



equinor

Norway Energy Hub

Workshop: Oil and gas in the context of energy security and clean energy transitions

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CHE scope

Safety Moment: Detonation in an ammonia plant, 1985

Where:

- POX unit in the Norsk Hydro N1 ammonia plant at Herøya

Cause:

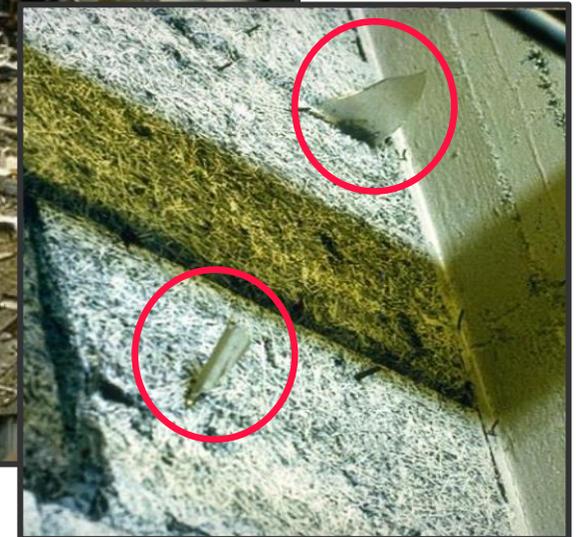
- A gasket in a water pump failed, causing a leak and loss of pressure followed by backflow from a pressurised H₂ drum
- 10-20 kg of hydrogen leaked from the system inside a building
- Most likely that a hot bearing ignited the gas cloud
- 3.5-7 kg of hydrogen involved in the explosion/detonation
- From the damage observed, detonation seems most likely

Consequences:

- Two fatalities, extensive damage
- Huge horizontal jet fire from the pressurised H₂ drum
- The explosion caused large number of fragments representing a severe hazard
- Glass windows were broken up to 700 m from the centre of the explosion.
- The plant was never re-built

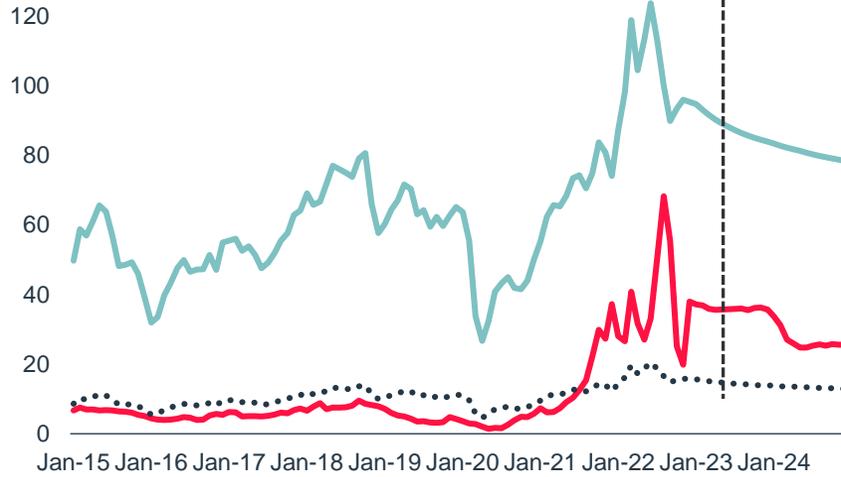
Learnings:

- Importance of barrier thinking and proper design standards (e.g. ventilation, backflow, H₂ in buildings...)



We are in a world of extremes

Oil and gas price

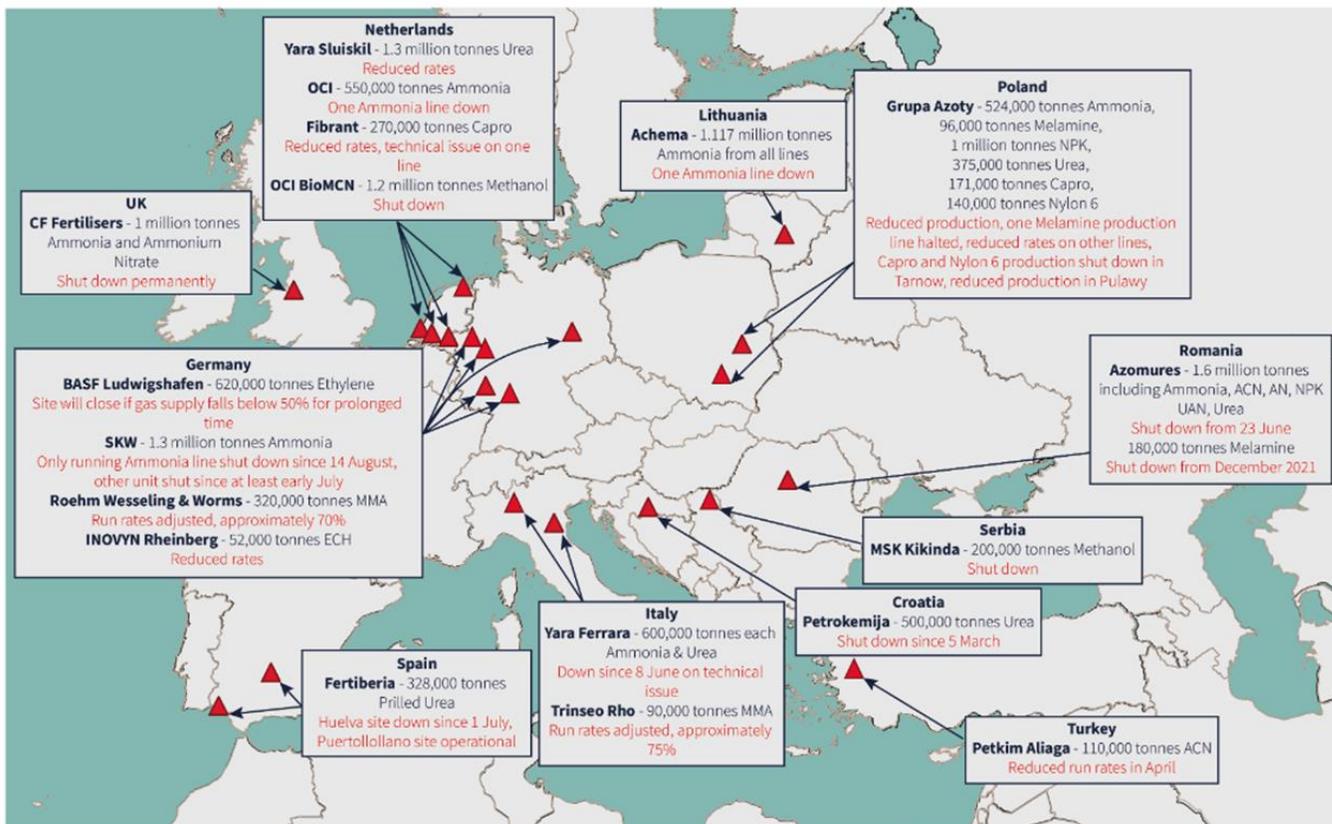


European power prices
\$/MWh



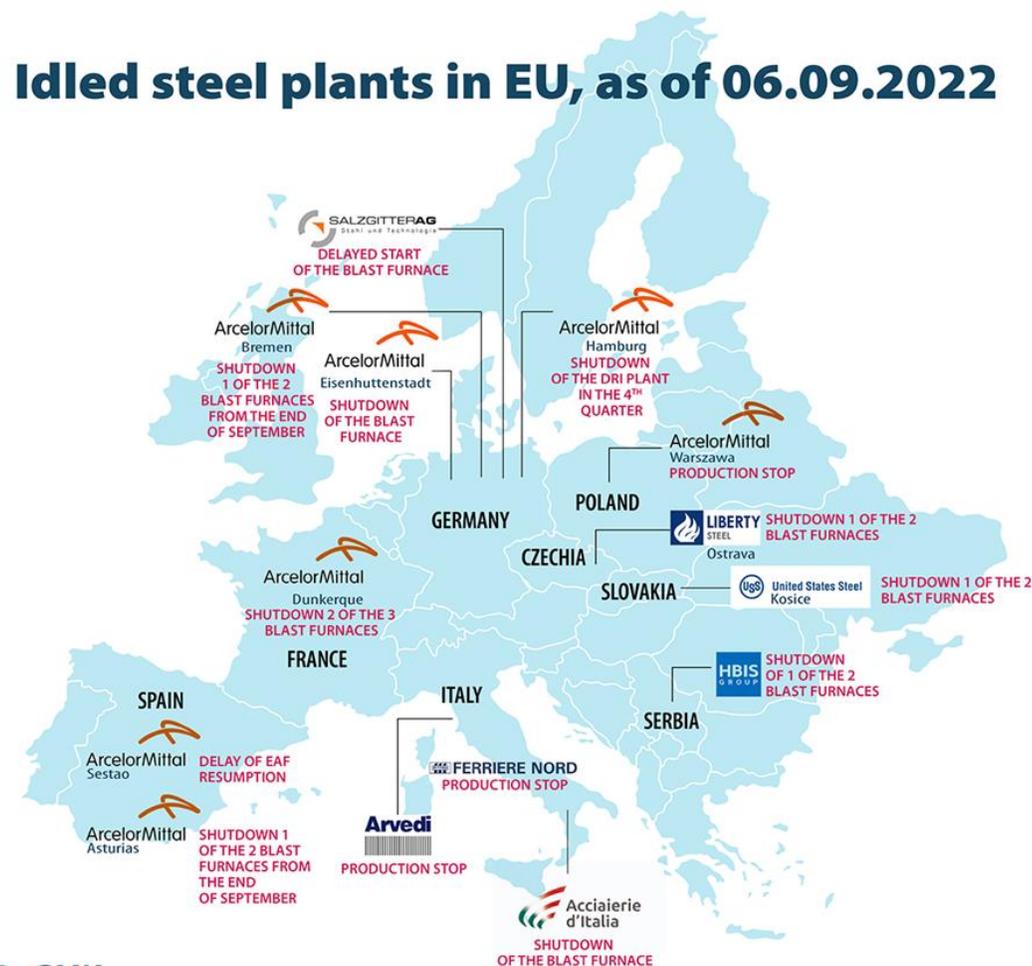
Source: Platts, Heren (history), ICE (projection)

In Europe that has caused energy demand destruction in e.g. fertiliser and steel



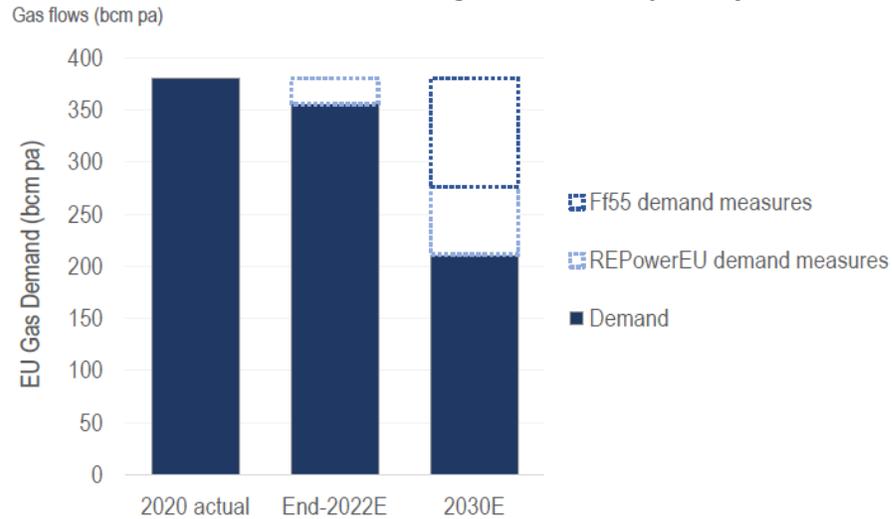
SOURCE: ICIS, Natural Earth

Idled steel plants in EU, as of 06.09.2022

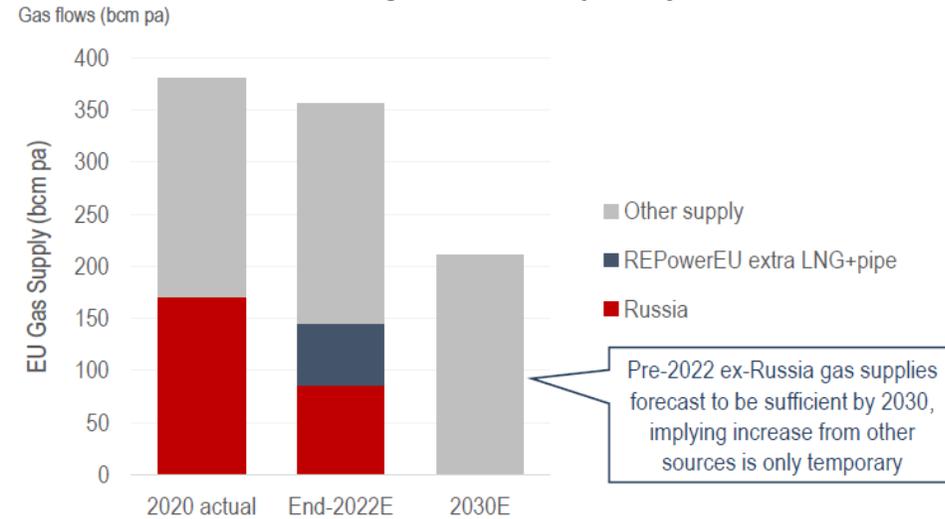


EU has responded with RePowerEU on top of FitFor55.....

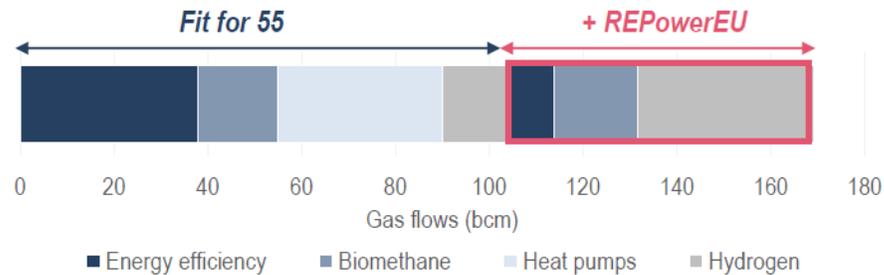
EU Fit for 55 and RePowerEU natural gas substitution pathway



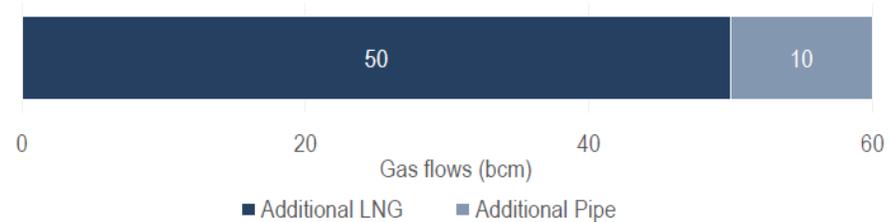
EU RePowerEU Russia natural gas substitution pathway



Where does 2030 gas substitution originate from?



Where does 2022 Russia gas substitution originate from?



....and further campaigns such as “Save gas for safe winter”

SAVING NOW FOR THE WINTER AHEAD



Saving energy now allows Europe to store more gas for the winter, when demand is higher. The Commission therefore proposes **that all Member States reduce gas demand by 15% from 1 August 2022 to 31 March 2023**. These measures will be voluntary at first.

If a gap emerges between supply and demand, the new **Regulation on coordinated gas demand reduction measures** creates the possibility to call a ‘Union Alert’ and impose mandatory reductions on all Member States.

Acting now will :

- **Reduce the negative GDP impact**
- **Help reach our 80% gas storage target** by 1 November, to maintain safe levels for this winter and beyond
- **Ease the burden on the economy and employment by allowing** planned and coordinated measures
- **Reduce market pressures** by sending the right signals about Europe’s preparedness

To achieve the 15% target, the Commission has adopted a **European Gas Demand Reduction Plan** with guidelines to protect households, essential users and industries from a gas shortage and help Member States to reduce gas demand.

The plan will :

- **Encourage fuel switching away from gas**, with a priority for renewables and cleaner fuels
- **Promote saving of non-critical gas for electricity and heat production**
- **Incentivise consumption reduction by industry**, for example through tenders or auctions for reduced gas use, interruptible contracts, and contract swaps
- **Promote reduced heating and cooling in buildings**, including through Member State awareness raising campaigns and action by individual citizens
- **Provide guidance to Member States** on prioritisation of industry sectors in case of curtailments



...while also accelerating projects and filling storages....

Germany FSRU plans for near term LNG supply

- In a bid to reduce dependence on Russian supply, Germany sees its potential LNG projects as vital, and is keen to expedite these
 - As part of its response to the Russian invasion, and the decision to suspend certification of the Nord Stream 2 pipeline, Germany is planning to fast-track four FSRU facilities:
 - RWE has secured two FSRUs with total capacity of 7.25 -10mtpa
 - Uniper has secured two FSRUs with total capacity of almost 11mtpa

FSRU	FSRU location	FSRU Capacity (Mtpa)	Charterer
Dynagas - Transgas Force	One in Wilhelmshaven, a decision is being made on the final three between Stade, Rostock, Eemshaven and Brunsbuettel	5.4 mtpa (7.5bcm) each	Uniper
Dynagas - Transgas Power			
Hoegh - Esperanza	three between Stade, Rostock, Eemshaven and Brunsbuettel	7.25-10mtpa combined (depends on 2 nd vessel)	RWE
Hoegh - (vessel tbd)			

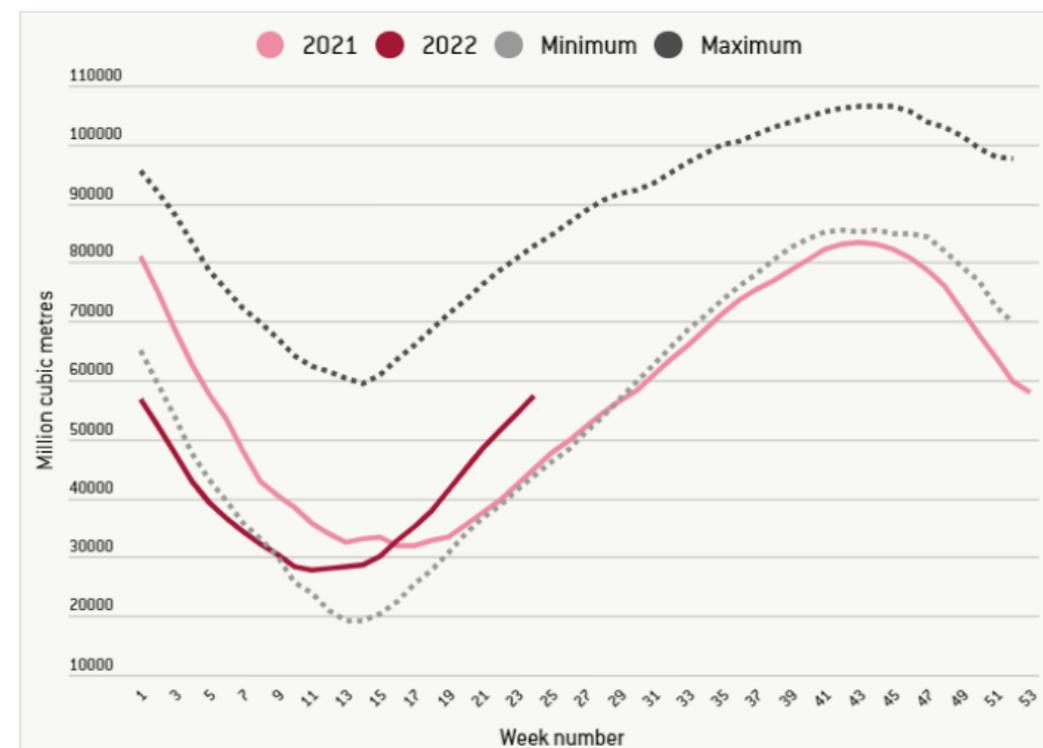
FSRUs are expected to commence service in early 2023

Permanent facilities to accommodate LNG imports

Potential Project (likely start date)	Regas Capacity (mtpa)	Ownership
Wilhelmshaven (2025E)	7.2	UNIPER with MOL
Brunsbuettel German LNG (2023E)	5.4	KfW 50%, Gasunie 40%, RWE 10%
Stade (2026E)	8.7	Hanseatic Energy Hub GmbH

Absolute storage levels

Total for EU+UK



....and even adjusting their medium-term “gas narrative”

Increased energy cooperation between the EU and Norway

Press release | Date: 23/06/2022

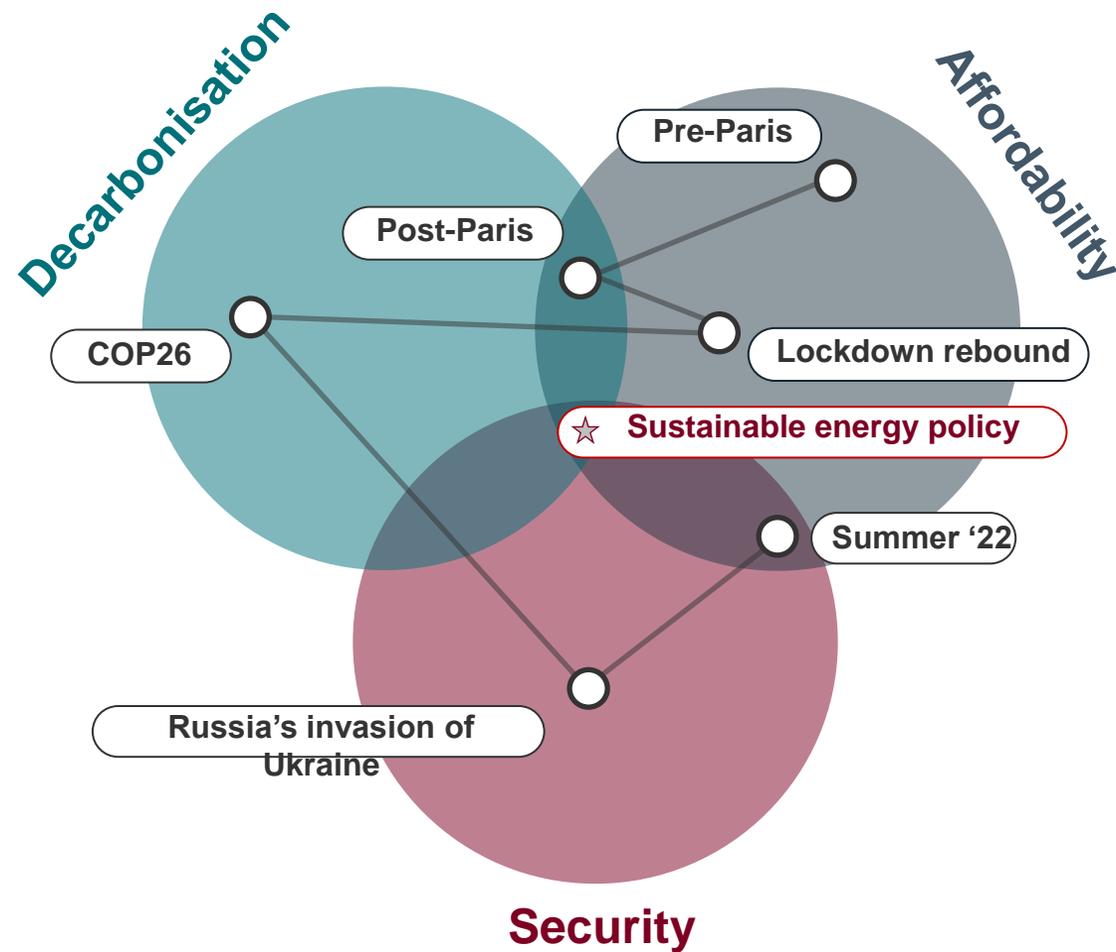
The EU and Norway will cooperate even closer in the field of energy. This is clear following today’s meeting between the Norwegian Minister of Petroleum and Energy, Terje Aasland, and Commission Vice-President Frans Timmermans.



Minster of Petroleum and Energy Terje Aasland in at meeting with Commission Vice-President Frans Timmermans in Brussels 23th June 2022. Credit: Arvid Samland / Ministry of Petroleum and Energy

- Recognising that Norway has significant remaining oil and gas resources and can, through continued exploration, new discoveries and field developments, continue to be a large supplier to Europe also in the longer term beyond 2030. The EU supports Norway’s continued exploration and investments to bring oil and gas to the European market.

....and thereby adjusting the focal point in the energy trilemma.



Shaping the European future of CCS and clean hydrogen

Competitive edge founded on experience, infrastructure and customers.



Capital Markets Day June 2021

15-30 MTPA

CO₂ transport and storage capacity by 2035

Equinor share

>25%

CO₂ transport and storage market share in Europe by 2035

3-5 MAJOR INDUSTRIAL CLUSTERS

Clean hydrogen projects by 2035

>10%

Clean hydrogen market share in Europe by 2035

Norway energy hub

- Contribute to combat climate change
- Ensure value creation and green transition
- Build on strenghts, competence and experience

3,9
Million boe/d
Oil & Gas

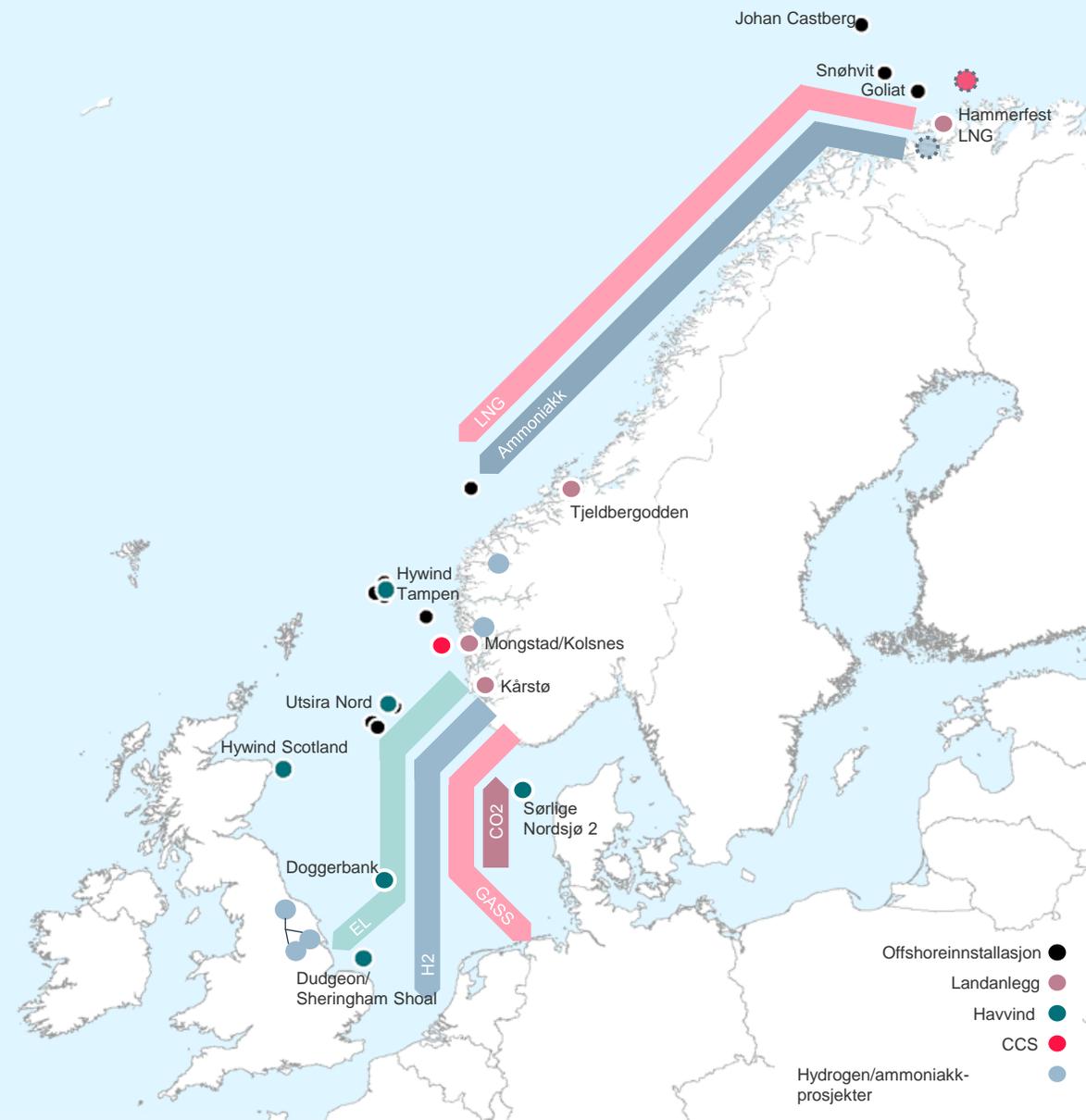
50-100
kboe/d
Export LNG

6,5
GW
Bottom fixed

3,5
GW
Floating

40
Million tons/år
CCS storage capacity

2
GW
Hydrogen



Enhanced Norwegian German Energy Cooperation

Signing Troll Gas Sales agreement in 1986

Signing Energy partnership 2050 in 2022?



What we need is three-fold:

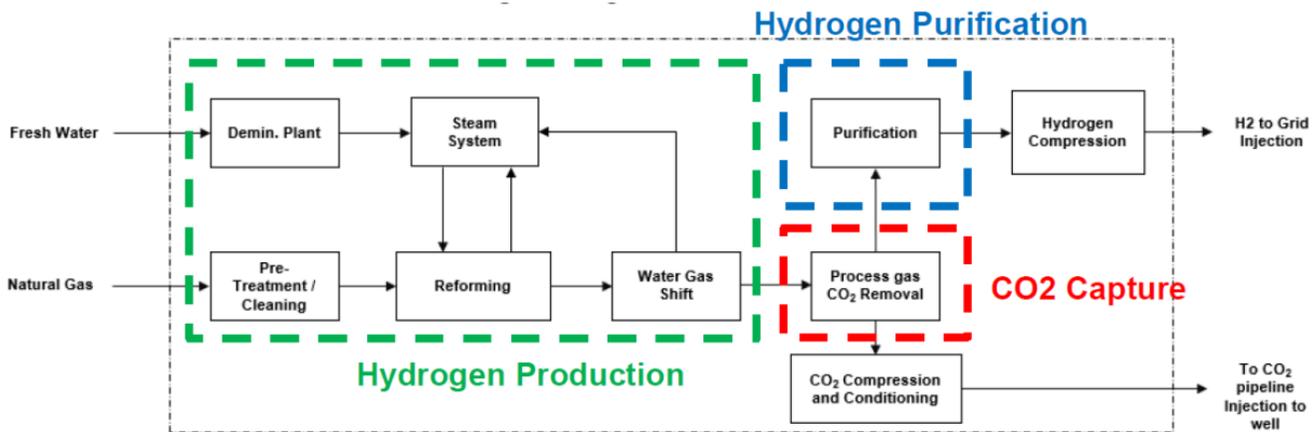
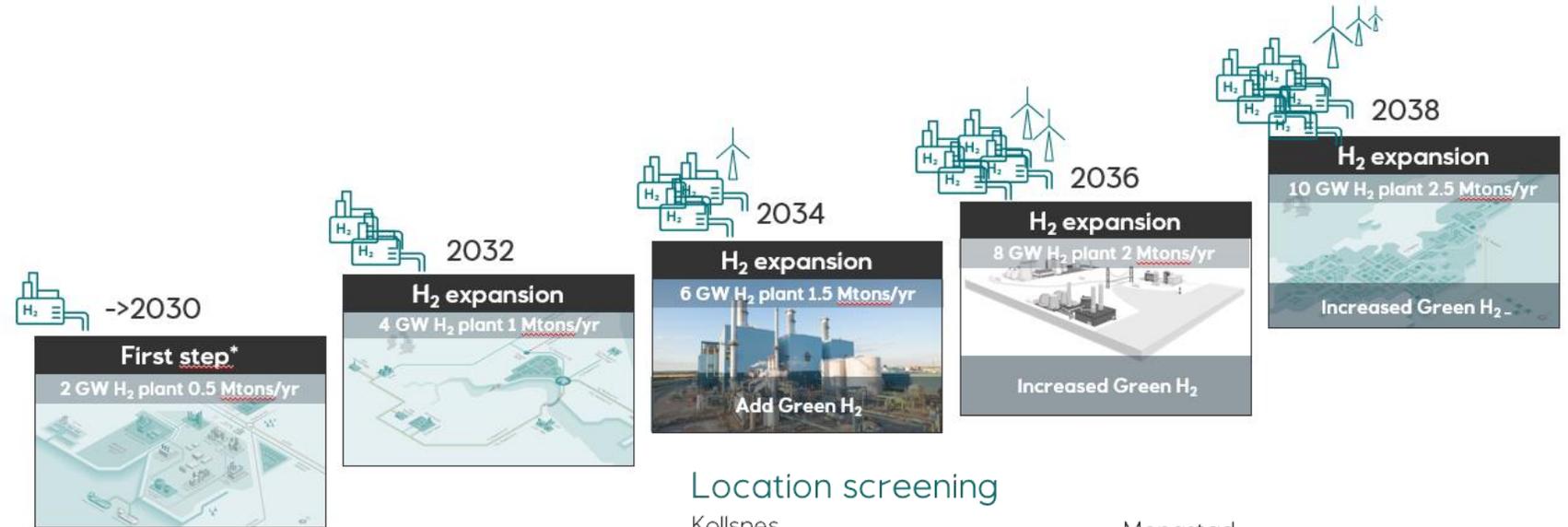
1. **Long-term security of demand** to underpin multibillion Euro investments: willing and able buyers of low carbon hydrogen and CO2 services.
2. **A regulatory framework** within and between countries **that gives predictability for investors** in industrial scale hydrogen and CO2 systems.
3. **Industrial investment partners with a long-term perspective** and **aligned incentives along value chains**.

A broad pipeline of H₂ projects targeting to supply the German market

H2M Eemshaven	NorthH2	AquaSector	H2GE	Clean H2 to Europe	Barents Blue
<p>Low-carbon H₂ from natural gas for hard-to abate industry and power.</p> <p>Transport to off-takers by pipeline.</p>	<p>H₂ production from offshore wind.</p> <p>Power to shore via cable– electrolyzer onshore.</p>	<p>H₂ production from offshore wind.</p> <p>Transported to shore via pipeline.</p>	<p>Large scale low-carbon H₂ production from NCS gas</p> <p>Transported to off-takers by pipeline.</p>	<p>Large scale low-carbon H₂ production from natural gas for export.</p> <p>Transported via pipeline to continental Europe and off-takers.</p>	<p>Low—carbon ammonia production from natural gas.</p> <p>Transported to off-takers by ship.</p>

CHE low carbon hydrogen production plant (West coast Norway)

- Ambition 2.5 million tons (100 TWh) of low-carbon hydrogen p.a.
- FID Phase 1 2026/start up 2030
- Up to 20 million tons CO2 stored p.a.
- Feasibility ongoing



Location screening

Kollsnes



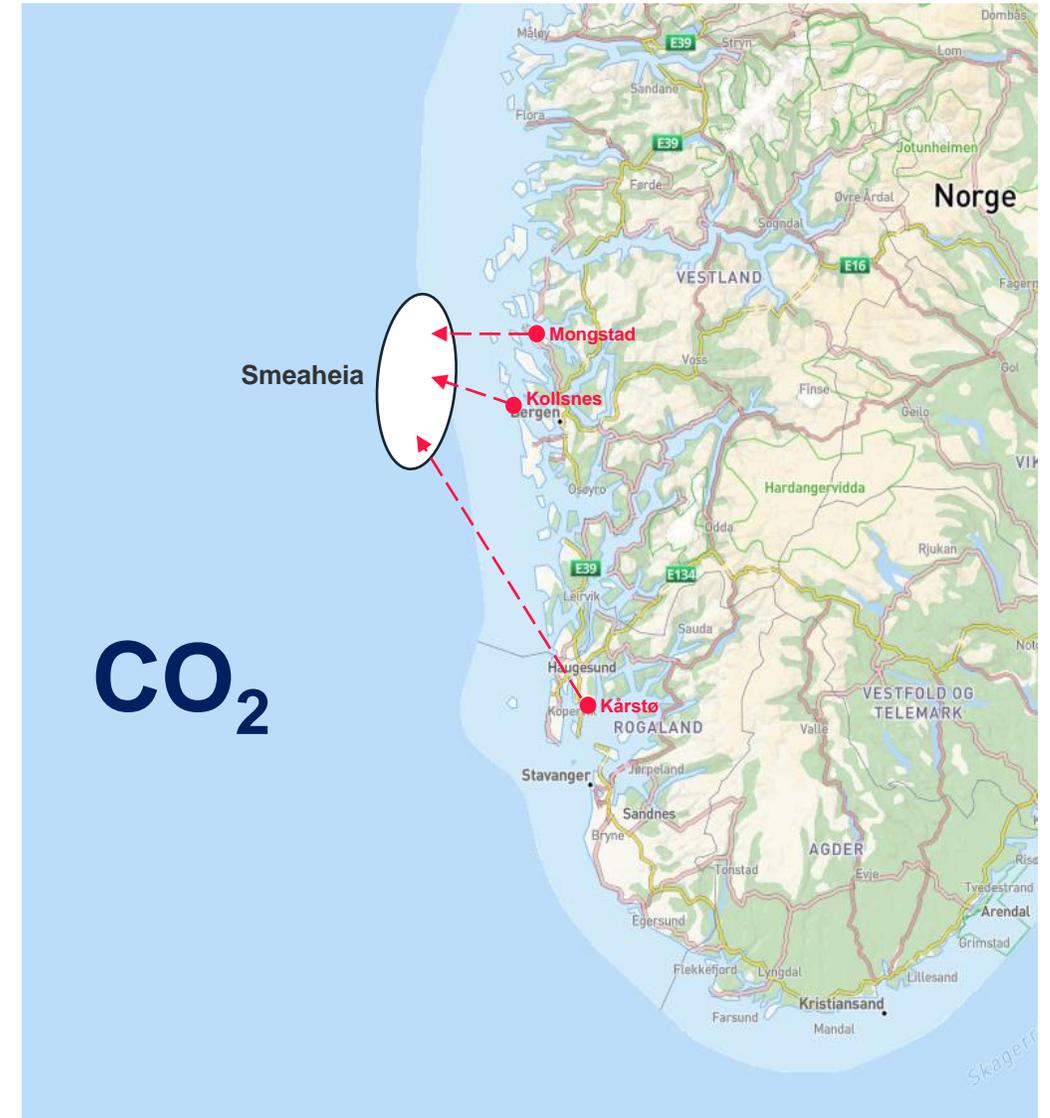
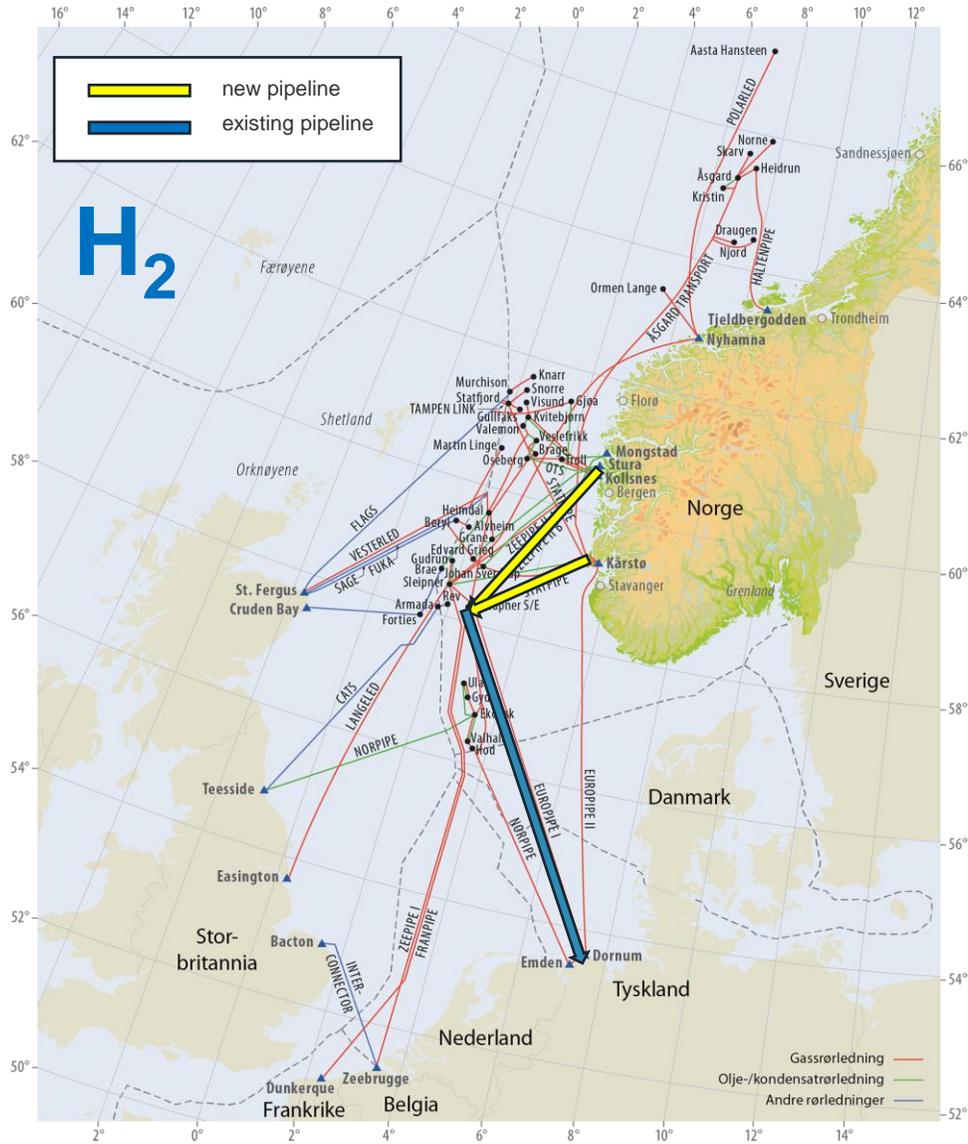
Mongstad



Kårstø

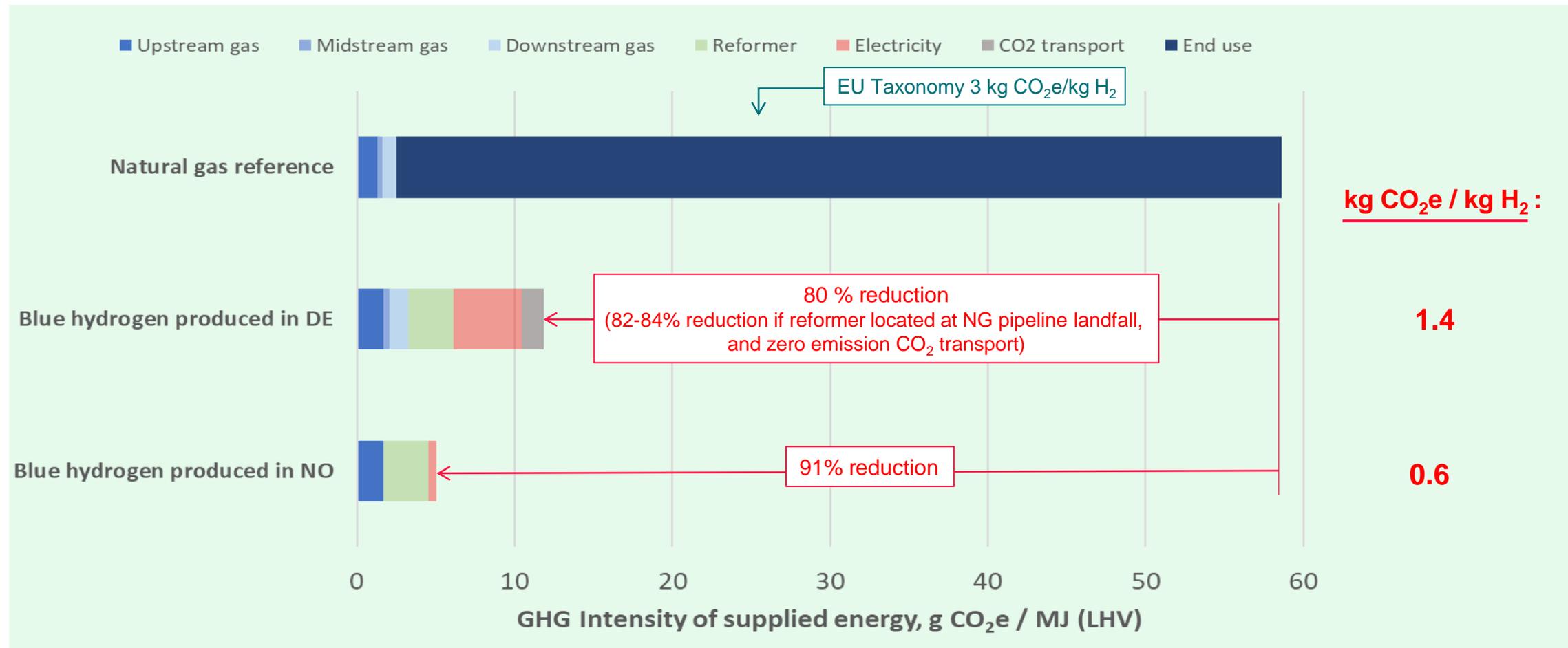


CHE – H₂ and CO₂ export options



Norway the best place in the world to produce blue H₂?

NCS gas and equal energy supply (higher heating value) to end use in Germany as example

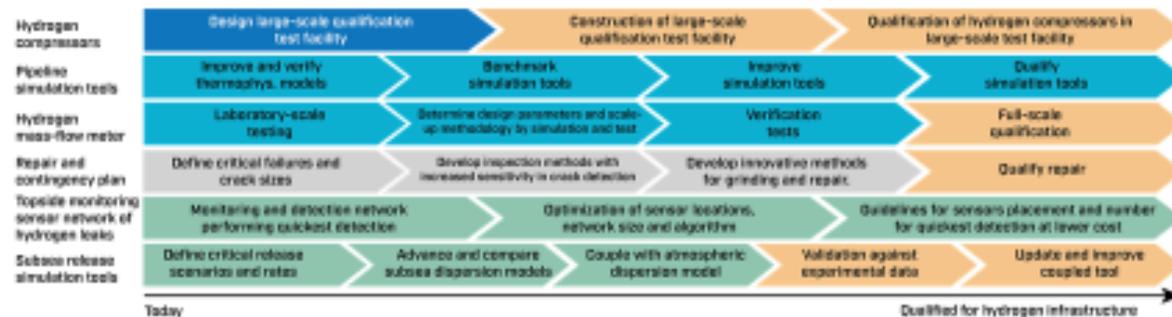
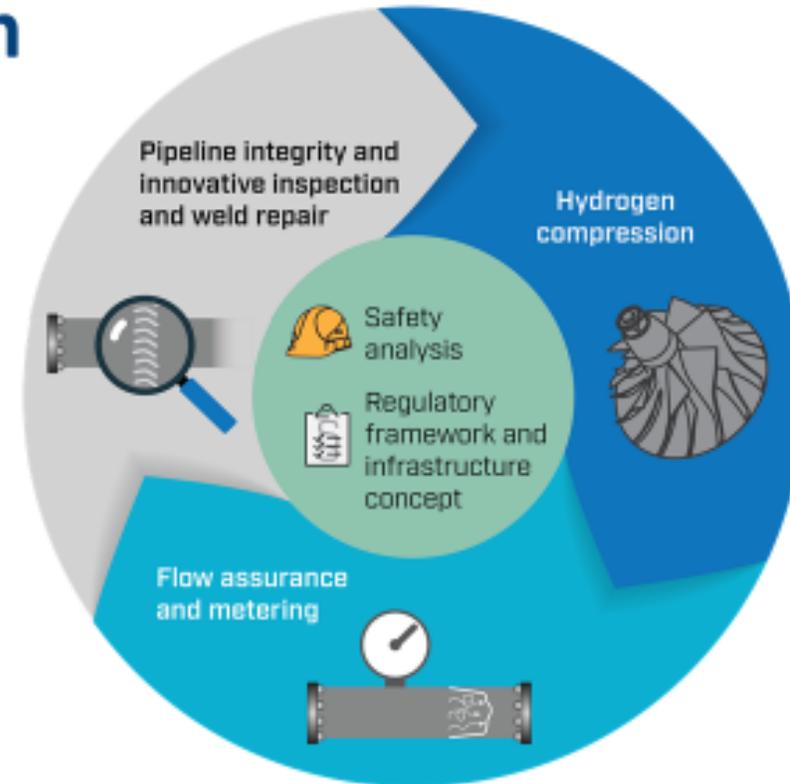


GHG intensity of natural gas supply from Norway to Germany: Upstream / Midstream / Downstream 1.3 / 0.3 / 0.9 g CO₂e/MJ (LHV) (Equinor, 2021)., Gas reforming carbon capture ratio 96%, natural gas input to reformer 3.25 kg/kg H₂, electricity need of reformer 3.5 kWh/kg H₂. Future (2030) grid electricity in DE assumed at 150 g/kWh, NO at 17 g/kWh. Including 2% loss in ship-based CO₂ transport from DE to NO.



The HYITE Green platform initiative (LCEH spin-off)

- Project initiative to Green Platform call
- Objective: HYITE will establish a strong basis for **decisions** to invest in **H₂ infrastructure** to develop a competitive **Norwegian H₂ industry**, by advancing key H₂ transport technologies and systems from the current pre-feasibility state to **technology validation within 2025**.
- Partners: Gassco, Equinor, Shell, CapeOmega, Hydro Havrand, Aker Horizon, Reinertsen, Sustainable Energy Catapult Centre, Cignus, Schlumberger, NDT Global, Kongsberg Ferrotech, Safetec, Subsea7, SINTEF and UiO.
- Duration: 2023-2025
- Budget: ~ 100 MNOK



Two PCI projects being developed to enable large scale CCS and H₂

CO₂ Import Pipelines



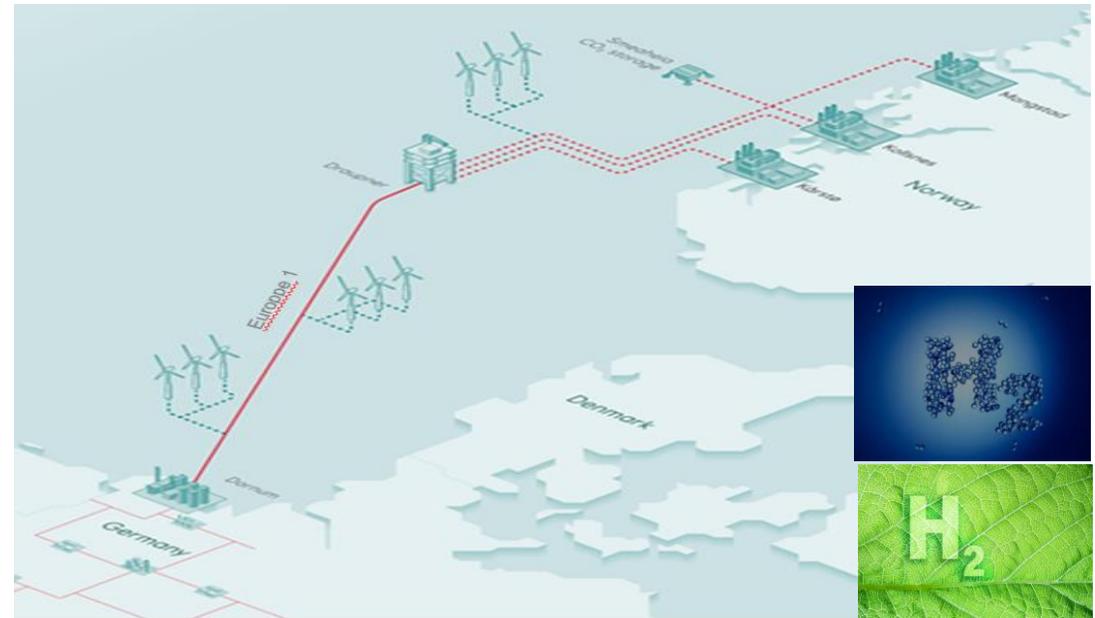
CO₂ imports from industrial emitters and hydrogen plants in Germany, Belgium, and also France, Netherlands and Baltics.

New pipelines, may later consider repurposed gas pipelines

PCI application in development, connecting with CO₂ large emitters / hubs hubs / backbones

Built for future expansion

H₂ Export Pipeline



Low-carbon H₂ from natural gas produced in Norway serving industrial off-takers in GER/ NWE.

New or partly new and partly repurposed natural gas pipeline. Feasibility study with Gassco.

PCI process initiated seeking to connect with the EU Hydrogen Backbone.

Built for future expansion and tie-in of H₂ from offshore wind along route.