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Does time matter? A multi-level assessment of delayed energy transitions and hydrogen pathways in Norway

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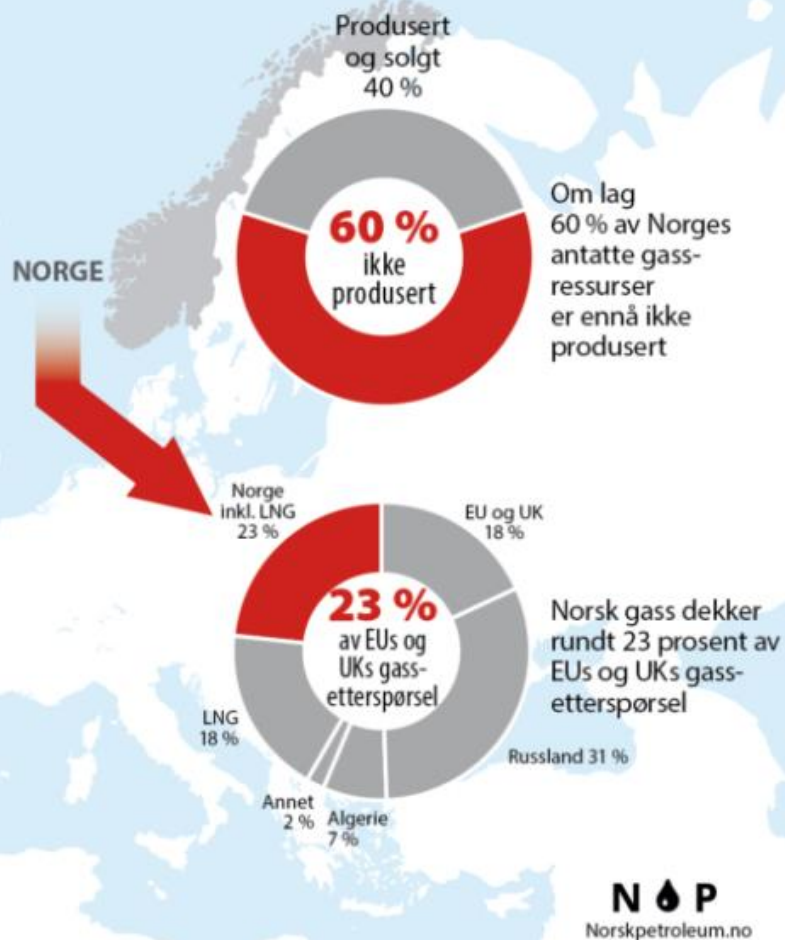
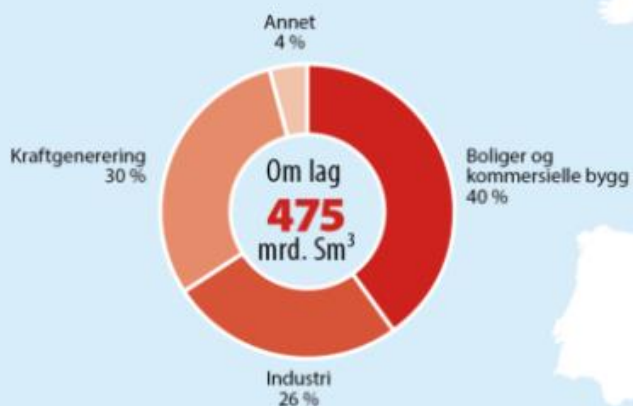


Norway gas export

Norsk gasseksport

Norge eksporterte om lag 114,8 mrd. Sm³ gass til en verdi av 475 mrd. kroner i 2021. Dette tilsvarer om lag 34 prosent av samlet norsk vareeksport.

Hva gass brukes til i EU og UK



% of total Norwegian exports

	2021	2022
Oil	26%	21%
Gas	34%	52%
Total	60%	73%



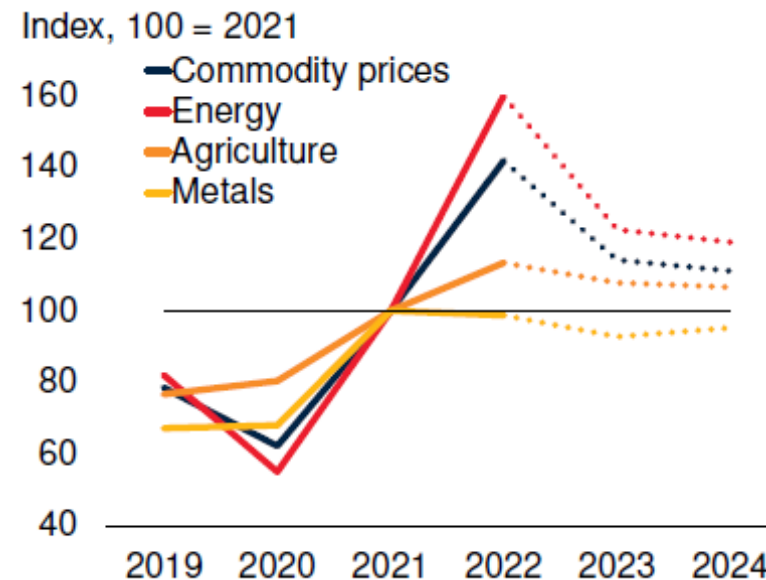
High Gas Prices

Equinor Internal Gas Prices

Period	Internal Gas Price (USD/MMBTU)
Q1 2023	17.36
Q4 2022	27.22
Q3 2022	42.34
Q2 2022	25.53
Q1 2022	29.77
Q4 2021	28.52
Q3 2021	13.91
Q2 2021	7.08
Q1 2021	5.46

Source: Equinor (2023)

E. Commodity price forecasts



Source: World Bank Commodity Market Outlook 2023

Further petroleum exploration



Norway plans for more gas and blue hydrogen as Europe turns away from Russia

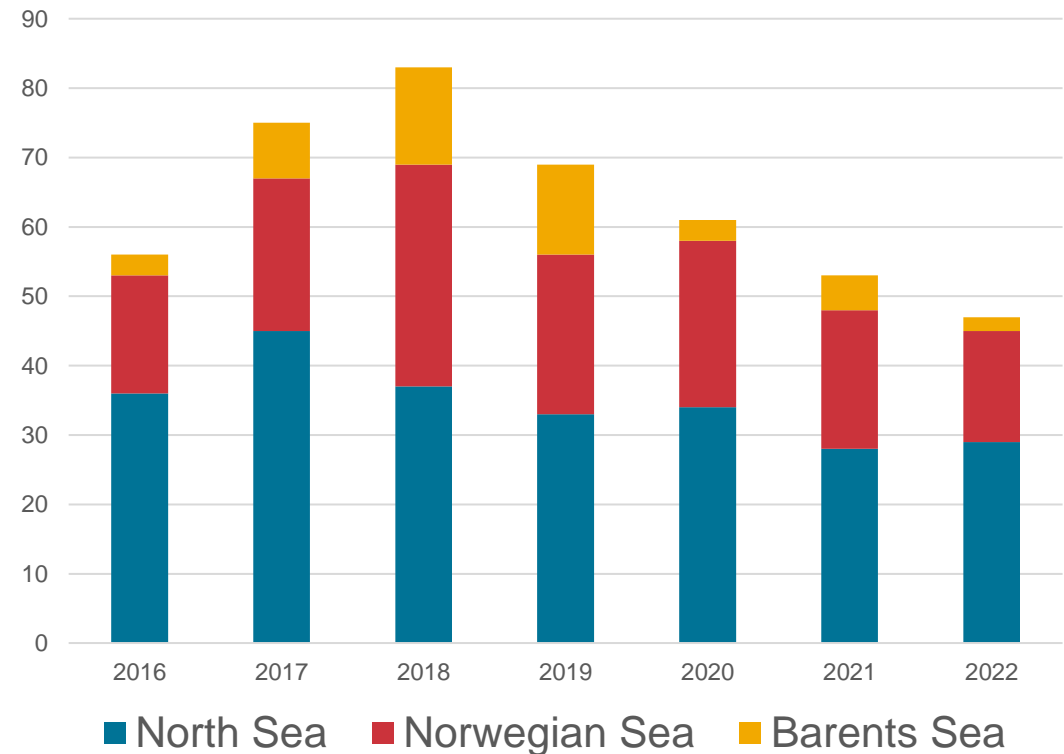
Petroleum & Energy Minister Terje Lien Aasland tells Upstream he wants his country to remain a key supplier of energy to Europe

7 April 2022 8:45 GMT UPDATED 11 April 2022 16:44 GMT

By Ole Ketil Helgesen in Stavanger

Source: Upstream Energy Explored (2022)

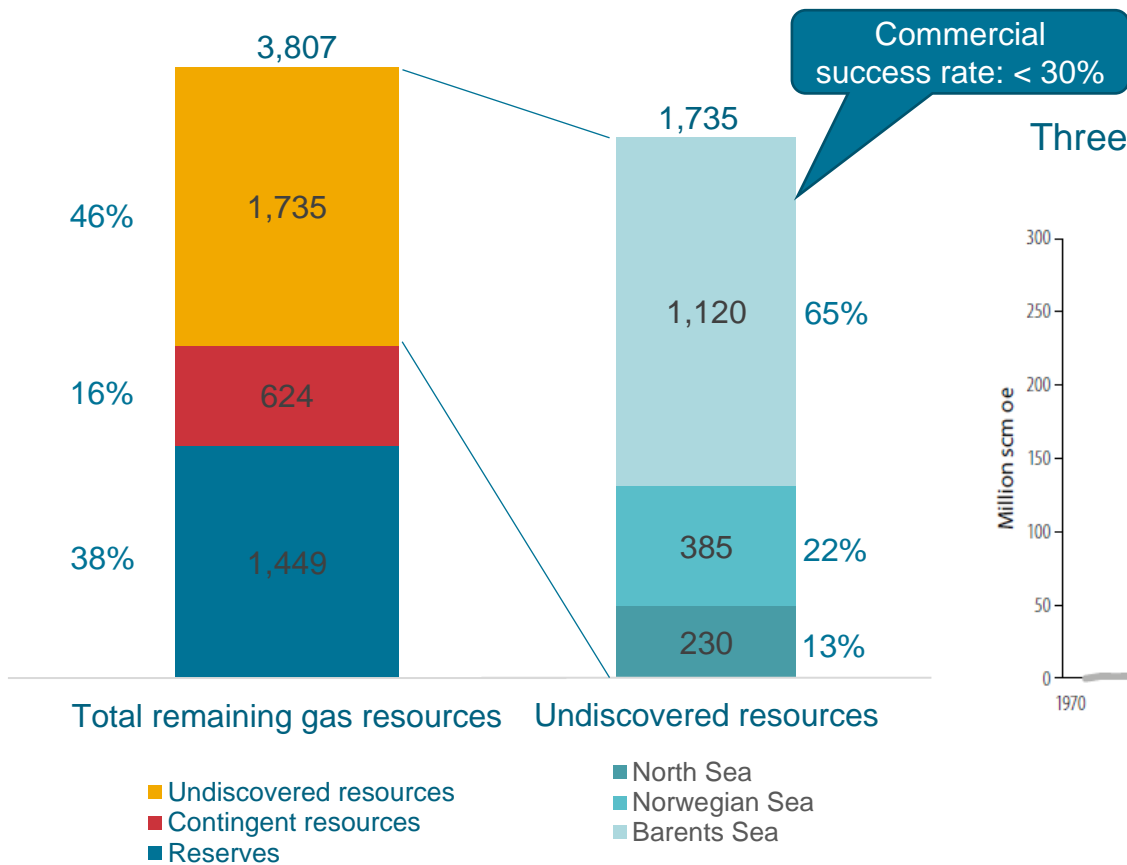
Number of production licences offered for awards in pre-determined areas (APA)



Source: NPD

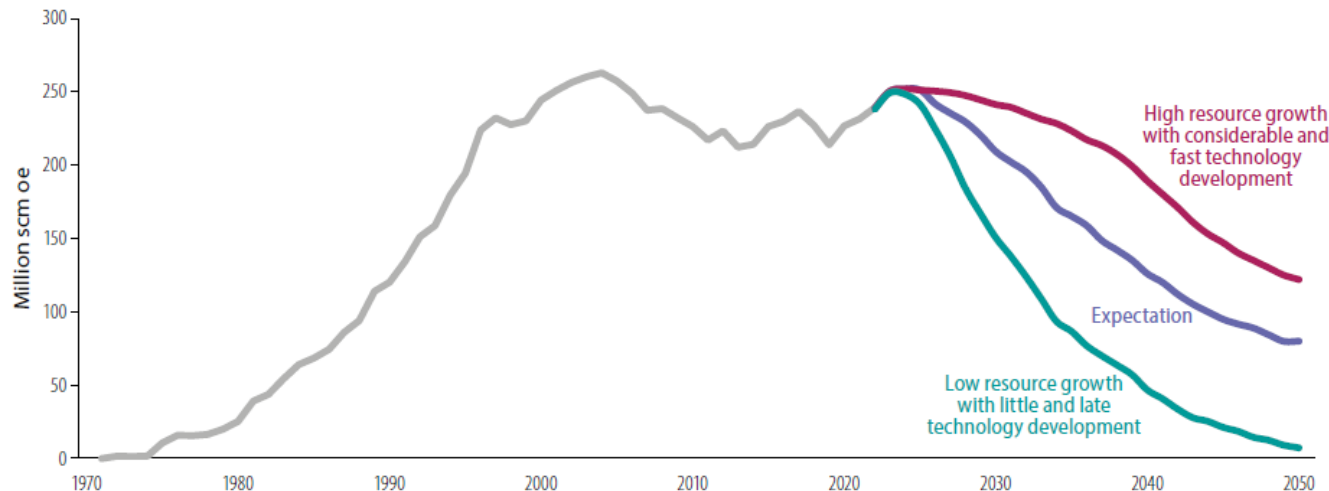
Natural gas resource in the Norwegian Continental Shelf

Total remaining natural gas resources in billion cubic meter (bcm) as per 31.12.2021



Source: Norwegian Petroleum Directorate (2022)

Three scenarios for production development on the NCS (2022-2050)



Source: NPD Resource Report (2022)



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European green deal

3 minute read · June 24, 2021 1:23 PM GMT+2 · Last Updated 2 years ago

Climate 'law of laws' gets European Parliament's green light

By Kate Abnett



[1/2] Flags of the European Union and its member states fly in front of the building of the European Parliament in Strasbourg, France June 30, 2017. REUTERS/Arnd Wiegmann

Source: Reuters (2021)

EU wants to phase out natural gas by 2049 to fight climate change

COMMENTS

By Euronews · Updated: 15/12/2021



Commissioner Timmermans and Simson said hydrogen should be front and centre in the EU's green transition. - Copyright: European Union, 2021.

Source: Euronews (2021)

Russia-Ukraine War impact on the EU



SUPPLY Diversifying away from Russia

- ✓ **Joint Energy Purchase platform** up and running
- ✓ **Outreach to international partners** : NO, US, Egypt, Qatar, Azerbaijan..
 - EU – US LNG (+ 15bcm in 2022 and + 50bcm thereafter)
 - Additional LNG terminals, pipeline-interconnectors** hydrogen-ready
- ✓ - **EU Gas storage today** : 44% compared to 40% last year

Accelerate deployment of renewable energy



Accelerated investments in renewables to replace fossil gas:

- Solar strategy, solar rooftop initiative & solar alliance – 12.6 bcm
- Wind - 8.4 bcm
- Hydrogen accelerator to increase renewable domestic production to 10mt and imports to **10mt - 27 bcm**
- Doubling biomethane production - 17 bcm



Simplify and speed up the **permitting process** of **renewable projects** and **associated infrastructure** by:

- defining go-to areas
- granting overriding public interest status

Possible show-stoppers:



- Electricity grids
- Critical raw materials
- Supply chains

Diversification of natural gas suppliers

Long Term LNG Contracts Are The Future For Natural Gas Markets

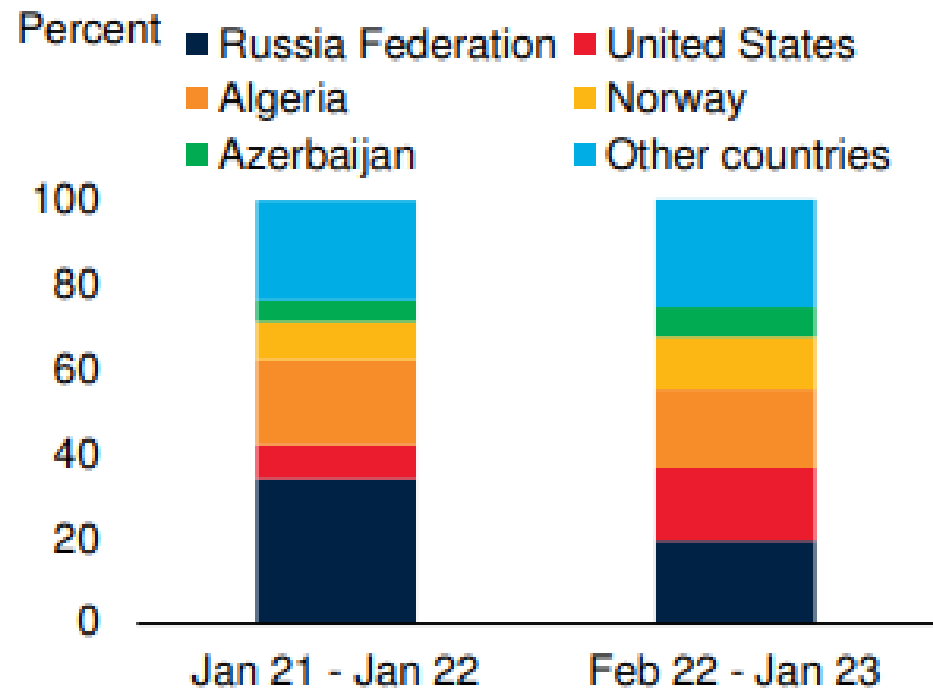
By [Irina Slav](#) - Jul 18, 2022, 7:00 PM CDT

- ▶ In the not-so-distant past, the natural gas spot market was one of the European Union's great points of pride as it moved towards a future powered by renewables.
- ▶ Russia's invasion of Ukraine combined with declining investment, long lead times on new projects, and emissions regulations have created a supply crisis.
- ▶ Now, the European Union and other gas importers are coming to terms with the fact that long-term LNG contracts are the only way forward.



Source: Oil Price.com (2022)

D. Shares of EU natural gas imports, by country



Source: World Bank Commodity Market Outlook 2023

EU's Renewable Hydrogen Contracts

EU, Kazakhstan Ink Agreement on Raw Materials and Renewable Hydrogen at COP27

BY ZHANNA SHAYAKHMETOVA in INTERNATIONAL on 8 NOVEMBER 2022

ASTANA – The European Union (EU) and Kazakhstan seek to strengthen their strategic partnership by signing an agreement on raw materials, batteries and renewable hydrogen on Nov. 7 at the sidelines of the 27th UN Climate Change Conference of the Parties (COP27), which kicked off in Sharm El-Sheikh, Egypt.



Kazakh Prime Minister Alikhan Smailov and President of the European Commission Ursula von der Leyen meet at COP27

Source: The Astana Times (2022, Nov 8)

NAMIBIA: Key points of the 'strategic' partnership with the EU on hydrogen

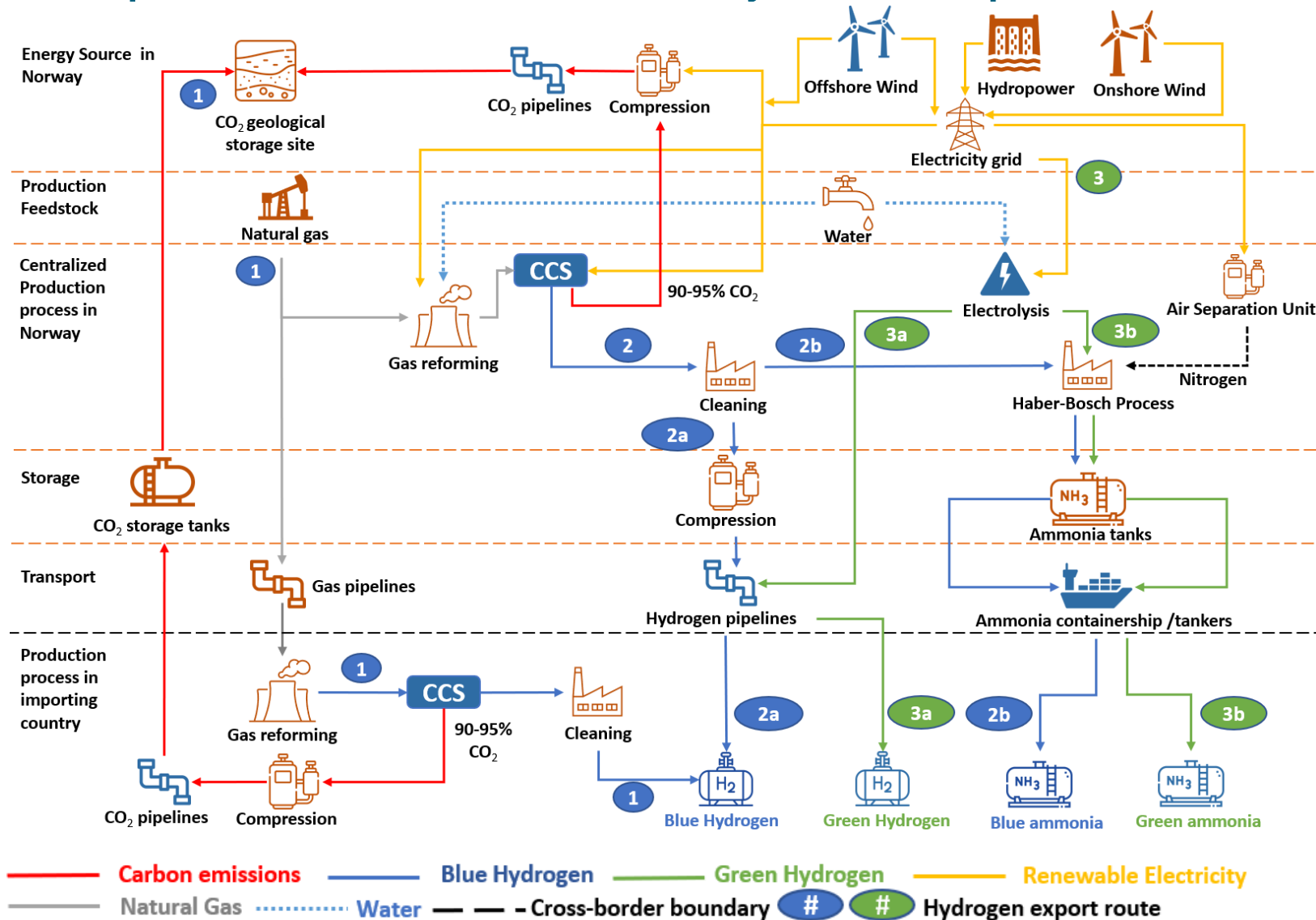
By Jean Marie Takoueu - Published on November 24 2022 / Modified on November 24 2022



The Namibian authorities have just signed a "strategic" partnership with the European Union (EU) on raw materials and green hydrogen. The EU is banking on this energy for the decarbonisation of its industry. Namibia, which has enormous potential for clean energy production, is expected to help.

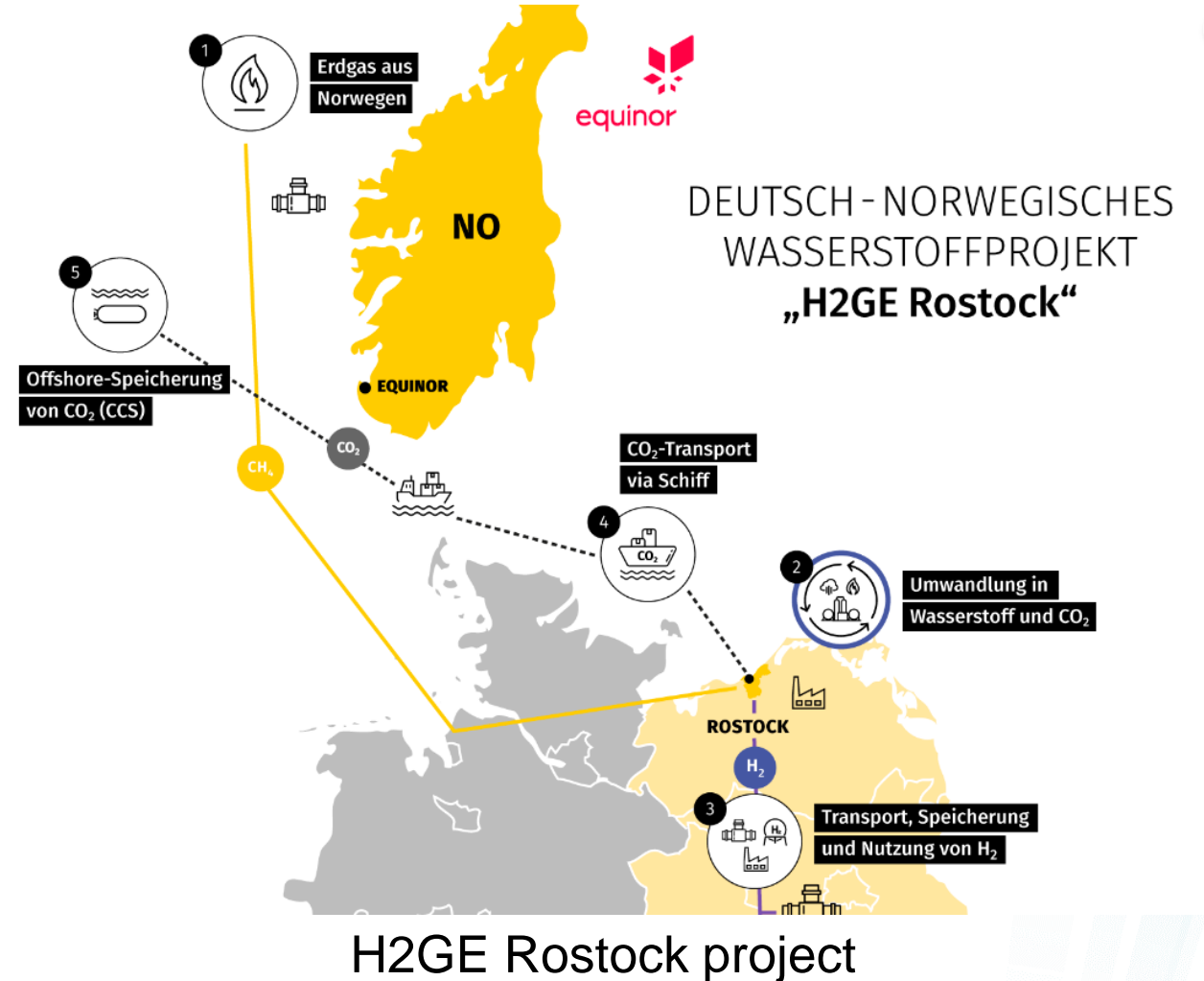
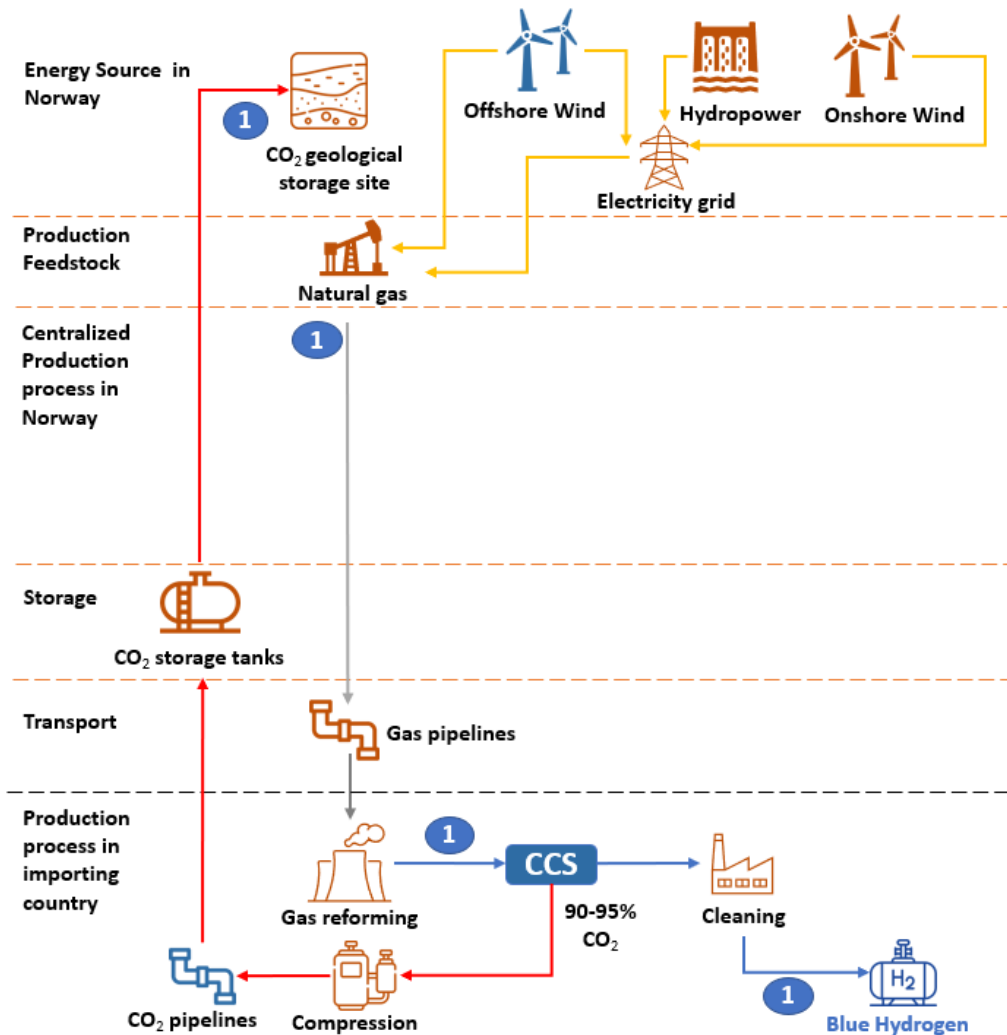
Source: Afrik21 (2022, Nov 24)

Hydrogen export routes from Norway to Europe



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Hydrogen Export Route 1

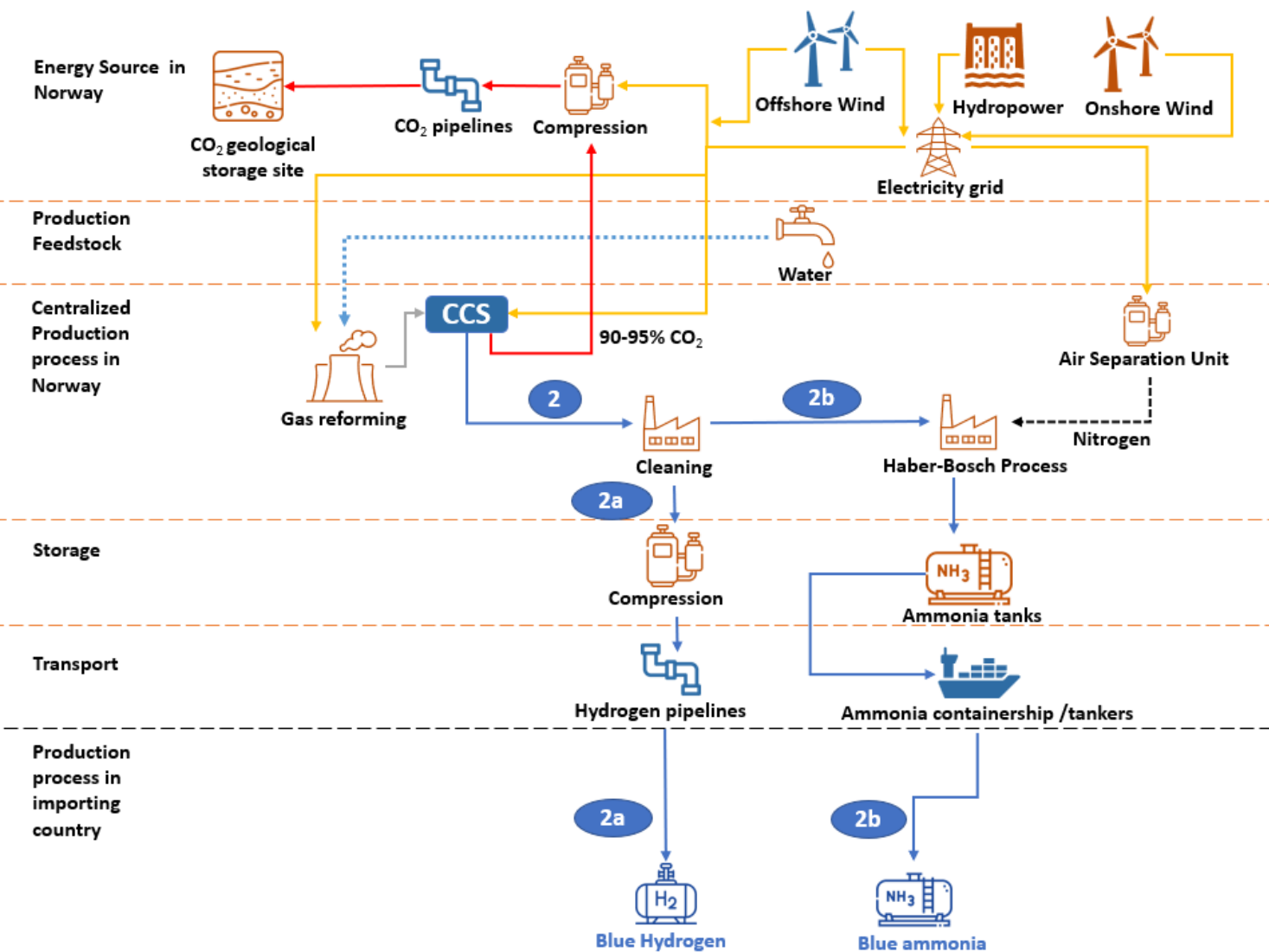


H2GE Rostock project



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Hydrogen Export Routes 2a & 2b

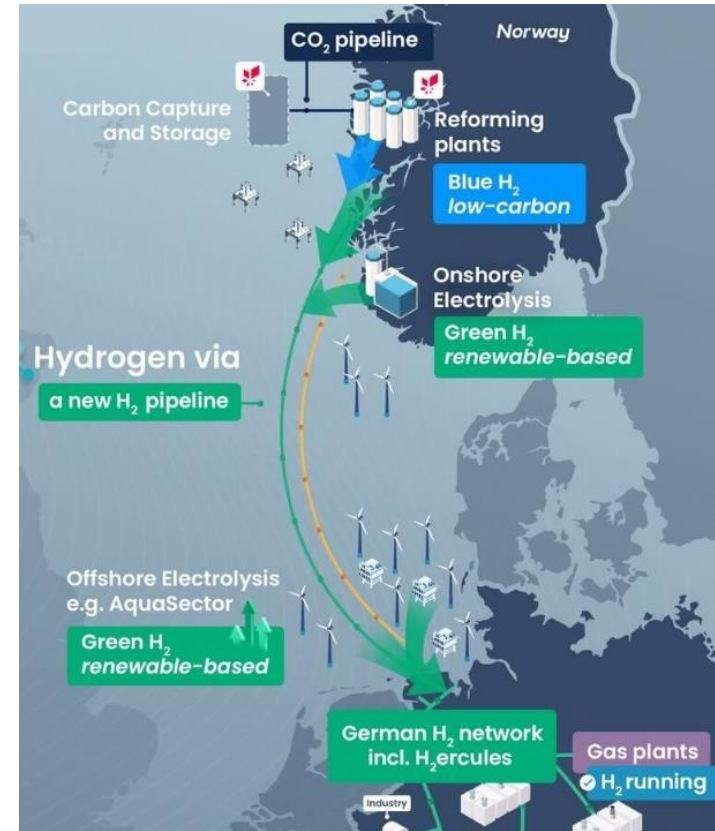
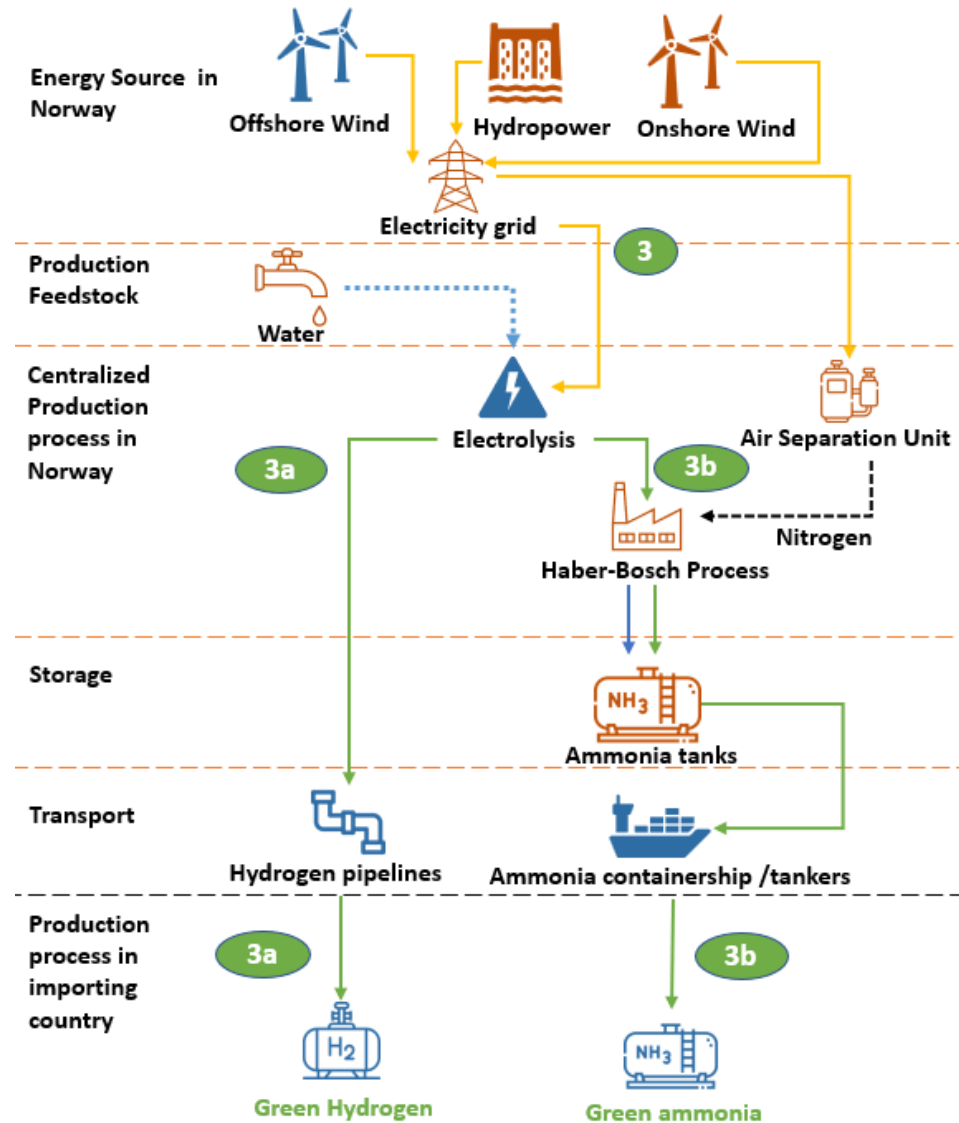


Equinor-RWE project (Southern Norway)



Barents Blue project (Northern Norway)

Hydrogen Export Routes 3a & 3b

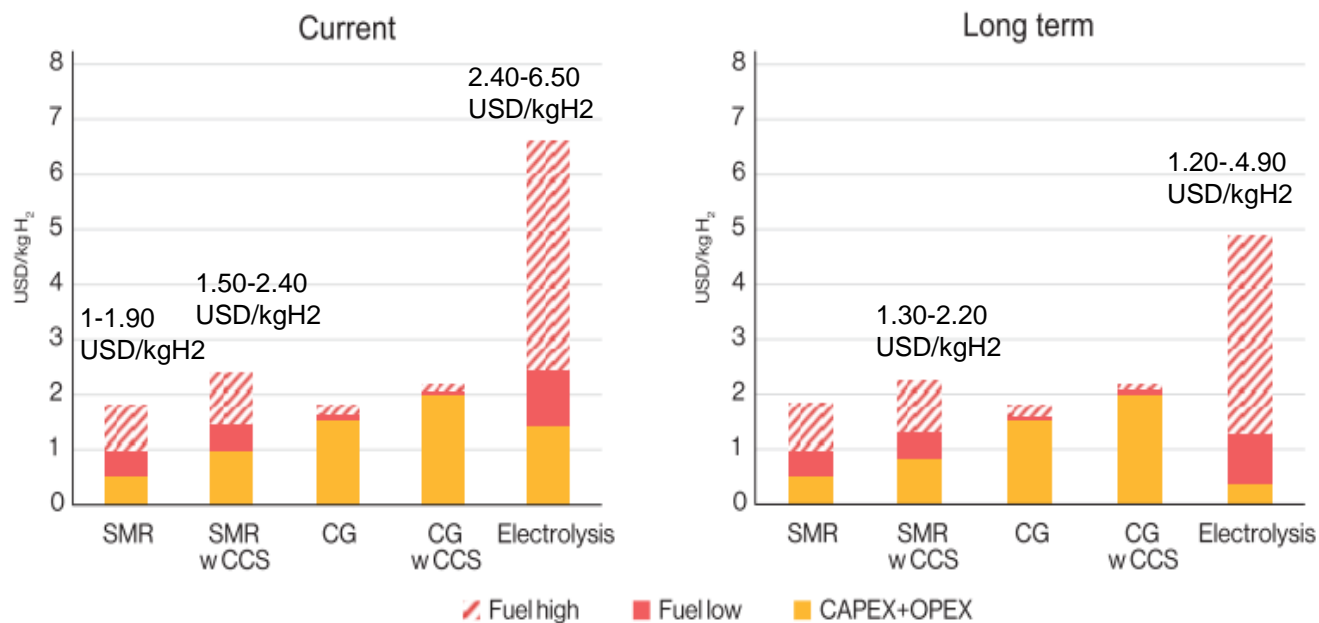


Equinor-RWE project (Southern Norway)



Green Ammonia Berlevåg (Northern Norway)

Hydrogen production cost



Blue H₂ production cost = 1.50-2.40 USD/kgH₂

45-70% of production cost = gas prices

Key assumptions:

Gas prices: USD3-9/MMBtu

Carbon capture rate: 80%

Efficiency rate: 69%

Green H₂ production cost = 2.40-6.50 USD/kgH₂

65-80% of production cost = electricity prices

Key assumptions:

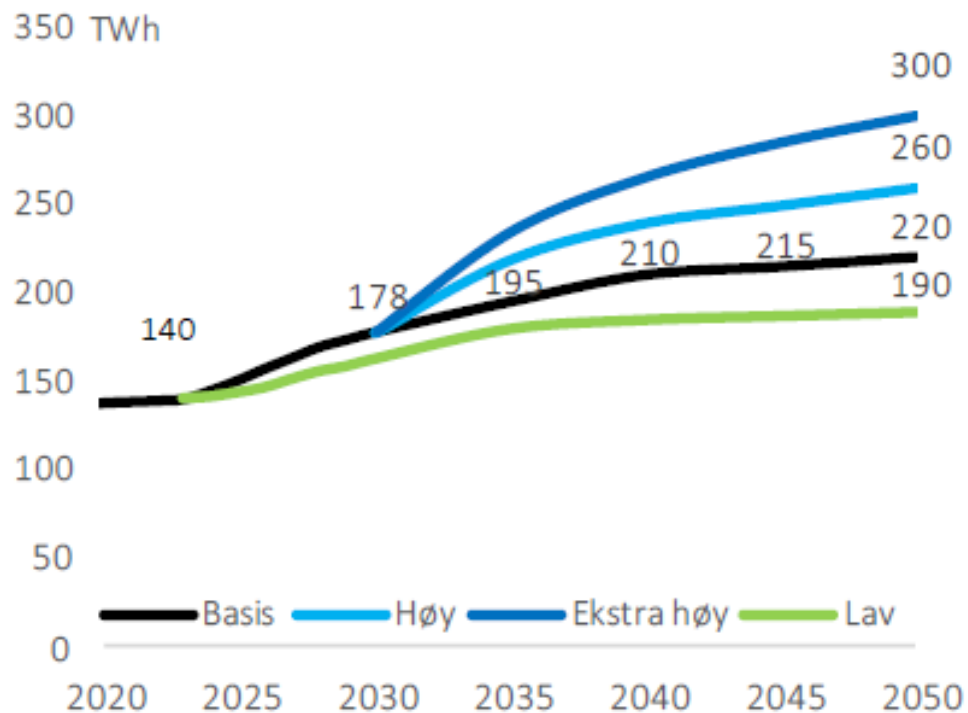
Electricity prices: 20-100 USD/MWh

Efficiency rate: 69% (74% long-term)

Figure 4. Current and long-term levelised cost of hydrogen production with different technologies

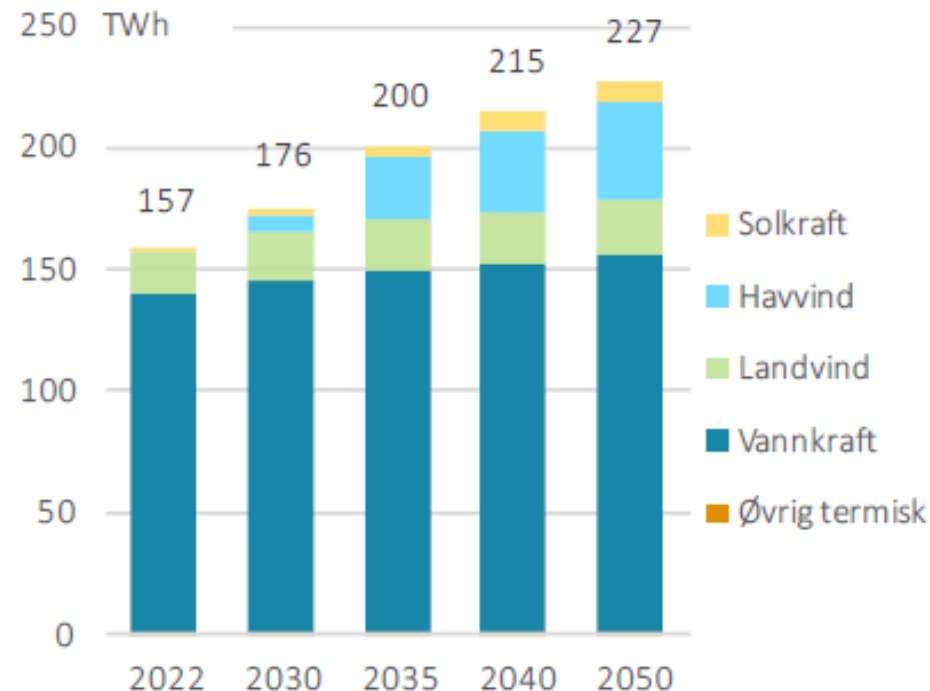
Source: IEA Cross-cutting: Hydrogen (2020)

Electricity market in Norway 2022-2050



Figur 8-3: Ulike scenarier for forbruksutviklingen i Norge 2022-2050.

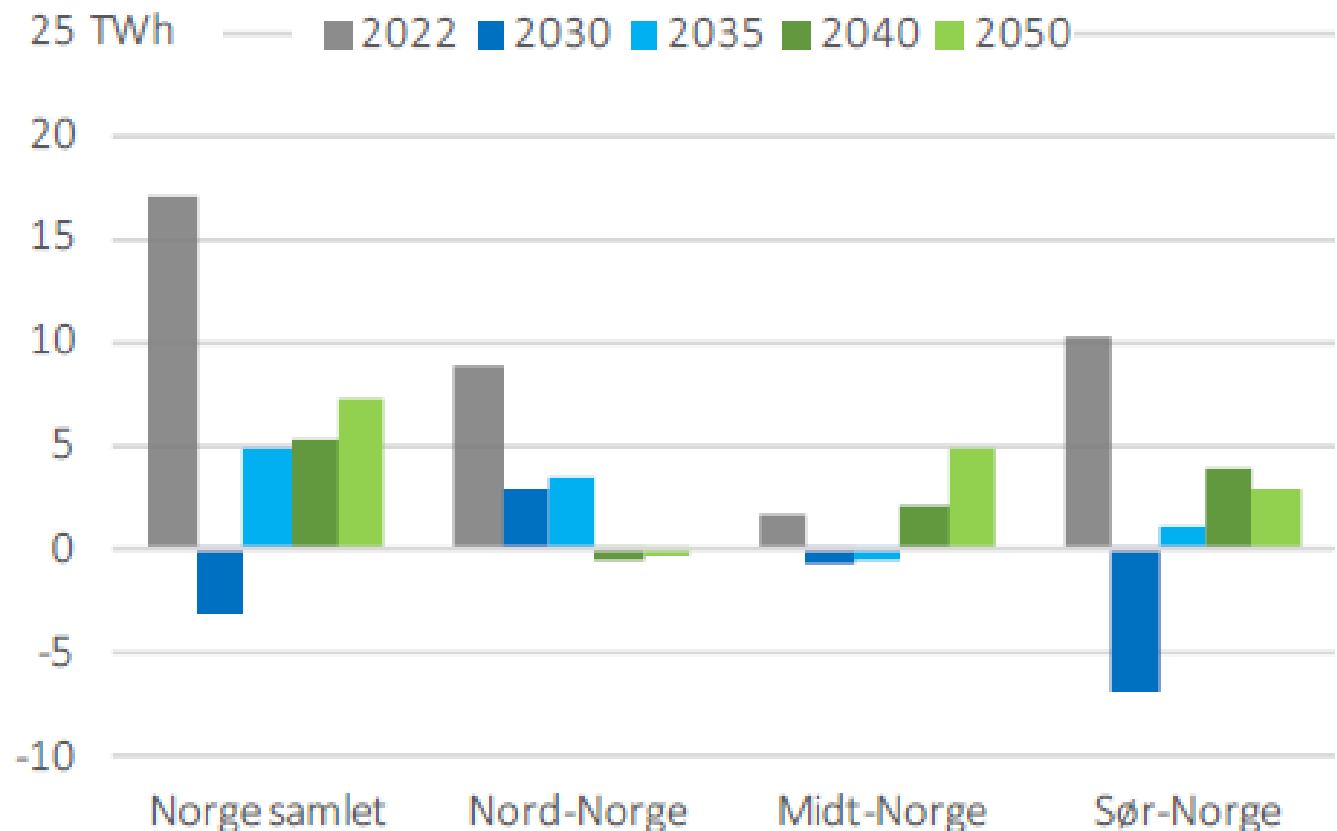
Source: Statnett (2022)



Figur 8-5 Utvikling i kraftproduksjon i Norge i Basis, målt i energi (TWh).

Source: Statnett (2022)

Energy balance by region in Norway 2022-2050



Figur 8-7: Utvikling i kraftbalanse i Norge samlet og per region i vår Basis



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Electrification of offshore platforms

Equinor plans to invest \$1.3 billion in Hammerfest LNG upgrade and electrification

BUSINESS DEVELOPMENTS & PROJECTS

December 20, 2022, by Ajsa Habibic

Norwegian energy player Equinor and its partners in the Snøhvit project have revealed plans to invest NOK 13.2 billion (around \$1.3 billion) in upgrading the Hammerfest LNG (HLNG) plant at Melkøya with onshore gas compression and electrification.



Illustration / Courtesy of Equinor

Source: Offshore Energy (2022, Dec 20)

30.01.2023 | 11:55 a.m. POLITICS & MARKETS

Equinor: CCS is three times as expensive as electrification of Melkøya

"Partial electrification with CCS is far more complex, more expensive, resulted in lower emission cuts and had far greater uncertainty and risk of cost increases," says Eva Sleire.



Compression without mitigation measures is not a realistic option, according to Equinor. | Photo: Helge Hansen / Equinor

Source: Energi Watch (2023)

EU Delegated Act for Renewable Hydrogen



EU Delegated Act defining green hydrogen is cleared by European Parliament after committee vote

The definition is crucial because it tells producers whether the H₂ they manufacture can be sold and traded as 'renewable' and be eligible for subsidies

28 March 2023 12:57 GMT UPDATED 28 March 2023 12:57 GMT

- Renewable hydrogen is defined as hydrogen produced with electricity from the power grid that contains more than 90% renewable energy sources.
- Helps to finalise investment decisions and allocation of EU subsidies.
- Delegated Act for other types of low-carbon hydrogen is expected only at the end of 2024. Uncertainties prevail for blue hydrogen investors.



Key Takeaways

- Low-carbon hydrogen could play an important role in facilitating a smooth energy transition to a post-petroleum economy, but only if action is taken in time during the window of opportunity
- Russian-Ukraine war has created a window of opportunity for Norway to enter this market, but this window is closing fast
- Further petroleum exploration at this stage: Risks > Benefits
 - May delay the energy transition process
 - May jeopardise the opportunity for Norway to build new green industries that can secure a post-petroleum future.
 - May end up stranded with gas resources due to competitive LNG markets, uncertainties about the blue hydrogen business model and the declining cost of green hydrogen
- Regardless of new gas discoveries, gas production levels will still decline
 - Need for a phase-out plan for the petroleum sector
- Blue hydrogen exporters via *Route 1* may bring in more economic gain initially, but less social benefit in terms of job creation
- Blue hydrogen exporters via *Route 2* face strong uncertainties due to high gas prices, CCS costs, and lack of a Delegated Act for Blue Hydrogen
- Green hydrogen exporters via *Route 3* are limited by the lack of power supply.
 - There is an urgent need to reduce power consumption and increase renewable electricity supply to ensure a smooth transition away from fossil fuel export.
- It takes 25 years to fully transform an industrial sector and value chain (European Commission, 2019)
 - To be ready for a climate-neutral Europe in 2050, actions and policies for a *full transformation* pathway need to take place in Norway by 2025



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End of presentation

For further question, please feel free to contact me at
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