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Communication

The Case for Policy in Developing Offshore Wind: Lessons from Norway

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Abstract: Offshore wind (OSW) has the potential to cut greenhouse gas (GHG) emissions and halt damaging climate change. However, policies to foster an OSW industry in Norway have long been small and scarce. Recent events suggest that this is changing, as the state-owned enterprise Enova decided to grant a record NOK 2.3 bn to build the world's largest floating offshore wind farm in 2019, the Hywind Tampen project. Based on previous work by the corresponding author, we summarize the political development of OSW in Norway to distil generalisable lessons. The corresponding author employed interviews, document analysis and process tracing, using a theory of policy change to characterise the observed political change. She found that the main obstacle for early OSW deployment has been that environmental and visibility concerns have exacerbated energy–political ones that are created by a longstanding lack of local energy demands. As the green energy demand on a global scale is soaring, the lack of OSW deployment for exports implies that climate–political objectives have been subordinated to energy–political ones, in the formulation of Norwegian OSW policies. This hierarchy of goals was not deemed to have changed, despite the recent political developments in the policy area of Norwegian OSW. Hence, the Norwegian case demonstrates the role of context and national sectoral policies in deciding the pace of sustainable energy transitions. It is suggested that future research considers how policy best practices for renewable energy deployment could be adjusted across varying national contexts to overcome political hurdles to the sustainable transition.

Keywords: offshore wind; renewable energy; sustainable transition; energy transition; policy paradigms; policy change; vested interests

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1. Introduction

Offshore wind represents one of the fastest-growing renewable energy sectors. In fact, between 2010 and 2018, the global offshore wind (OSW) market grew by almost 30% [1], and global installed capacity reached 35 GW in 2020. Offshore wind represents a vast energy potential that can cut substantial amounts of greenhouse gas (GHG) emissions and create jobs for fossil-based economies [2–4] required to transition [5–7] by the imperative of halting climate change and by the looming scenario of oil depletion.

Based on its world-leading petro-maritime expertise, Norway has had a unique opportunity to develop a strong supply industry to the international offshore wind market (e.g., [3,8–11]). However, policies to build a Norwegian offshore wind supply industry have long been small and scarce [8,10–13]. Even though the potential for the Norwegian industry has been communicated for at least 15 years [9,14], and despite significant investments in research and development [8,10,12,15], no active measures to capitalise on the investments to create a domestic market have been fully implemented.

Recent developments suggest that something has changed in the policy area for Norwegian offshore wind [16–19]. In August 2019, state-owned enterprise Enova announced that it would grant NOK 2.3 billion to the partially state-owned oil company Equinor to deploy the world's biggest floating offshore wind farm, Hywind Tampen [20,21]. In June 2020, Minister of Petroleum and Energy Tina Bru announced that two sea basins off the Norwegian coast would be opened to proposals for concession for offshore renewable energy production, and offshore energy regulations detailing the licensing process for project owners were adopted [17,18].

How significant are these political decisions? Additionally, how could we explain the previous indecisive actions resulting in today's belated efforts to grasp yesterday's opportunities? This communication draws on Dahl's [22] analysis, which explored the development of the policy area for Norwegian offshore wind (OSW) in the years 2012–2020. From a political science perspective, Dahl analysed the observed policy changes, namely Enova's 2.3 bn NOK Hywind Tampen grant and the two interlinked decisions to (1) open two sea basins and (2) adopt enabling regulations, for applications for OSW licenses. Dahl also analysed two Norwegian bottom-fixed OSW farm projects, Havsul and Siragrunnen, none of which have been realised to date. Her analysis detected important particularities of the Norwegian energy–political context, notably that of its energy–political paradigm, which has constituted a hurdle for major OSW deployment to date (ibid.).

Considering the particularities detected by Dahl [22], our objective is to distil the lessons that can be generalised to comparable cases. Contributing to the literature on sustainable transitions, our ambition is to strengthen the knowledge base for policymakers and other decision makers whose choices should realise such transition.

2. Background

Wind energy represents a considerable potential to cut GHG emissions and reduce the detrimental effects of climate change. Global wind energy (onshore and offshore) increased by a factor of 75 from 7.5 GW to 564 GW between 1997 and 2018 [23]. Whereas onshore wind now constitutes a mature technology, offshore wind is less developed, and constituted only 35 GW of the wind energy capacity deployed by March 2021 [24]. However, the uptake of offshore wind is increasing, reflecting the vast energy potential it represents [23].

In Europe, OSW and offshore renewable energy (ORE) more generally will be vital in achieving climate neutrality by 2050 at the latest [25]. The European Commission has set ambitious targets of installing a capacity of at least 60 GW in 2030 and 300 GW of OSW by 2050, respectively, implying that the 25 GW installed capacity by the end of 2020 [26] will be more than doubled and multiplied by 12, respectively. Extensive OSW deployment can also create as many as 900,000 jobs worldwide by 2024, highlighting how the fulfilment of European Green Deal objectives dovetails with Europe's post-Covid recovery [27]. GWEC expects that nearly 51 GW OSW will be installed by 2024, and that 17.3 direct jobs, defined as one year of full-time employment for one person, are created per MW of generation capacity over the 25-year lifetime of an OSW project. The 900,000 projected jobs therefore represent a low-case scenario (ibid.).

Whereas deployment to date primarily is constituted by bottom-fixed wind turbines, eighty per cent of the potential offshore wind resources in Europe (4000 GW) and Japan (500 GW), and 60 per cent of the resources in the US (2450 GW), are located in areas that are too deep for bottom-fixed wind turbines, i.e., 60 m or deeper [28,29]. Harvesting wind energy resources on such depths is facilitated by installing wind turbines on floating structures. Hence, it is relevant to examine the technical variety of offshore wind before we dive into the specific Norwegian context.

2.1. Energy Capacity and Outlooks

The term OSW combines two groups of technologies: Bottom-fixed (up to 60 m depths) and floating (60–2000 m depths) turbines (see Figure 1). Bottom-fixed turbines are installed on the seabed; floating installations are tied to the seabed at depths of 60–2000 m with different anchoring solutions. Floating technologies are younger and less mature than bottom-fixed and constituted only 66 MW of the global installed capacity at the end of

2019 [27]. Concurrently, the levelised cost of energy (LCOE) for floating wind turbines, which is the metric that is most used for comparing costs of different technologies [30], was between twice and three times that of bottom-fixed turbines, which reached an LCOE of EUR 45–79/MWh in 2019 [25]. Onshore wind, by comparison, had a global weighted average LCOE of 52.6 UDS/MWh, or approximately EUR 46.98, in the same year [31]. Comparison of LCOE between different sources must be done carefully, as LCOE estimation might vary, as it, e.g., might be based on either fixed or current prices [30].

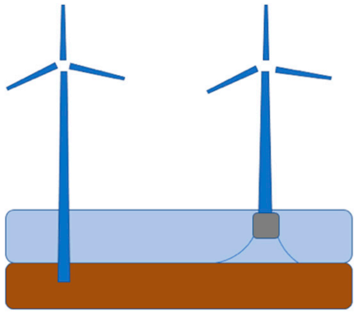

Figure 1. Main differences between bottom-fixed and floating wind turbines, simplified. Bottom-fixed (left side) and floating (right side) wind turbines. Whereas the bottom-fixed turbine is moored into the seabed (here illustrated by the example of a monopile), floating installations are anchored to it using different types of anchoring, here illustrated by the example of a spar buoy concept with catenary anchors.

However, as technology improves, the LCOE trajectory for floating wind turbines is expected to cross that of bottom-fixed turbines [30]. Expectations are driven mainly by experiences with the latter, whose costs dropped by approximately 50% between 2014 and 2019. Cost reductions are also awaited because floating wind technology is particularly susceptible to economies of scale, e.g., since floating wind developments can capitalise on the key cost reduction achievements for bottom-fixed offshore wind and since relatively more construction and assembly work can be conducted onshore. Compared to bottom-fixed turbines, floating turbines can also harness vaster resources since they can be located farther out at sea, where the stronger winds prevail. Floating installations are note limited by low-quality seabeds, either, which increases applicability. However, on the negative side, the more remote locations of floating offshore wind could increase the cost of accessing the turbines for maintenance and repair [32].

2.2. Previous Research: Political Hurdles to OSW Deployment in Norway

How have these potential energy resources been utilised in a Norwegian context? Public policies for offshore wind in Norway historically have been defined by characteristics of the nation's energy– and climate–political context:

First, Norway's energy policy is based on a principle of short-term cost-efficiency, following the deregulation of the electricity market in 1991 [8,12,15,33]. Therefore, the deployment of new renewable energy production must be socio-economically profitable in the short run [34]. Looking further back, however, a substantial Norwegian hydropower sector was created in the 1950s and 1960s, largely due to massive investments by the state [4]. Second, and as a result thereof, Norway represents an exceptional case abundant with cheap, renewable energy, generated mainly from hydropower [8,11,13]. This has made the large-scale deployment of (additional) renewable energy contingent on a rationale of power exports [19]. Claims for power exports, in turn, have been largely substantiated by referring to Norway's alleged ethical responsibility to substitute polluting energy production in Europe [35]. By the same token, such climate–political imperatives to deploy OSW for exports have been thwarted by political reluctance to let taxpayers and/or energy consumers finance cables and/or more expensive electricity (in periods when Norway is a net energy importer) [4,13]. Norway is already integrated to some extent into the

European power market, e.g., through the cable NordLink (opened May 2021) and North Sea Link (trial operation initiated 1 October 2021) [36], but additional cables are disputed, as witnessed by the NorthConnect cable, which was put on hold in 2020 [37]. Large-scale OSW deployment, therefore, has been difficult to legitimise politically [8,11–13]. Meanwhile, state support for offshore wind has been constrained to the purposes of research and development (R&D) [8,12,15,38–40].

Scholars have argued that renewable energy deployment in Norway has been restrained by vested interests, i.e., the stakeholders that are threatened by new knowledge and technology that can substitute what they have invested in themselves at any given time [13,41]. First, today's hydropower sector is largely a result of the systematic governmental investments of the state in the 1950–60s [4], allegedly being the cause of what Moe calls today's "hydro-institutional complex" (ibid.) among state institutions and the hydropower- and energy-intensive industries. Second, a strong petroleum sector has been argued to influence policies through connections to the Ministry of Petroleum and Energy (MPE) (ibid.). Finally, vested interests are found on each side of the debate about energy exports [13]. On the one side, the power-intensive industry is motivated by the competitive advantage that rich access to existing, low-cost electricity constitutes internationally. To protect this advantage, the power-intensive industry has sought to restrain the phase-in of energy from more expensive sources, such as offshore wind, into the energy system. Meanwhile, the incentive of increased export revenues has motivated grid companies to pull in the opposite direction. These two vested interests have enjoyed political influence through labour organisations and the trade associations' ties to the political centre [13].

3. Materials and Methods

Against this backdrop, recent events in the policy area of Norwegian offshore wind seem to break the previous pattern. Notably, Enova's decision to subsidise the full-scale demonstration project Hywind Tampen represents a scale-up of technology that is unprecedented in the history of Norwegian offshore wind.

The project deploys Equinor's floating offshore wind concept Hywind [42] which Enova previously supported financially at its pilot stage in 2009, to decarbonise oil and gas production at five of Equinor's platforms at the oil fields Gullfaks and Snorre [20]. With 88 MW production, the 11 turbines that are currently under construction promise to cut the oil fields' Co2 emissions by more than 200,000 tons per year [43]. For a visual of the Hywind concept, please see [42].

Hence, we followed Dahl [22] and started from the assumption that a shift has occurred during the recent years in the framework of goals and ideas that guide policies for Norwegian offshore wind, that is, the "policy paradigm" [44]. More generally, a typology for categorizing different types of policy change was employed using Hall's theoretical framework, which conceives of policy formulation as a process involving three main variables, namely, the policy instruments, the settings of these instruments and the overarching goals that guide policy, in a given area [44]. Correspondingly, three types of change can be distinguished: "First-order change" implies a change in the settings of the policy instruments in a given area, whereas the very instruments and the goals that drive policy remain. "Second-order change" depicts a change of both policy instruments and their settings. Finally, "third-order change" means that all three components are changed simultaneously. A critical distinction in Dahl's study [22] was that between third-order change and the two others, which are both labelled as "normal policy making" in Hall's theory [44]. Third-order change, meanwhile, is often accompanied by a change of policy paradigm:

That is, the framework of ideas and standards that policymakers work within, which specifies both the policy's goals, the tools that are conceived as appropriate to realise them and the character of the problems the policy aims to address [44]. Policy paradigms define the political discourse because they are fixed within the terminology through which policymakers communicate their work and are both difficult to scrutinise as a whole and often taken for granted. By the same token, paradigms are also influential (ibid.).

Applying Hall to the policy area of Norwegian OSW, Dahl's research question was whether recent changes represented a shift in the policy paradigm, that is, whether the overarching goals were altered or if the change was confined to the instruments and/or their settings [22]. As mentioned, the energy–political criterion that the deployment of new energy production is cost efficient in the short term has restricted OSW deployment in Norway. To operationalise the question of a third-order change, therefore, Dahl defined as a criterion that energy–political objectives had been lowered in rank in the hierarchy of goals guiding OSW policy formulation, i.e., that policies to foster OSW were observed that challenged the criterion of short-term cost efficiency. This also implied that climate– and/or industry–political objectives had been ascribed a higher rank.

Given that Norwegian energy policies have been guided by a principle of cost efficiency, Dahl also posited that the tendency to support offshore wind R&D might constitute a political response to calls to invest in offshore wind within limits set by this energy–political criterion [22]. To capture this phenomenon, Dahl developed the concept of the "cost lock in" to describe "the tendency of the Norwegian energy–political paradigm to incur state support for new (renewable) energy technologies to be channelled through alternative budgets, especially those for R&D" (our translation, from Norwegian original) [22]. Hence, the hypothesis that a third-order change had occurred in Norwegian OSW policies could be rejected if:

(1) The cost-efficiency criterion was still superior to GHG emissions reductions, in OSW policy formulation, operationalised by the following:
  - 1.1 R&D was still employed as a valve to support OSW in instances where the cost lock in politically excludes the option to subsidise from Norwegian energy policies' budgets.
  - 1.2 The price signal still guided new renewable energy deployment

(2) Energy–political objectives were still superior to industry–political ones in OSW policy formulation.

Furthermore, to identify an OSW policy that was motivated by climate–political goals of reducing GHG emissions, Dahl deemed it necessary to observe that Norwegian OSW energy resources had been (or were in the process of being) utilised for electrification purposes in (1) Norway and/or (2) Europe [22].

Dahl's analysis of the policy area for Norwegian offshore wind in the period 2012–2020 was conducted between October 2019 and May 2021 [22]. For a flowchart of the methodology used, see Figure 2. Methodologically, a case study approach was chosen, as such studies are suitable when the objective is to answer "why" or "how" something happened, when the researcher does not control the events and when the phenomenon to be studied is modern in character and plays out in a real-world context [45]. Hence, this approach was considered fitting for the objective of understanding (1) why the observed changes occurred and (2) whether these represent a new paradigm [22]. Process tracing and policy analysis were performed to trace the political processes and to categorise the observed policy changes, respectively. A series of 22 semi-structured in-depth interviews were conducted between January and August 2020 with representatives from the government, industry, NGOs and other stakeholders that have constituted the Norwegian offshore wind policy area. The interviews were performed after consent was granted by the Norwegian Centre for Research Data, within the guidelines set by the GDPR. The interviews were recorded and transcribed, and the text files were stored in a personal cloud provided by the Norwegian University of Science and Technology until the project ended in May 2021.

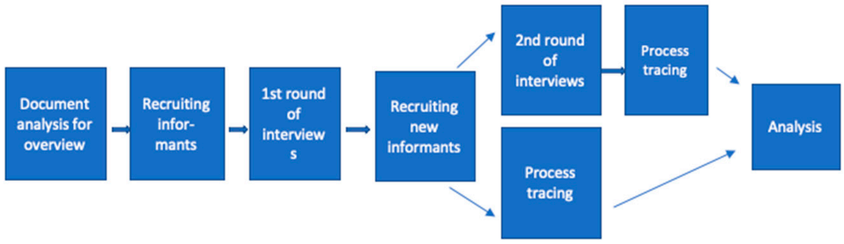

Figure 2. Methodology, stepwise.

The informants were recruited in a two-step process: The first round of interviews also served to recruit new informants that were expected to possess eyewitness knowledge about central events [22], in accordance with the so-called snowball method [46]. The initial interviews also served to gain an overview of the evolvement of the policy area in the chosen time period [22]. Moreover, since in-depth interviews allow statements to be used as a source of delimitation of the research topic [46], the initial interviews were also employed to include additional topics in the interview guide [22]. The informants were asked, amongst other things, to describe the overall discourse surrounding offshore wind in Norway and whether this had changed between 2012 and 2020. Other questions involved, e.g., whether and how the informant or the institution he/she represented had been engaged in the relevant political processes. Informants with proximity to the processes that produced the chosen events, namely, the political decisions of opening two sea basins and of adopting offshore renewable energy regulations, Enova's grant decision in 2019, and the two bottom-fixed wind farm processes, were asked about the course of events as well as who the influential actors were in these processes. All informants were also asked what persons and factors they perceived to have been influential to either hindering or advancing public policies to deploy offshore wind. Data from the interviews were also used for triangulation [47], i.e., to nuance and support observations from the document analysis [22].

A generous time frame was chosen as this is important to create the atmosphere needed to let the informant reflect freely, which is the goal of in-depth interviews [46]. Hence, the interviews were conducted within approximately one hour, provided that this suited the schedule of the interviewee [22], before the statements were categorised according to (1) the events they depicted and (2) categories that Dahl defined to comprehend the study's explanatory variables. As recommended by Tjora's stepwise-deductive–inductive method [46], Dahl also generated new categories as additional variables that emerged as important, especially through the earliest interviews [22].

The interviews provided the primary data source for the process tracing, which was further based on a document study of government white papers and meeting minutes, documents from stakeholder and public consultations, news stories and other public documents. These also served as the main basis for Dahl's policy analysis. Analytically, the attempt to categorise the observed change was performed using Hall's [44] typology for policy change. The concept of policy paradigms attached to this typology was used to operationalise the question of a shift, resulting in the rejection of the hypothesis that such a paradigm shift had taken place [22].

The interviews also constituted a main source of limitations to the study. First, it is possible that Dahl's role as a researcher rooted in the tradition of sustainable energy transitions might have incurred certain expectations on the side of the informant about normative attitudes the researcher might have [22]. This might threaten the reliability of the research results [46]. To minimise the risk of compromising reliability, therefore, Dahl [22] aimed to formulate the questions to be as neutral as possible, a factor that also underpins the research's validity [47].

Moreover, the politically contested nature of energy and climate policy in Norway implies that informants from both outside and inside politics might have a political agenda, from which arises two important risks: First, informants might overestimate their influence [48]. This was recognised as a challenge early in the project [22]. Second, there is no method to ascertain that the interviewee speaks the full and accurate truth [48]. Both of these risks were deliberately reduced in Dahl's study by a comprehensive triangulation of data [22].

4. Results

Our evidence [22] suggests that floating wind technology is less susceptible to public opposition than bottom-fixed technology, mainly because bottom-fixed turbines are located closer to the shore, making them more visible for citizens and more prone to cause (known) environmental effects (especially intersection with birds' flyways) [22]. In Norway, bottom-fixed installations have been susceptible to a public and political scepticism similar to that seen for onshore farms that is informed by environmental/biodiversity and aesthetical concerns. Concurrently, to the extent that the so-called "Wind power rebellion" towards onshore wind farms has increased the political feasibility of commissioning projects offshore in Norway, Dahl concludes that this effect is limited to floating wind projects (p. 89) [22]. Several studies employed the concept of NIMBYism (not in my backyard), i.e., "protectionist attitudes of and oppositional tactics adopted by community groups facing an unwelcome development in their neighbourhood", [49] to explain such types of resistance towards renewable energy [50] and (offshore [51,52]) wind [53] deployment. Hence, whereas Dahl did not investigate to what degree this phenomenon motivated resistance, the often local character of it [22] suggests that NIMBYism might provide some explanatory power in the Norwegian cases.

The Norwegian case also exhibits how, in two bottom-fixed projects proposal processes, environmental concerns were exacerbated by the lack of an energy–political rationale for OSW deployment in producing the negative outcome of the project [22]. Even though Norway's energy demand is expected to increase over the following decades due to the massive electrification needed for the energy transition [54,55], the dominant discourse remains confused about how much this demand will increase and how much of it will be covered by offshore wind in relation to alternative sources (chiefly, increased production from hydropower and onshore wind energy) [55–57], which effectively maintained political reluctance to deploying OSW for the purposes of electrification among elected officials. Besides, the case for deploying offshore wind for power exports remained contested at best throughout the period [22] and continues to do so (although one new power cable connecting Norway and the UK was opened in October 2021). Whereas two sea basins were opened for OSW license proposals, no state plans to deploy OSW for energy exports were detected in Dahl's study. More generally, the price signal was still observed to guide OSW deployment, meaning that the cost-efficiency criterion was still given a superior rank to climate–political objectives in OSW policy formulation.

Moreover, socio-economic concerns, i.e., for a potential reduction in tax revenues and jobs, also have occurred in the domain of fish banks, as OSW deployment would threaten a profitable fish industry in one case, Siragrunnen [22]. Meanwhile, the proposed wind farm's value creation was uncertain, making the project difficult to legitimise for authorities. The case therefore might suggest that Norwegian policies for OSW have given a higher priority to established (i.e., fisheries) industry and jobs than potential (OSW) ones, and, correspondingly, that value creation has been operationalised in the shorter rather than in the long term [22].

More generally, the lack of an (immediate) local energy–political demand and (often uncertain) environmental and socio-economic impacts have therefore constituted a potent mix for society and state bureaucrats to argue against OSW deployment, often leading to uncertainty as to which of the two is decisive [22].

Meanwhile, floating wind seems to benefit from an industry–political potential that bottom-fixed technology lacks [22]. For an overview of the main differences between floating and bottom-fixed wind, see Table 1. Floating wind installations are complex, moored structures that need to tackle the combined effect of wind and hydrodynamic loads (waves and currents). Hence, this industry draws largely on the know-how and capabilities of the petroleum and maritime industries. Therefore, floating wind presents an industrial opportunity for offshore oil- and gas-producing countries compelled to transition their economies both by climate imperatives (e.g., through the Paris Agreement) and the prospect of oil depletion. Concomitantly, state interest in bottom-fixed wind has been meagre, as this is a more mature technology wherein Norwegian comparative advantages are smaller.

Table 1. Main differences between floating and bottom-fixed wind technologies.

Floating	Bottom-Fixed
(Relatively immature)	(Relatively mature)
Higher production costs of energy	Lower production costs of energy
Opportunities for industry and innovators deriving from potential of technology development	Harder for newcomers (suppliers) to enter market, as this is more established
Large transferrable competences and capabilities from O&G	Higher known environmental impacts, especially on birds

Analogously, Dahl, in her study of Norwegian OSW policies [22], also found that the willingness within the industry [8,22] and state [22] in developing OSW has been contingent on low oil prices, as this releases transferrable capacity in the petro-maritime industries and incurs a sense of urgency to transition it. Dahl's analysis also suggested that this contingency has been weakened throughout the period [22], although none of these findings were investigated quantitatively. However, offshore wind investments and public policies tended to bounce back as soon as the oil price recovered, a tendency that seemed to have slowed down the creation of a Norwegian domestic offshore wind market over the period as a whole [22]. The Norwegian case, therefore, suggests that, in petroleum-exporting countries, floating wind policy and deployment might be vulnerable to soaring oil prices [3].

Against this background, the two offshore wind projects that have proved successful in acquiring state support in Norway highlight some essential features of Norwegian OSW policy:

First, both are based on floating technologies. This strengthens the impression that Norwegian policies for offshore wind are contingent on prospects for technology development and securing future employment within the incumbent petro-maritime industries [22]. Analogously, Dahl also claims that this finding asserts that Norwegian OSW policies are contingent on the strong incitements that floating technologies provide for R&D [22]. Bottom-fixed wind, as mentioned, is near-competitive with land-based wind but has gained little political support in Norway because the rationale for deploying new renewable, and in a Norwegian context still somewhat costly, energy production has been weak. Meanwhile, floating wind, which is relatively immature, seems to correspond well to the practical political compromise of canalising funding to renewable energy projects through R&D, referred to as the "cost lock in" [22]. Floating offshore wind, therefore, seems to be more compatible with the established Norwegian energy–political paradigm, paradoxically enough because the technologies are relatively immature [22].

Second, Dahl's investigation detected a tight and continuous dialogue between the state-owned enterprise Enova and oil company Equinor ahead of the grant decision [22]. The idea of supporting Equinor's Hywind technology further seems to have inspired a precedent 2017 decision to change Enova's mandate that enabled it to support the project. To be sure, the 2.3 billion grant was the largest in the enterprise's history. To this, Equinor could add the reduced costs incurred by the Norwegian petroleum tax regime, which permits the company a tax reduction of 78% [58] as well as a potential NOK 566 million from the so-called NoX fund, incurred by the 1000 tons of NOx emissions that the project is expected to cut [43,59]. The company can also expect cost reductions of around NOK 100 million per year incurred by the reduced Co2 taxes [60]. Equinor, as mentioned, is known to maintain a close dialogue with the MPE. Therefore, the analysis suggests that vested interests have a role in the recent history of Norwegian offshore wind policy [22].

Third, the success of Equinor's Hywind technology owes much to regulations in the UK, where the floating concept has been tested in real-world conditions in the world's first floating wind farm outside Scotland since 2017 [59]. Scaling up technology, in this case, was enabled by a combination of regulations, notably, the so-called contracts of difference, that reduce the risk incurred on the producer by volatile energy prices, which are common for new renewable energy technologies [61]. Meanwhile, the lack of similar policies in Norway has left project developers eager to scale up floating offshore wind to look elsewhere. Learning effects and the scale at Hywind Scotland have incurred costs for the Hywind technology to fall by approximately 70% between the initial demonstrator at Karmøy, and Hywind Scotland (CapEx per MW) [59]. Equinor also expects the costs to drop by an additional 40% between the latter and the Hywind Tampen project. Several sources also indicate that the demonstration of the concept's performance and durability in Scotland have been decisive in making it politically feasible to support the technology in Norway [22]. Enova's decision to support Norway's first offshore wind farm, therefore, seems to have been contingent on other nations taking the initial costs.

Fourth, Dahl detected considerable discrepancy between the prerequisites for creating a domestic OSW market and public policy [22]. The industry is clear that a minimum of two large-scale wind farms of approximately 500–1000 MW is the requisite for creating a domestic market and realising necessary cost reductions for floating offshore wind [62–64]. More recently, however, the government has voiced willingness to support OSW farm development at Utsira Nord [65], meaning that this discrepancy is possibly about to shrink. However, policies are not yet in place to realise a domestic market, meaning that Norwegian OSW policy is still lagging behind in terms of capitalising on its comparative advantages to develop OSW.

Fifth, a second floating installation was granted support in March 2020 through the EU's framework programme Horizon 2020 [66]. The project employs the so-called OO-Star concept and is the first to test a 10 MW floating turbine, which is now being installed outside Karmøy off the Norwegian southwest coast. The Norwegian part of the project was coordinated by the Norwegian Offshore Wind Cluster, aided by Innovation Norway's EU experts [22]. Olav Olsen, the enterprise behind the OO-Star concept, is dependent on their Spanish partner Iberdrola, which provides the financial guarantees required by the programme (that comes in addition to the partners' respective contributions) in addition to the wind turbine (ibid.).

Hence, the case also highlights how the conditions for financial support for smaller demonstration (pilot) projects have been weakened through the development of Enova's mandate [22]. This represents a change since Enova supported Equinor's (then Statoil's) pilot turbine Hywind Demo in 2009. Hence, the OO-Star case more specifically points to the prioritisation that the changes in Enova's mandate, especially with the new steering agreement in 2017 [67], represent, which effectively leaves to external (EU) sources and private partners to fund a range of Norwegian floating offshore wind concepts [22]. Moreover, this prioritisation of resources away from small- and medium-sized enterprises (SMEs) for the benefit of a partially nationally owned corporate begs the question of whether it was influenced by vested interests (ibid.).

Finally, Enova's multibillion grant to realise Hywind Tampen might be conceived as challenging the cost-efficiency principle [22]. However, the channelling of it through the programme for "full-scale demonstration" bespeaks a provision of R&D. Hence, Dahl concluded that the cost-efficiency criterion was still intact, meaning that a policy paradigm shift could not be detected [22].

5. Discussion and Conclusions

This communication has aimed at a critical stock-taking of the policy area for Norwegian offshore wind, building mainly on Dahl's [22] policy analysis, which assessed the development between 2012 and 2020. Chief in Dahl's analysis was the research question of whether recent policy changes represented a paradigm shift, i.e., whether the hierarchy of goals guiding policy was altered, in addition to the tools and their settings.

First and foremost, Dahl did not detect OSW deployment for the case of energy exports throughout the period [22]. This implies that climate–political objectives were subordinated to the energy–political principle of cost-efficiency, according to their operationalization. The failure to meet calls for (further) investments and enabling frameworks from industries willing to take part in the creation of a domestic OSW market also implied that the energy–political criterion had not been challenged by industry– or energy–political ones. Hence, a paradigm shift could not be detected in Dahl's analysis (ibid.).

More recently, however, the Norwegian government signalled [65] that it would consider subsidising (a) floating offshore wind project(s) at Utsira Nord by increasing the state budget grant to the state-owned enterprise Enova. Enova subsequently granted NOK 10 million, or approximately EUR 1 million, to the company Deep Wind Offshore to conduct a pre-project study for developing a commercial OSW project in the area [68]. This might be said to challenge the cost-efficiency criterion to some degree. However, bottom-fixed wind developments will still have to be conducted without the aid of state support, according to the latest energy–political government white paper [65]. The preference for floating OSW might suggest that policy is conditioned on the prospect of industry creation and technology development promised by floating wind. More recently, however, the new government announced that the first 1.5 GW of OSW to be installed in the first phase of deployment, in one of two subareas within the Southern North Sea II, will be landed in Norway for the purpose of supplying industry and/or households and improving the power balance in Southern Norway [69]. This decision must be seen in light of the soaring electricity prices in autumn/winter 2021/2022, that can be partly explained by a more volatile European electricity market [70,71]. Meanwhile, the question of exporting OSW power from the Southern North Sea remains a question to be settled only after thorough assessment of the effects that different landing solutions might incur on the power grid [69]. Recent policies therefore suggest that OSW deployment for large-scale energy production including exports, is still far from becoming a reality in Norway. Hence, our conclusion to the question of a paradigm shift is that this has not yet occurred in the policy for Norwegian OSW, but that this might (still) be about to change. The question of an ongoing paradigm shift, therefore, is one that future studies with the benefit of hindsight should respond to.

What are the lessons that can be transferred to other cases? Norway represents an exceptional case where renewable energy is abundant. One implication of this was that the lack of an energy–political rationale was found to have exacerbated scepticism incurred by environmental considerations. However, opposition to near-shore deployment remains relevant across national borders, which implies an urgent need for policies that can foster social acceptance. This suggests the importance of taking political considerations early into account, e.g., through reliable impact assessments in offshore wind concession processes. Research, therefore, should assess and further develop such policies, a task that demands particular attention from political scientists and policy analysts.

On a more general level, however, this conclusion suggests that sectoral policies can be detrimental to efficient policymaking and, as such, to the ability to respond to urgent challenges such as climate change. Notably, the mere dominance of the energy–political criterion over climate–political ones within Norwegian OSW policy constituted a barrier to deployment, as this has made state investments (except from exceptional cases, i.e., Equinor's Hywind Tampen) politically unfeasible, as well as the mere phase-in of new and expensive renewable energy to the energy system or for the purpose of exports.

One result of this lack of investments or enabling financial framework was the observed contingency of floating wind policy and deployment on available capacity in the dominant petro-maritime industries. This presents a considerable challenge for long-term investment and the creation of a domestic OSW market, as the instability that this contingency creates was shown to have slowed down the development of the industry over the period as a whole.

Hence, there is a clear role for policy in terms of clear guidelines and financial support in the pursuit of new industry development such as that of OSW. Compliance with the cost-efficiency criterion in a short term, concomitantly, seems incompatible with the goal of creating a domestic OSW market.

However, policies supportive of OSW through subsidizing R&D continues to represent a handy compromise for political leaders that are reluctant to contradict the cost-efficiency principle. For Norway to embrace the climate–political potential of OSW, therefore, breaking out of the cost lock-in remains imperative.

6. Suggestions for Further Research

The final lesson from Norway, therefore, perhaps is one that points to best practices elsewhere. Although the regulatory processes have been speeded up over the last years, the comparatively high pace of OSW deployment and policy development in Europe implies that Norway is already about to lose track if it is to cultivate its comparative advantage within floating offshore wind in the international market. This is especially alarming in view of the comparative advantages that Norway possess, which bespeak the low-hanging fruit that a third-order policy change provides. Above all, Norway's inertia is alarming in view of the evolving climate change itself.

Hence, research should investigate how policies employed in successful countries can be translated to different contexts. The Norwegian energy–political context also suggests that there is no one-size-fits-all. To resolve Norway's climate– and energy–political complex, therefore, contexts to be studied notably should consider that of an energy-abundant country, whose policies still need to come to terms with the fact that climate change and soaring energy demand is a challenge of global scope, and should be addressed accordingly.

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