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Creating offshore winners

How Norway can become a global leader in offshore wind

2022

CONTENTS

FOREWORD

The transition from fossil fuels to renewable energy sources is one of the greatest challenges and opportunities of our time. It is an absolute prerequisite for reaching the goals set by the Paris agreement and to limit the effects of climate change. Recent geopolitical escalations have heightened the attention on security of energy supply, leading to nations having to rethink their approaches, energy policies and sourcing strategies.

Karl Thomas Reinertsen
Managing Director
Capgemini Invent Norway

Offshore wind will undoubtedly be a very important component in limiting the effects of climate change and strengthening the energy security in Norway and Europe.

Norway has the unique opportunity of developing a leading role in offshore wind due to its highly skilled workforce and long tradition of working offshore in challenging conditions. Estimates show that the industry could create more than 50 000 new jobs (Menon Economics, 2022) and constitute as much as 25% of the energy production in Norway in 2050 (DNV, 2021). However, to realize this opportunity, we need to act now.

Preben Strøm
Managing Director
Energy Valley

At Capgemini Invent and Energy Valley, we are fully committed to accelerating the energy transition. This report is a result of our strategic partnership and our combined efforts in accelerating the growth of renewable energy production. It comprises an overview of key challenges and a set of concrete recommendations directed at authorities, industry players and NGOs to succeed with Norway's ambitions in offshore wind. Finally, the recommendations are specified in a timeline with key milestones and decisions as a tool for policy and decision makers for the years to come.

ABOUT THIS REPORT

his report is the result of a study carried out by Capgemini Invent and Energy Valley, based on the findings from 33 interviews held with a wide range of industry stakeholders. The challenges and recommendations identified are not to be seen as the opinion of the stakeholders interviewed. Nonetheless, Capgemini Invent Norway and Energy Valley would like to thank the following organizations for their participation in interviews and for sharing their insights.

Interview participants

In addition to these, public stakeholders including The Ministry of Petroleum and Energy (Olje- og energidepartementet, OED) and other organizations have been interviewed.

The study was conducted between June and August 2022, and challenges and recommendations are based on the current status at the time of writing.

EXECUTIVE SUMMARY

Offshore wind is pointed to by many as one of Norway's next big industrial adventures, and a key part of solving our own and Europe's urgent need for renewable energy. Recently, the Norwegian Government announced their updated ambitions to award acreage for 30 GW of offshore wind production by 2040, and in parallel, develop Norway to become one of the world's leading nations within offshore wind. While this is a significant target, other European countries have set even more ambitious targets and are already heading the race. For Norway to reach their ambitions and build global winners in the offshore industry, the time to act is now.

Despite a shared aspiration across industry and government, there is still uncertainty as to what needs to be done and when for Norway to bridge this gap and develop at the required pace. This report aims to address that by answering three questions; what decisions must be made, what actions must be taken, and when do these must happen to reach the ambitions set. We have spoken to more than 30 key stakeholders and experts in the offshore wind ecosystem to ensure a holistic view. The result is a suggested timeline with nine actionable recommendations to address the identified challenges, each with corresponding and interlinked milestones.

The challenges at hand are complex and interlinked, but they all come down to four core themes we need to address – predictability, speed and sustainability, industrial capacity, and talent.

Predictability is the most pressing challenge voiced by the industry, and a prerequisite to allocate resources and commit to investments. At the moment there is still uncertainty on governmental decisions related to both future concession rounds, grid infrastructure design and support schemes. To increase predictability in public strategy we recommend the Government to quickly develop and communicate a licensing roadmap with clear guidelines and regular awarding rhythm, a predictable public support scheme to facilitate allocation of capital, and a combined strategy that sees decisions on domestic consumption, export and grid infrastructure in relation to each other.

Secondly, the speed and efficiency of public processes need to significantly increase. While processes can and should be sped up, careful consideration must be taken with regards to sustainability, biodiversity, and coexistence with other offshore industries such as fishing and shipping. To succeed with both speed and sustainability, we recommend integrating holistic sustainability assessments from the start, financed by the Government before tenders being opened to industry players. This will both de-risk the projects, avoid environmental delays later in the process, and secure a better view of the total sustainability impact.

Thirdly, significant industrial capacity must be built, starting now. To secure that Norwegian ports, yards, and vessels have the capacity to deliver in time on the 30 GW ambition, we recommend a coordinated gap assessment and plan for supporting infrastructure along the coast is developed. Additionally, the industry itself needs to accelerate the transition from oil and gas to offshore wind now to secure long-term competitiveness against international players. Increased standardization is also key to secure industrialized, cost-efficient processes and components. Here the industry needs to collaborate across the value chain, where cluster and interest organizations can play a pivotal coordinating role.

Lastly, as offshore wind can become one of the most important industries for job creation in Norway, sufficient talent and workforce capacity must be secured in time. Transitioning part of the oil and gas workforce will contribute to filling the competence gap, but this will not suffice. Norwegian academia needs to launch new and tailored education paths to help fill the identified competence gaps.

Common for all areas is that significant efforts need to take place over the next couple of years. While the entire industry will not be built solely in that time, some critical decisions and actions contributing to the attainment of the goals must be taken now if Norway is to become the offshore winner we aim for.

INTRODUCTION

In recent years, the urgency to accelerate renewable energy production has significantly increased, driven by the need to decarbonize energy consumption to meet Paris Agreement targets, and to enable new green and power intensive industries. In addition to this, the push for energy security has been strengthened by recent geopolitical escalations, as exemplified by EU's plan to end its reliance on Russian fossil fuels by 2027[1]. This has led several European governments to revise their renewable energy capacity development goals.

→ Norway's ambitions are clear

In May 2022, the Norwegian Government announced their updated ambition to award acreage for 30 GW for offshore wind production by 2040, corresponding to nearly the same capacity as the current Norwegian hydropower production (Norwegian Government, 2022). The ambition is coupled with five fundamental principles guiding the development of an offshore wind industry in Norway, outlining an overarching ambition to become one of the global leaders in offshore wind. This should be achieved by leveraging existing competitive advantages from competence on offshore technologies and Norway's ideal geographic location with vast sea areas and favorable wind conditions.

Five fundamental principles for developing offshore wind in Norway:

1. Norway shall become one of the world's leading nations in offshore wind
2. The offshore wind industry shall be developed in line with the Norwegian model
3. We shall develop an offshore wind industry contributing with more jobs offshore offshore and in the supplier industry
4. The offshore wind industry shall contribute with power enabling new green industries onshore
5. The offshore wind industry shall be sustainable and developed in coexistence with other ocean industries

Fact box 1: The Norwegian Government's five principles for developing offshore wind in Norway (Norwegian Government, 2022).

[1]The European Commission presented in May 2022 the REPowerEU Plan, a two-fold strategy to reduce dependence on Russian fossil fuels and fast forward the green transition.

→ The time to act is now

While much has been written and discussed on what actions need to be taken to meet this ambition, limited clarity exists on the dependencies between different decisions and initiatives, and when key milestones need to be achieved. The purpose of this study has therefore been to develop a timeline of what is required, and when, to:

- Reach the ambition of awarding 30 GW by 2040
- Enable Norwegian value creation, and develop a Norwegian offshore wind industry to build global winners
- Secure a sustainable development towards both increased offshore wind power production and industry development

To meet these ambitions, there is a clear need to act now. The European Union has set an ambitious target of installing at least 60 GW of offshore wind capacity by 2030 as part of the Green Deal energy transition program (EU, 2020). The Union plans to quintuple that production to reach 300 GW by 2050, and the total need has been estimated to be closer to 450 GW (WindEurope, 2019). To support this, the EU countries Germany, Belgium, Netherlands, and Denmark have recently pledged to install at least 150 GW of offshore wind capacity in the North Sea by 2050, with the intention of creating a "green power plant" for Europe (Jacobsen, 2022). The total ambitions in Europe (Norway excluded) are to install 385 GW of offshore wind capacity by 2050 (Menon Economics, 2022), as illustrated in the graph below[2].

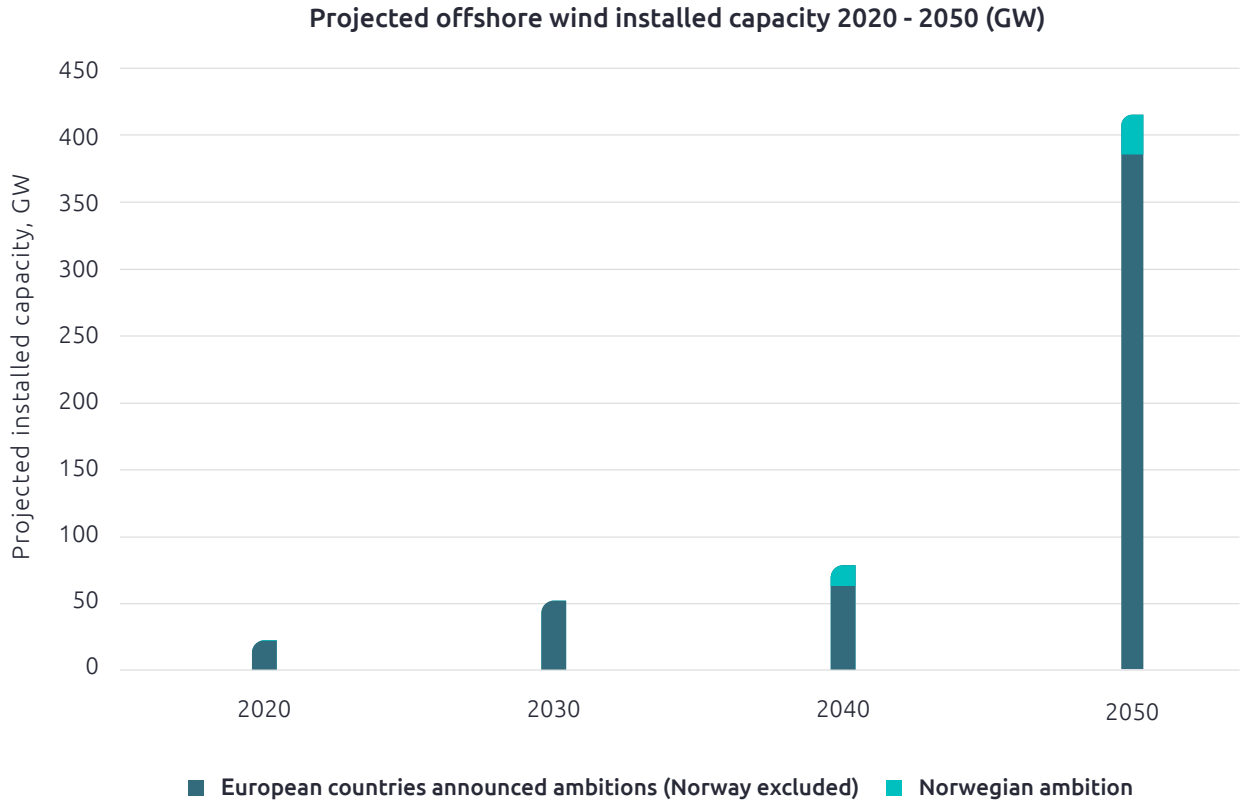


Figure 1: Norwegian and other European countries' announced ambitions for installed offshore wind capacity, (Menon Economics, 2022) and internal projections for Norwegian installed capacity.

The European targets suggest that Norway needs to significantly accelerate the development of a national offshore wind industry if we are to attain a leading position.

[2]While no clear projections for installed capacity in Norway have been estimated, this analysis assumes that by beginning construction in the early 2030s, and licensing an average of 3 GW every two years from 2023 onwards and 4,5 GW in the last two rounds, a cumulative installation capacity of 15 GW by 2040 and 30 GW by 2050 should be achieved.

→ Where are we now?

Currently, there is no installed capacity of offshore wind in Norway except for two test turbines[3]. The only project in construction is Equinor's Hywind Tampen floating wind farm which will power the Gullfaks and Snorre oil and gas fields on the west coast of Norway. Hywind Tampen is expected to enter operations by end of 2022, and it will be the largest floating wind farm in the world with a production capacity of 94,6 MW (Hovland K. M., 2022). This places Norway at the forefront of floating offshore wind, even though other countries have committed to more ambitious projects in the pipeline, but it also highlights a severe lag in bottom-fixed offshore projects. The prospect of attaining a leading position in bottom-fixed offshore wind therefore looks rather bleak without a substantial effort in the coming years. Nonetheless, the experience from other offshore industries suggests that attaining a leading position particularly for floating offshore wind can be within reach – but this will only be possible through the coordination of significant effort from governmental bodies and the industry as a whole.

On top of the Hywind Tampen wind farm, Norway has committed acreage for two additional offshore wind projects. The areas, Sørlige Nordsjø II and Utsira Nord are dedicated for bottom-fixed and floating respectively, and come with a production capacity limitation of 3 GW[4] and 1,5 GW. Although there is no set timeline, the industry expects the licensing process to open in the first quarter of 2023. Recently, Equinor announced development plans for the Trollvind park, a 1 GW wind farm powering the Troll and Oseberg oil and gas fields outside of Bergen (Equinor, 2022). The wind farm is also expected to have contribute with offtake capacity to the onshore power grid, but several details remain unanswered. The Government has announced that it plans to conduct the next concession round in 2025, but further details are still not disclosed (Norwegian Government, 2022). Despite the slow development to date, Norway boasts excellence in the offshore industry granting pivotal competences and technologies, and a unique ecosystem where the Government and the industry have a long history of successful collaborations. Several efforts have already been initiated to propel the industry development (see fact box 2 below).

[3] The test turbines are both located outside of Karmøy. The Hywind turbine was commissioned in 2009 and is the world's first floating offshore wind turbine and has a production capacity of 2,3 MW (NVE, 2022). The TetraSpar Demonstrator turbine was commissioned in late 2021 and has a production capacity of 3,6 MW (Stiesdal, 2021).

[4] Sørlige Nordsjø II will be tendered in two phases of 1,5 GW each

Current initiatives (non-exhaustive list):

- NVE to identify new areas for offshore wind development (NVE, 2022)
- NVE to conduct assessment of the effect on the Norwegian power system from introducing offshore wind (NVE, 2022)
- NVE to assess regulatory aspects of an offshore grid (NVE, 2022)
- Guidelines for area awarding process, concession process and applications for offshore wind
- Development of auction tender model outsourced to private consultancy by OED
- Offshore Wind Entry Program established by Norsk Industri
- Offshore wind test center established on Karmøy in Rogaland
- Offshore wind training center established in Egersund in Rogaland
- Norwegian Energy Partners established in 2017 to increase exports from the Norwegian Energy industry (NORWEP, 2022)
- The Green Platform projects, including Ocean Grid (Norges Forskningsråd, 2022)
- FME Northwind (FME Northwind, 2022)

Fact box 2: Non-exhaustive list of current offshore wind industry development initiatives.

In spite of these initiatives, the urgency around the development of offshore wind suggests that more needs to be done within a wide array of arenas. A set of challenges need to be tackled with utmost urgency to ensure that Norway's ambitions of becoming a world leading nation in offshore wind can be achieved successfully. The development of offshore wind will call for historical coordination of diverse stakeholders, making this one of Norway's greatest endeavors in modern times. This study is shedding light on the current challenges as well as how these should be addressed to accelerate and achieve Norway's ambition. Additionally, it suggests a recommended timeline pinpointing the milestones and decision points leading up to 2040. This is a necessary tool to support the vision with concrete calls to action and to ensure that critical steps and deadlines are not missed.

METHODOLOGY

The research objective of this study has been to develop a set of recommendations and a timeline to address the most pressing challenges that Norway faces in reaching its ambitions in offshore wind. Insights in this research were drawn from the analysis of previous academic and industry studies, and blended with the findings from focus interviews with a wide array of stakeholders.

We conducted **33 structured interviews** with corporate leaders, strategists, policymakers, and interest organization advisors directly involved in the development of offshore wind in Norway and abroad. The interviews focused on nine main dimensions, namely policymaking and public strategy, financing schemes, transmission infrastructure, sustainability, industry development, technology, collaborations and partnerships, talent and competences, and communication and public support. Experts were invited to share their opinions and visions on what they believed being the most pressing challenges surrounding the aforementioned dimensions, as well as on the solutions they deemed most appropriate to address these. The findings were then clustered in common themes and validated with a reference group. Reference group members included both former interviewees and stakeholders that did not provide input to the research.

The challenges and recommendations identified are not to be seen as the opinion of the stakeholders interviewed, but are Capgemini Invent and Energy Valley's views based on the insights given through interviews and other sources at the time of writing.

CHALLENGES

While Norway could be uniquely positioned to become a world-leader in offshore wind, this analysis has outlined a set of key challenges that need to be addressed to accelerate and ensure the realization of its offshore wind ambitions. Based on a broad selection of industry players interviewed, we have identified four main challenges that will be critical to solve:

→ **1. Predictability**

The industry is missing a clear and detailed roadmap on future concession rounds, what criteria tenderers will be evaluated on, the type of support schemes that will be provided and a strategy for the power generated. This will be crucial for developers' ability to plan and finance offshore wind projects. It is also necessary to enable planning of onshore and offshore grid development, whether being hybrid cables for export or development of the connections and transmission grid onshore. Subsequently, clear grid development plans are a necessity for planning new green and power intensive industries.

→ **2. Speed and sustainability**

The concession awarding process laid forth by OED suggests a ten-year timeline from opening of new areas until the offshore wind farm enters operations, and industry stakeholders point out possible inefficiencies in the process. Further, the approach to sustainability in the process does not clearly define how to ensure a holistic view from the start when prioritizing new areas for opening, or when awarding new concessions.

→ **3. Industrial capacity**

The most pressing infrastructure installation gaps are related to yards and ports for construction, assembly, and launch of floating turbines. Unclear concession roadmaps and grid development plans limit local ports' ability to plan and invest ahead of capacity needs. The need for standardization to allow for industrialization and economies of scale is another challenge in an industry where R&D investments and technology development are necessary to make projects economically feasible. Limited participation and engagement in international offshore wind projects can weaken Norwegian suppliers' competitiveness compared to other international players and could limit the development of Norway's local value chain.

→ **4. Talent**

With up to 28 700 new direct offshore wind jobs in 2050 (Menon Economics, 2022), it will be a challenge to transition offshore competences from a booming oil and gas industry, develop new competences and attract talent from abroad in a fierce offshore wind labor market.

1

Predictability

The lack of predictability in public strategy creates uncertainty and makes it more challenging for industry players to commit resources and capital to offshore wind initiatives. This is a key challenge raised by the majority of interviewees, as it impacts industry planning, scaling and capital commitments. This uncertainty is related to both future concession rounds, public support schemes and clarity on grid infrastructure and power export.

→ No roadmap for concession rounds after 2025

Current governmental plans do not include a roadmap for concession rounds from 2025 to 2040, when these will be announced, the number and size of the areas to be awarded nor which criteria tenderers will compete against.

Without this information, the industry will struggle to forecast future concession winning probabilities. An important aspect is that adequate size of areas is needed for projects to have scale and become profitable. There is therefore an important tradeoff for the Government – choosing if several companies should gain valuable experience with lower profitability, or if they should facilitate fewer, more profitable projects[5]. Although there are pros and cons to both scenarios, the main challenge for the consortia is the unpredictability around the size of the areas the Government will choose, as this ultimately postpones their planning and reallocation of resources from other industries and markets.

Another implication of this challenge is the need for other offshore industries to understand the total area 30 GW of offshore wind will require of the Norwegian seas, as this impacts the ability to facilitate coexistence.

The Government has stated that auctions will be the preferred model for awarding acreage for offshore wind development, except for Utsira Nord, where qualitative criteria will be considered to account for the immature technology of floating offshore wind. However, there is still uncertainty around what criteria will be included, and if these will be an assessment element used for other awarding other floating wind areas. In addition to technology and R&D-specific criteria, there is uncertainty around other qualitative criteria to be used related to sustainability, coexistence, ecology, and local content. Given the Government's stated ambition to develop a strong Norwegian supply chain, it is expected for participation of local players this to be reflected in the qualitative criteria.

[5]If only a small number of consortia were awarded an area, the incentives for a losing bidder to remain in the market and bid for the next concession would decrease, and competition would be hampered. This mechanism would be driven by the ever-increasing opportunity cost the bidder faces as it is not able to develop experience in the lost concession rounds. In the opposite scenario, where several consortia are granted small acreages, economies of scale might be harder to achieve and might result in unprofitable project NPVs.

→ Unclear public support schemes

Given Norway's deep waters and experience with floating sub-structures, it is in the country's best interest to make floating offshore wind competitive as soon as possible. This opportunity will be accelerated through targeted financial support schemes, aimed at supporting the development of the first large scale floating projects and technology development. The Norwegian Government has indicated plans to provide support for Utsira Nord and the first phase of Sørlige Nordsjø II (Hovland & Rustad, 2022), but not what form this will take or the magnitude of the support. The immaturity of floating technology currently puts floating offshore wind's LCOE well above that of bottom-fixed, emphasizing the need for support schemes in floating projects. Not knowing what type of support will be provided from the Government increases the complexity for developers to estimate the economic feasibility of the projects. This increases the risk of the project and could deter developers and financing institutions from investing in these projects.

Projected LCOE of floating and bottom-fixed offshore wind 2020 - 2050 (Euro/MWh)

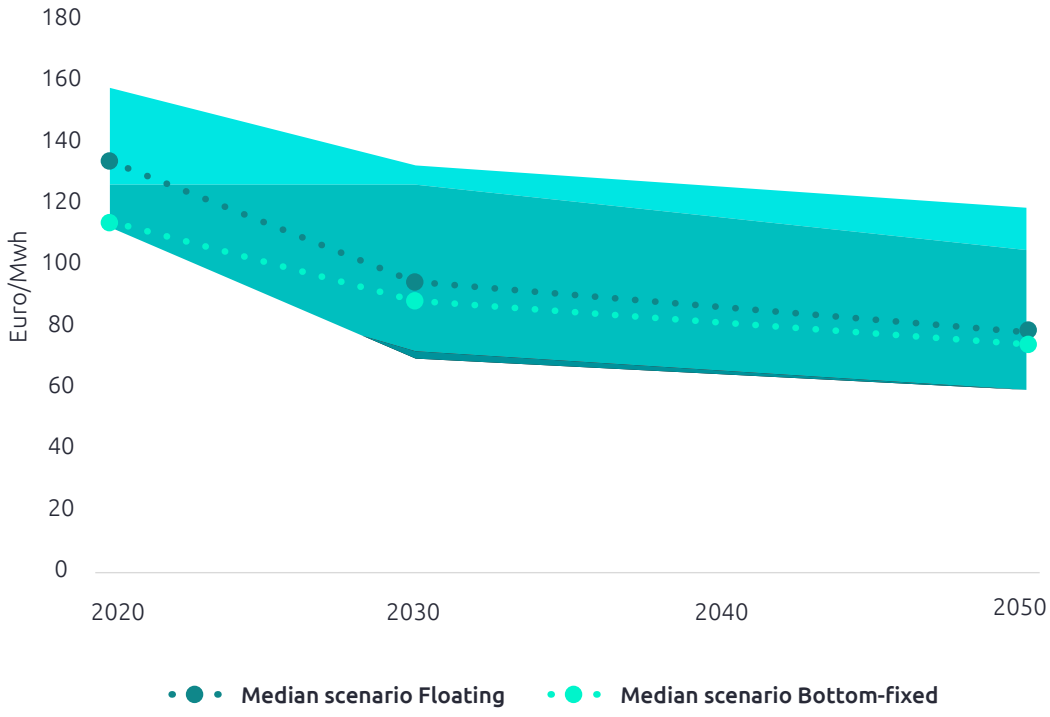


Figure 2: The development of LCOE for floating vs. bottom-fixed offshore wind. The graph uses 2014 baseline prices (Wiser, et al., 2016)[6]. High and low scenarios of the development of LCOE are shown as shaded intervals in the graph.

[6] The graph has been created using the 2014 baseline and projection presented by Wiser et al. (2016). More recently, NVE has estimated LCOE for floating offshore wind to be 116 Euro/MWh in 2021, and 67 Euro/MWh (2030), suggesting an even steeper learning curve (not accounting for exchange rates and inflation) (NVE, 2022).

→ Power consumption and export strategy

30 GW of installed offshore wind capacity by 2050 will leave Norway with more power than what current demand estimates project for domestic consumption, with estimates from DNV suggesting that as much as 25% of new power produced could be in surplus (DNV, 2021). This will open the door to opportunities such as export and the development of new power-intensive industries benefitting from larger power outtakes and lower power prices. Which of these to pursue is a decision that lies at a political level.

Pursuing a comprehensive export strategy will require bilateral and multilateral agreements with neighboring countries. However, despite Norway's engagement in several working groups with other North Sea-basin countries, no offtake agreements have yet been closed. To complicate this, Norway's ambitions imply that the development of an appropriate pipeline of bilateral agreements might be hindered by capacity constraints in governmental bodies responsible for these agreements such as OED or NVE. This concern was raised by several industry stakeholders in the interviews we conducted.

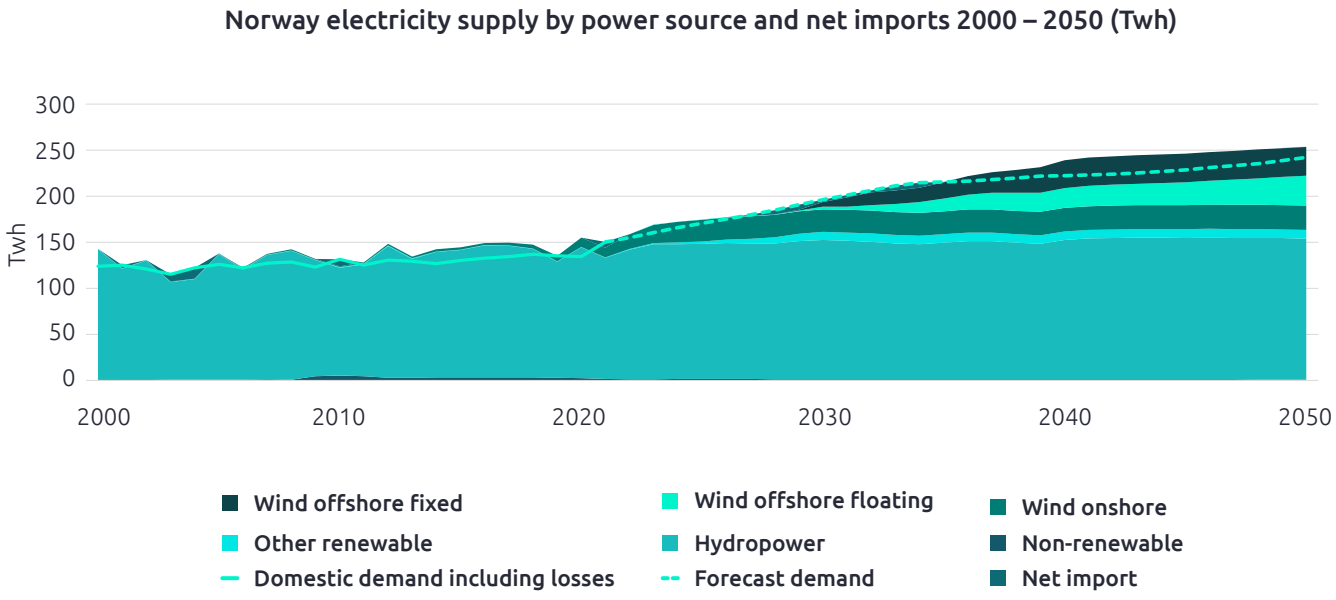


Figure 3: Historical data and forecast of Norwegian electricity supply over the next 30 years distributed by power sources. Sources: Historical data source (SSB, 2021) Forecast: (DNV, 2021)

Another way to utilize the excess power generated is by enabling the development of energy intensive industries, such as battery manufacturing, hydrogen, and ammonia. One of the guiding principles set forth by the Government states that the offshore wind industry shall contribute with power enabling new green industries onshore. However, the Government has not developed a strategy on where and when such production facilities will be feasible. Regardless, uncertainty on the balance between different alternatives for excess power consumption creates uncertainty for developers and the profitability of potential projects. Political indecisiveness also impacts the ability to plan upgrades of onshore grid for NVE and Statnett, as further detailed in the next chapter.

→ Grid infrastructure

The development of 30 GW of offshore wind capacity will require large-scale infrastructure investments in Norway's transmission network, both onshore and offshore. Long lead times, constrained supply chains and raw material scarcity contribute to increasing the complexity and urgency of this. In spite of this, development plans are still not clear, which leads to further uncertainty. In turn, this impacts industry planning as insufficient knowledge on where additional power outtakes will be possible limits visibility over suitable investment locations.

Offshore infrastructure

A key component to developing the offshore wind industry in Norway will be building a suitable offshore transmission infrastructure. While the first steps have been taken by OED in mandating the Norwegian Transmission System Operator (TSO), Statnett, with the coordinating responsibility for an offshore transmission grid (OED, 2022), it has not been defined who will be responsible for the construction of the required infrastructure itself. In addition, decisions on offshore grid development depend on political guidelines and are contingent on bilateral and offtake agreements, as outlined in the previous section. This, conversely, sparks the debate as to whether the first parks beyond Utsira Nord and Sørlige Nordsjø II phase I should be connected to shore with hybrid or radial cables. It should be noted that significant efforts to determine suitable infrastructure development plans are under way, including an assessment commissioned by OED to NVE on evaluating these different alternatives. This assessment, due to be released in October 2022, will use Sørlige Nordsjø II phase II as a starting point, but should also shed more light on long term infrastructure development.

There seems to be momentum and agreement in the industry and political sphere of a long-term meshed grid development in the North Sea, however there are limitations to current interoperability of HVDC solutions. A gradual development of a meshed grid could be possible by first establishing radials that are technically ready for hybrid connections. While substantial effort is being made to improve interoperability to allow integration to a fully meshed grid, further technical developments are required (Statnett, 2022).

Onshore infrastructure

The injection of additional capacity in the Norwegian grid will require substantial upgrades and infrastructure investments. Introducing volatile power capacity through offshore wind, further stresses the urgency to develop a plan addressing how, when and where the onshore transmission infrastructure needs to be upgraded, as highlighted by Statnett in the Grid Development Plan published in 2021 (Statnett, 2021). Statnett is currently working on an updated grid development plan to be released in 2023, which will take into account the 30 GW ambition, but without clear political signals and a holistic view on offshore development and green industry planning, it will be challenging to define the optimal overall solution.

Green industry planning

One of the five fundamental principles for offshore wind development set forth by the Government is that it should contribute with power enabling new green industries onshore (Norwegian Government, 2022). Most of these sectors employ highly energy intensive processes (such as high temperatures) which today can only be achieved by burning fossil fuels. Alternatives to this are currently prohibitive, but the abundance of clean energy from offshore wind could open the door for production of highly-energy dense vectors such as hydrogen, which is expected to play a major role in abating carbon heavy industries by substituting traditional fossil fuel inputs.

In order for this to materialize, hard-to-abate industries will be required to commit substantial capital in planning and developing new facilities as well as processes. In spite of this, limited visibility over when and where the onshore grid will allow significant power outtakes may slow down or even put on hold the relocation and development of hard-to-abate sectors along the Norwegian coast, as well as hydrogen production facilities.

2

Speed and sustainability

→ Licensing process efficiency

The proposed process for concession awarding and development laid forth by OED suggests that operations on Sørlige Nordsjø and Utsira Nord will not start before 2032 at the earliest. The stretched timeline is due to slow and highly sequential processing – an issue that has been a common theme in both the industry stakeholder interviews performed, as well as in the hearing responses. The currently proposed process lasts approximately ten years from the moment an area is opened for tendering until the commissioned park enters operations. The long lead times are largely driven by the six-year period from the area is awarded until construction is allowed to begin. While the process has been out on hearing since June 2021, with feedback received August 2021, the industry is still waiting for the second iteration after suggesting measures to improve efficiency.

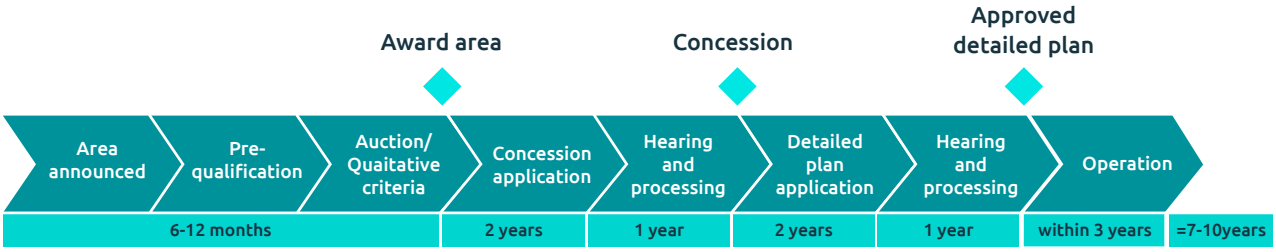


Figure 4: Visualization of current concession awarding process as proposed by OED in the hearing 11.06.2021 (OED, 2021).

→ Sustainability and environmental impact assessments

Sustainability should also be seen as one of the most essential parts of the process, as commissioning 1500-2000 offshore windmills in the Norwegian waters will have implications for both the seabed, the marine ecosystem, coexisting industries, and onshore areas impacted by new infrastructure development. Failing to address sustainability and the wider ecosystem holistically at an early stage could lead to project delays due to new information uncovered at a late stage, while also having negative impacts on the public image of offshore wind. A negative public opinion would increase the risk of resistance in the political processes, resulting in project delays. This should be kept in mind when assessing the impact of onshore infrastructure connected to the wind parks.

It is of utmost importance that the construction of offshore wind farms is done in a way that minimizes the negative impact from the offshore installations while not hindering the speed of the process. However, interviewees have indicated that the knowledge base on environmental and ecological impact from developing offshore wind farms is limited within Norwegian authorities today. This is further substantiated by a report from the Norwegian Institute of Marine Research (De Jong, et al., 2020), which suggests that more research needs to be carried out over time – especially about floating installations. The Government has awarded NOK 65 million to initiate seabed mappings of Sørlige Nordsjø II and Utsira Nord as well as NOK 10 million to analyze coexistence with related industries. However, the planned mappings are mainly researching the optimal placement of the windmills on the seabed and are not addressing the impact on marine ecosystems. The impression from interviewing the stakeholders is that a holistic plan for incorporating sustainability in all the offshore wind projects while keeping speed is missing.

Looking to more mature markets such as Denmark, some environmental impact processes take several years to complete (see fact box), while the companies in Norway will only have 2 years to complete the same studies. Discovering potential obstacles early on will be essential to reach the targets on time, and the Government will need to find a balance between performing the necessary assessments while not slowing down lead times.

Marine mammals	Offshore wind farms have the potential to impact marine mammals, and it will be important to assess them before, under and after construction to analyze the population. Denmark is spending 3 years on these studies before they build out their energy islands.
Fish stocks	Fish are moving to new reproduction areas due to climate changes, and it is therefore important to track them through different seasons over several years and start now.
Birdlife	Bird migration routes might be affected by wind parks. While one park might cause minimal damage, several on the same migration route might be a bigger issue. This calls for a holistic plan.
Geological seabed analyses	Analysis of the seabed, focusing mainly on where it is suitable to place the windmills within the parks. This can be used as background data for the other environmental studies. On tender for Utsira and Sørlige Nordsjø, with an expected timeframe of 1-2 years.
Coexistence agreements	Shipping routes, military territory, fishing areas, onshore construction, potential future industries such as carbon storage, and other relevant stakeholders with different agendas create hurdles when NVE is looking for new potential areas.
Other analysis	There is more to the seabed that need to be analyzed, such as seaweed's capacity for storing carbon and emissions forecasts.

Fact box 4: Examples of relevant environmental mappings and studies.

Underlining the issue of potential bottlenecks in public processes, is the capacity, or lack thereof, in relevant ministries and departments. While these might be scaled to meet the requirements coming from offshore wind today, the bandwidth in these offices will have to be significantly increased in the upcoming years, to efficiently process applications, ensure quality of development and construction processes, while facilitating new tenders.

3

Industrial capacity

To develop the capacity needed to deliver on the 30 GW target, given the assumptions about both necessary turbine sizes and numbers, local value chains will need to be scaled in the years to come. Significant investments are needed to ensure the required supporting infrastructure, such as ports, yards and vessels, for assembly, installation and servicing. In addition to this, industrialization and standardization are needed to ensure both attractive cost levels, and necessary throughput to meet the ambitions in time. Lastly, for Norwegian players to be competitive when the home market starts to develop, there is a need to start building experience and credentials.

→ Manufacturing, installation, and servicing capacity

The most pressing infrastructure installation gaps are related to yards and ports for construction, assembly, and launch of floating turbines, in addition to other offshore infrastructure such as HVDC components and cables. While it is not natural to assume that Norway will take a leading position in the manufacturing of components such as turbines, many interviewees have pointed to floating substructures manufacturing as an area where Norway could become a leader.

The construction, installation and servicing of such components require large, specialized yards. The smallest substructures for floating turbines require minimum 30-meter depths at the launch port while the TetraSpar concept, employed in Hywind Tampen, requires at least 100-meter depths at the launch port (Norsk Industri, 2021). The enormous size of the sub-structures thus imposes demanding requirements for yards and ports to be used for floating offshore wind. development, and until this is completed, it is uncertain whether current and planned investments are sufficient to meet future needs.

However, to date, details on where subsequent floating offshore wind farms will be developed after Utsira Nord and Trollvind have not been released, which makes it hard for yards and ports along the coast to commit investments in adapting their facilities for floating offshore wind. The limited visibility that this entails should also be looked in the optic of the long-term de-escalation of the oil and gas industry. Existing oil and gas infrastructure could and will partly be repurposed to offshore wind, and doing so in a way that prevents idle, insufficient, or inadequate infrastructure in the transition will be crucial. However, a comprehensive assessment is contingent on the identification of new areas for offshore wind development, and until this is completed, it is uncertain whether current and planned investments are sufficient to meet future needs.

New offshore wind ports in the Nordics is a project funded by Nordic Innovation aiming to foster collaboration between Nordic ports, to upgrade and customize ports to the fast-growing offshore wind industry. Six out of eight participating ports are Norwegian, including:

- The port of Karmsund, Rogaland
- Eigersund Næring & Havn, Rogaland
- Wergeland Group, Vestland
- Westcon Helgeland, Nordland
- Norsea Group, several locations along the Norwegian coast
- Semco Maritime Hanøytangen, Vestland

Fact box 5: New offshore wind ports in the Nordics (Nordic Innovation, n.d.).

Fremtidens Havvind is a collaborative project aiming to make Agder a successful hub for offshore wind and an important supplier to the offshore wind industry. Focus areas include:

- Facilitating collaboration between industry stakeholders
- Mapping and identifying relevant ports and yards for installation of offshore wind
- Creating a network for key industry stakeholders

Fact box 6: Fremtidens Havvind (Fremtidens Havvind, n.d.).

→ Standardization and industrialization

Interviewees have highlighted the industry's limited product and process standardization as another challenge. Standardization will be a crucial enabler of industrialization, leading to lower costs and increased installation speed by achieving economies of scale. In spite of this principle, the offshore wind industry still requires substantial investments in R&D, especially within floating technologies. These are still in their cradle, and advancements in turbine size, capacity, as well as sub-surface structures are a necessity to attain the ambitions that Norway has set for deep-water offshore wind installations. The need to balance advancements in technology and standardization has been increasingly pointed to as paramount to facilitate the scaling of the industry (U.S. Department of Energy, 2022), and failing to do so will likely come at a cost on either R&D or manufacturing and development costs.

As highlighted in the interviews conducted in this research, the high pace of R&D might have a counterproductive impact on new project development as manufacturing small-scale, semi-tailored components might be economically unfeasible. This argument has an impact that extends beyond the turbines themselves, as it might hinder investments in supporting infrastructure as well. This is exemplified by inadequate investments in new vessels despite today's considerable scarcity (Fearnley Offshore Supply, 2022). The trend of increasing turbine sizes to accommodate for higher capacity requirements has led to a level of unpredictability in the adequacy of today's vessel sizes. The lifecycle of vessels extends far beyond the R&D rhythm of the industry, entailing that vessels built today might become unfit to transport, install and service larger turbines developed after only a few years of vessel operations. This increases project risk for financiers and in turn complicates access to capital solutions for ship-owners and investors. value chain.

Ultimately, while continuous innovation and R&D is required to achieve capacity levels that current technical solutions cannot offer, the pace of R&D should also enable some degree of standardization to enable economies of scale. Finding this equilibrium should allow the improvement of margins, thereby making the investment in heavy asset attractive to financiers and preventing bottlenecks in the value chain.

→ Experience and refereces

Developing a local value chain and a competitive supplier industry in Norway is one of the principles guiding the development of the offshore wind industry set forth by the Norwegian Government (Norwegian Government, 2022). In spite of the excellence developed from what is today one of the leading oil and gas industries in the world, offshore wind-specific experience is limited, especially when compared to neighboring markets.

An obvious prerequisite for developing a competitive full-scale offshore wind value chain in Norway will be to develop a sufficient pipeline of projects in the home market. However, in order to achieve this and ensure the competitiveness of Norwegian suppliers, their current limited engagement in offshore wind projects has been described as a potential threat to the attainment of the Government's principles. Developing references, competences, and exposure from more experienced markets can be a paramount necessity to build credibility and competitiveness, especially in light of the qualitative criteria the Government is expected to set forth in the concession awarding strategy. Creating a solid base of experience early on will also be pivotal in positioning Norwegian suppliers in international markets and fostering the development of a solid export industry.

Not being able to participate in international projects from early on might therefore hamper Norwegian suppliers' long-term competitiveness both domestically, as well as internationally.

4

Talent

The development of the offshore wind industry in Norway will require a substantial know-how and competence development with estimates projecting up to 28 700 new direct jobs in the offshore wind industry in 2050 (Menon Economics, 2022)[7].

This will demand resource transfers from relevant industries, development of new skills as well as importing talent in an extremely scarce offshore wind labor market. Despite this, each of these mechanisms is connected to challenges that will need to be addressed to achieve the ambitions of becoming offshore wind winners.

→ Knowledge and workforce transition from oil and gas

Over the last five decades, Norway has developed global leading excellence in oil and gas and offshore industries. The know-how connected to this will be crucial for developing offshore wind given the overlap the two have. In particular, knowledge on deep-water operations and floating substructures could possibly position Norway as a global leader within floating offshore wind. The competence spillover and talent transition are nonetheless hampered by renewed favorable conditions in the oil and gas industry. 2022 saw record high prices for fossil fuels, which increased E&P activities in Norway. While certainly positive to secure cashflows in the short term, this has diverted the attention of several suppliers from offshore wind, and lowered the incentives for firms to invest significantly in the development of competences in offshore wind.

[7] While the 28 700 figure addresses the creation of new direct jobs, ripple effects on the wider industry contribute to growing the estimate to a projected total 52 000 new jobs (Menon Economics, 2022).

→ New competence development

While knowledge transfer from the oil and gas industry will be crucial to serve the development of the offshore wind industry in Norway, the level of ambitions make it such that in the medium to long term the development of new talents will also play an essential role. However, former studies and findings from the interviews outline a scarcity within certain functional areas that should be addressed, such as computer science and robotics, project management and logistics, electrical engineering, process and production technique, operations and maintenance disciplines, and maritime and aeronautical techniques (Menon Economics, 2022). In addition to these, offshore wind-specific skills and competences such as within aerodynamics could be needed, depending on the segments of the value chain Norway will deliver. Significant work is being carried out to investigate the competence gap in offshore wind in Norway, such as a current initiative led by Energy Valley (2022), which can be expected to increase in the years to come with the scaling of the industry. Therefore, it will be imperative to tackle the talent scarcity challenge with urgency. To close the gap, there will be a need for both scaling up existing educational programs, and to create new, specialized learning tracks in new disciplines.

→ A fierce global offshore wind labor market

It should be noted that the scarcity of offshore wind experts is not only a Norwegian challenge but rather a global one, destined to intensify as other countries prepare to scale their own offshore wind industries. This entails that attracting foreign talent will also be increasingly challenging, particularly in what will likely become a first-mover type of game. While Norway has set itself ambitious goals, the introduction of this report has briefly mentioned how other countries have moved faster until now and will be able to scale faster. If unaddressed, this challenge might lead to early movers being able to absorb a majority of the global talent pool, while laggards will struggle to secure relevant foreign competences.

RECOMMENDATIONS AND TIMELINE

Through the interviews and research conducted for this report, we have identified nine actionable recommendations within four main categories that can be implemented to address the challenges and accelerate the realization of Norway's ambitions. The following timeline visualizes the actionable recommendations and when they need to happen in relation to each other and should serve as an overview of the most important focus areas for policy makers and industry players in the coming years.

Ensure predictability	1. Develop licensing roadmap and strategy	The government should develop a roadmap outlining acreage tendering rhythm and planned awarding approach towards 2040, including assessment criteria aligned with ambitions and strategic objectives
	2. Establish a financial support scheme	A support scheme should be established by the government to make floating offshore wind projects economically feasible until LCoE is lowered. A CfD scheme has been outlined as the most suitable option
	3. Define a combined strategy for consumption, export and grid infrastructure	To secure that dependencies between green industry planning, power export and grid infrastructure requirements are accounted for, the government should define an overarching strategy for how these three should be developed in coherence
Balance speed and sustainability	4. Streamline the licensing process	Government agencies should quickly implement suggested improvements on current licensing process, enabling parallelization of selected concession awarding steps and reducing processing lead times with additional capacity
	5. Integrate holistic approach to sustainability from the start	To avoid delays and avoidable damage to onshore and offshore ecosystems, impact assessments should be initiated now and financed by the government, taking a holistic approach to sustainability and coexistence considerations
Build industrial capacity	6. Secure the necessary manufacturing, installation, and servicing capacity	The government should take initiative to perform a gap assessment of current/planned vs necessary capacity of ports, yards and other supporting infrastructure to enable timely planning of expansions and refitting of existing infrastructure
	7. Accelerate industry transition	Norwegian developers and suppliers should accelerate the reallocation of resources from O&G, and use opportunities in more mature markets internationally to gain experience that can be used when Norwegian areas open up
	8. Collaborate for increased standardization	The industry should exchange knowledge and coordinate R&D along the value chain, to find the suitable balance between technological advancement and standardization that can enable better economies of scale
Secure talent	9. Develop and attract necessary competencies	Industry and academia should develop upskilling programs and tailored educational paths, which in addition to transitioning workforce from oil and gas and attracting expertise from abroad is needed to secure a sufficient and capable workforce

Figure 5: Overview of recommendations.

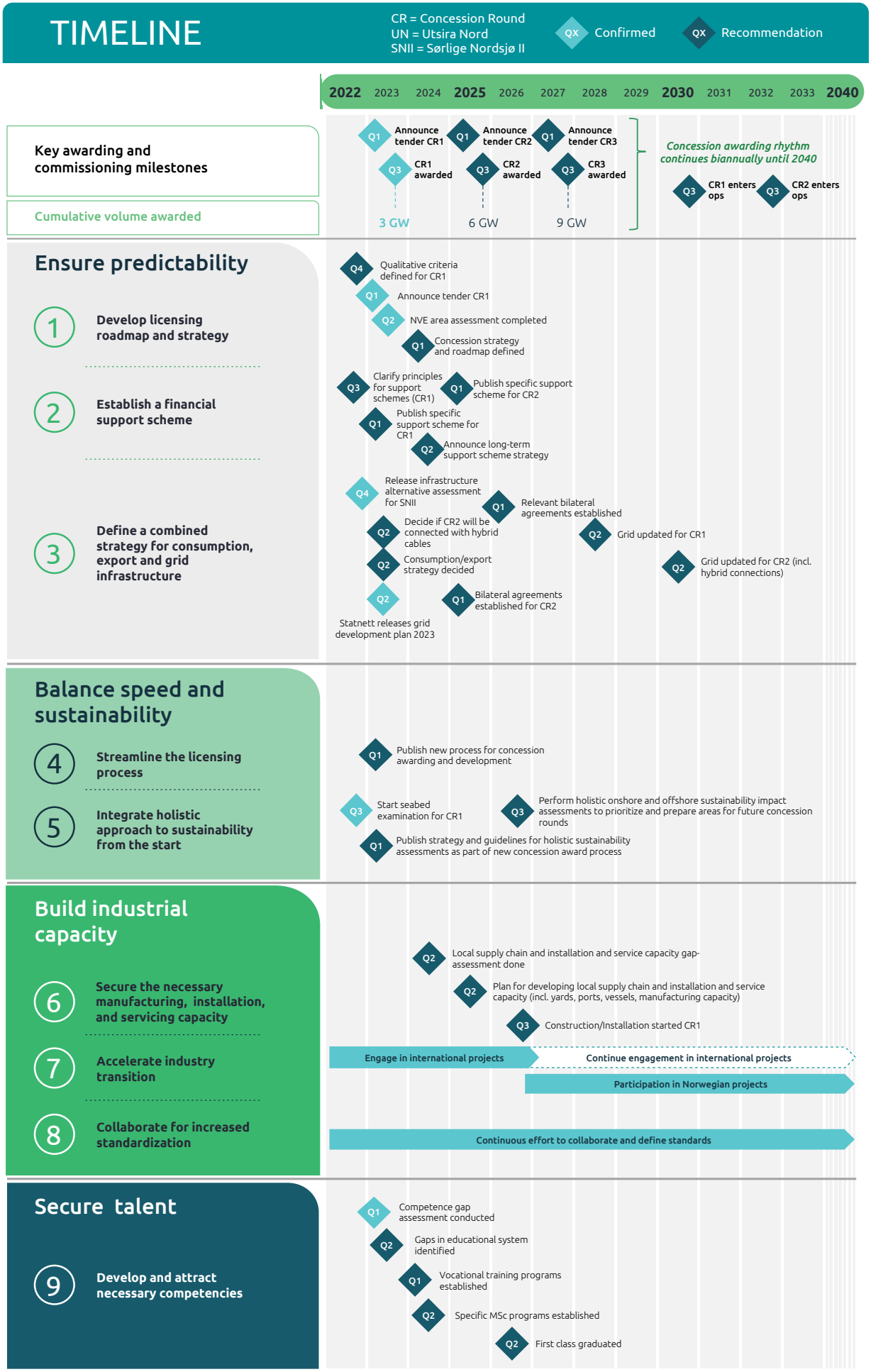


Figure 6: Timeline to 2040 including key milestones to achieve Norway's ambitions in offshore wind.

ENSURE PREDICTABILITY

As discussed in the challenges and outlined in interviews, lack of predictability is the key challenge the industry is facing. By developing roadmaps and setting a clear pace and ambition for the coming years, stakeholders will have clearer incentives to invest in the Norwegian offshore wind market.

1

Develop a licensing roadmap and strategy

Our first recommendation is for the Government to develop and publish a comprehensive concession strategy and roadmap, indicating the size and numbers of upcoming areas and an awarding rhythm of concessions. Based on feedback from industry players, we recommend a biannual awarding of acreage supporting minimum 3 GW production capacity per round from 2025, increasing to 4,5 GW in the last two concession rounds to reach 30 GW in 2040. The size of awarded areas and corresponding projects should reflect a balance between being large enough to allow for scaling, but small enough to allow for several developers and consortiums to gain experience.

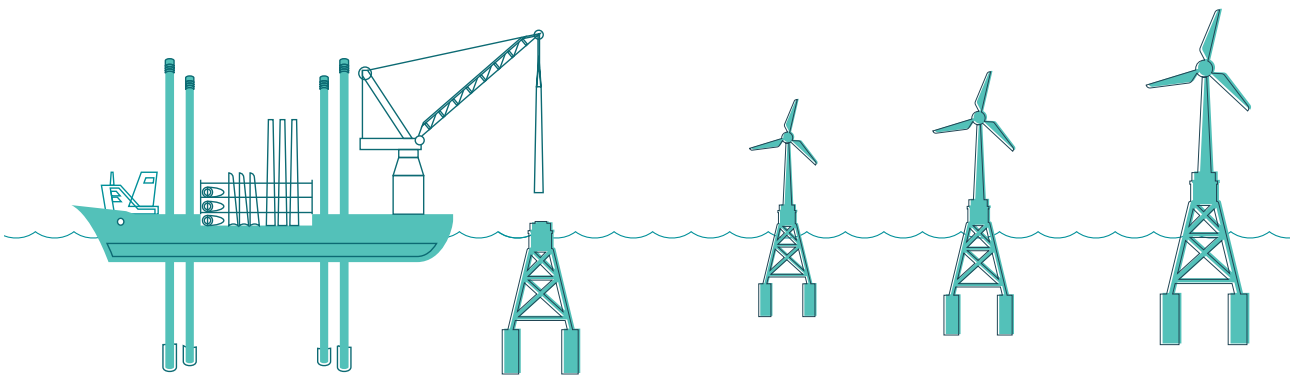
In addition, the Government should clearly state which qualitative criteria will be used in the coming concession rounds and have them reflect the goals of the guiding principles set forth by the Government. To contribute with more jobs offshore and in the supplier industry, as the third guiding principle states, the qualitative criteria should include having a certain level of local content, or other mechanisms to ensure this. The industry has done a thorough assessment of the concession process that was on hearing until August 2021. In line with what several interviewees highlighted, some of the qualitative criteria suggested includes the level of technology development and its potential for cost reduction, ability to build Norwegian talent and competent suppliers, project execution capacity and consideration for sustainability. The Government should publish the qualitative criteria defined for the first concession round as soon as Q4 2022, in order for developers to prepare themselves for the tender in 2023 according to the given criteria. When going forward, the qualitative criteria defined for each concession round should consider lessons learned from the earlier projects, and if needed should be adjusted to reflect the strategic objectives and the status of industry development.

Creating a detailed concession timeline will give predictability for industry players, enabling a long-term commitment of capital and long-term service agreements. Our recommendation is for this concession strategy and roadmap to be published by Q1 2024, in due time for the second concession round scheduled in 2025. The strategy should balance the need for clarity and predictability with the need for flexibility to adjust criteria over time as experience is built.

2

Establish a financial support scheme

A support scheme should be established to make the offshore wind projects economically feasible, and accelerate technological advancements required to enable scale to ensure the necessary development speed to meet Norway's ambitions in time. Ensuring price certainty in floating offshore wind will be particularly important to de-risk projects and stimulate investments, which in turn will be essential to ensure the continued leading position in floating technology that Norway boasts today. The uniform impression from the industry is that Contracts for Difference (CFD) is the preferred setup for such a support scheme, as it well known, tested and relatively simple. Using CFDs in offshore wind is common in other European markets that are more mature and is the preferred financial instrument incentivizing low carbon energy production. Benefits from using CFDs include de-risking power price volatility without over- or undercompensating the developer, higher debt levels lower capital expenditures by decreasing the expected return on the investment, and a certain cash flow for developers enables them to allocate capital towards other initiatives (Oslo Economics, 2022). Disadvantages with CFDs include higher administrative costs and a long-term financial commitment for the state involving uncertainty around power prices that could reduce flexibility in future state budgets. Regardless, the NPV of the CFD payments made by the state will be lower than that of a so-called investment support scheme, making it the favorable option for both the developer and the Government.



Whether or not there will be financial support schemes to be used for Utsira Nord and the first phase of Sørlige Nordsjø II, should be communicated as soon as Q3 2022 for developers and financial institutions to start prioritizing capital and projects for the first concession round. By Q1 2023, the detailing of these support schemes should be published, stating the duration and magnitude of the support. This decision is closely related to the publication of a surplus power strategy, as projects with the ability to export might be in less need of financial support, due to higher power prices in available markets, or more to account for the additional cost for developing offshore grid needed for exports (as discussed in the next section of this chapter). By Q2 2024, a long-term strategy for support schemes in future concession rounds should be published, further increasing the predictability, and lowering price risk. While detailing specific levels of support for projects far in the future is of little use, an ambition level should be set for the different types of projects and technology development for the coming years.

Contract for difference:

A contract for difference in the context of offshore wind is a contract where a guarantor (The Norwegian State) guarantees a fixed price per MW/h to the wind farm owner. The contract is valid for a pre-determined period or for a pre-determined power production volume. If the market price is below the guaranteed price the guarantor pays the difference to the wind farm owner. Conversely, if the market price is above the guaranteed price, the guarantor will receive the price difference from the wind farm owner.

Fact box 7: Contracts for difference explained.

3

Define a combined strategy for domestic consumption, export, and grid infrastructure

The injection of 30 GW of additional capacity unlocked by development of offshore wind in Norway will likely create a power supply beyond the Norwegian domestic demand. How this surplus will be employed is a decision that lies at a political level, and the current uncertainty around this could be a hindrance to the timely development of both offshore wind, onshore and offshore grid infrastructure and green industry planning. These things are closely interlinked, and failing to look them as a whole can result in inefficient and less sustainable solutions, where we have to invest in a more costly infrastructure than needed. To avoid this, the Government should define a combined strategy for how to develop both domestic consumption, export and grid infrastructure.

→ Export, storage, and consumption

Estimates by DNV suggest that by 2050 as much as 25% of the power production from offshore wind in Norway could be directed for export (DNV, 2021). This could be crucial to open additional revenue sources which in turn could support the financial feasibility of several projects that could remain otherwise uneconomical and therefore undeveloped without additional state funding[8]. To facilitate this, the Norwegian Government must establish offtake agreements with neighboring countries, and this should be pursued and secured as part of a holistic power export strategy. The strategy should also consider the Norway's guiding principle of employing the additional capacity to build a green industry for hard to abate and energy intensive sectors, which calls for a balance between increased domestic consumption and export targets. The potential benefits of exports available to the developer, must also be weighed against the cost of establishing necessary on- and offshore infrastructure.

[8]Industry stakeholders have advised us that projects in the southern parts of the Norwegian economic zone such as Sørlige Nordsjø II are economically unfeasible without hybrid connections due to the long transmission distance and proximity to the European continent.

As mentioned in the challenges, a study by NVE, expected to be published in Q4 2022, is currently investigating infrastructure alternatives, and will focus on potential connections of Sørlige Nordsjø II phase II. Different solutions being evaluated include radial connections to Norway, to Norway and neighboring countries, only to neighboring countries and other hybrid solutions. As an extension of this effort, there is a need to have a long-term approach that extends beyond phase II of Sørlige Nordsjø II and that evaluates grid alternatives also for areas that are currently being evaluated for potential development.

Such an assessment should define the balance between exporting the additional capacity and employing it to feed the development of a power intensive green industry, and define concrete strategies for both. The development of an export strategy should set the guidelines for the necessary bilateral offtake agreements, which should be developed and closed with relevant partners by Q1 2026. The urgency of this is driven by the necessity to plan the suitable upgrades and extensions for onshore and offshore transmission lines, as explored more in detail in the following section. Given current capacity constraints and vast scopes in relevant authorities, establishing a dedicated agency mandated with the development of bilateral agreements could be a suitable solution not to miss on this target. In parallel to the development of general offtake agreements, a decision concerning whether the second concession round should be connected with hybrid cables should also be made by Q2 2023, to allow for the development of agreements prior to the opening of the tender in 2025. To give developing consortiums the predictability over the type of agreements that will be set prior to the tender being opened, the deadline for closing offtake agreements for the second concession round should be Q1 2025.

BALANCE SPEED AND SUSTAINABILITY

While predictability plays a central role in supporting the development of offshore wind in Norway, speeding up the processes from area announcement to start of production is key. However, this needs to be done in ways that ensures high sustainability and coexistence standards. Formalizing how sustainability and coexistence will be addressed throughout the process will be pivotal to de-risk new projects development, ensure the avoidance of public opinion resistance, and at the same time help speed up the process. Leveraging the power of data and digital technologies, the processes could be further integrated and collaboration could be improved.

4

Streamline the licensing process

To ensure the timely development of the offshore wind industry in Norway in line with the ambitions set by the Government in 2022, accelerating the licensing process will be essential. Hearing responses have suggested that both the sequential nature of certain steps, and the allotted processing time of each step, in the suggested process create considerable inefficiencies (Aker Offshore Wind AS, 2021; Norsea Group and Parkwind NV, 2021). Lead times from the moment an area is announced for tender to the moment the park is commissioned and in operations could therefore be significantly reduced.

The current process treats the concession application, detailed planning, and development of new areas as strictly separate and consequential processes. If allowing more parallelization, developers could initiate detailed planning in parallel with developing the concession application and while the application is processed. Later in the process, contracting and procurement processes, which themselves have significant lead-times, could be run partially in parallel with approval of the detailed plan. Additionally, the industry has pointed to the detailed planning as having the potential of being shortened. This is substantiated by the shorter planning lead-times in the oil and gas sector, which should be an indication of what can be achieved in offshore wind, given the right frameworks (Aker Offshore Wind AS, 2021). While the total efficiency gain is difficult to calculate, increased parallelization and reduced processing time could enable substantial improvements, and in developing the timeline presented in this report we have assumed a possible reduction from ten to seven years from announcement to operations[9].

These recommendations are in line with the hearing response from industry players, and it is expected to be part of the revised guide for area allocation, licensing process and application for offshore wind power.

To support the accelerated processing rhythm, relevant authorities, ministries and departments will need to expand their capacity to prevent the development of processing bottlenecks and ensure the timely development of the industry. While this additional demand could be satisfied by external hiring, the reallocation of resources from oil and gas departments could be a natural first step to support the higher load within offshore wind.

[9]For comparison, Kriegers Flak in Denmark, developed and operated by Vattenfall Vindkraft A/S, was completed and connected to grid in 2021, five years after awarding the area in October 2016 (4C Offshore, 2021; Vattenfall, 2021)

5

Integrate holistic approach to sustainability from the start

In addition to streamlining the licensing process, formalizing and accelerating environmental impact assessments for onshore and offshore ecosystem will be imperative to prevent further delays and to de-risk new project development. In particular, we recommend at least a partial adoption of the Danish model, entailing that ecosystem impact assessments on the seabed and on the marine flora and fauna should be state-funded and conducted on areas identified as potentially suitable for development. Doing so prior to opening the licensing process to bidders considerably de-risks project development, as it prevents delays later in the process (Danish Energy Agency, 2017). Leveraging the power of digital to establish data models that can follow the process, could further ensure the transparency and completeness of sustainability assessments, and further speed up these processes.

Environmental impact studies should be as comprehensive as possible, and given that some studies can take several years to complete as outlined in some of the interviews we conducted, these should be initiated as soon as new areas are identified for potential development to not create bottlenecks. We recommend formalizing the strategy and guidelines outlining a holistic sustainability assessment as part of a new licensing process, to be published in Q1 2023, before the first bidding round opens.

Moreover, we recommend OED to initiate a holistic sustainability assessment considering all the new areas identified by NVE, to be published by Q3 2026. This assessment would contribute to a prioritization of the areas to develop after concession round 2. The study should perform an impact assessment of both the offshore ecosystem, considering areas not in isolation, but in relation to each other, and coexistence with other industries. Detailed maps for other industries, such as those created and published by Fiskeridirektoratet should be considered when performing these assessments. This, in turn, would contribute to defining the total environmental impact of new project development. Additionally, the assessment should also evaluate onshore environmental impact. Appraising the impact of grid upgrades and extensions as well as the development of supporting infrastructure, such as ports and yards, will be a paramount component to prevent not only avoidable environmental damages, but also to avoid public resistance to the development of necessary infrastructure, as explained in the following section.

BUILD INDUSTRIAL CAPACITY

Constructing, launching, and servicing large offshore wind projects will require tailored infrastructure in proximity to the commissioning site. While it is expected that a large share of industrial yards and ports will be repurposed from the oil and gas sector as activity at some point slows down, specific requirements in offshore wind will require substantial investments in expanding or refitting of existing infrastructure. In addition to this, several efforts will need to be made by industry players in terms of resource allocation and strategic shift now to ensure long-term competitiveness.

6

Secure the necessary manufacturing, installation, and servicing capacity

The development of supporting infrastructure is contingent to political decisions addressing where and when new areas will be opened for development. NVE is expected to publish a new report in Q2 2023 with an assessment of new areas for development, which should contribute to partly reducing uncertainty. A crucial element that is still unclear is the capacity gap and the required level of investments in onshore manufacturing, installation, and servicing infrastructure and assets to satisfy demand in the offshore wind industry.

While some capacity is planned to be repurposed from oil and gas, a detailed assessment of the gap between installed or planned infrastructure (see a few examples in fact boxes 5 and 6) and required infrastructure to deliver on the 30 GW ambition has not been conducted. Failing to match the two might result in either idle or insufficient capacity, or even worse, unfit infrastructure. We therefore recommend that the Government takes initiative to conduct a supporting infrastructure gap assessment working together with the industry, to be published by Q2 2024. This will necessarily be followed by specific infrastructure development proposals and plan by Q2 2025, addressing how the gap should be filled. These milestones are defined by backtracking from the estimated construction start dates of Sørlige Nordsjø II and Utsira Nord, which according to the expedited process outlined in this report could take place in Q3 2026. An additional essential element to be addressed in such an analysis will be the ownership and operating model of new infrastructure. Answering these questions will provide the industry with the predictability it needs and the transparency will allow it to commit resources where required to support the upscaling of the offshore wind industry along the coast.

7

Accelerate industry transition

While the need to increase the predictability over the concession awarding process and transparency over incoming project pipelines and on support schemes is frequently highlighted, the industry's role in reallocating resources will be key. Companies currently face high opportunity costs in investing in offshore wind initiatives given renewed favorable conditions in core business areas within oil and gas. Nonetheless, postponing the shift from oil and gas too long might be detrimental to companies' long-term competitiveness both domestically and internationally. This in turn would hamper the role Norwegian companies could play in building a local offshore wind industry. The call to action is therefore to redirect capital and resources to offshore wind initiatives early on, even if the NPVs of the first projects might be lower than comparable oil and gas initiatives. In the long run, making this strategic shift should be profitable, as we believe the first-movers will have a strong competitive advantage in future rounds.

Given the current limited opportunities in the Norwegian offshore wind industry short-term, we see engaging in international projects as a first important step for Norwegian companies to build competences and references. The limited participation in international projects has been outlined especially for small and medium enterprises, which might not have the resources to position themselves competitively in international tenders. We therefore encourage larger developers to support the involvement of small and medium sized Norwegian suppliers also in international projects through the development of strategic alliances and partnerships. This will foster the development of competences to be employed in Norway, as well as accelerating the development of Norwegian suppliers' competitiveness in international arenas, and could be seen as investing in long-term sustainability of the local value chains, to prepare for upcoming Norwegian projects.

However, to become attractive partners to both Norwegian and international developers, Norwegian suppliers must first achieve the right quality at attractive cost levels. To enable this, they should take advantage of agencies such as Export Finance and Innovation Norway. These organizations have both relevant support schemes and relationships that Norwegian companies with export potential in offshore wind could benefit from leveraging even more actively. These agencies should also increase their efforts to promote Norwegian suppliers and developers and assist them in securing international contracts, with a special focus on smaller players.

8

Collaborate for increased standardization

One critical element that has been identified as a challenge to scaling manufacturing and installation of offshore wind is the uncoordinated progress of R&D and lack of standardization. As discussed previously, while innovation and R&D still is needed, lack of standardization prevents large scale investments in manufacturing processes as well as supporting infrastructure, and in turn keeps margins low, especially for floating turbines. Some interviews even indicated that this has led to some OEMs participating in projects at a loss. While competition and colluding regulations should not be transgressed, we recommend the industry to initiate discussions around product standardization to give both predictability around infrastructure development, as well as unlocking higher margins.

An example of where dialogue on standardization could be beneficial is related to turbine size.The industry in Norway could aim for a certain size of the turbines, e.g., 15 MW, and strive for mass production of these for the first concession rounds instead of commissioning project-specific solutions for all.

The role of organizations like Innovation Norway and energy clusters extends beyond supporting and promoting Norwegian companies abroad. We recommend that they increase their efforts creating meeting fora and facilitating discussion to foster knowledge exchange and innovation. The Government's offshore wind forum is another arena that should be continued, to secure close dialogue between industry and government.

SECURE TALENT

One of the guiding principles for developing offshore wind in Norway as stated by the government is to develop an industry contributing with more jobs offshore and in the supplier industry. Offshore wind in Norway can become one of the most important industries for job creation, contributing to an estimated 28 700 new jobs directly in 2050 (Menon Economics, 2022). To better meet this demand, it will be crucial to upskill people working within offshore industries today, educate a new offshore wind workforce and attract the right competencies from abroad.

9

Develop and attract local competencies

→ Upskill existing offshore talents

As outlined in the previous recommendation, Norway exhibits world-class offshore expertise that should be leveraged to attain a competitive advantage within floating offshore wind. Innovation Norway is launching a competence and export program aimed at supporting Norwegian offshore suppliers transitioning from oil and gas to offshore wind, until the supplier's first references are secured in international markets. In addition to these types of initiatives, the industry must take responsibility for upskilling and prioritizing parts of its offshore workforce to leverage the competitive advantage within floating offshore wind before other markets catch up.

→ New education paths

Educational institutions should establish and advertise tailored education paths within relevant fields to develop applicable competences, increasing workforce capacity, strengthening existing and developing non-existing competences. The work has already begun on several institutions, such as UiB's research project subsidized by The Research Council of Norway addressing seabed surveys, but academia needs to be pushed. The Government must communicate to academia when and how many workers are needed, so they can develop the programs aiming to close the future capacity gap. In addition, industry players should play an active role collaborating with academia on R&D projects and communicating the needed competences. However, the responsibility to create the needed programs lies with academia, and universities should take the opportunity to shape the first offshore wind programs in a country that could potentially become an important hub for floating technology development and R&D.

→ Attract talent from abroad

While the booming oil and gas industry potentially will occupy the needed competences for years to come, and education paths take time to develop, it will be important to also attract the right competences from abroad. As other offshore wind markets are moving faster than Norway, the industry should start creating the conditions and incentives that makes it favorable to work here remotely or in person. Some of these conditions will include projects with world leading technology development and a fast-growing market, in addition to favorable benefits, Norwegian HSEQ standards, local job opportunities for English speaking partners and local integration support for families.

Within the area of talent and workforce development, the offshore wind industry can be inspired by how the relatively new Norwegian battery industry has addressed the same challenge. Through pro-active dialogue with academic institutions, close collaboration across industry players and by showcasing Norway as an attractive place to work, they have in short time managed to initiate several new educational paths and attracted key expertise from the industry-leading nations in Asia.

SUMMARY AND CONCLUSION

The study has identified the most important challenges that need to be addressed for Norway to become a global leader in offshore wind, with a recommended way of moving forward. The challenges are interlinked, and some of them calls for action right now for the targets to be within reach.

First and foremost, the industry needs more predictability to make it feasible to prioritize resources and capital to offshore wind initiatives. The report addresses this by placing the recommendations on a timeline that shows the suggested near-term milestones, and seeks to answer what needs to be done, who is responsible, and when they have to start. A unison industry is asking for a roadmap, and this is crucial if Norway wants to follow the speed of the most fast-moving countries and build a world-leading industry. The Government needs to facilitate for Norway to keep up with other countries' speed, while the green transition must go hand in hand with protection of nature and wildlife.

It is important to underline that the speed of development is not only dependent on governmental choices, and the industry needs to be ready to build industrial capacity when industry players get their desired predictability. They need to start the transition from other industries and should get experience from abroad before the first projects on Norwegian soil are up and running. When the pipeline for the first Norwegian projects is ready, they should define standards to achieve scale and industrialization. The companies need experience, but they also need the right talent and a sufficient amount of it. It will be of upmost importance that the offshore wind industry secures talent – by upskilling the existing workforce within oil and gas, establishing more tailored education paths, and attracting talent from abroad.

The timeline can be used as a tool by policy and decision makers in the offshore wind industry in the years to come. Reaching the 30 GW target while following the five fundamental principles for developing offshore wind will be challenging, and it is therefore important with a holistic plan. Overall, the report shows that it is possible for Norway to take a leading position within offshore wind, but it will require significant efforts from industry players, governmental bodies, and the society at large. With this, and close, constructive collaboration between all stakeholders, Norway might become the offshore winners the country aims for.

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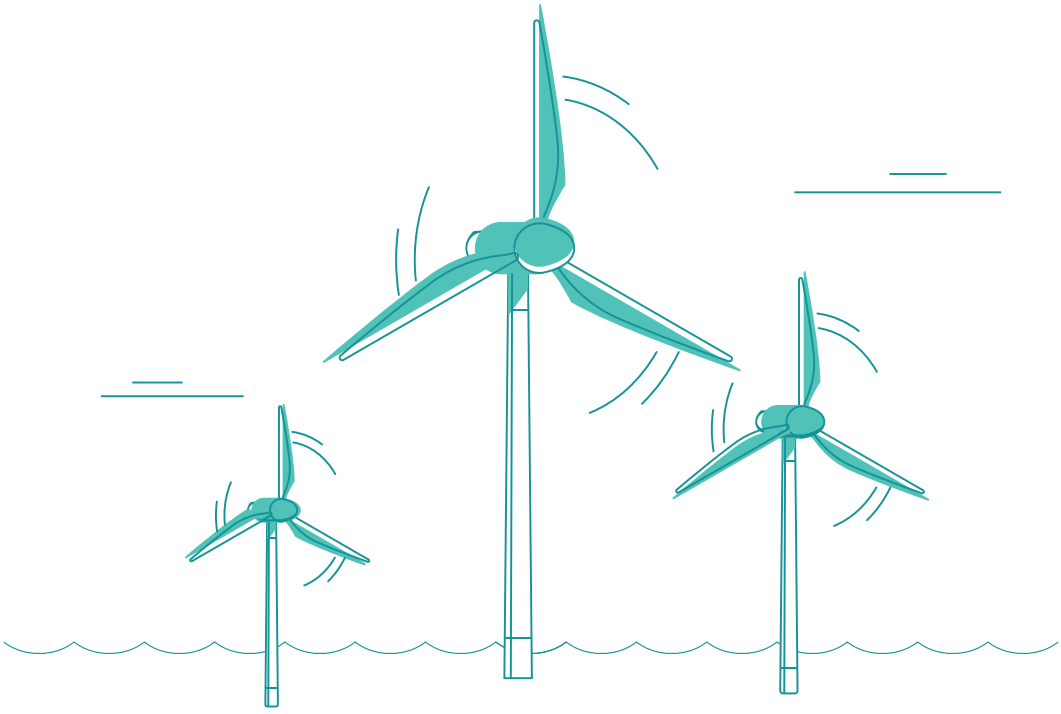

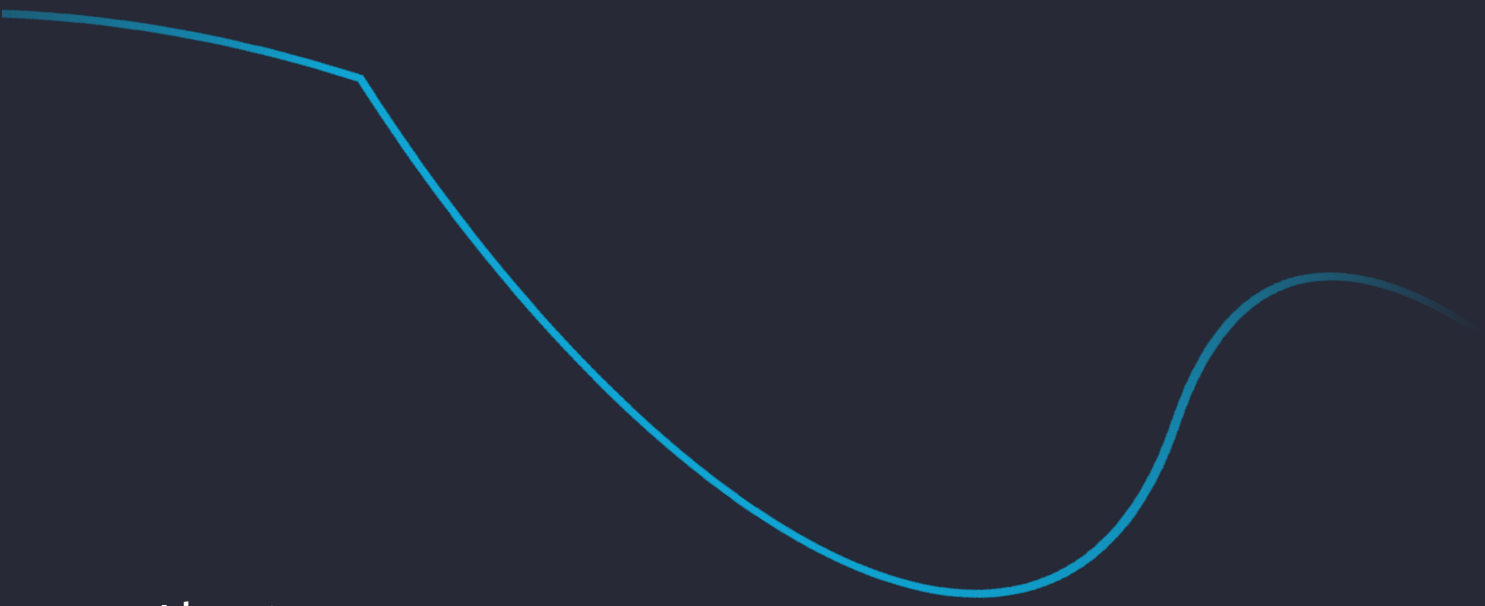

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