EQUINOR

Technology Strategy

Energi I Nord, Rotvoll
8 February 2024

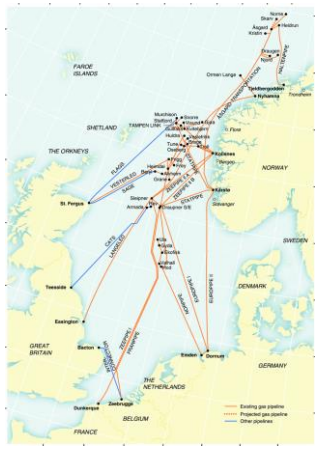
Gunleiv Skofteland

CHIEF RESEARCHER FACILITIES
EQUINOR

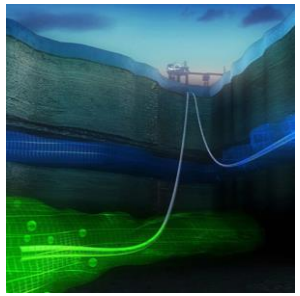
Transforming through technology

1972 — 2022 2030 — 2050

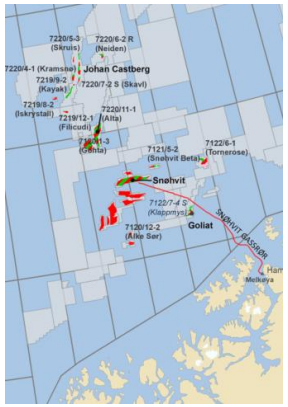
1972
Field developments



Gas infrastructure



CO_2 removal and storage

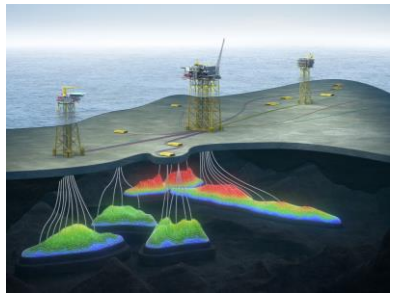


Hammerfest LNG
(Subsea to beach 145 km)

Åsgard subsea compression

Floating wind power

Northern Lights



Unmanned field developments

***50 years** of industry history, realised by innovation, and project execution excellence*

Technology strategy

Delivering on the corporate / BA ambitions to accelerate our transition

CORPORATE AMBITIONS → TECHNOLOGY STRATEGY

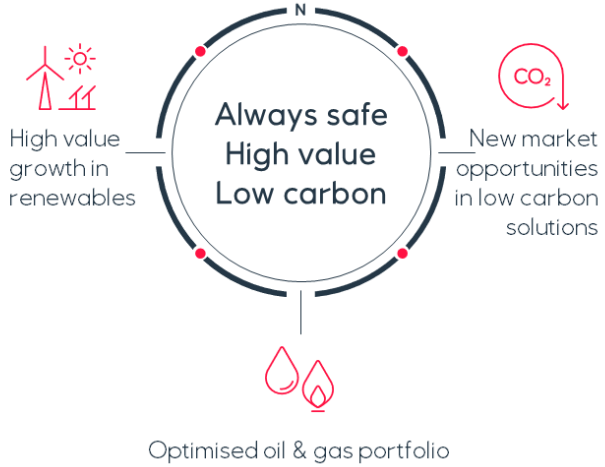
A leading company in the energy transition

Turning natural resources into energy for people, and progress for society

Why we are changing

- Creating value through the energy transition
- Net-zero ambition gives new industry opportunities
- Technology excellence and innovation define winners
- Market dynamics set margins under pressure

Accelerating our transition



How we will get there - together

- Safe and secure operations
- Guided by our values
- Building on competencies and our experience
- Together as one team – engaging partners and society

MISSION

Transforming through technology

Guiding principles

- **Embed** data and digital
- **Scale** for competitive advantage
- **Integrate** technology
- **Co-innovate** with partners
- **Deliver** distinctive expertise
- **Modernise** our delivery models

Value-creating technology to be developed over 11 cross cutting themes across three pillars

- **Delivering** impact to the business today
- **Applying** solutions to build the company of tomorrow
- **Transforming** into a data driven company

Always safe | High value | Low carbon

Equinor Technology strategy

'TRANSFORMING THROUGH TECHNOLOGY'

Equinor's technology mission

GUIDING PRINCIPLES | Transform the way we operate

Embed: data and digital

Scale: for competitive advantage

Integrate: technology

Deliver: distinctive expertise

Modernise: our delivery models

Co-innovate: with partners

STRATEGIC THEMES | What the technology strategy is solving for

Delivering impact to the businesses today

- Discover and utilise the total near and in field resource potential
- Extend lifetime and re-use of infrastructure
- Optimise energy production through next gen operations
- Drive cost-efficient scaling of offshore wind

Applying solutions to build the company of tomorrow

- Develop large-scale value chains for hydrogen and derivatives
- Capture synergies through energy system integration
- Build scalable solutions for carbon capture, transport & storage
- Develop competitive solutions for trading and supply

Reduce CO_2 emissions from our activities

Transforming into a data-driven company

- Develop a resilient and scalable digital foundation to drive business agility
- Accelerate data-driven decision making

What does it take?

- **People and capital prioritisation**
- **Internal delivery models and ways of working**
- **New business models & strategic partnerships**
- **Capability building**
- **Safety, security and sustainability improvement & technology resilience**

Delivering impact to the businesses today

Discover and utilise the total near and in field resource potential

Objectives

What this theme is solving for

- Improve and develop **solutions to unlock time-critical** proven and unproven near field resources
- Industrialise and **accelerate tie-back solutions**
- Develop **technologies for step change well cost**

Topics

Building blocks to deliver on objectives

- Data-driven solutions for unbiased target identification and characterisation
- Efficient well planning, construction, intervention, plugging and abandonment
- Effective subsea processing to reduce field development cost and increase recovery
- Efficient reservoir modelling, production forecasting and monitoring

Delivering impact to the businesses today

Extend lifetime and re-use of infrastructure

Objectives

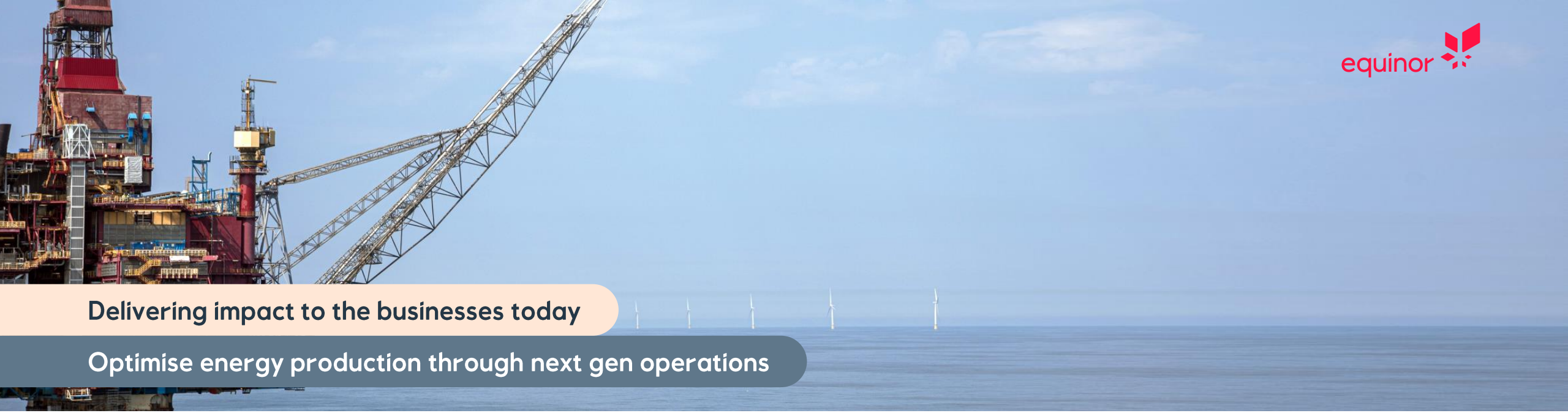
What this theme is solving for

- **Apply technology** to prolong life and improve integrity of assets and infrastructure, reducing costs
- **Simplify and adopt** existing technological building blocks (i.e. interchangeable solutions and physical assets) to enable re-use
- Deliver while ensuring **safe, low-carbon and resilient operations;** safeguard operational technology (hardware and software) assets

Topics

Building blocks to deliver on objectives

- Lifetime extension
- Low cost and targeted re-use of equipment, installations and wells
- Life cycle sustainability and circular economy
- Improve safety in operations and design



Delivering impact to the businesses today

Optimise energy production through next gen operations

Objectives

What this theme is solving for

- Optimise **installation, hardware modification and maintenance processes**
- Drive technology and digitalisation to **improve field development and energy efficient** operations to lower unit production cost

Topics

Building blocks to deliver on objectives

- Predictive and efficient maintenance and performance monitoring
- Real time prediction and optimisation of energy production
- Balance high recovery with low energy consumption
- Digital technologies and tools for operations and holistic resource utilisation

Delivering impact to the businesses today

Drive cost-efficient scaling of offshore wind

Objectives

What this theme is solving for

- Optimise **early phase design** and deliver differentiated solutions that **drive cost advantage** with competitive sustainability attributes
- Develop **digital solutions** in development and operation **to drive value**
- Develop **scalable and repeatable solutions** to enable Equinor to reach 2030 capacity target

Topics

Building blocks to deliver on objectives

- Data-driven site selection, early phase concept optimisation and ecosystem impact reduction
- Standardisation and industrialisation in construction and installation
- Data-driven decision support in operations and maintenance

Delivering impact to the businesses today

Applying solutions to build the company of tomorrow

Reduce CO_2 emissions from our activities

Objectives

What this theme is solving for

- Develop and integrate **cost efficient technology** to reduce emissions from owned/ controlled operations (incl. platform electrification) and from purchased energy
- Enable **reduction of embedded emissions** in purchased services and goods, including via design optimisation

Topics

Building blocks to deliver on objectives

- Production methods and strategies that enable CO_2 reduction
- Facility design and construction for CO2 footprint reduction
- Reduce CO_2 emissions from ongoing energy production

equinor

Hydrogen & Low Carbon Solutions

Supporting corporate strategy & ambitions

Strategic focus areas

High value growth in renewables

Optimised oil & gas portfolio

New market opportunities in low carbon solutions

3-5 MAJOR INDUSTRIAL CLUSTERS
Clean hydrogen projects by 2035

>10%
Clean hydrogen market share in Europe by 2035

15-30 MTPA
CO_2 transport and storage capacity by 2035

>25%
CO_2 transport and storage market share in Europe by 2035

Equinor share

Low carbon power

2.5 GW installed low carbon generation capacity (TRITON acquisition, SSE partnership and MoUs with Engie and RWE)

Renewables

12-16 GW Installed net capacity of by 2030

Maritime

50% absolute CO2 reduction in 2030 in Norway

50% absolute CO2 reduction in 2050 globally

Fuel switching to low carbon and zero carbon fuels

EQUINOR

Technology Strategy

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Applying solutions to build the company of tomorrow

Develop large-scale value chains for hydrogen and derivatives

Objectives

What this theme is solving for

- Enable **profitable business in hydrogen** and derivatives
- Foster **attractive strategic partnerships** to gain access to the best projects/ technologies
- **Monitor market to stay updated** on latest development & maintain strong view on tech. roadmap

Topics

Building blocks to deliver on objectives

- Hydrogen and derivatives production and use for transport, power and industrial sectors
- Hydrogen and derivatives transport and buffer storage
- HSE for hydrogen and derivatives

Hydrogen and low carbon solutions key focus areas

Safety & sustainability

Safety –tools, requirements, guidelines and assessment

Climate impact & diffuse emissions management

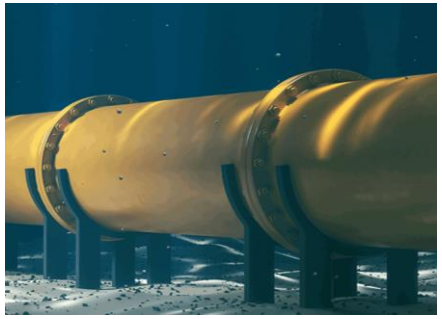
Value chain life cycle analysis models

Production

Efficient and clean H_2 production

Green H_2, methanol and sustainable aviation fuel

Dynamic production, scale up, industrializing and safety in design.



Transport

H_2 transport systems – Pipelines offshore and onshore

Metallic materials exposed to hydrogen

Large ammonia carriers & pipeline systems

Storage

H_2 storage in salt caverns and porous media

NH_3 in rock cavern

End use

H_2 and NH_3 fired gas turbines

Low carbon fuels for shipping and D&W

NH_3 safety

Hydrogen safety & trust

Climate impacts of hydrogen emission & leak

Hydrogen life cycle assessments

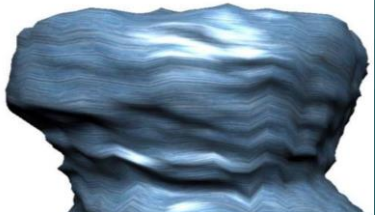
Hydrogen value chain modelling

TDI RLC Hydrogen Value Chain Technologies

Hydrogen and hydrogen carriers from renewable energy

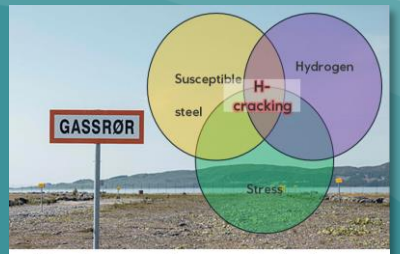
Hydrogen compression

Improved Clean Hydrogen Production



Hydrogen storage

Hydrogen transport systems



Metallic materials exposed to hydrogen

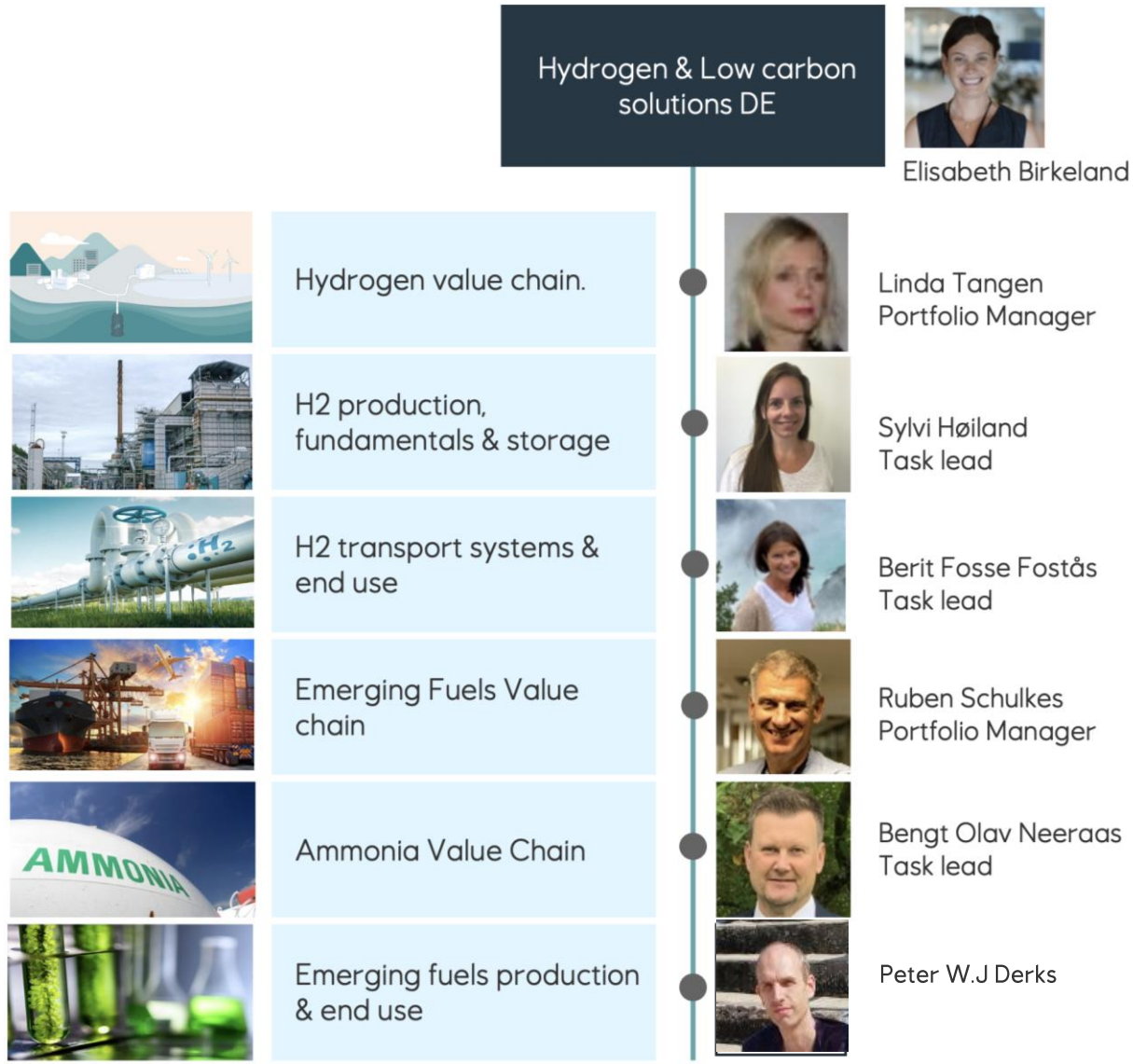
Hydrogen Gas Turbines

Hydrogen & low carbon solutions

Accountable for delivering solutions for current business needs and long-term opportunities within Hydrogen & Low carbon solutions

We are a Delivery Entity with 40+ skillful researchers developing expertise and performing research and technology development within hydrogen and emerging fuels value chains.

Our mission is to deliver competence,toolboxes and technology to develop large scale value chains for hydrogen and derivatives through business partnering and strategic external partners



Collaboration with externals key to succeed

FME's

HYDROGENi

HyValue

The Research Council of Norway

HOME | FUNDING FROM THE RESEARCH COUNCIL | CENTRES FOR ENVIRONMENT-FRIENDLY ENERGY RESEARCH

Centres for Environment-friendly Energy Research

Research institutions

SINTEF

NORCE

The Welding Institute

IFE

ifp Energies nouvelles

Academia

University of Oxford

Universitas Bergensis

NTNU

MITei MIT Energy Initiative

Suppliers

SIEMENS energy

Baker Hughes

MITSUBISHI HEAVY INDUSTRIES

Thomassen Energy a Hanwha company

Hydrogen pro

Linde

GREEN HYDROGEN SYSTEMS

TOPSOE

Industry & energy

ENGIE

sse

snam

GASSCO

DNV

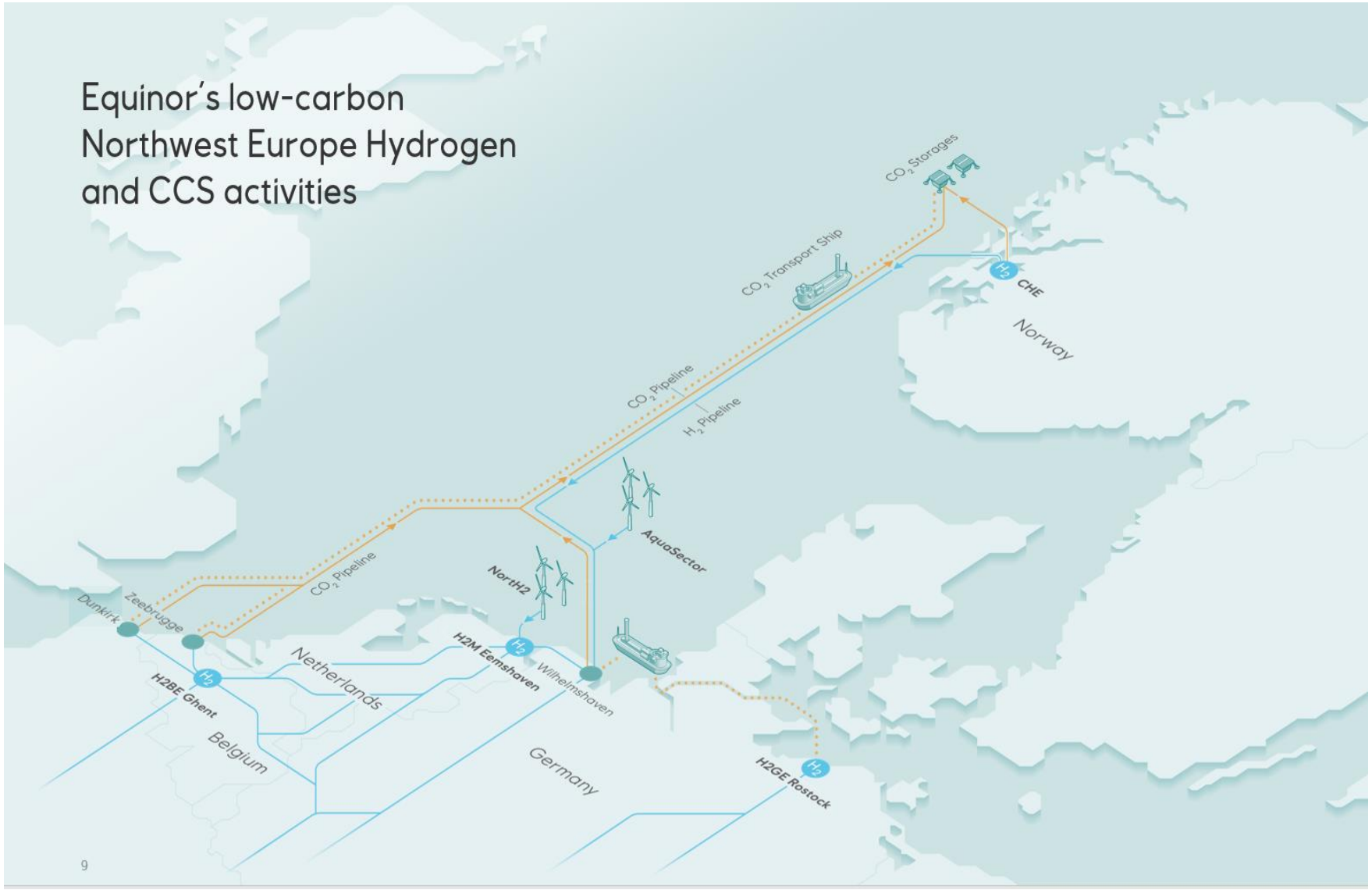
Supporting development Hydrogen value chain

Enabling trough technology and competence

CHE project deliveries

- Technology assessments Hydrogen production and pipeline transport systems
- Technology qualification plans and activities

RWE strategic collaboration - green H2 and H2 ready GT roadmaps

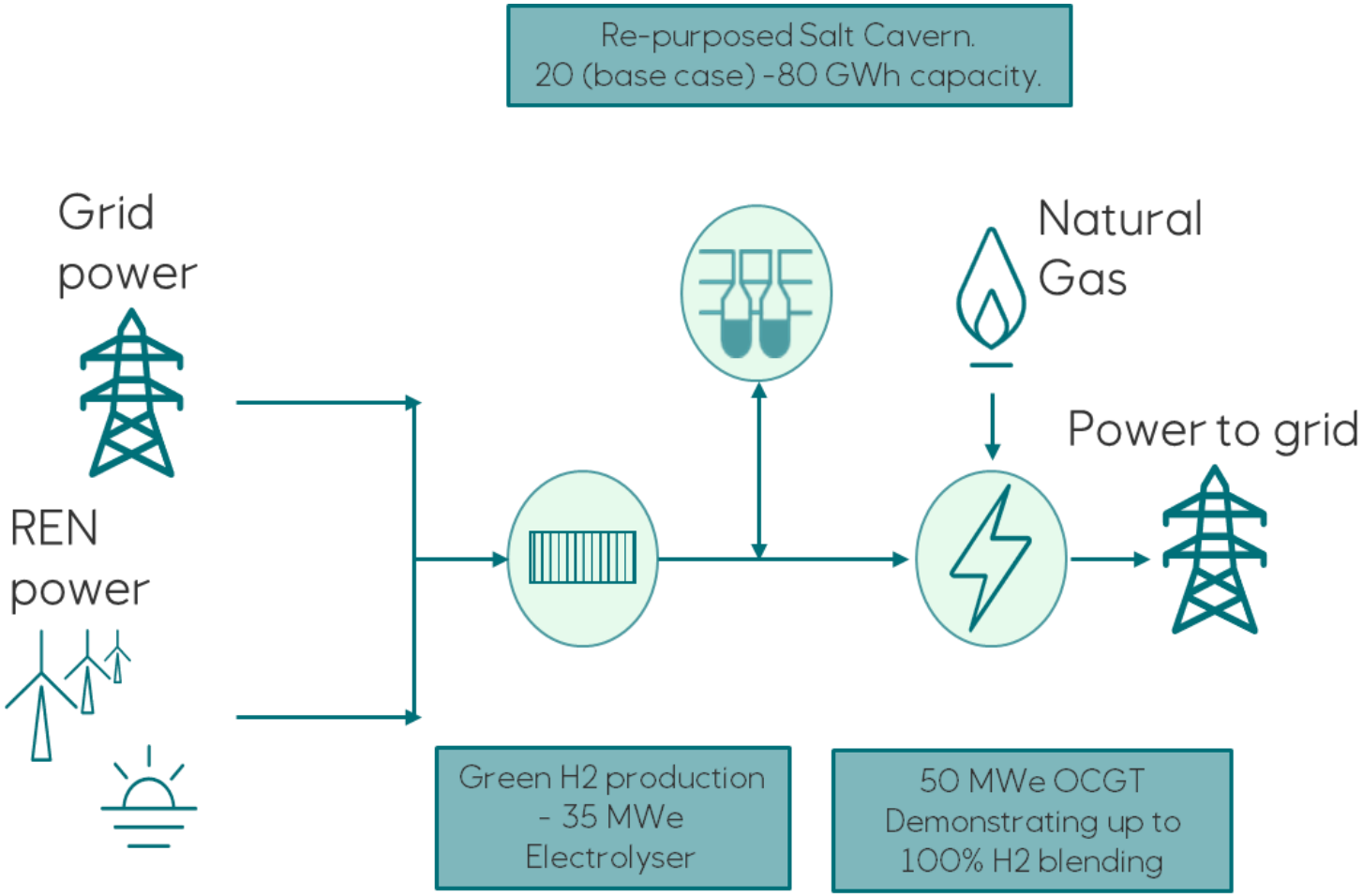


Maturing trough piloting – Aldborough Hydrogen Pathfinder

Equinor limited to no experience in AHP key focus areas – AHP will advance development and deployment of hydrogen technologies

AHP key in

- Qualifying and de-risking H2 storage
- Qualify well safety barriers for H2 storage wells
- De-risking future green H2 projects
- Safety learnings



Carbon Capture and Storage

Equinor's CCS ambitions

15-30 MILLION TONNES PER ANNUM

CO_2 transport and storage capacity by 2035
Equinor share

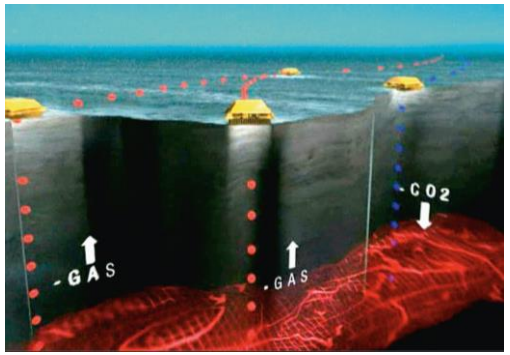
>25%

CO_2 transport and storage market share in Europe by 2035

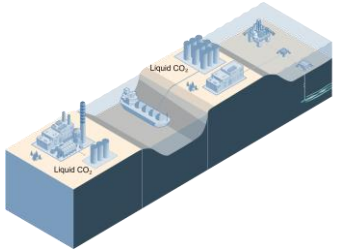
CCS is ready to be deployed at scale

Sleipner
Operation 1996

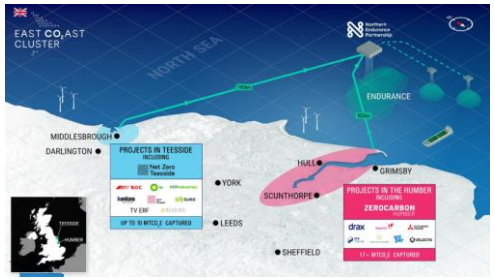
Snøhvit
Operation 2008



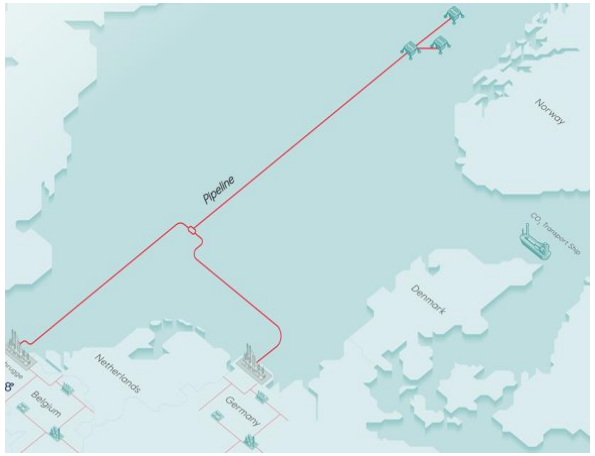
Northern Lights
Operation 2024



Northern Endurance Partnership
Operation 2026



CO2 Highway Europe
Operation 2029



3. Scale-up to bring costs down

2. Northern Lights – Market opener

1. Sleipner/Snøhvit – Technology works!

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Technology Strategy

Applying solutions to build the company of tomorrow

Build scalable solutions for carbon capture, transport and storage

Objectives

What this theme is solving for

- Develop solutions to **profitably manage and optimise CO2 solutions for** transportation and storage, at scale together with partners
- Establish **competitive advantage** in licensing carbon storage acreage

Topics

Building blocks to deliver on objectives

- CO_2 storage identification, maturation and optimisation
- CO_2 transport and injection system optimisation
- CO_2 storage integrity and monitoring
- CO_2 value chain system optimisation

"CO2 Highway Europe"

CO_2 pipeline transport – connecting continental Europe to NCS

Norway

Denmark

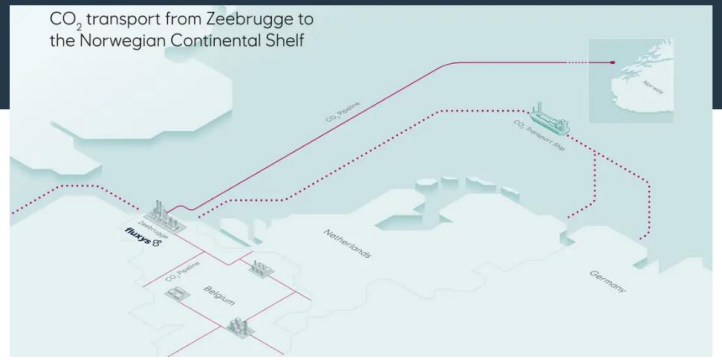
Great Britain

Netherland

Belgium

Fluxys and Equinor launch solution for large-scale decarbonisation in North-Western Europe

29 JUNE 2022 08:30 (CEST)



Equinor and Wintershall Dea partner up for large-scale CCS value chain in the North Sea

30 AUGUST 2022 08:00 (CEST)

Equinor's CCS portfolio | September 2023

USA

Project name	Project type	Country
Northern Lights (NL)	CO_2 transport & storage	NO
Northern Endurance Partnership	CO_2 transport & storage	UK
Smeaheia	CO_2 transport & storage	NO
CO2 Trunkline	CO_2 transport & storage	DE,NO,BE
Net Zero Teesside (NZT)	Power + CCS	UK
Keadby 3	Power + CCS	UK
Peterhead	Power + CCS	UK
Bayou Bend	CO_2 transport & storage	US

NORTHWEST EUROPE & UK

Applying solutions to build the company of tomorrow

Capture synergies through energy system integration

Objectives

What this theme is solving for

- Identify and pursue opportunities **to integrate solutions**, across technologies and energy sources, in early phase design
- **Manage intermittency in the energy market** to capture value upside in operations

Topics

Building blocks to deliver on objectives

- Multi-technology energy system modelling and market analysis tools
- Storage and sector coupling solutions for handling of intermittency and flexibility