Outlook for Norway

Building sustainable industrial advantage through the green transition

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NHO + BCG

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Introduction

Imagine: The year is 2040. Norway is still a leading energy supplier to the European continent, but now primarily utilizing renewable energy sources to produce both power and green molecules for export. The mainland industry is flourishing with access to abundant and stable energy as a continued key competitive advantage, together with a highly skilled workforce. Digital solutions are developed and implemented everywhere; infrastructure and plants are equipped with sensors, vast amounts of data are analyzed and used directly in decision support, and production processes are highly automated.

The country's yards and local manufacturing sites have been transformed, with significant engineering know-how focusing on export industries such as offshore wind, hydrogen, and carbon capture and storage. New jobs in green value chains have compensated for lower activity in the oil and gas industry, resulting in continuous high industry employment and robust value creation. Norway is on the path to achieve its 90-95% gross emissions reduction target by 2050, driven by electrification and other decarbonization measures.

Can this be a reality? It certainly can – but realizing this vision requires immediate action.

Several reports have assessed the topic of Norway's green transition in recent years. Through this work commissioned by NHO, BCG aims to present new perspectives by providing the following:

1. An updated quantitative assessment of Norway's competitiveness in the green transition
2. Insights into why other countries are advancing more rapidly and outperforming Norway in competitiveness
3. Specific recommendations for Norway to accelerate its climate progress and development of green value chains, based on lessons from leading countries

Our primary goal is to propose specific action points that both the private sector and government can utilize to accelerate the green transition. We believe this perspective can also be of interest to the general public, enabling a better understanding of what it will take to build new green value chains and reach climate targets.

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Executive summary

Norway possesses robust foundations for a successful green transition thanks to our unique natural resources, strong industrial- and technological expertise, a well-educated population, and significant revenues from the oil and gas industry. These advantages present Norway with an excellent opportunity to make long-term investments in accelerating the green transition, while maintaining our position as an energy superpower. However, other countries are more ambitious and making more substantial progress in achieving their climate goals and establishing green value chains. The critical question for Norway as a nation is: How can we create industries that not only ensure sustainable value creation for future generations and provide local employment, but also effectively address climate challenges?

Compared to other countries in Northern Europe, Norway's 2030 climate goal of a 55% emissions reduction compared to 1990 is not particularly ambitious. Denmark, Germany, the United Kingdom, Finland and Sweden are all more ambitious, with goals in the range of 60-70%. Additionally, Norway has reduced its emissions by less than 5% over the past 30 years, and significantly greater cuts are needed to achieve the climate goals. Other countries have started earlier and have made more progress in both decarbonization and in establishing green value chains. As an example, Norway has a weaker position in offshore wind and hydrogen compared to peers, while the position is somewhat stronger for carbon capture and storage.

Our analysis indicates a decline in Norway's competitiveness in the green transition since last time we measured it in 2021, primarily due to more rapid improvements in other countries. Consequently, Norway has dropped from fourth place in the 2021 ranking to seventh in this year's ranking. When comparing Norway with countries doing well in the green transition, two key areas emerge where Norway is outperformed: leading countries have stronger political frameworks and are better at attracting green investments. In particular, they are better at creating concrete roadmaps with goals and milestones for green development and continuously assessing and adapting policy frameworks and support mechanisms to attract investors.

Offshore wind is an example of a green value chain that should be prioritized in Norway. This technology is a realistic option to meet the sharply growing power demand towards 2050. In addition, Norway has strong competitive advantages and a high potential for value- and job creation in offshore wind. Denmark, Germany, the United Kingdom, and the Netherlands are successful countries within offshore wind. These countries ensure long-term outlooks and transparency for the developers, and the governments collaborate with the industry to design required political frameworks and incentives.

To reach the climate goals and have successful development of green value chains, the government, the industry, and the general public all have important roles to play, with the following actions recommended:

- For the government, the most important success factor is to establish a holistic roadmap with interim targets and milestones for both green value chains and climate, with a clear plan on how to achieve these milestones. This should encompass an adaptable support framework, revised as needed to meet targets. Additionally, a substantial expansion of both onshore and offshore power production and grid infrastructure is essential.

- The industry must ensure collaboration and fair value distribution between players across value chains. Local stakeholders must be involved early in the development of power plants, grid and industry, and the value creation must benefit local communities while minimizing adverse effects on both people and the environment.

- Both government and industry need to engage in clear communication with the public, fostering a shared understanding of the necessity to both develop green value chains and achieve climate targets. Establishing new industries will initially require government support, but the value chains are expected to become profitable in the longer term for both local communities, the industry, and Norway as a nation.

More specific recommendations should be formulated for each value chain, and we have exemplified how this can be done for offshore wind with seven concrete proposals. For this value chain, it is particularly important to create predictability through ambitious targets and an accompanying plan for which areas will be tendered over the next ten years. The level of support from the government must reflect the risk faced by developers, such that the overall attractiveness is sufficient for Norway to attract leading players.

Sammendrag

Norge har et sterkt utgangspunkt for å lykkes med det grønne skiftet. Vi har unike naturressurser, sterk industri- og teknologikompetanse, en generelt høyt utdannet befolkning og store inntekter fra olje- og gassindustrien. Norge har derfor en enestående mulighet til å gjøre langsiktige investeringer som vil akselerere det grønne skiftet og kunne opprettholde vår posisjon som energistormakt. Likevel ser vi at andre land er mer ambisiøse og har større fremgang både når det gjelder å nå klimamålene sine og i oppbyggingen av grønne verdikjeder. Hvordan skal vi som nasjon skape industri som sikrer varige verdier for fremtidige generasjoner, arbeidsplasser lokalt og samtidig løser klimautfordringene?

Sammenliknet med andre land i Nord-Europa, er Norges klimamål for 2030 på 55% utslippskutt i forhold til 1990 ikke spesielt ambisiøst. Land som Danmark, Tyskland, Storbritannia, Finland og Sverige er alle mer ambisiøse, med mål fra 60 til 70%. I tillegg har Norge kun redusert utslippene med under 5% de siste 30 årene, og det er nå helt nødvendig med betydelig større kutt for å kunne oppnå klimamålene. Andre land har startet tidligere og kommet lengre i arbeidet med avkarbonisering og etableringen av grønne verdikjeder. Norge har for eksempel en svakere posisjonen innen havvind og hydrogen sammenlignet med andre land, mens posisjonen er noe sterkere for karbonfangst og -lagring

Våre analyser viser at Norges konkurransekraft i det grønne skiftet har svekket seg siden vi sist målte denne i 2021, først og fremst fordi de andre landene forbedrer seg raskere enn Norge. Dermed faller Norge fra en fjerdeplass på rangeringen i 2021 til en syvendeplass i årets rangering Sammenlignet med landene som scorer høyt, er det spesielt to dimensjoner der de gjør det bedre enn Norge; de har sterkere politiske rammeverk og er bedre til å tiltrekke seg grønne investeringer. Særlig er de bedre til å lage tydelige veikart med mål og milepæler for grønn utvikling, og til å fortløpende vurdere og tilpasse rammevilkår for å tiltrekke seg industribyggere og investorer.

Havvind er et eksempel på en grønn verdikjede som bør prioriteres i Norge. Denne teknologien er et realistisk alternativ for å kunne møte den forventede økningen i kraftbehov mot 2050. I tillegg vil norsk havvind kunne stå for enorm verdiskapning og etablere et betydelig antall arbeidsplasser. Til tross for at vi har gode konkurransemessige fortrinn gjennom unike vindressurser og offshore-erfaring og kompetanse, ligger Norge bak sammenliknbare land som Danmark, Tyskland, Storbritannia og Nederland. Disse landene sikrer langsiktighet og transparens for utviklerne, samtidig som myndighetene samarbeider med industrien for å utforme nødvendige politiske rammeverk og insentiver.

For å lykkes med klimamål og utvikling av grønne verdikjeder, har myndighetene, industrien og befolkningen generelt viktige roller å spille, med følgende anbefalte tiltak:

- For myndighetene er det viktigste å etablere et helhetlig veikart som viser hvilke mål og milepæler vi skal nå både innen klima og grønne verdikjeder, med en tydelig plan for hvordan målene skal nås. Dette inkluderer riktige rammebetingelser som oppdateres om nødvendig for å nå målene. I tillegg er det nødvendig med en storstilt utbygging av kraftproduksjon og kraftnett både på land og på sokkelen.

- Industrien må sikre samarbeid på tvers av verdikjeder og rettferdig fordeling av verdi mellom aktørene. Lokale interessenter må involveres tidlig i utbyggingen av kraft, nett og industri, og verdiskapingen må komme lokalsamfunn til gode samtidig som negativ påvirkning på mennesker og natur begrenses.

- Myndigheter og industri må sikre tydelig kommunikasjon slik at befolkningen forstår behovet for både å bygge opp grønne verdikjeder og å nå klimamålene. Etablering av nye industrier vil kreve statlig støtte på kort sikt, men vil være lønnsomt på lengre sikt, både for lokalsamfunn, industrien og Norge som nasjon.

Spissere anbefalinger bør utformes for hver enkelt verdikjede, og vi har eksemplifisert hvordan dette kan gjøres for havvind med syv konkrete forslag. For denne verdikjeden er det særlig viktig å skape forutsigbarhet gjennom ambisiøse mål og en tilhørende plan for hvilke områder som skal tildeles de neste ti årene. Støttenivået fra myndighetene må reflektere risikoen utviklerne møter, slik at den totale attraktiviteten er god nok til at Norge tiltrekker seg ledende aktører.

1

Norway has the potential to be a winner in the green transition

Norway is a significant supplier of energy to Europe, providing approximately a quarter of the total gas consumption used for heating buildings, power production, and industrial needs [1]. To maintain its position as a substantial player in the European energy landscape, as well as a country with a significant export economy, Norway will need to build green export industries to compensate for reduced oil and gas exports towards 2050.

The good news is that Norway has a solid starting point to succeed in the green transition: Several competitive advantages, an increasing will to act, the advantage of constantly improving technologies and potential high benefits for society if succeeding.

Norway's key competitive advantages include natural resources, human capital, and technology. Norway has the highest hydropower production[1] in Europe and currently has a low-carbon electricity surplus. The flexible hydropower also provides an advantage to balance variable renewable energy. This is particularly relevant when building out the offshore wind industry, which has a potential of more than 300 GW installed capacity [2]. Other natural assets provide additional advantages; examples include reservoirs to store CO_2, mineral resources, bio resources and clean sea water.

[1] Around 137 TWh in a normal year.

In addition, Norway has a highly educated and skilled workforce bringing together both expertise and practical know-how from sectors such as oil and gas and process industries, that can be leveraged in developing green value chains. Finally, world-leading technology in industries like offshore, maritime, and digital can be applied to accelerate green growth.

Both corporates and the government are supporting the green transition and have shown increased focus coupled with willingness to act in recent years. NHO has previously explored the subject in reports such as "Grønne Elektriske Verdikjeder" [3], and "Felles energi- og industripolitisk platform" [4, 5] and launched "Kraftløftet" [6] in collaboration with LO and the government. The government has also addressed the topic, most lately in the September 2023 report "Grønt Industriløft 2.0", which articulates the vision across nine green value chains [7]. Other examples of willingness to act include support of green research and industry projects through "The Green Platform Initiative" [8], electrification of industry and transport, and a pronounced ambition for offshore wind followed by the announcement of auctions for area development [9].

The continuous improvement in technology, scale of implementation and the following decrease in cost (LCOE[2]) for key technologies such as offshore wind, solar PV, batteries, and carbon capture and storage (CCS)[3] present significant advantages for realizing the green transition. These developments make the business case for green projects increasingly compelling, drawing enhanced interest from investors. Several technologies do no longer require government support to be realized – they are inherently profitable. This is not unique for Norway, but rather an advantage for all countries embarking on the green transition.

Norway's success in the green transition would offer a range of potential benefits to society. Menon Economics estimates that the floating offshore wind industry alone can generate NOK 21-96 billion in revenue in 2050, while employing around 50,000 workers [10]. Similarly, Nasjonalt Eksportråd recommends that Norway sets a target to comprise 10% of the global offshore wind market by 2030, which would yield revenues of approximately NOK 85 billion per year [11]. Other examples include the green hydrogen value chain, with the industry expecting a revenue potential of NOK 85 billion by 2030 [12] and the green maritime industry, with a revenue potential around NOK 50 billion by 2030 [3].

Regardless of the exact value potentials of green value chains, the order of magnitude emphasizes that Norway can and should take the lead in the green transition. The nation has all the prerequisites to succeed; now it's the time to commit our resources and do more.

[2] Levelized Cost of Energy – a measure for average net present cost of electricity over the lifetime.

[3] Carbon capture and storage: Carbon is stored in underground reservoirs (not utilized for other purposes).

Green value chains

We define green value chains as the full range of activities that produce, deliver, and dispose products in a sustainable manner and/or create products required to mitigate climate change and loss of nature. This perspective does not delve into the details of each value chain; instead, it shows the progress across some selected ones – particularly offshore wind – in addition to assessing competitiveness on a broader basis across all value chains.

2

Comparable countries are more ambitious and progressing faster

As Norway considers the path forward, it is worth examining how the country compares to others in terms of green transition ambitions and advancements. Here, targets and progress on both climate and green value chains are relevant measures.

2.1. Norway is less ambitious on climate targets and behind peers on cutting emissions

Norway has targeted a 55% reduction in gross emissions by 2030, compared to 1990 levels, as illustrated in Figure 1 (and a 90-95% reduction by 2050).[4] Compared to countries in Northern Europe, that target appears unambitious. Denmark is leading the way with a 70% reduction target, followed by the UK at 68%, Germany at 65%, Sweden at 63%, and Finland at 60%.

It is not completely accurate to compare emissions targets one-to-one, as this approach does not take into account underlying factors such as industry development, the starting point of power production mix (e.g. hydropower) as well as the population growth path since 1990 - emissions have historically been highly correlated with GDP. Norway's GDP-growth path has been somewhat steeper than peers (more than a doubling of the economy, compared to 50-100% increase for peers), but this is no excuse for less ambitious climate targets. The economic growth, partly driven by the oil and gas sector, has made Norway one of the wealthiest nations on earth, with all the prerequisites to act boldly on climate. In light of this, the Norwegian 2030 target is modest.

When it comes to emissions reduction to date, Norway has seen only a 4.6% decrease since 1990, a modest reduction relative to most similar countries. Although Norway's 2030 emissions reduction target is less ambitious than many of its peers, Norway must achieve the steepest decline in emissions the coming years to reach that target. Emissions must fall by 7.2 percentage points annually from 1990 levels, which means accelerating the reduction rate to nearly five times that of the past five years. Meeting this challenge will require significant effort.

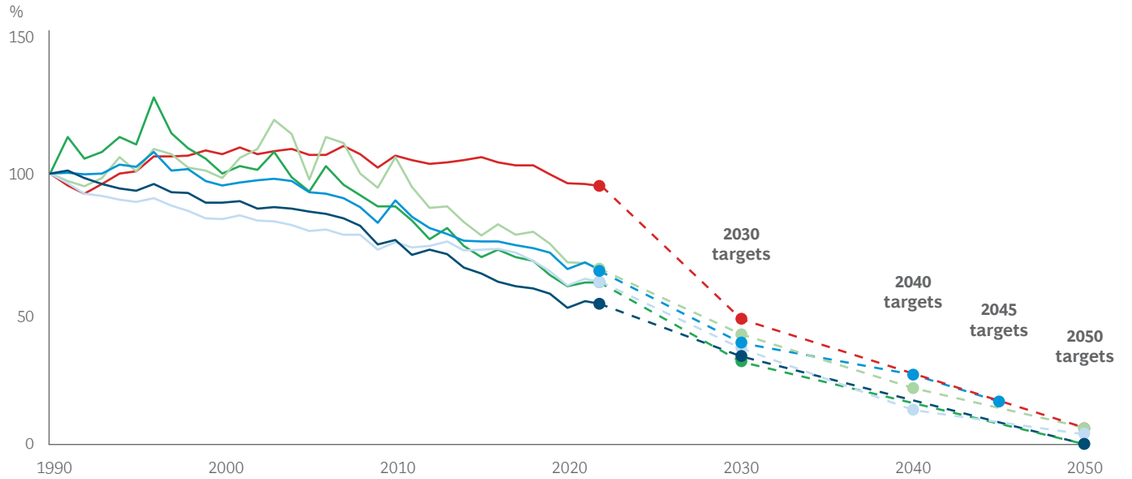
It is worth noting that the effort will be significant, and the oil- and gas industry is often mentioned as a key to reach targets, accounting for ~25% of current Norwegian emissions. In order to maintain the status as a leading contributor to European energy security, while also contributing to reaching emission targets, the industry must continue to decrease production emissions. In addition, new production must be evaluated in the context of the capability to capture and store CO_2 emissions derived from these sources to supply Europe with low-emission energy.

2.2. Norway is lagging in offshore wind and hydrogen, but is strong on CCS

To compare value chain ambitions and progress, we have selected three focus industries that provide a set of illustrative examples: offshore wind, hydrogen and CCS. These three will most likely be key in the green transition, both for Norway and for Europe.

Figure 1 | GHG emissions reduction paths

Annual emissions and targets[4] (1990 level = 100%)



1990-2022 reduction	-5%	-41%	-35%	-37%	-40%	-49%
2030 target	-55%	-70%	-60%	-63%	-65%	-68%
Remaining to target[5]	-50%	-29%	-25%	-26%	-25%	-19%

Source: SSB; Statistics Denmark; State Treasury Republic of Finland; Umweltbindesamt; SCB; UK Government; BCG analysis

[4] Nationally determined contribution (NDC) targets applied for comparison. Gross emissions excluding land use, land use change and forestry (LULUCF).

[5] Remaining to reach 2030 targets relative to 1990 levels.

To measure the progress along the selected example value chains, we have chosen to compare the relevant capacities for each of these industries (i.e., *installed* capacity for offshore wind; *production* capacity for hydrogen, and *capture* capacity for CCS). Furthermore, such capacity is differentiated by the amount of capacity currently *under development*, the amount of capacity currently *under construction*, and the amount of capacity *in operation* across countries. Note that the capacities are adjusted for the GDP of each country, such that the resulting numbers indicate progress across value chains relative to the size of economies, see Figure 2.

Offshore wind

Countries with considerably shorter coastlines and less offshore wind potential than Norway are setting more aggressive targets for installed capacity than our ambition of 30 GW awarded by 2040. Almost all North Sea countries have stronger targets; Germany aims for 30 GW by 2030 and 70 GW by 2045, the Netherlands plans 21 GW by 2031 and 70 GW by 2050, and the UK 50 GW by 2030. These targets are also more ambitious by nature than Norway's, since they specify that the capacity should be in operation by the given year and not only awarded.

Norway is behind its peers on progress and has only a fraction of the installed capacity compared to Denmark (2.3 GW), the UK (14 GW), and the Netherlands (4.5 GW). This is despite a strong start on floating offshore wind with the Hywind Tampen (88 MW) project. The two offshore wind tenders Utsira Nord and Sørlige Nordsjø II have both faced delays, with Utsira Nord being postponed awaiting the decision from ESA.[6] The interest in pre-qualification for Sørlige Nordsjø II was low, and many participants are expressing uncertainty as to whether they will end up bidding due to unfavorable business cases.

Hydrogen

Unlike neighboring countries Denmark and Sweden, which respectively have targets of 4-6 GW and 5 GW electrolysis capacity by 2030, Norway currently lacks a quantified ambition for hydrogen production. Other North-European nations are setting ambitious targets as well: Germany and the UK are aiming for 10 GW each, and France for 6.5 GW by 2030, with President Macron recently announcing massive funding for both green, pink,[7] and white[8] hydrogen [13].

The hydrogen industry is less mature than offshore wind, with most countries having a pipeline of projects in the planning phase. While Australia and the Netherlands are leading (with commissioned capacity only at pilot scale), Canada has larger-scale plants both commissioned and under construction. Norway has yet to realize any larger plants; however, several projects are in the development stage, with the 600 MW Aker/Statkraft project in Narvik potentially becoming one of the first large-scale facilities in Europe. The recent deal between Equinor and the German utility RWE, focusing on large-scale export of hydrogen to Germany via pipelines, highlights the potential for Norway to play a significant role also in the blue hydrogen market. Despite growth in Norway's hydrogen industry, there is uncertainty as to the number of projects that will be realized.

With a likely future power deficit, the Norwegian competitive advantage of low power prices is about to diminish. In addition, the Inflation Reduction Act (IRA) in the United States offers highly beneficial incentives for hydrogen producers, attracting companies from all over the world – including Norway.

Carbon capture and storage

Although Norway lacks a quantified ambition when it comes to CCS, targets are likewise rare among comparable countries. The UK is an exception, targeting 20-30 Mt annual carbon capture and storage by 2030. Japan is also highly ambitious on CCS, with a target of 120-240 Mt by 2050.

Norway is currently one of the leaders on CCS, with the oil and gas installations Sleipner and Snøhvit having captured and stored carbon for decades. The Longship project currently under construction plans to store up to 1.5 Mt CO_2 annually, partly from Heidelberg Materials (previously Norcem) (cement production) and Hafslund Oslo Celsio (waste management), with plans to increase the annual rate of storage to 5 Mt. Local players such as Aker Carbon Capture are also pushing this emerging industry, at home and abroad.

Meanwhile, as other countries make headway, Norway's continued leadership in CCS is uncertain. The UK is planning considerable capacity, Denmark just announced €3.6 billion in state aid for CCS, and both Canada and the United States are advancing, with projects at scale in operation and under construction. Both the Heidelberg Materials and Hafslund Oslo Celsio CCS projects have experienced significant cost increases from their initial estimates, and frequent news of delays and uncertainties around project realizations add to this concern.

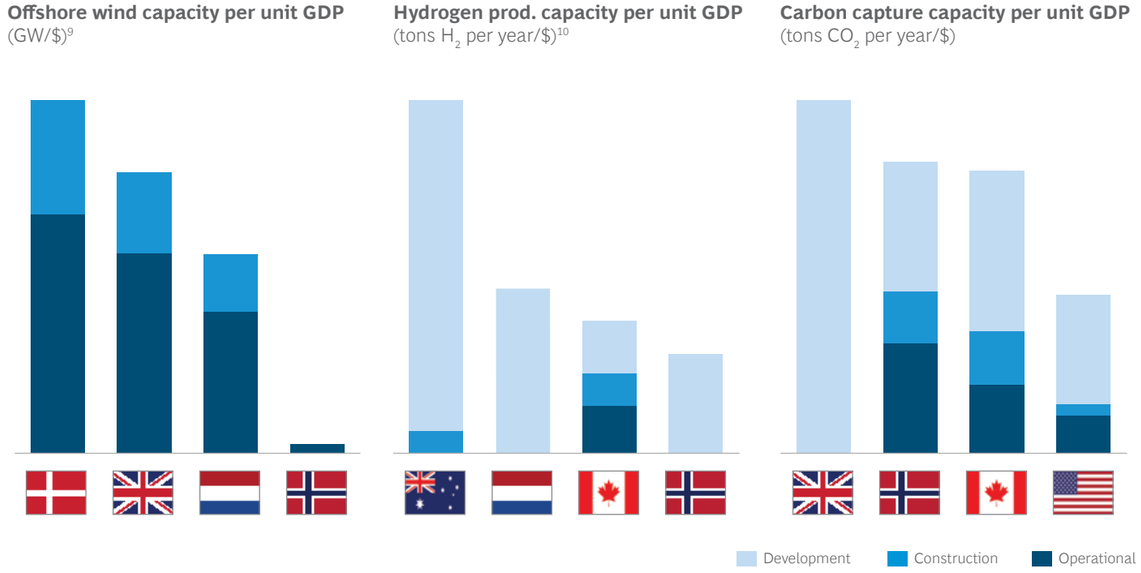
[6] The EFTA Surveillance Authority (ESA) monitors compliance with European Economic Area rules and needs to approve the government support scheme suggested for Utsira Nord.

[7] Hydrogen produced through electrolysis powered by nuclear energy.

[8] Natural formed hydrogen found in geological formations.

Figure 2 | Value chain progress

Value chain progress adjusted for GDP, top three peers shown together with Norway



Source: GlobalData; BCG analysis

[9] Only includes capacity in operation or under construction.

[10] Green and blue hydrogen included.

3

Other countries are surpassing Norway on the competitiveness ranking

Norway has modest targets for creating green value chains and generally lags behind other countries on progress. To better understand why, we have performed a comparison of peer countries to evaluate what Norway is doing well, and what is required to accelerate progress.

3.1. Five dimensions determine competitiveness in the green transition

In 2021, NHO and BCG developed a “temperature gauge” to quantitatively rank selected countries’ competitive positions in the green transition. The purpose of the temperature gauge was to identify and measure sources of competitiveness as a host nation for economic growth related to the green transition, focusing on technology domains that have strong export potential. The results from the study were presented in the report “Norway’s competitiveness in the energy transition” [14]. The same framework, now updated with the most recent data, is used to provide an analysis of competitiveness.

The approach builds on recognized frameworks for measuring national competitiveness from the World Economic Forum [15] and the EU [16], adjusted for the purpose of the green transition. The assessment is based on 30 different indicators categorized into five dimensions, each weighted 20%.

- **Human capital:** Access to relevant competencies, labor, and supply chain
- **Market and capital:** General market conditions and access to capital and demand market
- **Policy framework and incentives:** Political facilitation of legislation, support schemes, and priorities
- **Natural resources and infrastructure:** Local resource availability and access to relevant infrastructure
- **Technology and innovation:** Access to relevant technology, R&D investments, and pace of innovation

For each indicator, each country receives a score based on their performance relative to peers. The indicator scores are either absolute or adjusted to population size or GDP. As an example, the indicator *Share of renewable energy* is absolute, *Employees in green industries* are adjusted to population, and *Investments* and *Subsidies* are adjusted to GDP.

The evaluated countries are the same as in 2021. The European countries were selected among the top quartile of the Environmental Performance Index [17], which assesses environmental sustainability performance in 180 countries. The non-European countries were selected based on their economic scale, population size, EPI rankings, and to provide representation of a total of four continents in the green transition.

3.2. Norway is falling from fourth to seventh position

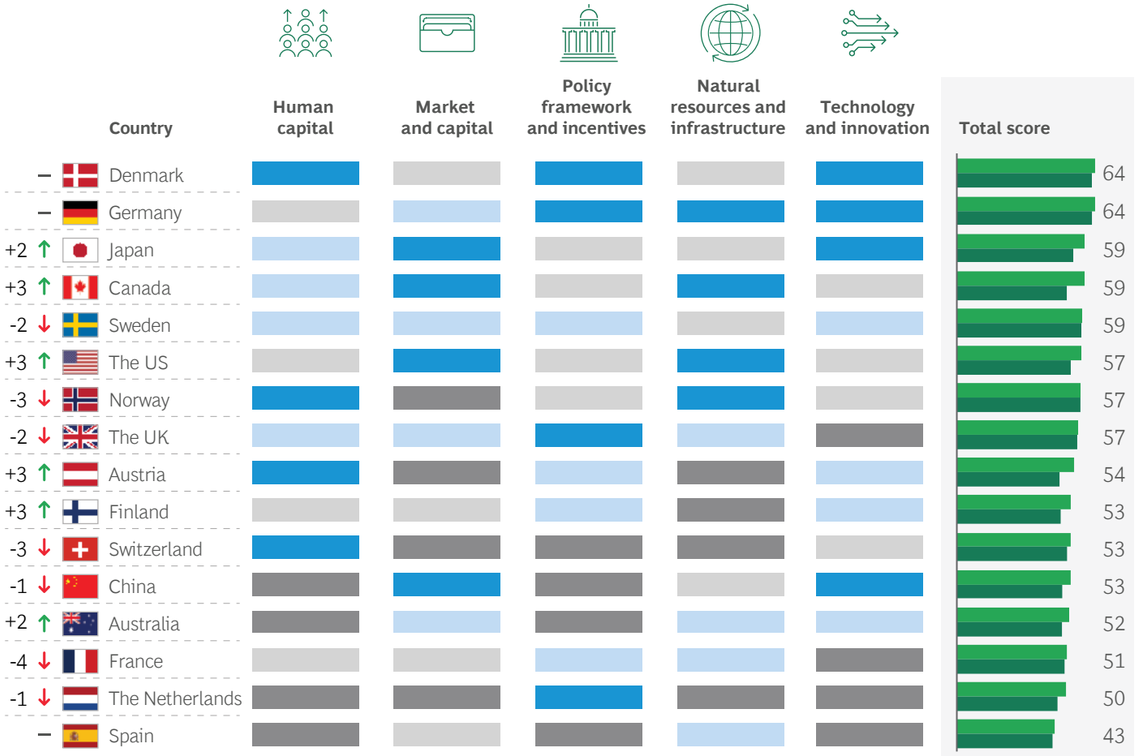
Norway has made several initiatives to advance the green transition. Globally, the country is leading in electric vehicle adoption, with more than 80% of new personal vehicles being fully electric in 2023 (up from 55% in 2020) [18]. The first offshore wind sites are being tendered, with a vast range of areas identified for further buildout. Additionally, the 2023 “Grønt industriløft” identifies nine priority sectors, such as offshore wind, hydrogen, and CCS, and includes nearly 150 measures for value creation across green industries.

Despite the progress Norway has made in recent years, our updated competitive analysis shows that the country has been bypassed by Canada, Japan, and the United States and is currently ranked seventh, three places down from the assessment in 2021 (see Figure 3).

Other nations have achieved key improvements over the past three years:

- **Japan** has submitted the Nationally Determined Contribution with new climate gas reduction targets in 2022, and a CCS Long-Term Roadmap with targets for 2030 and 2050 showing both the industry and the investors the will to drive the green transition.
- **Canada** has increased its ambitions through the 2030 Emissions Reduction Plan, launched in 2022, and recently implemented stronger support mechanisms as a response to the IRA in the United States. Additionally, IRA's incentives for North American value chains has increased the relevance of Canada as a host nation for green industries.
- **The United States’** big move was passing the IRA legislation with increased subsidies for green value chains, along with improved emissions reduction plans, including rejoining the Paris Agreement.
- **Austria** ranks higher from committing to a more ambitious emissions reduction target and thanks to increased spending on environmentally related R&D.
- **Finland** introduced the Climate Act in 2022, followed by increased renewable investments.

Figure 3 | Competitive assessment results



Source: NHO- and BCG analysis

3.3. Norway has been resting on its laurels

In recent years, the *Policy framework and incentives* and *Market and capital* dimensions have become more important. With increased inflation and interest rates, investors are seeing diminishing returns and are more selective when it comes to investments. When favorable policies create profitable business opportunities, global investments naturally gravitate toward the relevant markets. Uncertainty and unfavorable policies are, on the other hand, more readily deterring potential investors.

Taking this into account in a sensitivity analysis[11], we see that Norway is surpassed by the UK, Finland, the Netherlands, France, and Austria, and will then be ranked 12th, underscoring Norway's reduced competitiveness in the green transition.

The sensitivity analysis shows how Norway, which is rich in natural resources, has been a slow adapter to new market conditions. Due to globalization and increased knowledge and technology development, it is no longer enough to only have attractive natural resources, and we see that countries with less beneficial foundations are speeding up. For example, the Netherlands, with limited natural resources but impressive plans and policies, moves up six places in the sensitivity analysis. The country is currently a leading nation in offshore wind (see Section 5.3), much of which is due to the determination and smart policies of the government. This highlights an important lesson: Reliance on natural resources alone is no longer a guarantee of success. Instead, to stay relevant in the green transition, countries must have an impactful strategic plan and facilitate the right initiatives.

3.4. Leading countries have stronger support mechanisms

Norway is being outpaced by peers that are implementing swift and impactful actions in the green transition, particularly in the dimensions of *Policy framework and incentives* and *Market and capital*. For Norway to excel as a host nation for economic growth related to the green transition, learning from successful peers is key, illustrated by the following case examples.

[11] 40% weight to *Policy framework and incentives*, 30% to *Market and capital*, 10% to remaining dimensions.

Case study 1: Denmark among the best in class on public-private collaboration

The Danish Government has set ambitious targets of reducing greenhouse gas emissions by 70% by 2030, compared to 1990 levels, and achieving climate neutrality by 2050. Unlike most countries, the targets are written into law, with the minister for Climate, Energy and Utilities accountable for sufficient progress. If the progress is not adequate, the Danish Parliament can place a vote of no confidence against the minster, making the pledge to reach the targets strong.

To reach the climate targets, Denmark has a clear roadmap with sector specific plans and targets. To ensure sufficient involvement from corporates, the government has formed 14 climate partnerships, each representing a sector of the Danish economy. The partnerships were tasked with crafting a proposal outlining how their respective sectors could contribute to CO_2e reductions while supporting Danish competitiveness, exports, jobs, and welfare. This resulted in more than 400 recommendations from the partnerships to be captured by the government in various policies.

Each partnership is structured differently but is chaired by a representative from a private sector company appointed by the Danish Government, with one or two business organizations serving as secretariats. Typically, the drafting of the recommendations has been an open process involving several companies and organizations from the entire sector [19].

The partnerships have been largely successful. About 80% of the recommendations have been implemented or are in the process of being implemented. The initiative also fostered collaboration and networking across different sectors, leading to new ideas and significant movement up the learning curve.

To ensure progress and feasibility of emissions reductions, Denmark has set a plan for tracking wherein the Danish Energy Agency publishes biannual reports that assess the country's progress and determine if the current pace is sufficient to meet the targets, or if there is a need for additional initiatives. Secondly, new national climate targets are proposed at least every fifth year. The targets must have 10-year perspectives, and the level of ambition needs to point toward the ambitions for 2050.

Case study 2: Germany with strong and targeted support mechanisms

Under the Climate Protection Act, Germany aims to reduce greenhouse gas emissions by 65% by 2030 and to phase out the use of coal in the power sector. To achieve this, the government provides financial support, mostly through the Climate and Transformation Fund. This fund consists largely of carbon pricing revenues and is expected to provide €44 billion in funding in 2024 to drive the energy transition and climate protection [20]. Two key programs funded are Carbon Contracts for Difference and the Renewable Energy Act.

Carbon Contracts for Difference, launched in June 2023, is a funding initiative to decarbonize energy-intensive industries. The program is worth tens of billions of euros and provides financial assistance by covering the difference between the carbon market price and the carbon price needed for making carbon abatement projects profitable. This enables profitability for inherently expensive projects such as green hydrogen production and electrifying industrial heat.

In Germany, the Renewable Energy Act is historically the most important green funding scheme. Since 2000, it has paid renewable power producers the difference between their LCOE and the power market price, totaling over €200 billion so far [21]. This has helped increase the renewable share in Germany's electricity generation mix from 6% in 2000 to more than 50% in 2023. The funding has also been successful in bringing down the cost of renewables through scaling of technologies such as solar PV and wind power. The importance of further increasing the renewable electricity share and electrifying households and industry is even higher now as Germany is currently striving to reduce the reliance on Russian gas in the energy system.

In parallel, the German Government supports green projects through the EU Important Projects of Common European Interest (IPCEI) scheme, which funds transnational projects within the EU. Further, the government has launched a program reducing electricity costs for major power-consuming German companies that compete in global markets.

Case study 3: The United States with incoming investment flows enabled by favorable policies

The United States' Inflation Reduction Act and Infrastructure Investment and Jobs Act are the largest federal investments in climate ever, with a combined USD ~470 billion[12] in new energy and climate funding over the coming decade. The support is provided through either direct subsidies or through transferable tax credits. The IRA also has incentives for local content, meaning that companies leveraging North American supply chains qualify for additional support. This incentivizes companies across supply chains to move operations to North America. A similar support framework is not applicable for Norway due to EU regulations limiting the use of, for example, direct subsidies and local content requirements. However, the IRA is an interesting case study to understand the global race to attract green value chains.

While it is still too early to draw final conclusions as to the impact of the IRA, there are strong indications that this could be a global game changer:

- For industries like battery- and hydrogen production, the cost advantage of the United States when including IRA support is remarkable. Our analysis shows that the levelized cost of battery production from a new battery factory (post-IRA) could be around 30-50% lower than the European median cost. Similarly, producing and shipping green hydrogen to Asia could be 30-40% cheaper than producing the hydrogen in Asia.[13] As a consequence of the support mechanisms, growth in clean technologies in the United States is estimated to increase significantly compared to pre-IRA estimates,[14] seen in Figure 4. Here, both the deployment of green technologies like offshore wind and CCS and the production of EVs and hydrogen is expected to increase significantly.
- Investments in green manufacturing have increased since the IRA went into effect in August 2022. Q2 2023 had five times the investments compared to an average quarter in 2020/2021, with battery manufacturing driving the majority of the growth (seen in Figure 5). This trend is expected to continue, as there is likely to be a delay from the implementation of the IRA to when the majority of investments are made. Also, there has been some uncertainty regarding the practical implementation of the policies, likely leading to a surge in investments once cleared out.
- Several corporates have announced investments in new facilities across the Atlantic Ocean, pointing to the IRA as the most important reason. Examples are battery manufacturers Freyr, Northvolt and Itavolt announcing new factories in North America in 2023. According to the European transport campaign group Transport and Environment, two thirds of Europe's planned battery production pipeline is at risk of being transferred to North America [22]. Another example is the fertilizer manufacturer Yara planning two new factories in the United States due to more favorable incentives and lower energy prices than in Europe.

The commitment and willingness to invest heavily in subsidies for green industries in the United States represents a sharpening of the international race for attracting green value chains. Norway and other countries falling behind in the race risk losing key future industries [23].

3.5. Uncertainty, delays and unfavorable support policies make Norway less attractive

Market attractiveness and capital flow have a great influence on the green transition. The countries and areas with the most beneficial terms and conditions will be most attractive to investors and developers. This is not a question of subsidies and grants alone; rather, it reflects the sum of policies, government funding, and perceived risk. The desire to stay relevant in the development of green value chains was shown when the United States introduced the IRA; the EU (through the Grean Deal Industrial Plan), Canada, Japan, Australia, and the UK all responded with ambitious support mechanisms. This development underscores the intensifying global race to build domestic green value chains. Countries that fail to implement attractive policies risk falling behind those actively working to create appealing market conditions for green investments.

In the current Norwegian landscape, there has been a noticeable hesitation among investors to commit to green energy- and industry projects. Political uncertainty, delays, and general unpredictability are all factors affecting the market and risk perception among investors. Examples include the retroactive resource rent tax on onshore wind, the delays in offshore wind tenders, inadequate hydrogen support and policies, and the lack of clarity in battery subsidies. These elements make Norway less attractive than other countries such as Sweden (onshore wind), the UK (offshore wind), and the United States (hydrogen and batteries). Increasing inflation and interest rates have also made developers more selective with investments, increasingly motivating them to seek lower-risk projects in larger economies.

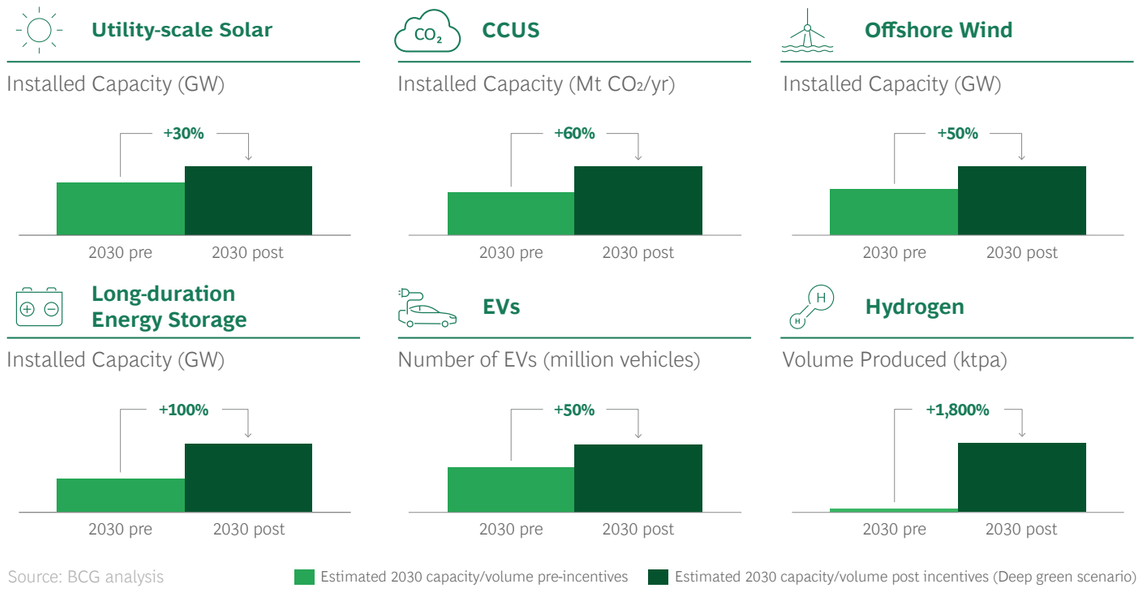
Norway, despite having been surpassed by other nations in the green transition competitiveness analysis, has the capacity to become a European frontrunner. Norway holds a unique financial position with low debt-levels and a substantial sovereign wealth fund. This enables Norway to have a long-term perspective, where a commitment to develop green value chains will pay off in the long run. By channeling resources into renewable energy sources, Norway can maintain its relevance in the global energy mix while fostering job creation, export opportunities, and innovative technological solutions.

[12] Some IRA support mechanisms are uncapped, and the funding can therefore exceed this estimate.

[13] Asia chosen because it is expected to be one of the largest importing regions.

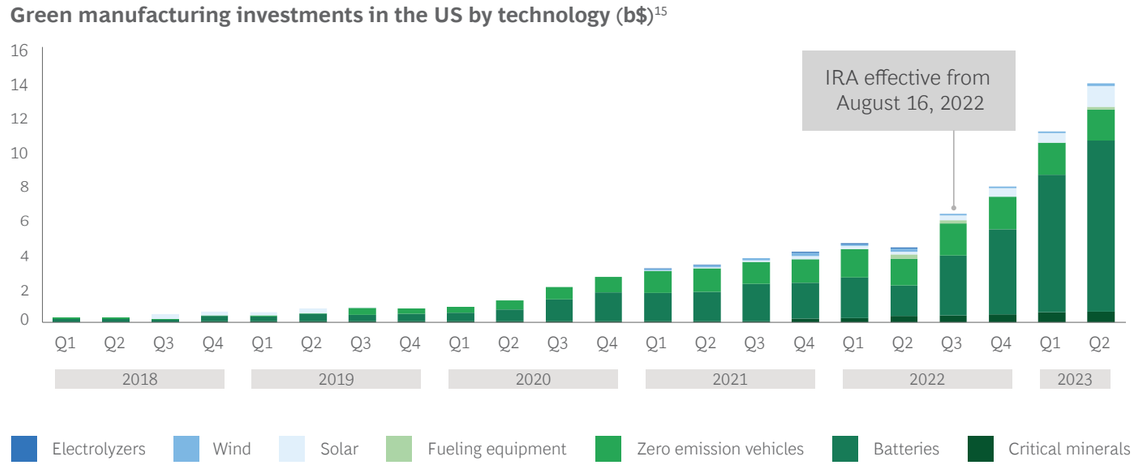
[14] The shown "Deep green scenario" represents a high, but not unrealistic, estimate for the potential impact on value chains from IRA.

Figure 4 | IRA acceleration of clean technology



Source: BCG analysis

Figure 5 | Manufacturing investments in the United States



Source: Clean Investment Monitor catalog; BCG analysis

[15] Chart includes investments in manufacturing not including investments in deployment of the technologies.

4

Norway needs to prioritize a limited number of green value chains

As the previous chapter points out, improving the dimensions *Policy framework and incentives* and *Market and capital* is essential to improve Norway's competitiveness. Establishing a holistic strategy that includes roadmaps for both climate and green value chains is a core part of this, and the leading countries are doing this better than Norway at the moment. The roadmaps must include longer-term targets and concrete short-term milestones and actions for each value chain. Currently, there is strong international competion for attracting investor capital, making reliable policies fundamental. Norway should aim to be a leading country within a limited number of value chains.

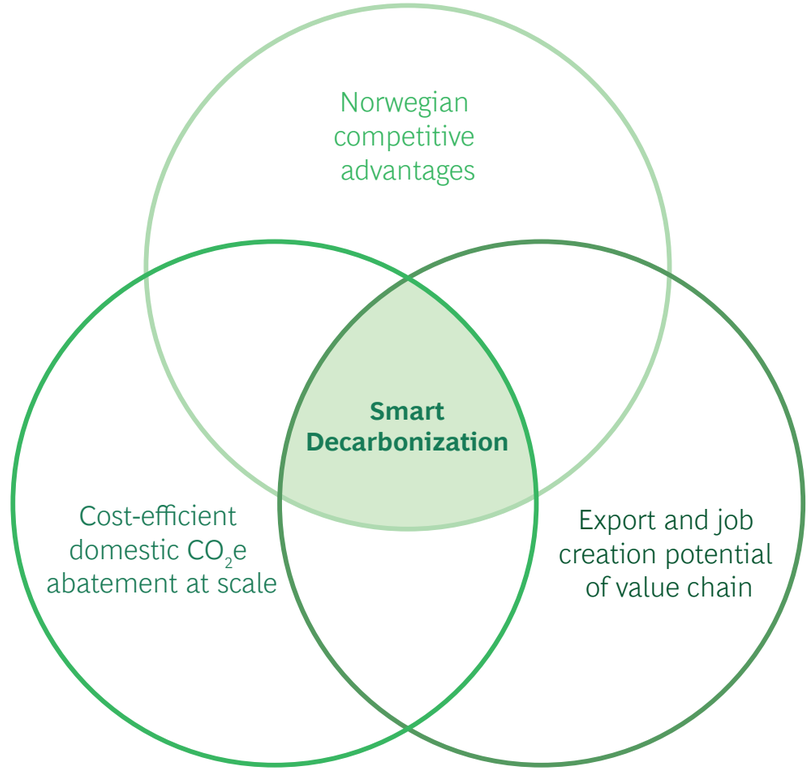
Hence, it is essential to identify which industries should be prioritized. Green value chains can be evaluated using BCG's Smart Decarbonization framework (illustrated in Figure 6), including assessment of each industry in terms of:

- **Cost-efficient domestic CO_2e abatement at scale:** Potential to reduce emissions in Norway in a cost-efficient manner through production of goods or services required in the green transition, including industries serving as key enablers for decarbonization, such as renewable energy production.
- **Norwegian competitive advantages:** Differentiators that Norway has compared to other countries which enable products and services that can compete successfully on international markets.
- **Export and job creation potential:** Value potential of export given size of end market and likely production capacity in Norway. This includes not only the export of end-products, but also – more broadly – the export value of technology, components, and solutions from the value chain.

Norway should focus on industries that lie at the intersection of these three dimensions, as they drive both the emissions abatement required to reach climate targets and can become competitive export industries crucial for future value creation in Norway. The Smart Decarbonization framework is particularly useful for industry and government when working together to identify which value chains should be prioritized for subsidies and public support.

Examples of green value chains relevant to Norway include offshore wind, hydrogen, CCS, batteries, maritime, process industry, smart energy systems, and green minerals, among many others. Applying the Smart Decarbonization framework reveals that some industries stand out as more important for Norway than others. In this perspective we purposely do not present a prioritization across all value chains, but rather use Offshore Wind as an example of one important value chain for Norway, which is explored in depth in the following chapter.

Figure 6 | Green value chains enabling smart decarbonization drive both emission reduction and build competitive export industries



5

Offshore wind could be a new export play for Norway

Offshore wind is a green value chain with high potential for Norway, offering essential support in powering decarbonization initiatives. Norway's unique strengths such as offshore experience and strong wind resources give significant competitive advantages. In addition, there exists considerable potential for new jobs and export value.

5.1. Offshore wind should be prioritized

Offshore wind is one of the best examples of a value chain fulfilling all three dimensions of the *Smart Decarbonization framework:* First, it is a **key enabler for decarbonization** at scale in Norway. Considering the power required for electrification and new industries, DNV expects an electricity consumption around 400 TWh in 2050, up from around 140 TWh today [24]. Offshore wind is currently not the most cost-competitive option; however, it is one of few realistic alternatives for large-scale build-out of renewable power production in the foreseeable future. The combined projected electricity generation only from unexploited hydropower capacity, onshore wind, and solar PV would leave us with a deficit around 150-200 TWh in 2050 to cover domestic power consumption. While these energy sources will play a role to avoid a power deficit in the medium term (2030-2035), offshore wind[16] is one of few options to meet the growing demand towards 2050 [25, 26, 27]. Nuclear power production could become an option towards 2040, but should not (yet) be relied on as a significant contributor to the Norwegian power supply before 2050, due to the uncertainty on development in technology and cost.

Second, Norway has unique **competitive advantages** in offshore wind. Applying the same logic as employed in comparing competitiveness for countries, Norway has a particularly strong position in three out of the five dimensions for offshore wind.

- ***Natural resources and infrastructure:*** Some of the best offshore wind resources in the world are found along the coast, and the deep fjords are perfect for construction and storage of wind turbines.
- ***Human capital:*** The expertise and know-how of workers and the supply chain in the oil and gas industry are well-suited for transitioning into offshore wind.
- ***Technology and innovation:*** Strong research environments benefit from experience developing leading offshore, maritime, and digital technology.

Third, offshore wind holds a **large potential for both export and job creation**. Menon estimates up to 50,000 jobs in 2050 [10], while BCG has previously estimated up to 150,000 jobs if the offshore wind ambition is significantly increased [28]. Few other industries can replace such a large fraction of the current 200,000 jobs in the oil and gas industry. There are three major opportunities for export and job creation in Norway:

1. Establish a (full) value chain, i.e., develop offshore wind farms and build infrastructure for exporting electrons and green molecules (hydrogen and its derivatives) to supply Europe with clean energy.
2. Norwegian yards can construct foundations and other components to supply the rapidly growing floating offshore wind industry in Europe.
3. Norwegian companies can sell engineering and technology on a global scale, as we have seen happening in Denmark and increasingly also in the UK.

5.2. Good progress in recent years, but still a long way to go

Norway has an ambition to award areas for 30 GW offshore wind capacity by 2040. Suitable sites for offshore wind development have been identified by NVE with a technical potential of 300 GW, far exceeding the areas required for 30 GW [2]. The governmental plan includes awarding of the sites through tenders evenly distributed over time.

The tenders for the first two sites, Sørlige Nordsjø II (3.0 GW) and Utsira Nord (1.5 GW) were announced in March 2023, with a planned deadline for submission in August/September. However, Sørlige Nordsjø II has been postponed to February/March 2024 and Utsira Nord has been postponed indefinitely awaiting the ESA decision.

Postponed tenders are not uncommon when a country is awarding offshore wind sites for the first time. More concerning is the fact that participation in the pre-qualification round for Sørlige Nordsjø II was low, with only seven consortia participating. Several of these consortia have also expressed uncertainty as to whether or not they will participate in the final auction round.

There are several reasons for the limited interest in the Sørlige Nordsjø II auction:

- The industry is experiencing its first crisis, with several companies struggling due to sharp cost increases; this is driving the need to prioritize tenders.
- The cap on government support set to NOK 23 billion implies that the two-sided CfD,[17] for which the developers compete, have an implied cap per MWh produced. This level is considered too low by some developers, given the risk profile of the project.
- The decision to prohibit hybrid cables that connect offshore wind farms to both Norway and the European continent in the initial auctions, opting instead for radial cables delivering power exclusively to the Norwegian shore, has proven to be unattractive. Norwegian power prices are generally lower than those in the European continent; moreover, developers are also responsible for costly construction and operation of the offshore grid, which implies both higher risks and costs.

On top of the bumpy start for the two offshore wind auctions, critics have expressed concern that Norway has not opened the offshore wind industry at scale earlier and that the targets are unambitious compared to those of countries such as Germany, the UK, and the Netherlands. As other countries are rapidly accelerating their efforts, Norway risks losing the competitive edge it has in offshore wind.

5.3. Peers can be an inspiration for best practice policies and incentives

To understand how to accelerate the offshore wind industry, learning from other countries could be useful. Comparable North Sea countries including Denmark, the UK, and the Netherlands have established themselves as leaders in offshore wind policies and can serve as inspiration.

[16] The potential for onshore wind is high, but strong local resistance limits the viability of large-scale buildouts.

[17] Contract for Difference: The state provides a guaranteed price for the power produced over a certain period of time (usually 15 years). If the wholesale power price is below the CfD-price, the state pays the difference to the wind farm owner, and if the wholesale price is above the CfD-price, the developer pays the difference to the state. The result is a fixed price for the developer.

Since the early 2000s, **Denmark** has been determined to establish a world-leading offshore wind industry. This effort began with pioneering research on wind turbines in the 1970s and the commissioning of the world's first offshore wind farm, Vindeby, in 1991. To foster the growth of renewable energy, the Danish Government has enacted and consistently updated the "Lov om fremme af vedvarende energi" legislation, with a particular emphasis on offshore wind [29]. This law explicitly details the processes for the development and support of new sites, adapting its models as the sector has evolved. The support mechanisms have shifted over time from fixed-term or volume-based tariffs with the TSO Energinet responsible for the transmission grid to CfD-style auctions offering greater flexibility in energy transmission solutions. The government takes a holistic approach to the industry, including initiatives like developing supply chain clusters (for example, around the Port of Esbjerg, supporting the broader North Sea region), investing in research and talent development (notably at the Danish Technical University, home of the world's largest public wind research institute), establishing a streamlined permitting process, and actively promoting industry growth through its stake in offshore wind pioneer Ørsted. The government has consistently been a frontrunner in establishing the right policies and frameworks for the industry, maintaining close dialogue with industry stakeholders throughout the process.

Considering that **Germany's** maritime area is just about 3% of Norway's, Germany's goals to reach 30 GW installed offshore wind capacity by 2030 and 70 GW installed by 2045 are very ambitious. The clear ambitions and the proven commitment from the government is viewed as highly attractive among developers, since it provides predictability and allows for building local scale of value chains. Also, synergies in operations and maintenance of large wind farms located close to each other offer a cost advantage for developers. The attractivity was reflected when 7 GW of offshore wind capacity was tendered in July 2023 for a total of €12.6 billion paid by developers to the state. This was a new price record for Germany, and a big surprise to many. An industry requiring large subsidies only a couple of years ago now yielded high income to the state from the lease of offshore sites that could be leveraged in grid development and maritime biodiversity protection [30].

The UK has set a clear and ambitious target to install 50 GW offshore wind capacity by 2030, up from 14 GW in operation today [31]. The target is aligned across the main political parties, and there is a clear political will to reach the target, even though the timeline for delivery is narrowing. The UK has been an early mover in encouraging renewable energy production, through CfDs and annual auctions. However, in Allocation Round 5 (AR5) fall of 2023, the maximum achievable CfD price was set too low, resulting in an auction without offshore wind bidders. The government took responsive action and increased the maximum price for Allocation Round 6 by 66% in spring 2024 compared to AR5, applauded by the developers for its determination. The UK has also experienced delays related to grid development and connections. In July 2023, the government published a recommendation to map out a centralized strategic plan for transmission network, including considering multipurpose interconnectors, i.e., electrical cables both connecting offshore wind farms and acting as interconnectors between countries [32].

The Netherlands views offshore wind energy as one of the most important pillars in its climate policy [33]. The country achieved its 2023 goal of 4.5 GW operational offshore wind capacity and has almost doubled the target for 2030/2031 to 21 GW installed capacity; this will cover about 75% of its current electricity needs [34]. The pathway toward 2050 has been defined, and the "Offshore wind energy roadmap" concretizes this plan, including designated sites and estimated timelines [35]. The roadmap looks 10 years ahead, is updated regularly, and offers clarity and predictability for developers. The Netherlands Enterprise Agency is responsible for surveys, selection of wind farm sites, and more, ensuring a one-stop shop for auctions and permits. TenneT, the state-owned TSO, is responsible for developing and operating the offshore grid [36]. All new offshore windfarms are connected to this grid, contributing to a substantial risk and cost reduction for offshore wind developers. Going forward, combining offshore wind energy offtake with hydrogen production and other innovative solutions will have more focus, reflecting the holistic thinking on the green transition and offshore wind as a key part of it.

Norway can be a digital winner in wind

Artificial intelligence (AI), once limited to niche applications, has now gained widespread adoption across several industries. New digital solutions utilizing data for learning and decision support will significantly shape green industries, including the offshore wind sector.

Norway has a strong industrial research community, including both universities and research institutes. Many successful technology spin-outs have emerged from this community. In addition Norway has a growing start-up scene, and new companies are now targeting the offshore wind industry.

Nurturing the research and start-up communities can enable large cost reductions for the offshore wind industry, reducing the need for governmental support in the longer term. New technology companies can also enable exports where Norwegian software services are sold to global offshore wind players. A concrete example is the use of AI tools to optimize operations and maintenance (O&M) of offshore wind farms. Optimizing O&M is complex and requires balancing a vast range of parameters, such as:

- Cost of maintenance (vessels, fuel, spare parts, crew)
- Power generation (uptime of turbines, wake effects, lifetime extension)
- Revenue (trading, ancillary services, offtake options)
- Safety and compliance (technician safety, grid and environmental compliance)

Examples of key operational questions are:

- Are the turbines producing at their optimal potential?
- What level of forecasted production should be reported to the grid operator?
- When is the optimal time to dispatch a repair team?
- Should five service vessels be in operation, or is four enough?
- What is the optimal stock of spare parts?

These problems are far too complex for humans to solve perfectly, and doing it optimally requires digital tools. Optimizing O&M has high potential, and we have seen improvement potentials worth several billion NOK across portfolios of offshore wind farm owners. Taking it one step further, the optimization can, in addition, include the design and construction of wind farms. Performing an end-to-end optimization for the full lifetime of projects has great value that the industry has just started unlocking.

Optimizing commercial operations is an increasingly important part of optimal O&M. As the offshore wind penetration in the European power system is increasing, wind farm owners must deal with higher power price fluctuations and the risk of "cannibalization" – when power prices are low whenever wind conditions are good due to high generation output from multiple wind farms. Developers are therefore working on measures to hedge risk through trading while also optimizing the system integration through, for example, building facilities to produce green hydrogen when power prices are low. Combined with increasingly interconnected grid structures, with the potential for hybrid cables and planned energy islands in the North Sea, the complexity of commercial operations is increasing. Examples of key questions wind farm owners face:

- Should power be sold on long-term power purchase agreements or in the merchant market?
- How can balancing cost be minimized?
- Should the wind farm participate in the ancillary service market, or only in the wholesale market?
- Should power the next day be sold on the market, or used to produce green hydrogen?

These questions are complex, and applying AI and optimization tools to solve them will be critical both for the profitability of the industry and the balance of the power system.

6

Our recommended actions for Norway's green transition

Reaching Norway's climate targets and accelerating growth of green value chains requires immediate actions from multiple stakeholders. Government, corporates, and the general public are all important in this effort, each with distinct responsibilities.

Actions for accelerating green value chains and reaching climate targets are presented in the section below, followed by more concrete recommendation for the government to succeed with the offshore wind value chain. As described in Chapter 5, offshore wind has high potential, and is here serving as an example on how actions can be formulated for a prioritized value chain. Similar recommendations could be made for other value chains, such as hydrogen and CCS, in future outlooks.

6.1 Key actions for government, corporates and the general public

Government must create a holistic plan and act boldly

1. Develop a holistic strategy covering both green value chains and climate, featuring long-term targets supported by specific short-term milestones. Estimated impacts on emissions reduction from developing the green value chains should be quantified, and progress should be tracked. Climate targets should be legally binding and established through broad political agreements, with active participation from industries crucial to emissions reduction.

2. Ensure policy framework that is sufficiently appealing for prioritized value chains to attract private investments. Be ready to quickly adapt the framework to secure progress if developers are hesitating. Support mechanisms should be flexible enough to adjust if external factors, such as inflation, interfere with the achievement of targets. Taxes on emissions should be coordinated with support mechanisms to ensure that reducing emissions is profitable for companies, while maintaining overall policy competitiveness compared to other countries. Provide regulatory predictability and avoid retroactive taxes on successful green value chains.

3. Build required infrastructure at scale, with power generation and the on- and offshore grid as the first priority. Energy efficiency and development of hydropower, onshore wind and solar PV will be important to mitigate medium-term power deficits, while offshore wind is a realistic alternative to significantly increase power production beyond 2030. Secure sufficient funding for government entities to shorten concession processes and policy development for both grid and power generation.

Corporates should seek industry collaboration and local involvement

4. Collaborate with government, suppliers, and across value chains to shape the growing industries holistically. Ensure equitable distribution of profits in supply chains and work together to avoid bottlenecks. Apply a well-considered logic for establishing local supply chain clusters, balancing resilience with cost, quality and robustness of alternative international vendors.

5. Involve local stakeholders (e.g., residents, indigenous people and environmentalists) early in plans for building power generation, grid, and industry. Ensure that benefits are captured locally through jobs and other value creation, and that impact on nature is limited as much as possible.

6. Build capabilities and invest in R&D to develop technologies and solutions that will enhance the business case over the long term. Train the next generation of blue-collar workers for jobs in green value chains and upskill existing workers in the oil and gas industry.

Government and the industry alike must communicate the urgency to the general public

7. Acknowledge the importance of the two-fold mission of building green value chains and reaching climate targets. It implies both enabling the future green jobs and welfare of the Norwegian people, and securing an inhabitable earth for future generations.

8. Emphasize that subsidies and government support will be needed in the short-term to establish the new value chains, but that these investments will be profitable for the Norwegian society long-term.

9. Clearly communicate the rationale behind developing a portfolio of green projects, acknowledging that while most will succeed, others may not progress as expected. It is important to learn also from less successful ventures to proceed forward. Given the urgency of accelerating green value chains and meeting climate targets, inaction is costly. Individual projects that do not succeed should not halt overall progress.

6.2 Seven specific actions to win in offshore wind

Complementary to our suggested actions for accelerating green value chains and reaching climate targets, we have some specific recommendations for the government to succeed with the offshore wind value chain.

1. **Clear and ambitious targets** must be aligned across political lines to enable proactive and supportive governance over time. To ensure actions are taken, both short-term (2030) and long-term (2050), ambitions must be articulated, as seen in the UK and the Netherlands. Norway should substantially raise its 2040-ambition to become a leading offshore wind nation. This would replace jobs in the oil- and gas industry, increase the attractivity for large-scale establishment of supply chains and enable larger synergies for developers [28].

2. **Clear plan and roadmap** with a 10-year horizon should include plans for areas, projects size, and tenders. Examples are the roadmap in the Netherlands, which is updated regularly [35], the annual Allocation Rounds in the UK, and Germany's development plans for hitting 30 GW installed offshore wind capacity by 2030 [37]. This will improve predictability, making investments in supply chains bankable, and allowing developers to factor in synergies from future projects into business cases. Having a transparent string of projects allowing for large-scale development of multiple projects in parallel, will also enable standardization and faster progress along the learning curve, which will reduce the LCOE.

3. **Transparent and efficient auctions** will make the bidding process easier, and less time and cost consuming for developers. A balance between price and qualitative criteria such as system integration, innovation, emissions, biodiversity and local supply chains should be attained. Wind Europe suggests that such qualitative criteria should complement, but not duplicate existing policy instruments, and that there should not be added administrative cost from such criteria [38]. A one-stop-shop to assign concessions will speed up the development process and accelerate the commercial operation date.

4. **Sufficient subsidies** in the form of indexed CfDs are most viable and set the right frames based on estimated cost- and revenue potential, while reducing the risk for developers. Right ceiling price levels are needed to balance the risk for developers with sufficient upside potential. If the ceiling price is set too low, quick turnarounds - like what the UK did after AR5 - are necessary to avoid delays [32].

5. **Grid infrastructure** is key in developing and connecting new wind farms. Coordinated grid planning across wind farm sites has the potential to reduce the total cost of grid development by exploiting synergies. From a developer perspective, central grid infrastructure – developed, operated, and owned by a TSO – can reduce both cost and risk. Norway should consider hybrid cables serving as interconnectors to the UK or the European continent, as this could reduce the need for subsidies by improving business cases for developers. In addition, onshore grid infrastructure needs to be planned and expanded as part of a holistic plan to avoid unnecessary delays in offshore development.

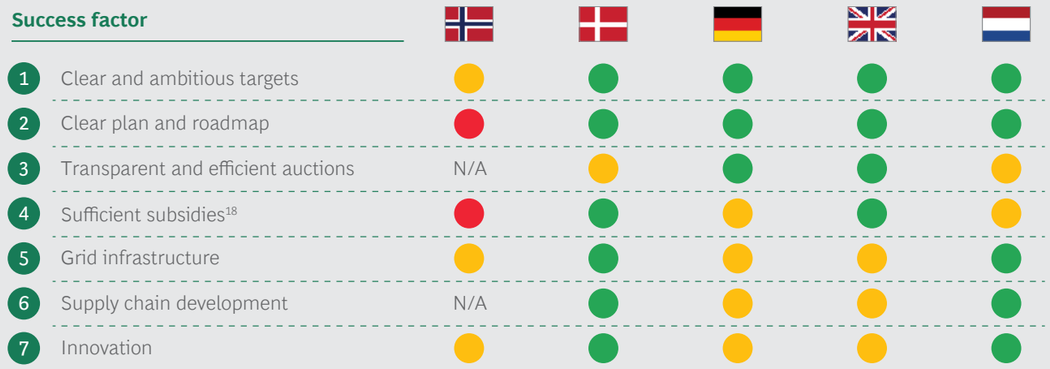
6. **Supply chain development** should be balanced between localization of ecosystems, security of supply, quality, speed and price. For Norway, green steel from Sweden could be used for foundations and turbine towers, turbines could be sourced from Denmark, and vessels and floater foundations could be built in Norway. Denmark is an example of a country that is good at building local industry ecosystems to increase synergies and reduce costs. Norway should ensure that its infrastructure, such as ports and yards, will enable efficient buildout of offshore wind farm supply chains, including assembly of the offshore wind turbine. Note, however, that excessive focus on local content in less mature markets may increase costs for developers [39].

7. **Innovation** and new solutions are important when developing a new industry. Three main topics emerge as areas for innovation: physical solutions to enable offshore wind; digital solutions to improve costs and revenue during development, construction, and operation; and offtake solutions for best use of the power produced. The government should utilize universities and research institutes to ensure the ability to foster industrial research and spin-out companies in parallel with industry development. This approach is key to succeed faster and create value and should take advantage of the strong Norwegian activity in the EU research framework programme. This could be achieved both through the establishment of research centers dedicated to relevant topics, and by being nudged through tender requirements. As an example, the Netherlands Enterprise Agency (RVO) communicated that it would include criteria for innovation and impact from both system integration and nature inclusion initiatives for the IJmuiden Ver tenders. The Netherlands has fostered an environment with strong research institutions and several start-ups, and the auction format encourages collaboration directly with developers.

Figure 7 | Current status of Norway and peers across recommendations

To better understand Norway's current status within offshore wind, it is relevant to compare the implementation of key success factors with peer countries. The following analysis examines the frameworks for offshore wind growth for Norway and peers across the seven recommendations previously described.

This comparison shows that Norway is generally behind the leading countries in most dimensions, emphasizing the need to accelerate efforts to take a leading position in the offshore wind race.



Source: Expert interviews; BCG analysis

[18] Currently announced support schemes, including raised CfD price cap in the UK.

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