory and purposive character of the wind energy project to electrify the primary oil and gas project? What scenario would apply where the platform and wind energy projects are proposed jointly and simultaneously, thus forming two components of a larger single project?

Characterizing a project as independent and as a principal asset, in other words, a standalone project, would typically mean that it is assessed and approved under the regulatory regime for the type of project in question. This reasoning is based on general notions of obligations in contract law related to independent and accessorial objects, contracts, and obligations. A principal object/obligation is characterized by having its own existence or objective, irrespective of another object/obligation. A principal can exist without a pre-existing asset or obligation and conduct its own activity. On this reasoning, the nature and independent characteristics of an offshore wind energy project developed to electrify an existing oil and gas field would suggest that it is an independent project. After all, a wind energy project is developed to harness the power of the wind to produce electricity as its sole and primary objective. The reason why renewable electricity is generated, and the location of consumption of this electricity, would, on such a strict principal reasoning, have little relevance *a priori*.

An opposite conclusion could, however, also be reached. By following the *accessorium sequitur principale* principle, it might also be possible to conclude that the wind energy project is (after all) connected to electrify an oil and gas asset, meaning that the wind project is nothing more than an extension of the main activity, namely the extraction of hydrocarbons by the offshore oil and gas platform asset. The extraction and processing of the oil and gas is the sole function of the platform, and the function of the wind energy project is to electrify that very asset. If this reasoning applies, the wind energy project is merely an accessory or addendum to the oil and gas activity. On this basis, the offshore wind energy project could be governed by the petroleum regime, and not the offshore wind regime,[79] and therefore approved as a modification of the existing oil and gas field. If this is the chosen route, then fewer regulatory steps may be needed.

These questions have relevant practical implications and no straightforward answers. The scenarios discussed expose the evident tensions and resulting regulatory uncertainties related to the classification of a wind energy project and its characterization as either an individual or ancillary/connected project. These are critical considerations that will direct regulators (and legislators) to the applicable legal framework(s) when confronted with the task of determining the offshore wind energy project's legal character. Already in 2020, the UK Oil and Gas Authority, in its UKCS Energy Integration report and its Annex 1 on Offshore electrification, raised a critical point: '[w]indfarm leasing and consenting process would be considerably longer than consenting to the O&G platform modifications'.[80]

[78] In this article, we do not discuss the differences between licensing or concession systems regulating oil, gas, or wind in general. For some literature on this see, inter alia, Tina Soliman Hunte, Jørn Øyrehagen Sunde and Ernst Nordtveit (eds), *The Character of Petroleum Licences* (Edward Elgar 2020); Catalin Gabriel Stanescu, Eduardo G Pereira and Aaron Koenck, 'Petroleum Concessions, Licenses and Leases:"Same-Same but Different"?' (2019) 8 LSU Journal of Energy Law and Resources 95.

[79] In Norway, eg the definition of petroleum activities is rather broad. It includes 'all activities associated with subsea petroleum deposits, including survey, exploration drilling, production, transportation, utilisation and decommissioning, including planning of such activities, but not including, however, transport of petroleum in bulk by ship', s 1-6 c) Lov om petroleumsvirksomhet, LOV-1996-11-29-72.

[80] UK Oil and Gas Authority (n 26) 22.

The intended function of the proposed offshore wind energy project: electrifying an existing oil and gas asset

A separate regulatory approach: two principal objects

As discussed, the electrification of existing offshore oil and gas assets by new offshore wind developments exists. Hywind Tampen is the world's first and, so far, only example. At first, it may seem (intuitively) sound to view each part of the project as independent and governed by different regulatory regimes.

There are several sound legal arguments to justify this position, as each of the components represents a principal object that can be regulated independently and on its own. First, the components are different technological solutions developed to extract or use very different types of energy. They have other characteristics (oil and gas are extracted and will be consumed and be no longer available; wind is used to generate electricity without it being consumed) and entail different security risks. Secondly, the project components are built *at different times*. As remarked, the oil and gas platform has been designed, constructed, and built most likely without any future consideration of being electrified by offshore wind energy; offshore wind electrification comes at a later stage. Thirdly, considerations regarding sea space use and the extent and type of environmental impact assessment differ greatly. Fourthly, it could be argued that while the offshore wind energy project has been designed to electrify the oil and gas asset, its primary function, to produce renewable energy, would still occur, even in the absence of the oil and gas field, for instance by having a cable connection to the shore. Fifthly, and likely based on these considerations, it is natural to understand why energy law regulatory regimes tend to apply different rules to different sectors and distinguish between various projects; energy law and administrative law, to date, tend to take a sectoral approach with different regimes applying to the regulation of oil and gas developments and the regulation of offshore wind parks; the idea of an integrated energy regulatory regime is still a relatively novel concept.

The implications of viewing each project as independent are critical; a complete list of these is hard to compile as it would vary between jurisdictions. However, each project will follow its own regulatory regime, meaning that the new offshore wind project would be under the regular offshore wind energy legislative regime, and the offshore hydrocarbon project will continue to be regulated by the oil and gas framework *as independent projects*. Crucially, this means that a new license or concession needs to be obtained to develop the wind energy project, requiring all 'normal' licensing steps to be followed. An entire offshore wind licensing procedure, including the opening of areas and the grant of a license in a defined area, may take several years (anything from two to seven).[81] This might imply that the offshore wind license holder differs from the oil and gas license holder, increasing competition for the project or perhaps having the opposite effect. Additionally, different time frames, environmental impact requirements, stakeholder participation, etc, would have to be followed.

A separate and independent regulatory approach based on the existence of two different projects is arguably sound from the perspective of general regulatory principles in infrastructure development. It follows the rules developed for the particular sector and infrastructure type, ensures compliance with environmental and safety measures tailored to each regime, may create more competition for the new offshore wind project, and is more predictable overall. However, it has time as its enemy. It is substantially more time-consuming and will not, in itself, contribute to the fast-tracking of offshore electrification as a new and independent license procedure governed by a different regime would need to take place. Additionally, but perhaps a weaker argument, is that in this scenario, license holders may differ, potentially leading to operational hurdles and financial disincentives. However, it does not need to be so as onshore electrification shows projects can be

[81] See eg Baltic Wind.eu, 'Vestas and Ørsted Warn of Consequences of too Slow Wind Farm Approval Process' (19 August 2022) <https://balticwind.eu/vestas-and-orsted-warn-of-consequences-of-too-slow-wind-farm-approval-process/> accessed 15 November 2023; Rabobank, 'The Bottlenecks Challenging Growth in the EU Offshore Wind Supply Chain' (13 March 2023) <https://www.rabobank.com/knowledge/d011354306-the-bottlenecks-challenging-growth-in-the-eu-offshore-wind-supply-chain> accessed 15 November 2023; Atlantic Council, 'US Offshore Wind's Growing Pains: Permitting and Cost Inflation' (26 June 2023) <https://www.atlanticcouncil.org/blogs/energysource/us-offshore-winds-growing-pains-permitting-and-cost-inflation/> accessed 15 November 2023.

adjusted and tailored even if owned by different entities (as it happens with most providers and consumers of electricity).

An integrated regulatory approach: an accessory to a principle

Conversely to this approach, the Norwegian regulator has decided that the electrification of an oil and gas set of platforms by a new offshore wind park is a *modification* of the existing plan for development and PDO,[82] not as a standalone project. This means that the wind park was a part of the oil and gas development, regulated by the oil and gas regime in its entirety, not requiring a separate and lengthy offshore wind licensing process, and effectively fast-tracking the electrification process.

In Hywind Tampen, the joint venture partners of this oil and gas field, Equinor (acting as operator and owning 51 per cent of the license), Petoro AS (30 per cent), and OMV Norge (19 per cent), requested the offshore wind project to be evaluated as a part of the existing oil and gas fields Gullfaks and Snorre, and modifying the approved PDO of the former.[83] The Norwegian Oil and Energy Ministry evaluated the application and concluded that this was indeed a modification of the PDO of the already granted license for the operation of the Gullfaks field, based on Section 4-2 of the Petroleum Act.[84]

The reasoning of the Ministry was succinct. Among the arguments and conditions, some key elements were stressed. First, it was relevant and important that the owners of both projects would be the same entities; this created synergies and reduced conflicts. Secondly, a requirement to submit by 31 December 2023 a report of the effect of the wind park on the Gullfaks field and its CO_2 emissions was imposed. Thirdly, the demand that licensors must facilitate coexistence with other entities and seek solutions in case of spatial conflicts for current or future activities.[85]

While already in place, the Offshore Energy Act, regulating offshore wind, was not applied based on the broad 'scape' provision contained in its Section 1-2. This provision allows the regulator to render the act inapplicable and instead substitute it with other legislation, in this case, the petroleum regime.[86] The logic behind this clause is to avoid an instance of 'double regulation', as explained by the Offshore Energy Act's preparatory works, particularly for an 'integrated part of a petroleum installation'.[87] This means that none of its provisions related to the governance of offshore wind projects were triggered, and no procedures had to be complied with. With this, the Ministry effectively recognized the wind park as an accessory to a principal project, the Gullfaks oil and gas field.[88]

This outcome considers the project as an accessory to the principal, following the principle *accessorium sequitur principale.* It also follows the pragmatic approach of the legislator already foreseen in 2010 to use offshore renewable energy in connection to oil and gas activity or even maritime transport and prevent a case of 'double regulation' as stressed by the preparatory works, an especially relevant legal source in Norwegian law. The consequences are telling: the wind park can be constructed following the administrative procedures related to the modification of an existing

82 Olje-og energidepartement, Hywind Tampen—godkjennelse av endret plan for utbygging og drift av Gullfaks (19/1750-18) (8 April 2020).

83 ibid.

84 'The Ministry shall be notified of and shall approve any significant deviation or alteration of the terms and preconditions on which a plan has been submitted or approved and any significant alteration of facilities. The Ministry may require a new or amended plan to be submitted for approval' s 4-2, para 7 of the Lov om petroleumsvirksomhet, LOV-1996-11-29-72; Olje-og energidepartement (n 82).

85 'Det at eierskapet til vindkraftverket følger eierskapet på feltene, slik samarbeidsavtalen fastsetter, er viktig. Slikt gjennomgående eierskap gir gode insentiver både under utbygging og drift og legger dermed til rette for god ressursforvaltning'; Olje-og energidepartement (n 82).

86 Olje-og energidepartement (n 82).

87 Ot.prp.107 Om lov om fornybar energiproduksjon til havs (2008–2009) p 79 (own translation).

88 This is also the opinion of Finne that uses the Norwegian term «tilbehør» to refer to offshore wind electrification projects connected to oil and gas platforms. A tilbehør is an accompaniment or accessory: Eirik Finne, *Havvindproduksjon som" tilbehør" til petroleumsinstallasjoner* (2022). See also discussing this case and more generally the regime of petroleum and offshore wind interface: Maria Koch Haugane, 'Havenergilovas og petroleumslovens regler om tildeling av konsesjon for kraftleveranser til petroleumsanlegg' (2023) 572 MarIus.

and granted license and PDO for an oil and gas field. No new license procedure must be triggered and the entire oil and gas regime applies to this modification or accessory.

In contrast to the separate regulatory approach, this is based on qualifying the wind project as an accessory to one existing—with its own regulatory regime—and, as justified in the Norwegian Offshore Energy Act preparatory works, not requiring 'double regulation'. This modification approach used by Hywind Tampen brings advantages worth observing, many of them of particular interest to the oil and gas field operators. First, the time benefits are obvious as the handling of a modification of an existing license for oil and gas is much shorter than the procedure to award a license. In this way, it may save years of lengthy regulatory permitting processes for the offshore renewable energy facility.[89] Secondly, this approach means that the oil and gas operators are the parties in a position of power to determine who will conduct the electrification process for the offshore oil and gas asset, avoiding the issue of two separate license holders and considered important for Norwegian authorities.[90] Thirdly, the full oil and gas regime applies to the project, avoiding double regulation or legal uncertainties concerning the applicable law; for example, the typically favourable tax regime applicable to oil and gas would apply to the offshore wind energy project, allowing the offshore wind project (or its electricity once running) to be deducted as a cost.[91]

This approach has some drawbacks, two of which are quite obvious: that the regulation might not be fit for purpose (in this case for offshore wind) and that it may not promote competition for the development of the offshore wind project. The construction of an offshore wind energy project has a different set of consequences when it comes to the marine environment in which it is located compared to oil and gas assets (eg the spatial implications). If this integrated option coexists with separated rules for 'normal' offshore wind projects, there is a risk that project developers will prefer constructing offshore wind parks to electrify oil and gas projects as long as they are 'accessories' as it is faster and may simply no competition for the license. This may have wider negative implications for the development of offshore wind energy development for the sole purpose of generating electricity. Not surprisingly, the pragmatic approach to the Hywind Tampen approval as an accessory has been criticized by offshore renewable energy project developers not interested or able to engage in oil and gas electrification projects as 'unfair'.[92]

Perhaps less obvious is that the classification of the project as a modification and, therefore, an accessory, should restrict the project design. Among these, the project should be built in parallel with a new oil and gas field development, or if after the oil and gas field is present, then it should generate power for the oil and gas field either exclusively or for the most of its production. This seems to be the view of the Norwegian Ministry of Petroleum and Energy when stating in 2022 that 'If a wind park is both connected to the grid on land and a petroleum field, then it is foreseen that it will be by the Offshore Energy Act and not the Petroleum Act'.[93]

The timing of the offshore wind project: development of a new oil and gas platform and a new offshore wind energy project at the same time

As noted, the complexities of which regulatory regime will apply to the offshore electrification project are inherently related to the temporal nature of the project components with two possible avenues with contrasting outcomes based on whether the project is independent or an accessory. But what would the regime look like if a new offshore oil and gas asset is proposed with a related offshore wind energy project, thus bolstering the accessory and ancillary infrastructure argument? Take, for example, the Canadian federal government's 2021 regulatory approval of the Bay du Nord project in Atlantic Canada, which would mark the first offshore oil and gas project outside

[89] UK Oil and Gas Authority (n 26) 22.
[90] Olje-og energidepartement (n 82).
[91] Ignacio Herrera Anchustegui, 'Is Hywind Tampen's State Aid Approval a Kickstart for the Norwegian Offshore Wind Industry?· Decision 017/20/COL Hywind Tampen, EFTA Surveillance Authority' (2020) 19 European State Aid Law Quarterly 225.
[92] Norsk Havvind, *Norsk Havvind uttrykker synspunkter om rettferdig konkurranse innen havvindkraft* (2021).
[93] Norwegian Ministry of Petroleum and Energy, *Veileder for arealtildeling, konsesjonsprosess og søknader for vindkraft til havs*, p 14 (own translation).

Canada's 200-mile Exclusive Economic Zone, effectively drilling in Canada's extended continental shelf.[94] The approval for this project is subject to stringent environmental, GHG, and air quality conditions.[95] Equinor, as the proponent, was expected to make an investment decision on the project in the course of 2023 but has now postponed this decision until 2026.[96]

For purposes of discussion, the Bay du Nord project may (as a hypothetical example at this stage) combine the development of both the oil and gas asset and the offshore wind asset either jointly or in a coordinated (symbiotic) fashion. Again, the question arises: which regulatory regime would the project fall under? If the objective is to fast-track the scaling-up of offshore wind energy and the rapid decarbonization of the oil and gas sector, a 'combined effort' approach is needed. This could mean that the project approval and different permits will be conducted simultaneously, under the same regulatory regime and a single regulator. Ultimately, this is a techno-legal (as well as economic) decision by the planned operators of the Bay du Nord project. Nevertheless, any regulatory regime must be sufficiently broad to encompass both the traditional oil and gas approval considerations and (emerging) offshore wind energy considerations, as well as the individual and cumulative environmental impacts on the affected marine environment. Here, the Bay du Nord's geographic challenges both in terms of distance and depth may support the combining of oil and gas with offshore technical forces.

At the risk of stating the obvious, both Norway and Atlantic Canada (Newfoundland and Labrador) share a similarity in acting as respective hydroelectricity generation powerhouses. Newfoundland's electricity grid consists of 96 per cent hydroelectricity.[97] Due to geographic constraints, however (unlike in Norway), near-shore electrification of oil and gas infrastructure is not feasible for Atlantic Canada. For example, the Terra Nova field is located 350 km from shore.[98] The geography of Atlantic Canada means that platforms are installed in depths ranging from 80 metres (Hibernia field) to 1170 metres (Bay du Nord), while Equinor's offshore Hywind Tampen project, located approximately 140 km off the Norwegian coast, is in water depths between 260 and 300 metres.[99] In both Canada and Norway, therefore, electrification of offshore oil and gas installations will likely have to rely on offshore wind energy projects, likely floating wind energy, which in itself is still an emerging and new industry.

In this scenario of joint development, an integrated regulatory approach with a single regime and a licensing process could be justified by assessing both assets as a single project. There are good arguments in this case that mirror but go further than when compared to the accessory or modification alternative. First, the project has been designed as a unit and will be built simultaneously. Secondly, environmental impact considerations could and should consider the specificities of this hybrid project in the assessment. Thirdly, a joint approach would prevent conflicts between potentially different license holders. Fourthly, regulators will be able to set design, safety, and regulatory requirements that may be integrated in the licensing conditions. Fifthly, this approach may incentivize and facilitate the development of integrated energy projects and the reduction of GHG emissions in the case of new hydrocarbon extraction developments.

[94] The implications of this are many and outside of this article's scope. For more information concerning Canada's submission to Commission on the Limits of the Continental Shelf pursuant to Article 76 of the United Nations Convention on the Law of the Sea: <https://www.un.org/depts/los/clcs_new/submissions_files/submission_can1_84_2019.html> accessed 15 November 2023. The construction of an offshore wind farm in an Extended Continental Shelf brings about interesting issues related to Public International Law. See on this: Ignacio Herrera Anchustegui and Violeta S Radovich, 'Wind Energy on the High Seas: Regulatory Challenges for a Science Fiction Future' (2022) 15 Energies 9157; Paul Elsner and Suzette Suarez, 'Renewable Energy from the High Seas: Geo-spatial Modelling of Resource Potential and Legal Implications for Developing Offshore Wind Projects Beyond the National Jurisdiction of Coastal States' (2019) 128 Energy Policy 919.

[95] Canadian Ministry of Environment and Climate Change, Decision Statement Issued under Section 54 of the Canadian Environmental Assessment Act, 2012 (6 April 2022).

[96] Reuters, 'Equinor delays Bay du Nord Canada oil project up to 3 years over rising costs' (n 13).

[97] Canada Energy Regulator, Provincial and Territorial Energy Profiles, Newfoundland and Labrador, Electricity <https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/provincial-territorial-energy-profiles/provincial-territorial-energy-profiles-newfoundland-labrador.html> accessed 15 November 2023.

[98] Suncor, 'Terra Nova Field' <https://www.suncor.com/en-ca/what-we-do/exploration-and-production/east-coast-canada/terra-nova> accessed 15 November 2023.

[99] Equinor, 'The Hywind Tampen Project' <https://www.equinor.com/energy/hywind-tampen> accessed 15 November 2023.

A pragmatic approach: the Norwegian options for 'fast-tracking' electrification

These different approaches to offshore electrification based on the function or time the projects are developed lead to several regulatory doors with varied and important consequences. Norway, following its pragmatic approach to offshore energy regulation, has taken a path in which it may fast-track electrification projects of oil and gas fields, but also offshore wind projects more generally.[100]

The Offshore Energy Act of Norway includes in Section 1-2, discussed above in 'An integrated regulatory approach: an accessory to a principle', a rule that allows for the Act's dis-application for specific projects. This provision is complemented by Sections 2-2 and 2-3, the latter added on 16 December 2022.[101] These provisions deal with the opening up of areas in sea spaces controlled by Norway for offshore renewable energy projects and the granting of specific spaces for concrete projects as part of the licensing procedure. As discussed below, they offer an alternative in which offshore wind projects (for electrification but also more generally) may be speeded up by 'jumping over' procedural requirements.[102] Both provisions are drafted so that, ultimately, administrative discretion by the regulator may allow specific projects to benefit from these fast-track mechanisms. In a way, they somewhat resemble the 'renewables acceleration areas' introduced in Article 15C of the Revised Renewable Energy Directive adopted in October 2023, but with different approaches and underpinnings.[103]

Section 2-2 of the Offshore Energy Act requires pre-opening certain areas for offshore wind activity based on a previous general impact assessment plan. Its fourth paragraph states, '[t]he Ministry can make exceptions to the rules on opening up areas in special cases'. Thus, under certain circumstances, offshore wind parks may be built in areas that have not been pre-qualified as suitable for offshore wind activity and without an area-specific allocation procedure, but still require a production license to be granted pursuant to Section 3-1.

The 2022 addition to the Offshore Energy Act, Section 2-3,[104] creates an exception for the assignment of an an offshore wind-specific area, which eventually may lead to an operation license pursuant to Section 3-1. The main rule is that designated areas are allocated through a competitive process. However, and this is the new part, '[i]n special cases, based on an application, the Ministry can allocate an area without advertisement or competition'.[105] The Ministry has full discretion when to apply this exception. Still, the general requirements of technical competence and financial capability and health, environment and safety set by Section 2-3 need to be met.[106]

The Offshore Energy Act, therefore, sets two "fast tracks". Under the exception of Section 2-2, an offshore area does not need to be opened; this also involves that the step to assign a specific area to a developer – generally through competition – is omitted. Under Section 2-3 of the Offshore Energy Act, it is this last assignment step in the process that is set aside. For both cases, obtaining a production license under Section 3-1 is needed.

These Norwegian provisions offer an alternative approach to electrification and may inspire other regimes for 'fast-tracking' offshore energy projects in general and/or the electrification of oil and gas fields more specifically. These rules do not qualify the project as integrated or separated one with respect an oil and gas field, but they partly 'solve' the timing problem of opening an area and/or conducting an allocation procedure for a specific area.

[100] See for an assessment on this, particularly concerning the fast-track benefits for oil and gas electrification through offshore wind: Siv Elén Årskog Vedvik, Hurtigløp for elektrifisering av sokkelen med havvind? - Moglegheiter og hindringar i dagens regelverk (forthcoming, 2024).

[101] Lov om endringar i havenergilova (utlysing og tildeling av areal), LOV-2022-12-16-96.

[102] Vedvik (n 100).

[103] Directive (EU) 2023/2413 amending Directive (EU) 2018/2001, Regulation (EU) 2018/1999 and Directive 98/70/EC as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652.

[104] This provision has been linked to the Equinor Trollvind project—partly due to the precedent of the Hywind Tampen case. More of this connection between the law modification and Trollvind can be seen in the report of the discussions in the Norwegian Parliament <https://www.stortinget.no/no/Saker-og-publikasjoner/Publikasjoner/Referater/Stortinget/2022-2023/refs-202223-12-06/?m=4> accessed 15 November 2023.

[105] 'Eitt eller fleire område innanfor eit område som er opna etter § 2-2, skal som hovudregel lysast ut og tildelast gjennom konkurranse. Departementet kan i særlege tilfelle tildele eit område etter søknad utan utlysing og konkurranse. Det kan bli kravd vederlag for tildelinga', 2-3 of the Lov om fornybar energiproduksjon til havs, LOV-2010-06-04-21.

[106] Vedvik (n 100).

Words of caution are due, however. These provisions do not fully address the regulatory problem. To what extent does the rest of the offshore wind regime apply to the project? Are there rules of the petroleum regime that would apply to it? As we mentioned, is this subject to an assessment based on the project being principal or accessory? Does this apply to projects built jointly? For now, with no application of the provisions in practice and its scant content, no clear answers can be given.

CONCLUSIONS AND LOOKING AHEAD

As explored in this article, the oil and gas and renewable energy sectors are coming together at a pivotal time. Oil and gas producers, petro-economies, and private fossil industry actors are increasingly looking at the large-scale integration of renewables in their conventional fossil fuel projects. One of these trends is the electrification of oil and gas production platform infrastructure in the offshore environment, beyond near-shore electrification from onshore renewable energy, which was first installed in Norway at the Troll East (A) platform in 1996.

Offshore wind-led electrification takes this concept one step further, offering new decarbonization opportunities for the oil and gas sector and potentially opening new commercial opportunities for the global offshore wind energy sector. The successful integration of *offshore* renewable energy generation assets with existing (or even future) oil and gas production platforms brings about important legal challenges related to, among other factors, the applicable regulatory regime to the electrification process. This article analysed different scenarios to categorize the nature of an electrification project. In an attempt to map different possibilities and to discuss resulting taxonomies, this article has identified and discussed several factors: the relationship between the offshore projects (whether they are both a principal object or the electrification may be qualified as an accessory of the oil and gas development), the intended function of the project, and the construction of the project in a temporal sense (oil and gas assets first, offshore assets separate, or both assets developed and built together). As noted, determining the nature of the electrification project may prove pivotal to identifying the applicable legislation.

The Norwegian regulatory and legislative experiences concerning the electrification of offshore oil and gas assets through offshore wind projects may act as a potential model for future regulatory regimes. This includes the possibility of both 'fast-tracking' electrification projects, based on the idea that the wind park is an accessory to the oil and gas regime, or following a separate licensing and regulatory scheme for each project. However, the Norwegian model does not remove all regulatory problems and leaves many questions to be answered, including those of the applicable legal regime(s) to the project and the associated consequences of this choice, which are plentiful. Accordingly, regulators and project developers may use these first attempts to inspire their own regime.

Looking further ahead at the next stage of the global offshore wind energy industry, industry and policymakers must work to align priorities to advance an overall build-out of the offshore wind energy sector. This ought to include the issue of decarbonizing strategic offshore oil and gas assets through wind energy electrification. There are developments in the offshore energy space (particularly in Denmark and the Netherlands) on the utilization of offshore infrastructure to build out the European hydrogen industry using offshore wind energy. A forward-thinking legal and regulatory environment will have to re-examine the role of renewables and existing offshore infrastructure, particularly concerning what regime applies and the consequences of such choices. Arguably, at this stage, in the Norwegian and Canadian offshore contexts, these discussions are somewhat exploratory. However, these examples serve to underline the importance of planning the co-development of offshore wind energy projects with oil and gas platforms and to highlight the need for clarity in the design and reform of legal and regulatory frameworks to support the 'greenification' of the global offshore energy sector.

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