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BUBBLE BURST:

WHY NORWAY'S BLUE HYDROGEN FANTASY IS OVER BEFORE IT STARTED

Norwegian companies and politicians have peddled fantastical expectations for European hydrogen demand to justify new fossil gas fields in the Arctic. This report makes the case that these plans are nothing more than wishful thinking. Not only will European demand for hydrogen be lower than Norwegian expectations, but hydrogen made from gas using carbon capture (blue hydrogen) will fail Europe's climate policies and be more expensive than hydrogen produced with renewable energy (green hydrogen). As green hydrogen costs dramatically decrease and the set of practical uses for hydrogen narrows, the window for blue hydrogen as a so-called bridge to green is closing faster than blue hydrogen projects can be built.

The cancellation of two of Norway's proposed blue hydrogen projects in September 2024 has truly burst the blue hydrogen bubble. The projects do not have a future because blue hydrogen is too expensive and dirty for Europe's needs. This briefing shows that the failure of blue hydrogen projects is no surprise. Norway's blue hydrogen plans are nothing more than a fantasy designed to excuse a push for more fossil fuel exploration.

Norway should stop dreaming of blue hydrogen as a lifeline to its declining fossil gas industry and instead plan now for the inevitable transition away from fossil fuels.

NORWAY'S BLUE HYDROGEN FANTASY

Germany and Norway signed a joint statement in January 2023 announcing their intention "to ensure a large-scale supply of hydrogen with the necessary infrastructure from Norway to Germany by 2030." This led the two countries to conduct a joint feasibility study for a hydrogen value chain, including a hydrogen pipeline to be operated by Gassco (the Norwegian state enterprise in charge of gas and now hydrogen transport from Norway to Europe). At the same meeting, Norway's majority state-owned energy company, Equinor, signed a memorandum of understanding for hydrogen supply with German electricity supplier RWE. RWE planned to import Equinor's hydrogen through a pipeline to "hydrogen-ready" gas power plants in Germany that will "gradually" switch to hydrogen. Despite the optimistic rhetoric, this project has now been shelved – with Equinor noting the lack of a market for blue hydrogen – and Gassco have confirmed that they have ended their work on a hydrogen pipeline from Norway to Germany. This hydrogen pipeline from Norway was earlier included in the EU's projects of common and mutual interest (PCI/PMI), a list of important cross-border infrastructure, giving it access to a broader range of public financial support. In December 2023, Equinor also signed a letter of intent with German gas company SEFE, which intends to become "a long-term off-taker of giga-scale, low-carbon hydrogen" from Equinor's projects on the continent and in Norway (which are now cancelled).

Using blue hydrogen to meet European demand is strongly supported by both government and opposition parties in Norway. The Norwegian government actively pushed for world leaders to commit to a transition away from fossil fuels at the 2023 UN climate summit (COP28) in Dubai. However, after securing the agreement, Labour Party Prime Minister Jonas Gahr Støre rejected the call for Norway to make a plan for a transition away from oil and gas, saying that "Norwegian gas, with capture and storage of CO_2, can be a very important factor of production for hydrogen, which itself is important for European industry."

Norway is already Europe's most aggressive oil and gas explorer and one of five countries responsible for over half of all planned expansion of oil and gas from new fields from now until 2050. But with gas demand declining in Europe (the primary market for Norwegian gas), blue hydrogen is increasingly used as a reason to justify continuing gas exploration. In a parliamentary question in May 2024, the Conservative Party's Nikolai Astrup said that German politicians had asked Norwegian parliamentarians on a recent trip to Germany for more gas for "scaling [up] the hydrogen economy." Astrup demanded a "more offensive exploration policy" to keep gas production high for blue hydrogen. This would mean expanding exploration in the Barents Sea in the Arctic.

In the same question, Astrup made a claim (not disputed by the Energy Minister) that the government has a goal of 10% of Norwegian fossil gas production going to blue hydrogen for sale to Germany by 2030. Equinor and Shell set targets for projects that together would produce nearly 3 million tonnes (Mt) of blue hydrogen in Norway by 2040. However, both of these projects have been shelved.

Germany's hydrogen strategy targets more than double its current demand for hydrogen (and hydrogen derivatives like ammonia) by 2030 (up to 3.9 Mt), 50 to 70% of which will be imported. The strategy calls for a nearly sevenfold increase from current levels by 2045.

The EU aims for 10 Mt of green hydrogen production plus 10 Mt of green hydrogen imports by 2030. In comparison, existing hydrogen demand in Europe was 7.44 Mt in 2022. As in the rest of the world, European hydrogen production currently comes almost entirely from fossil fuels without carbon capture. While hydrogen today is mainly used for refining oil and producing ammonia, European countries see hydrogen as having a future role in decarbonising industrial processes, in heavy-duty areas of transport, and in other cases where electrification is difficult.

THE REALITY: NO FUTURE FOR NORWEGIAN BLUE HYDROGEN

Non-binding joint statements, vague production forecasts, and far-off future targets are easy to make, but the reality is that no progress has been made on any Norwegian blue hydrogen project. The two most prominent project proposals have been shelved. In September 2024, Equinor and RWE cancelled their cooperation around blue hydrogen before it got beyond early planning, with Equinor admitting that neither the policy framework nor market for blue hydrogen were in place. Just days later, Shell announced that it would not proceed with its project, stating that "the market for blue hydrogen is not there, nor are there any signs that the market is on its way to maturing. Green hydrogen is clearly favoured." These cancellations expose the fundamental flaw behind Norway's blue hydrogen fantasy – the lack of demand for blue hydrogen in Europe.

Norway's hopes for blue hydrogen are undermined by three fundamental facts:

1) **European policies prioritise green hydrogen because it produces lower emissions.**
2) **Green hydrogen costs are declining.**
3) **European hydrogen demand has been exaggerated, as even green hydrogen only makes sense for a limited set of uses where direct electrification with renewables is currently unavailable.**

EUROPEAN POLICIES PRIORITISE GREEN HYDROGEN

EU policies express a clear preference for producing hydrogen from renewable energy (green hydrogen). While blue hydrogen has been presented as a potential "bridge" to green, the reality is that multi-billion dollar blue hydrogen projects take years to plan, finance, and build and would require a secure market for decades to make a return on investment. No Norwegian blue hydrogen project has yet broken ground, and as the 2030s approach, the window for any blue hydrogen project to supply the EU is closing.

As Norwegian Energy Minister Terje Aasland told the Norwegian parliament in May 2024, "The premise [for future blue hydrogen exports] is that there are long-term contracts, and that is also something that Germany has to give explicit expression for through their desire to use blue hydrogen as the basis for the hydrogen economy." But European climate policies clearly prioritise green hydrogen, both directly in hydrogen policy and through climate policies that will rapidly increase carbon costs.

The Norway-Germany hydrogen cooperation agreement itself describes blue hydrogen as only relevant for a "transition period" and commits to increasing renewables to produce green hydrogen. At the same time, the EU has only set targets for green hydrogen and the EU's hydrogen strategy says that "the priority for the EU is to develop renewable hydrogen."

Although the strategy adds that "in the short and medium term," other forms of "low-carbon" (including blue) hydrogen may be needed, this is "primarily to reduce emissions from existing hydrogen production [which generally uses gas with no CCS] and support the parallel and future uptake of renewable hydrogen." It also warns that support for non-green hydrogen in a transitional period "should not lead to stranded assets." As Hydrogen Europe notes, green hydrogen is "eligible for compliance with all sustainability targets put in place by the [EU] Green Deal," while other types of hydrogen "do not enjoy any explicit targets."

EU subsidies and the Emissions Trading System favour green hydrogen

EU and German hydrogen subsidies are almost entirely reserved for green hydrogen. The EU Renewable Energy Directive (2021) sets a legally binding target that EU states "shall ensure" that at least 50% of hydrogen for final energy and non-energy purposes must come from renewables by 2030. Since most hydrogen is produced today with fossil fuels, this leaves little room for new fossil-based projects, including blue hydrogen. In Germany, the National Hydrogen Strategy "restricts direct financial support to the production of green hydrogen," though funding of other low-carbon (that is, not just blue) hydrogen "is also possible" on the demand side with strict emissions standards.

The EU's Emissions Trading System (ETS) will compound blue hydrogen's cost disadvantage. Rising carbon prices will make blue hydrogen less viable and green hydrogen more attractive year-on-year over the coming decade. This will shorten and ultimately close any window in which blue hydrogen could realistically serve as a transition to green hydrogen.

The ETS sets caps, which decrease every year, for trading emissions credits in the EU, Iceland, Liechtenstein, and Norway. The ETS already covers power, heavy industry, and civil aviation and is being extended to other sectors. On its current trajectory, the emissions cap will reach zero by 2039. By this point, there will be very little room for emissions from blue hydrogen, even in the unlikely event that CCS reaches historically high rates of carbon captured and stored (more below). Crucially, the emissions cap will decrease every year, pushing carbon costs up, therefore making blue hydrogen more expensive and green hydrogen more competitive. As development timelines for a blue hydrogen project are likely several years (see below), and no Norwegian project has yet to break ground, it is highly unlikely that any project could make a return on investment in the short window between starting operations and 2039.

GREEN HYDROGEN COSTS ARE DECLINING

While EU policy squeezes blue hydrogen from one side, market forces are closing in from another. In 2022, BloombergNEF's global head of strategy warned of the implications for fossil gas producers planning hydrogen production. He said blue hydrogen projects could become "white elephants" and that "producers of natural gas that may be hoping for conversion to hydrogen to give their assets continual life really need to think again."

In BloombergNEF's 2023 levelised cost of hydrogen analysis (estimating the total costs for the full lifecycle of hydrogen production), green hydrogen outcompetes blue hydrogen by the early 2030s in all 28 markets analysed.[a] For Germany, this is true regardless of whether the electrolysers (which split hydrogen and oxygen in water using electricity to produce green hydrogen) are cheaper Chinese models or more expensive Western ones. Regarding ammonia (a derivative produced from hydrogen), BloombergNEF predicts that green ammonia could overtake blue ammonia from 2030 because "global policy support is stronger."[b]

a Adithya Bhashyam, "2023 Hydrogen Levelized Cost Update," BloombergNEF, July 10, 2023, Subscription Only.
b Adithya Bhashyam, "Ammonia Supply Outlook 2024: A Clean Takeover," BloombergNEF, August 8, 2024, Subscription Only.

While electrolyser costs are falling rapidly, gas prices are vulnerable to conflict, weather, and other factors, creating instability for blue hydrogen. This is why the think-tank Agora Energiewende concludes that a blue hydrogen-dependent scenario "currently adds a significant risk to Europe's future energy security." Rethink Energy has predicted that green hydrogen will be "the only colour left in play" globally after 2039 because of future high gas costs. In addition, blue hydrogen costs are affected by CCS costs, which have not fallen over time and are often underestimated (see more below).

A peer-reviewed article from January 2024 highlights the role of both policy and gas prices in limiting the window for blue hydrogen to compete with green. The paper explains that "a pure cost perspective suggests a limited competitiveness window" for blue hydrogen. Even this conclusion is only possible with very high carbon capture rates of at least 93%, which have never been achieved. The researchers conclude that if EU climate ambition is "translated into stringent CO_2 pricing schemes or equivalent regulation" as expected, "this would not only immediately close the competitiveness window for higher-emissions blue hydrogen, but narrow the window of any bridging technology." Germany's 2045 climate neutrality target specifically "might not leave time for even a low-emission blue hydrogen bridge."

Blue hydrogen projects take too long to build

The Global CCS Institute notes that CCS projects often take longer than six years to be realised. A Norwegian blue hydrogen project supplying Europe would not only have to build the plant that converts fossil gas to hydrogen, the CO_2 capture facility to capture the carbon from that process, and the CO_2 pipeline to take the CO_2 to storage, but would also require a hydrogen pipeline. None of this exists today. As Agora Energiewende notes, the lack of CCS infrastructure in place today means blue hydrogen "will not be available in the short-term."

EUROPEAN HYDROGEN DEMAND HAS BEEN EXAGGERATED

European hydrogen targets have been criticised for overestimating demand. As more scrutiny has been applied to assessing the use cases for hydrogen (whether green or not), it has become apparent that these are limited to just a few sectors where electrification or other alternatives are not more practical. Much smaller amounts of green hydrogen produced close to demand centres can meet realistic estimates for hydrogen demand. This severely undermines the case for blue hydrogen exports from Norway.

Fatih Birol, head of the International Energy Agency (IEA), said at the start of 2024 that Germany's and others' hydrogen plans would have "very high" costs, and it was "completely unclear" where demand would come. He noted that only 7% of global hydrogen projects will likely be finished by 2030. For Birol, "current overblown expectations could distract from the fact that there are more important problems to solve."

European hydrogen ambitions are already being scaled back. The EU Court of Auditors, which audits EU finances, concluded in a highly critical report in July 2024 that the EU's targets for green hydrogen were "driven by political will rather than… robust analyses" and needed a "reality check." The targets for 10 Mt production and 10 Mt imports are not legally binding and were partly based on existing hydrogen demand. Existing hydrogen mostly goes to fossil fuel-related activities (like oil refining) and fertiliser production, both of which have to be significantly reduced. Therefore, existing hydrogen demand is a poor guide for real future green hydrogen needs.

Many proposed hydrogen projects are already stalling. The EU has delayed tenders for several years for its Hydrogen Backbone scheme (for coordinating cross-border hydrogen infrastructure), which massively underestimated costs because of major uncertainties. Germany's planned hydrogen pipeline network has been delayed until 2037. In June 2024, the result of the German H2Global Foundation's first auctions for projects that could provide hydrogen imports ended with just one winner: a project to supply green ammonia.

Realistic, limited forecasts show domestic production can meet most of the EU and Germany's hydrogen demand. In April 2024, BloombergNEF[c] projected only 4 Mt of "low-carbon" hydrogen supply in Europe by 2030. Transport and Environment and Agora Energiewende also show that domestic production with little or no imports can better meet a smaller, more realistic forecast of Europe's hydrogen needs. For Germany, BloombergNEF[d] shows that additional demand would have to emerge to justify any imports on top of projections for green hydrogen production.

Hydrogen hype is increasingly being questioned globally. According to BloombergNEF's 2024 supply outlook, only 30% of the announced supply for commissioning by 2030 will likely be built. Similarly, the Boston Consulting Group found in September 2023 that only 0.2% of the volume of 1,300 proposed hydrogen deals had reached final investment decision (FID) or started operating. Several companies have already downgraded their hydrogen expectations. Blue hydrogen, in particular, has struggled in recent years. In its 2023 review, Hydrogen Insight concluded that "blue hydrogen seems to be very much a second-best option being trumpeted only by those with vested interests in fossil fuels."

The primary reason projections of hydrogen demand are being revised downward is that direct electrification with renewables is almost always cheaper, more efficient, and better for the climate. While hydrogen has developed slower than expected, electrification with renewables and battery technology improvements in batteries have only accelerated.

Hydrogen's low energy density not only makes it a poor substitute for fossil fuels compared to electricity but also means that transporting hydrogen is inefficient and expensive. Even in the limited cases where hydrogen makes sense, reducing consumption and supporting a more circular economy can further reduce hydrogen demand. The alternatives to hydrogen are outlined in the box below.

c "Hydrogen Supply Outlook 2024: Regional deep dives," BloombergNEF, May 23, 2024, Subscription Only.
d Ibid

INEFFICIENT CARRIER: WHY HYDROGEN DEMAND FORECASTS ARE BEING REVISED DOWN

Transport: Battery vehicles are over three times more efficient than hydrogen fuel cell cars, while hydrogen fuel cell trucks need double the capital costs and triple the running costs of battery electric trucks. Electrification is also the future of rail travel. Only long-distance shipping and aviation have a case for hydrogen (or hydrogen derivatives like ammonia, e-fuels, or methanol). Here, too, demand reduction, efficiency improvements, improved batteries, and other new technologies will reduce hydrogen demand further. Long-distance shipping will also be reduced because, as energy strategist Michael Barnard points out, 40% of bulk shipping today is for transporting fossil fuels that must be phased out.

Heating Buildings: 54 independent studies found that there will "be no significant role for hydrogen in heating." Powering boilers with green hydrogen would need six times the renewable energy used for heat pumps, while blue hydrogen would take at least 40% more gas than using gas directly for heating. Heat pumps are four times more efficient than using electricity to produce, compress, and transport hydrogen.

Industrial Heat: Industry is one of the areas where hydrogen is most heavily pushed, but, even here, electricity can meet 78% of industrial heating demand with existing technologies and as much as 99% with technology in development. This would be far more efficient than using electricity to produce, compress, and transport hydrogen, as well as eliminating the third of industrial energy lost between final energy (energy received) and useful energy (energy actually needed for a specific use).

For steel production, alternatives to fossil fuel and hydrogen use include using more scrap processed with electric arc furnaces. Within cement production, beyond using alternative materials to reduce demand, the 32% of emissions that are not related to process emissions (that currently can only be reduced using CCS) can be avoided through electrification. As Michael Barnard shows, blue hydrogen compares poorly to electricity for high-temperature heating. Blue hydrogen is at least double the cost of fossil fuels per unit of thermal energy, because 45% of the energy from fossil gas is lost in producing hydrogen.

Grid Balancing: Rapid development of batteries and pumped hydropower mean hydrogen has a very limited role in long-duration grid balancing (storing energy as hydrogen for seasons when solar and wind energy produce less). Just 1% of the global technical potential for pumped hydro storage would be needed to transition to a world with 100% renewable energy. Hydrogen also has no role in direct power generation. Hydrogen and synthetic fuels made with hydrogen could be up to six times more expensive than fossil fuels.

Fertiliser Production: The use of fertilisers produced with ammonia (a derivative of hydrogen) needs to be reduced going forward by better crop management and reduced food waste to tackle the extremely high costs of nitrogen pollution from intensive fertilisation (including high nitrate levels in water, eutrophication, soil depletion, and highly potent nitrogen oxide emissions). The EU Farm to Fork Strategy aims to reduce fertiliser use by at least 20% by 2030. This reduces future hydrogen demand yet further.

Transporting Hydrogen is Challenging
Transporting hydrogen, or its derivatives, over long distances is difficult, dangerous, and expensive, which is why around 85% of the hydrogen produced today "never leaves the compound on which it is made, let alone cross[es] an international border," and is produced "in the quantities required just-in-time for the process."

Transport and storage of hydrogen are space and energy-intensive. Hydrogen is diffuse, easily leaked, and not liquid at room temperature, meaning equipment needed to produce and move hydrogen has to be built to withstand low temperatures and high pressures. Hydrogen has low energy density per volume compared to methane; its energy density is 40% that of LNG and 25% that of jet fuel.

Shipping hydrogen is particularly challenging. Liquifying hydrogen so that it can be shipped uses up 30 to 40% of its energy content. A liquid hydrogen ship would therefore need more trips, on top of much more expensive storage infrastructure, than LNG. This makes shipping liquid hydrogen about five times more expensive than shipping LNG. Shipping can also be dangerous because of leaks and explosions, something that has affected the world's first liquid hydrogen ship and hydrogen road transport. BloombergNEF also warns against the safety and security risks associated with transporting ammonia, where "deadly accidents are common."[e]

Transporting hydrogen through pipelines, which is central to Norway's hydrogen plans, is very difficult. This is due to its low energy density and the challenges of keeping the smallest molecule in the world from leaking. Only a few hundred kilometres of hydrogen pipelines exist today. Converting existing fossil gas pipelines is also highly challenging. A peer-reviewed article from August 2024 found that every part of the existing gas supply chain, from pipelines to the distribution, pumping, and compression, would have to be replaced or significantly retrofitted at great difficulty and enormous cost to move hydrogen, with "serious safety and environmental concerns."

"Blending" hydrogen with fossil gas for transport through the gas network is also challenging. Due to safety issues, gas pipelines can usually only manage up to 20% hydrogen blends without expensive upgrades. As blending reduces the amount of energy carried, more of the mix has to be burned than pure fossil gas. As a result, in addition to price increases, the emissions reductions will be limited – a 20% hydrogen blend only reduces emissions by 7%). In any case, the EU Hydrogen Strategy is focused on pure hydrogen, not blending.

In the few cases where hydrogen is needed and there is no alternative, exporting the final product produced from hydrogen – for example, steel – is usually easier than exporting hydrogen to then make the product elsewhere. As such, Germany's import strategy has been heavily criticised for "oversized" imports.

e Adithya Bhashyam "Ammonia Supply Outlook 2024: A Clean Takeover," BloombergNEF, August 14, 2024, Subscription Only.

BLUE HYDROGEN FAILS THE CLIMATE TEST

Norwegian Energy Minister Terje Aasland and Conservative MP Ove Trellevik have falsely claimed that blue hydrogen is "emissions-free." There are clear reasons why EU policy favours green hydrogen over blue. Blue hydrogen is worse for the climate than green hydrogen for three reasons:

1. **Upstream Emissions**: Norwegian fossil gas is generally considered to be relatively clean regarding upstream CO_2 emissions and methane leakage compared to other countries. However, production emissions vary between fields and tend to increase as fields age, meaning field-specific data is needed to accurately assess the emissions associated with any potential blue hydrogen production. It is also worth noting that the International Energy Agency found that methane emissions from the global oil and gas sector are likely underreported by as much as 95%.

2. **Carbon Capture is an Expensive Failure**: Blue hydrogen's "low-carbon" claims primarily depend on capturing 90 to 95% of emissions from the gas to hydrogen conversion process. For example, the Equinor-RWE hydrogen cooperation agreement cites these ambitious capture rates. However, no operating CCS project has captured more than 80% of emissions.

   In the 52 years since the first carbon capture project started, global carbon capture capacity is only targeting around 0.1% of global emissions. But this figure hides the fact that most carbon capture plants are not operating at full capacity and many are operating far below.

   Out of all large carbon capture pilots in the last 30 years, 80% have been terminated or postponed. The IEA has downgraded expectations for CCS in its scenarios by 40%. In Norway, a full-scale CCS project at Mongstad was abandoned in 2013 and highly criticised by a parliamentary inquiry. One of two projects in Norway's new CCS flagship, Northern Lights/Longship, is already threatened. Norway's existing CCS projects, removing carbon from fossil gas production at Sleipner and Snøhvit fields, only have a combined 1.7 Mt CO_2 storage capacity (less than 4% of national emissions in 2023), and faced enormous challenges that make them a poor model for projects planned at a larger, unproven scale.

   CCS is one of the most expensive and least effective climate mitigation strategies according to the IPCC. As Carbon Tracker points out,[f] CCS projects "require tailored engineering and bespoke infrastructure" with "low modularity," meaning "very low levels of technology learning and cost reductions in the whole supply chain." This makes CCS heavily reliant on subsidies. An Oxford University study found that higher-CCS future scenarios would cost USD 1 trillion more each year than lower-CCS scenarios. Offshore CCS is also a threat to vulnerable ocean environments, with long-term monitoring to avoid leakage being expensive and requiring harmful seismic blasting. There have also been severe CO_2 leaks from onshore CO_2 pipelines, a key part of CCS infrastructure, in Mississippi and Louisiana.

3. **Hydrogen is an Indirect Greenhouse Gas**: When released directly into the atmosphere, hydrogen strengthens the climate change-causing effects of other greenhouse gases like methane. Research shows that hydrogen has a global warming potential (GWP) two to six times higher than previously thought, up to nearly 12 times that of CO_2. This is a significant concern for all hydrogen production, storage and transportation, as preventing the smallest molecule in the universe from leaking will pose a challenge.

   Burning pure hydrogen also produces up to six times the nitrous oxide (NOx) of burning fossil gas, while even blended hydrogen (with fossil gas) can increase NOx emissions – an indirect greenhouse gas that also causes air pollution.

   For these reasons, even green hydrogen needs to be limited to essential use only and should be produced close to its point of use to minimise the risk of leakage and avoid unnecessary emissions.

f The quoted report can be downloaded at the link by creating a free log-in.

NEW GAS DEVELOPMENT IN NORWAY IS NOT NEEDED

Proposals for blue hydrogen projects in Norway are led by oil and gas companies. Equinor and Shell, the first and sixth biggest fossil gas producers in Norway, have each proposed major blue hydrogen projects that have now been shelved. Norway is Europe's most aggressive oil and gas explorer, as both government and industry are fixated on production growth. With gas demand declining in Norway's primary market, Europe, blue hydrogen is cited as a reason to explore for more gas. In May 2024, the Conservative Party's Nikolai Astrup demanded a "more offensive exploration policy" to keep gas production high for blue hydrogen.

Despite agreements with Germany stating that blue hydrogen exports would be replaced by green hydrogen after a transition period, Energy Minister Aasland has freely admitted that the government is only interested in exporting blue hydrogen. Prime Minister Støre has claimed Norway "can produce hydrogen from gas in a longer perspective" while lobbying German government representatives to be more positive toward blue hydrogen. Even if Norwegian politicians wanted to export green hydrogen, Norway has decreasing spare renewable capacity because of increasing energy demand and little new power generation. Despite this, the government wants to electrify oil and gas fields and an LNG facility from the (almost entirely renewable energy) grid to reduce emissions in the oil and gas sector, further reducing potential spare renewables for green hydrogen in order to produce more fossil fuels.

Equinor's hydrogen agreements with German companies have always been non-binding but are always accompanied by more concrete gas deals that expand fossil gas-fired power in Germany. The Equinor-RWE cooperation planned to build new gas-fired power stations in Germany with the promise that they could be replaced with blue and green hydrogen "as soon as it is ready for export from Norway." However, even before the project's cancellation, the final site for hydrogen production was never chosen. It is not clear where new renewable energy for green hydrogen would come from, as Equinor lost the first offshore wind auction held in Norway in 2024.

In contrast to these vague hydrogen plans, Equinor and RWE also signed a binding new gas supply agreement in October 2023 that will supply 1 to 1.5 billion cubic metres (bcm) of gas to Germany each year for five years – and this agreement remains in place despite the shelving of the accompanying hydrogen plans.

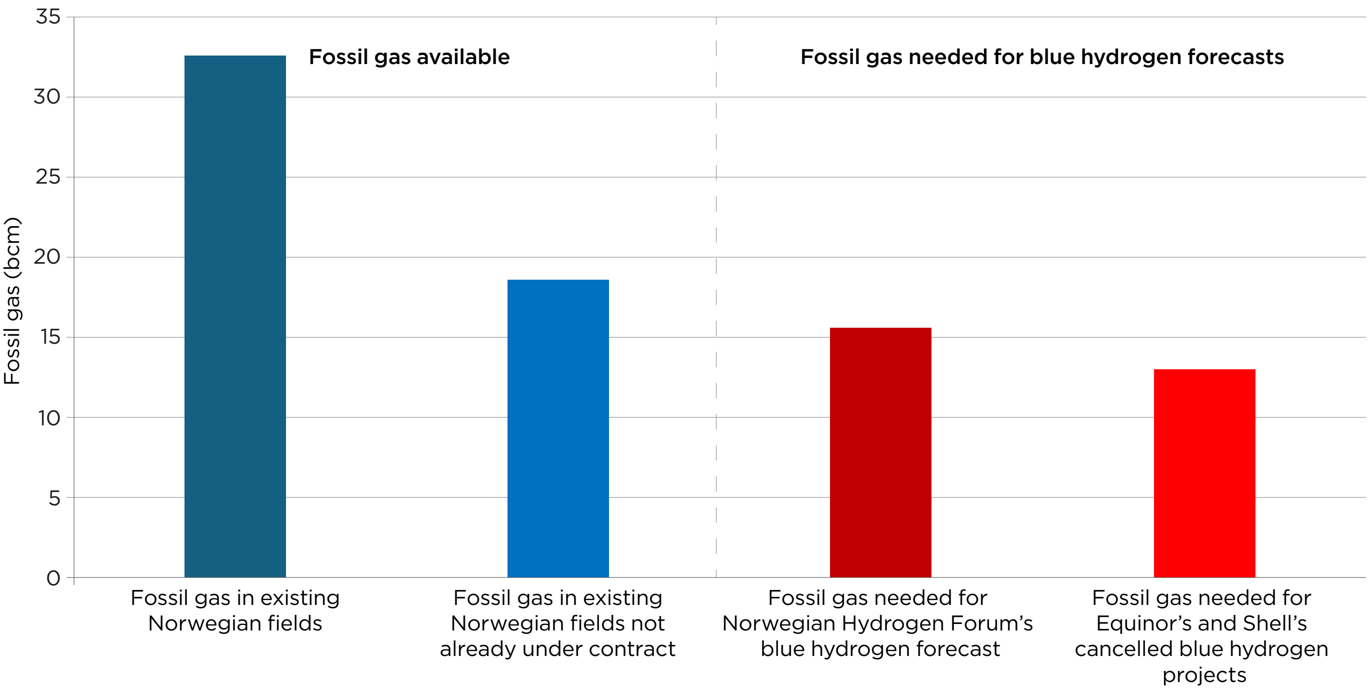
Similarly, Equinor's cooperation with the German gas company SEFE, signed in December 2023, was primarily a legally binding agreement for Equinor to supply 10 bcm of gas for 10 years with the option of another five years – one of Equinor's largest ever gas agreements – while the hydrogen agreement with SEFE was a non-binding letter of intent.

The recent project cancellations affirm the analysis presented in this report that blue hydrogen exports from Norway are unviable and that green hydrogen promises are empty. But the fantasy does not stop there. The idea that Norway's proposed blue hydrogen projects would require opening new gas fields is also misguided.

An analysis of fossil gas production and potential gas demand for proposed blue hydrogen projects and targets shows that there would have been no need to open new fields for these projects. As Figure 1 shows, fossil gas in currently producing fields that is not presently under contract could have easily met the demand for blue hydrogen. Simply put, even when ignoring blue hydrogen's dire prospects, over-hyped blue hydrogen hopes do not justify more exploration for more gas.

Even if Norwegian politicians' claims about the need to explore for more fossil gas to meet European blue hydrogen demand were true, most undiscovered

Figure 1: Norway's Blue Hydrogen Fantasy Never Needed New Gas: Fossil gas available in Norway compared with fossil gas needed to meet Norwegian blue hydrogen forecasts and targets (2040).



Sources: Fossil gas in existing fields and fossil gas in existing Norwegian fields not already under contract (bcm): Rystad Energy. Hydrogen needed for Norwegian Hydrogen Forum's blue hydrogen forecast (Mt): Norwegian Hydrogen Forum. Conversion factor for fossil gas (bcm) to fossil gas (kg) or vice versa: 0.76kg/Sm3, from National Standard Factors of the Norwegian Environment Agency (version from April 2024). Conversion factor for fossil gas (kg) to hydrogen (kg) or vice versa: 3.4kg fossil gas/1kg hydrogen, from German-Norwegian Energy Cooperation Joint Feasibility Study by Gassco (Norway) and Deutsche Energie Agentur (dena) - the German Energy Agency (Germany).

Norwegian oil and gas reserves are in the Arctic, which not only would take far too long to explore for to meet EU hydrogen needs but would also put Norway on a collision course with the EU's Arctic Strategy.

The time from discovery to production for existing Barents Sea oil and gas fields in the Arctic has been 17 years on average. Any new gas from the Barents Sea would not be available to supply Europe with blue hydrogen in a timeframe that fits with EU policy that sees blue hydrogen as (at most) a short-term transitional option. The 2021 EU Arctic Strategy also clearly states: "The EU will… push for oil, coal and gas to remain in the ground, including in Arctic regions." The EU Commission has committed to "work with partners towards a multilateral legal obligation not to allow any further hydrocarbon reserve development in the Arctic or contiguous regions, nor to purchase such hydrocarbons if they were to be produced."

It is time for the Norwegian gas industry and the Norwegian government to face the facts. Norway's blue hydrogen plans are not viable, and neither is opening new gas fields in the Arctic. It is time to plan for a phase-out of Norway's oil and gas industry and a just transition for its workers and communities.

CONCLUSION AND RECOMMENDATIONS

Last month's project cancellations prove that Norway's blue hydrogen fantasy is ending. Blue hydrogen faces substantial policy and market headwinds in Europe that it cannot overcome. Blue hydrogen is expensive, requires too much upfront capital investment and time, and is not clean enough to meet Europe's needs.

Norwegian companies and politicians have clung to the blue hydrogen fantasy, dreaming that it will support their ambition to open new fossil gas fields in Arctic waters. It is time to give up on this misguided dream once and for all and move Norway toward a viable future. The following recommendations are designed to steer Norway and the EU toward a future free of fossil fuel pipe dreams.

Norway should:

- **Abandon all plans for blue hydrogen exports to Europe;**
- **Stop oil and gas exploration and not approve any new oil and gas fields;**
- **Make a detailed plan for a just transition away from oil and gas that protects workers while creating new jobs in sustainable industries; and**
- **Stop lobbying Germany and Europe on blue hydrogen projects.**

The EU should:

- **Make clear that there is no room for blue hydrogen in its hydrogen strategy;**
- **Follow up its Arctic Strategy by stating publicly that Norway should not explore for more gas (or oil) in the Arctic;**
- **Cease any financial support for blue hydrogen projects and gas infrastructure that is "hydrogen-ready;"**
- **Limit hydrogen use to sectors where electrification, recycling or reuse, or other cleaner alternatives are not available; and**
- **Produce green hydrogen close to its point of use and not seek to import hydrogen long distances.**

Germany should:

- **Publicly reject blue hydrogen imports from Norway (or other countries); and**
- **Make a more realistic hydrogen strategy that is less reliant on trade, and that focuses domestic green hydrogen on the few areas where there are no alternatives.**

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Oil Change International is a research, communications, and advocacy organization focused on exposing the true costs of fossil fuels and facilitating the coming transition towards clean energy.

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