Norway Energy Hub – Norway's opportunity to support the transition towards lower emissions in Europe through hydrogen

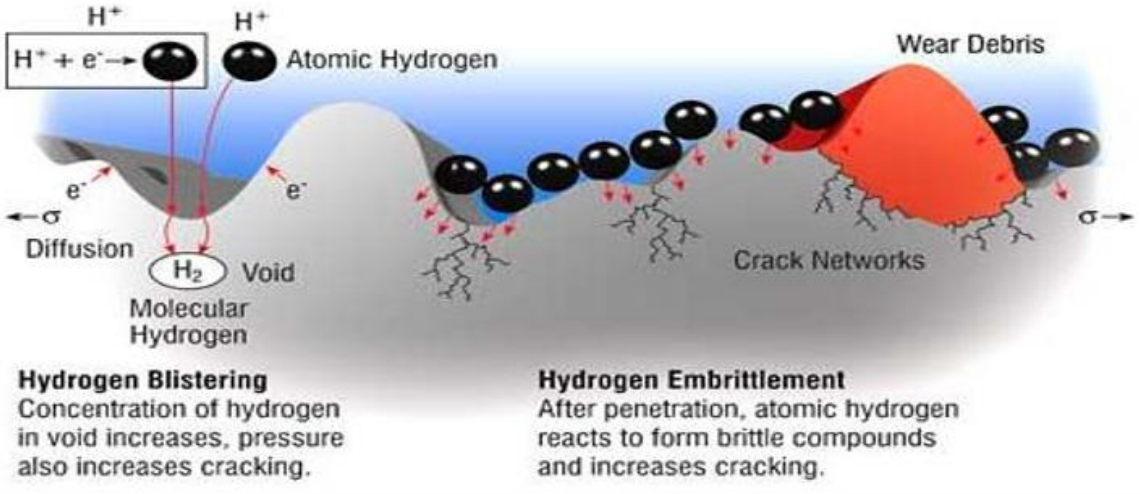
EFECT workshop

02.12.2021

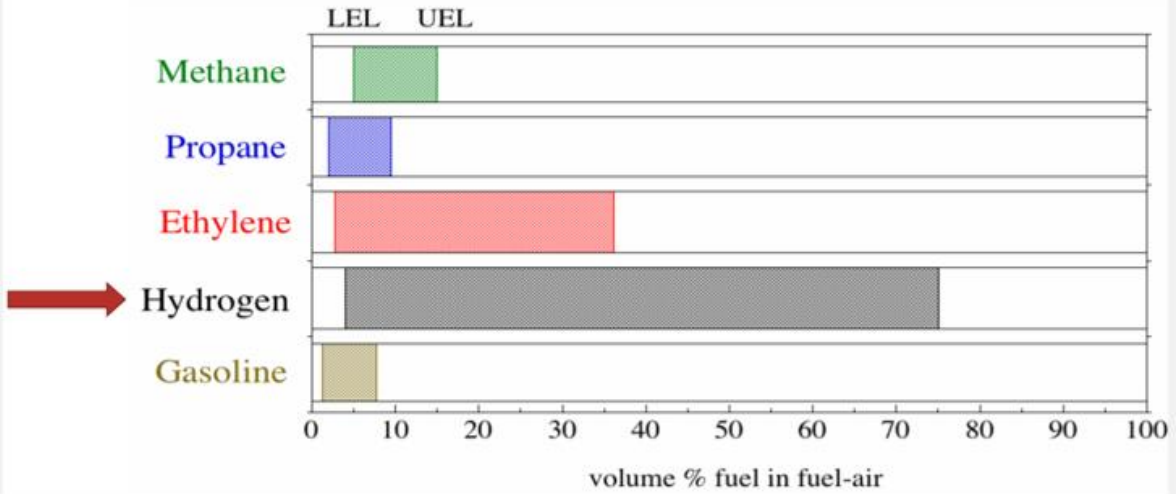
Ulrik Olbjørn
Project Manager CHE

CHE scope

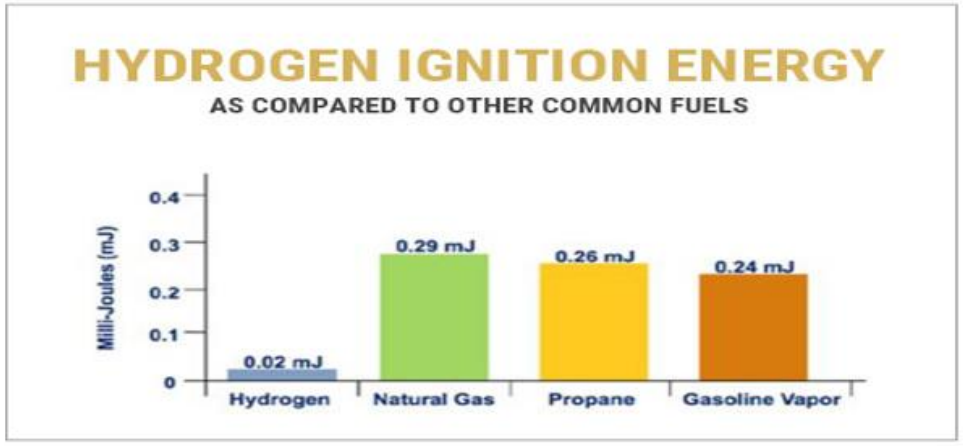
Containment (small molecule + failure mech.)



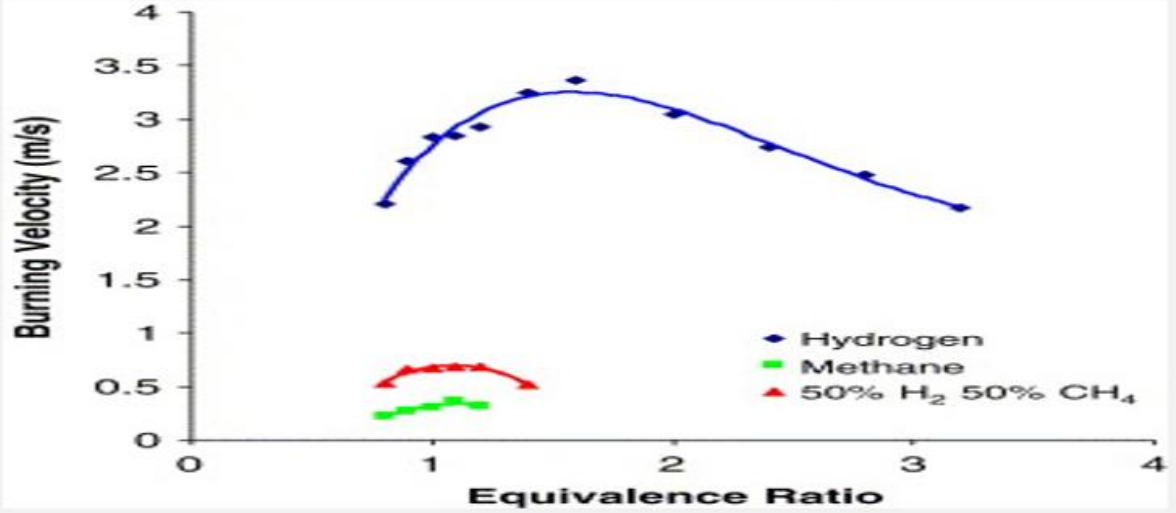
Flammability (wide range)



Ignitability (low energies)



Reactivity (fast flame acceleration and DDT)



Shaping the European future of CCS and clean hydrogen

Competitive edge founded on experience, infrastructure and customers.

15-30 MTPA

CO_2 transport and storage capacity by 2035

Equinor share

>25%

CO_2 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

En industriell plan for energinasjonen Norge

- Bidra til å bekjempe klimaendringene
- Sikre verdiskaping i det grønne skiftet
- Bygge på et sterkt utgangspunkt
- Muligheten er nå

3,9
Millioner boe/d
Olje- og gassproduksjon

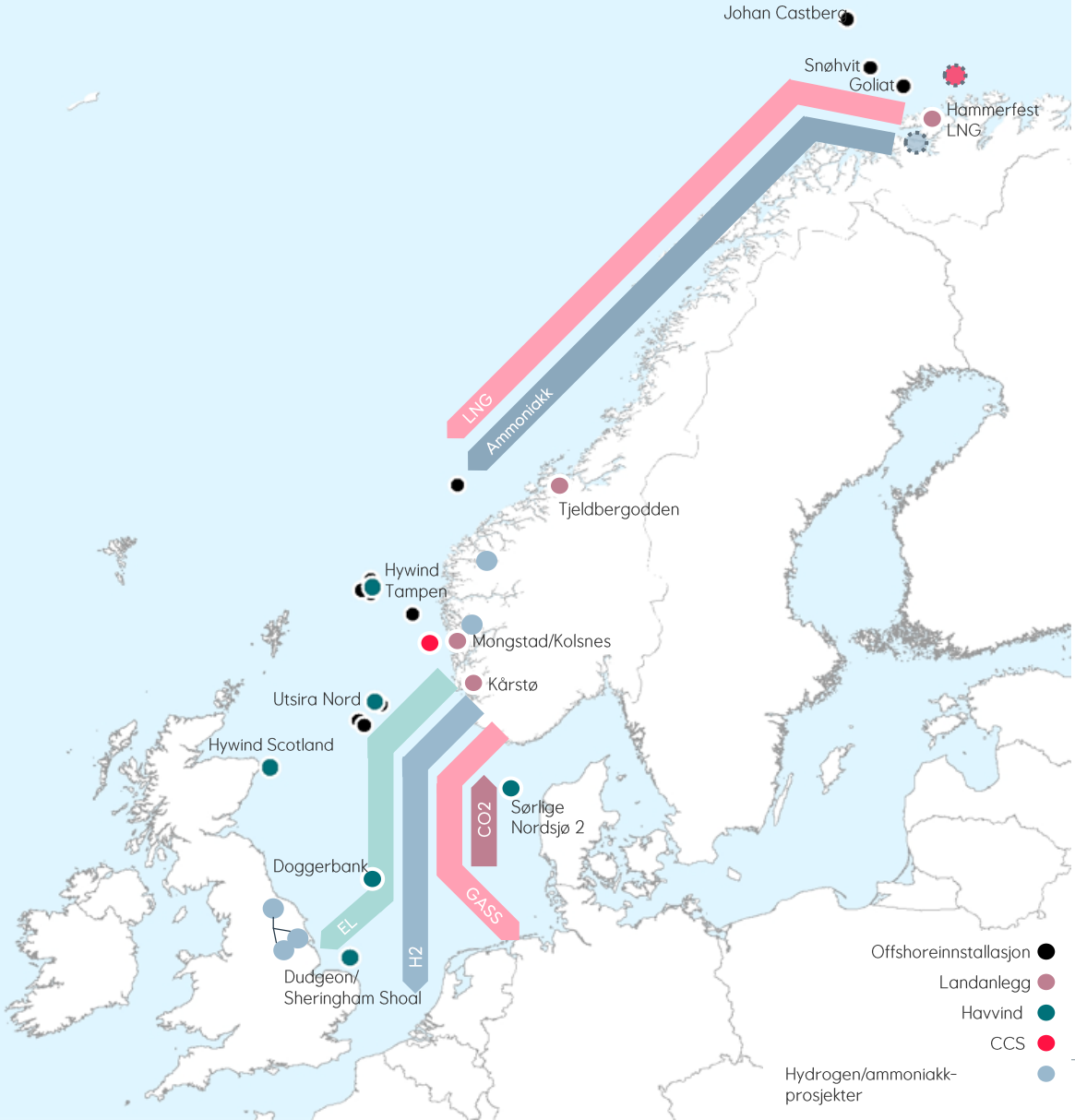
50-100
kboe/d
Eksport av LNG

6,5
GW
Bunnfast vindkraft

3,5
GW
Flytende havvind

40
Millioner tonn/år
CCS lagringskapasitet

2
GW
Hydrogen



A cooperation that creates value and contributes to reaching climate targets

Decarbonise oil and gas production and products

Value creation from oil and gas is the foundation for achieving the goals

50 billion in investments in decarbonising production

Decarbonisation makes hydrogen production possible

Maintain activity and jobs

Industrialise offshore wind

Power to Norway and profitable export of power to Europe

~ 220 billion in investments

10 GW objective for FID offshore wind by 2030

Profitable and global Norwegian supplier industry

Deliver a commercial service for transport and storage of CO_2

~ 80 billion in investments

40 million tons per year in storage capacity

10-15 storage licenses

Thousands of jobs in development phase

Deliver hydrogen as energy carrier at scale

~ 50 billion in investments

2 GW of blue hydrogen

Stepwise development towards 10 GW capacity in combination with green hydrogen

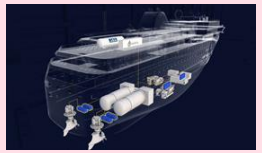
Long-term and profitable jobs

Equinor Hydrogen Portfolio

NORWAY

2024

LH2 Maritime



Liquid H_2 to decarbonize maritime transport in Mongstad

Mongstad

Low Carbon fuels at Mongstad

2025

HyDemo Norway

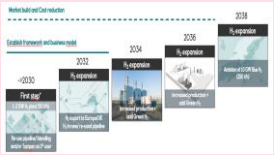
H_2 production with very low CO_2 footprint for marine fuel

Barents Blue

Blue ammonia production in Finnmark for global market

2030

Clean Hydrogen to Europe



Long term vision for exporting hydrogen to Europe

UK

Hydrogen to Humber

Demonstrate world's first at scale hydrogen value chain

2026

Zero Carbon Humber

H2 and CO2 parallel transmission system (Humber)

H2H Saltend

Supplying BLUE hydrogen to the Saltend Chemical Park (Humber)

2028+

H2H – Phase 2

Drax

Complementing renewables with clean flexible power

Green

Phasing of green hydrogen to H2H Saltend concept

Keadby

World leader in carbon neutral fuels and chemicals

NW EUROPE

2027

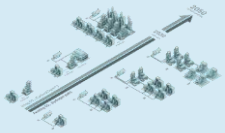
H2Magnum (H2M)

H2 production for on demand power production

Engie collaboration

2027

H2morrow steel



Supply Blue H2 to one of Europe's largest CO2 point sources (steel)

2027

North H2

Development of large-scale OW park dedicated for green H2 production

US

2030+

NE USA

Clean hydrogen for power, fuel and industry - Decarbonizing gas in the NE US

CHE | Indicative modular build-up to manage market risk

Steps of ~2 GW / ~4 Mton CO_2 per module, every ~2 years

Market build and Cost reduction

Establish framework and business model

->2030

First step*

1-2 GW H_2 plant (50 t/h)

Re-use pipeline/ blending and/or Tampen as 1st user

2032

H_2 expansion

H_2 export to Europe/UK
H_2 in new/ re-used pipeline

2034

H_2 expansion

Increased production + add Green H_2

2036

H_2 expansion

Increased production + add Green H_2

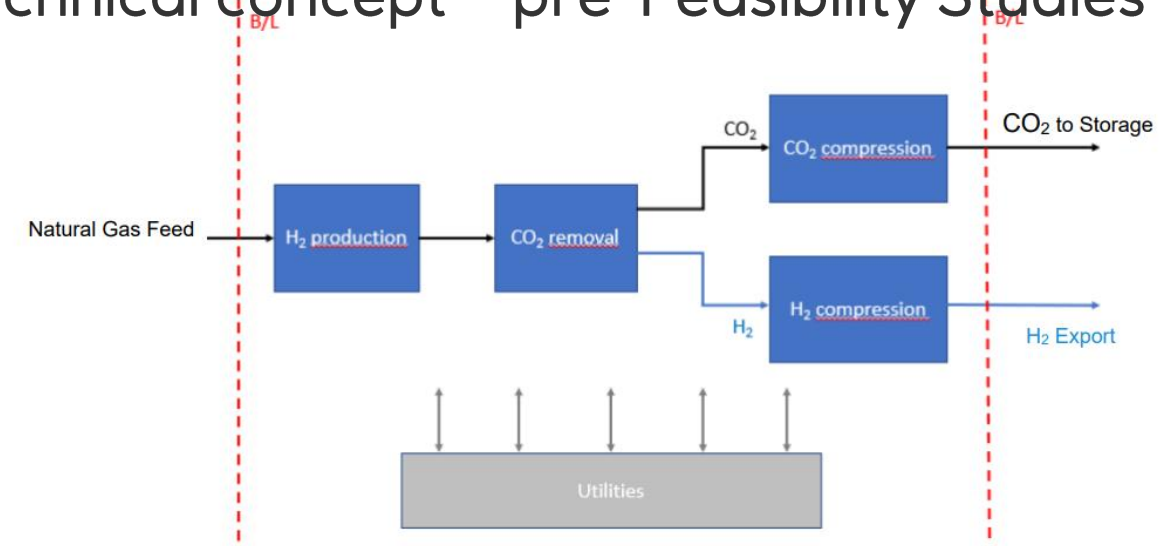
2038

H_2 expansion

Ambition of 10 GW Blue H_2 (250 t/h)

- Standardized, Modular, Stepwise and Sizable approach creates flexibility to manage uncertainty in market and regulatory framework
- Re-use pipeline/ blending in Gassled provides flexibility
- H2 to Tampen - Possible 1st user

Technical concept – pre-Feasibility Studies



Key numbers

Cost estimate (Contractor estimate, onshore plant only) XX Mrd NOK (class A+)

Parameter	Requirement	Phase 1 (2 GW)	Phase 2-5 (-> 10 GW)
CO_2 capture rate (incl. CH_4 in product)	> 95 %	99 % (95 %)	99 % (96
Hydrogen purity	> 98 %	98.1 %	
Energy efficiency (incl. CH_4 in product)	> 75 %	82 % (85 %)	76 % (79 %)
H_2 production		50 t/h	250 t/h
Gas consumption		5.5 MSm^3/a	30 MSm3/a
CO_2 captured		3.7 Mt/a	20 Mt/a
Power from grid	minimize	170 MW	650 MW
Water consumption		300 m^3/h	1500 m^3/h
Area demand		Ca. 300'000 m^2	
Technology maturity	proven technology	Technologies are either proven or on track to be qualified within 2030	
Scalability	standardized and scalable	Same technology process configuration for phase 1 and 2 but with different unit designs	

Location screening

Kollsnes

Mongstad

FF55 | Market for (blue H2) dependent on regulatory framework

1H21 | 2H21 | 1H22 | 2H22 | 1H23 | 2H23 | 1H24 | 2H24 | 1H25 | 2H25 | 1H26 | 2H26

EP election 24/05

Delegated act on Additionality for RFNBOs in Transport

Trilogue negotiations

TEN-E

Trilogue negotiations

CBAM, LULUCF, ESR, Refuel aviation, Refuel Maritime, Cars and Vans, Gas/Hydrogen, methane

Commission

FF55 | Winter package

Parliament

FF55 – short

FF55 – Long

Regulations take immediate effect after publication

Winter Package

Winter Package – Lo

Council

FF55

Winter Package

ETS, ETD, RED, EED, AFID

Member State

National transposition of Directives

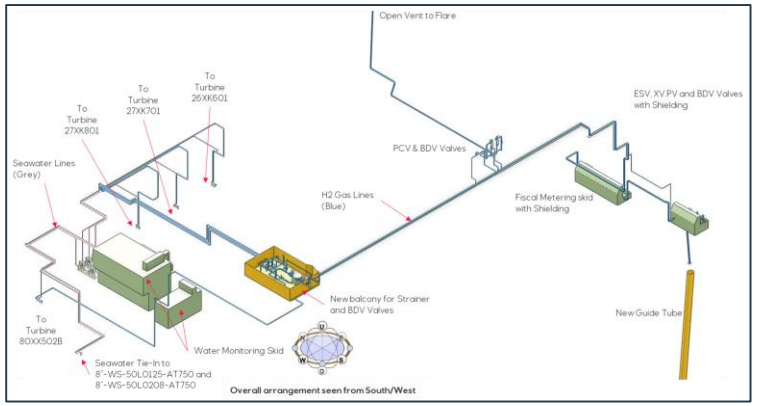
National transposition of Directives

Hydrogen and Gas Decarbonisation package

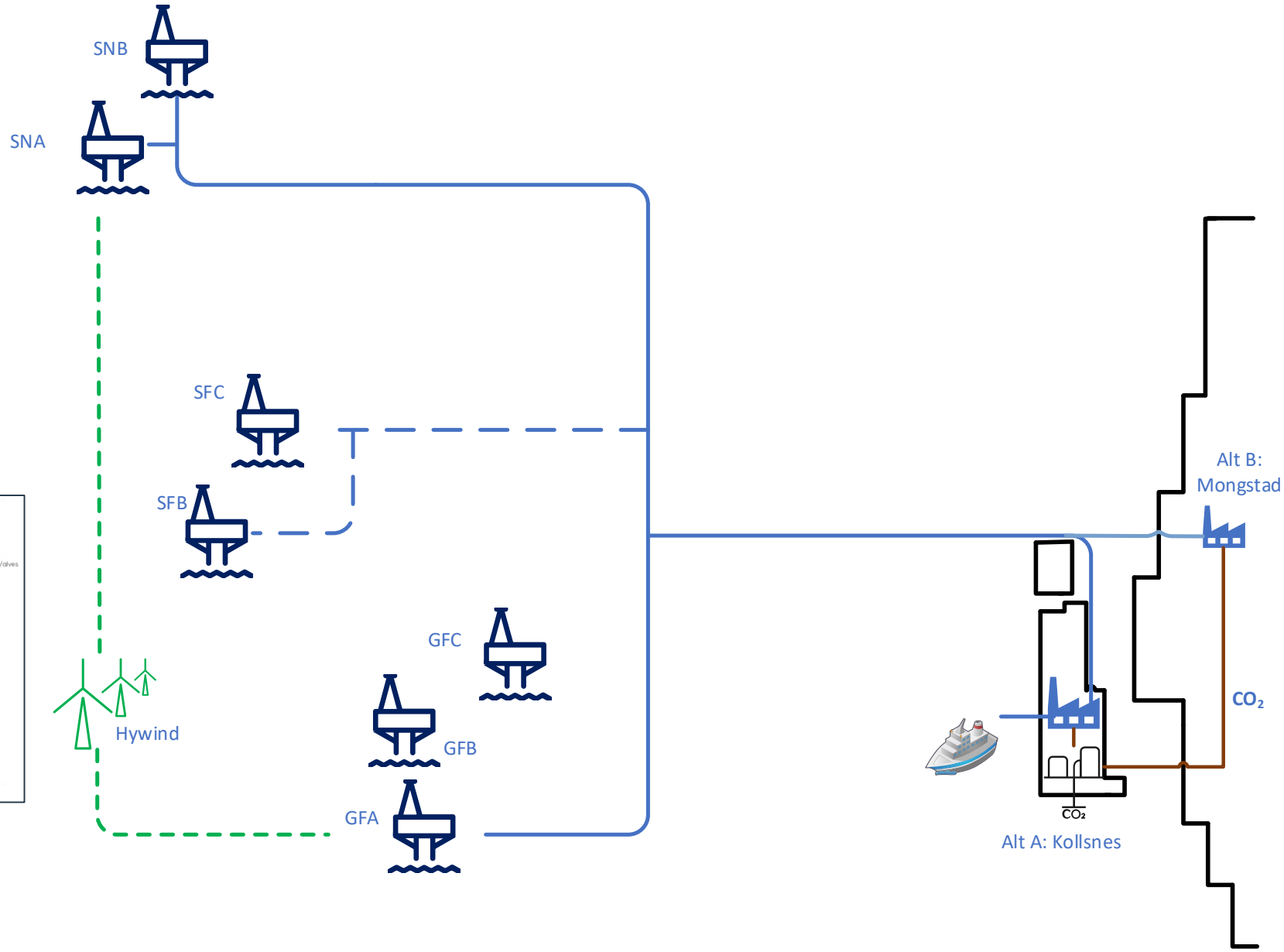
Legislative packages are implemented and impact the market from the mid-twenties

Hydrogen-offshore a possible H2 offtaker? Concept overview

Hydrogen from Kollsnes or Mongstad to Tampen area



Topside mod example



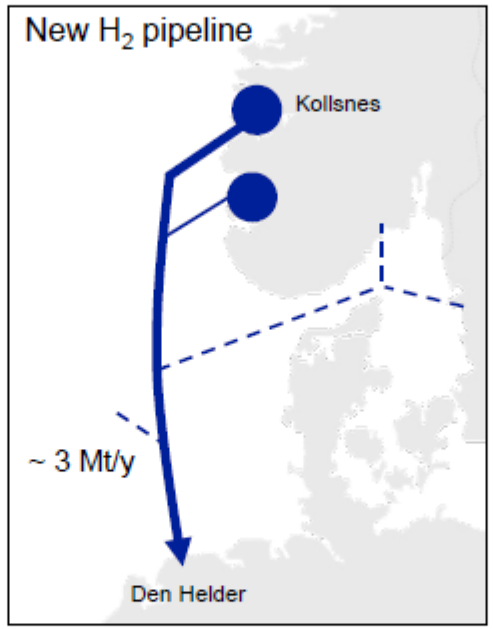
Transport options – new pipeline vs existing pipelines

New Pipeline

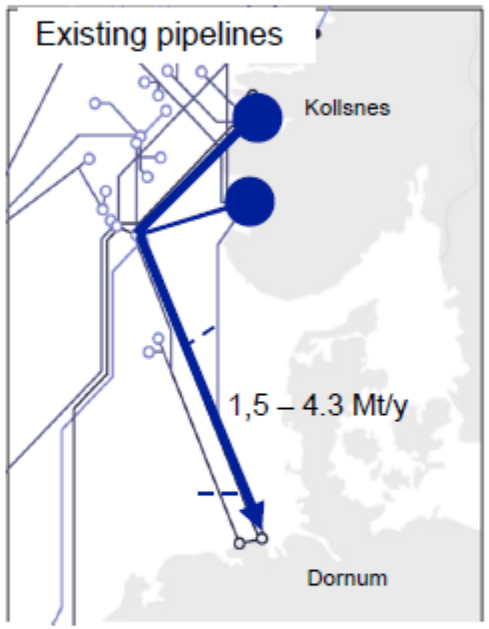
- Volume: ~3 Mt/year
- Outlet pressure: 50 barg
- Diameter: 40 inches
- Inlet pressure: 120 - 150 barg
- Potential other inlets/offtakes
  - Grenland / Sweden
  - Downstream windfarms

Existing Pipeline

- Zeepipe IIB and Europipe – 40"
- Statpipe – 28"
- Reduced pressure
- potential to be increased due to R&D activities
- 1.5 – 4.3 Mt/y
- Exit in Emden
- Potential for blending



CAPEX, ~16 BNOK
(main pipeline only from Kollsnes to Den Helder)



CAPEX, 1 – 2 BNOK
(bypass around Draupner, rock intervention, subsea facilities etc.)

Hydrogen export 2030-2040 potential using existing infrastructure

CHE

10 GW – long term ambition

Utsira

- 1.5+GW – long term solution
- Connecting to Kårstø for green hydrogen & ammonia production

Sørlige Nordsjø II

- 3 GW - Ca. 85 Km from Europipe 1/Ekofisk

NorthH2

- 4 GW - Ca. 40 Km from Europipe 1

Aqua Sector

- 300 MW to start with, 10+ GW future case - Ca. 1 Km from Europipe 1