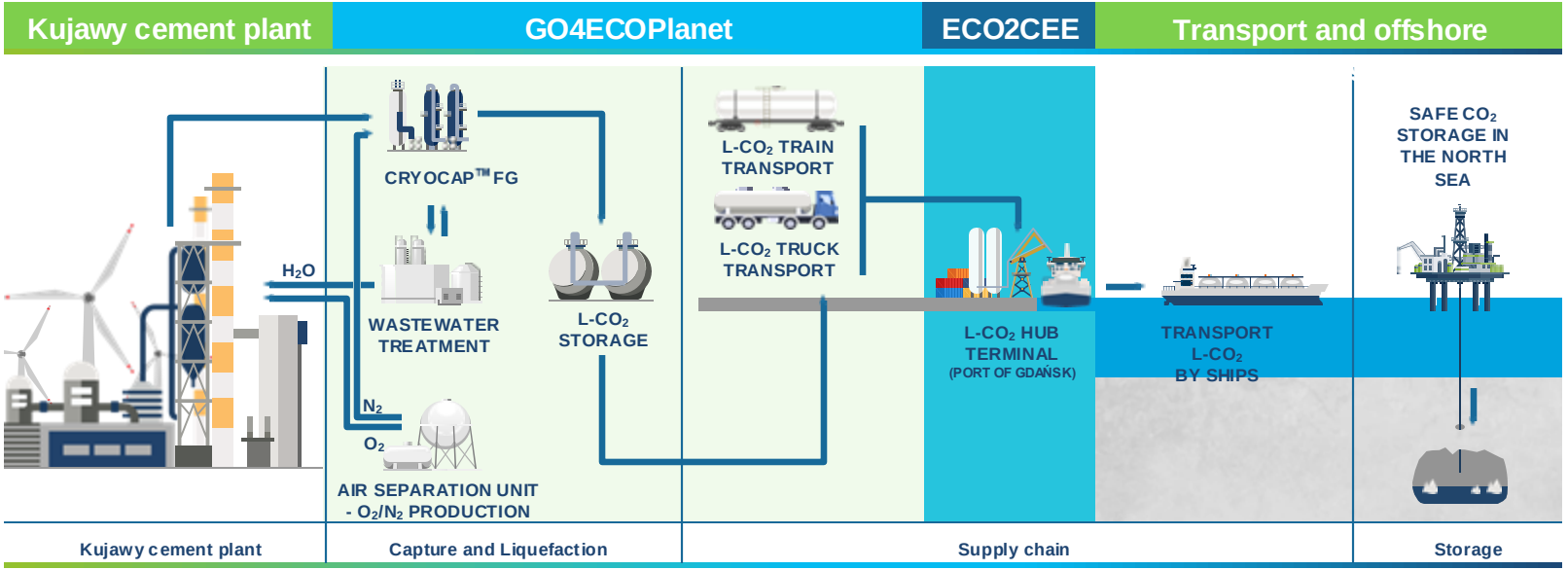
GO4ECOPLANET KUJAWY - VALUE CHAIN

FROM CAPTURE TO STORAGE



- 1.1 mtpa CO_2 capture capacity
- Inland transport: ~200 railcars, regular rail freight service (up to 2 trains per day)
- Maritime transport: up to 2 vessels, 1-2x/week

TIMELINE & KEY BUSINESS CONDITIONS

TO REALIZE THE PROJECT

Preparatory phase - ongoing

EU grant (228m€) awarded;
Environmental decision and Building Permit - granted;
Feasibility Studies and FEED completion;
Detailed engineering - Capture plant
Transport & Storage contracts negotiation

WP1 - Financial Close / FID

All contracts in place, including permanent storage and the supply of railcars and ship

WP2 - Main Equipment Delivery

Civil works - capture plant incl. intermediate storage & loading terminal

WP3 - Entry Into Operation

Subject to the readiness and operativity of the entire value chain, including:
- Capture unit,
- Railcars,
-Transhipment terminal (HUB),
- Ship,
- Storage sink.

2022-2026 | **Q2 2026** | **Q3 2028** | **2029**

Critical areas

- Alignment of FID and Start of Operations across the CCS value chain
- CO_2 Export terminal ready on time
- Cost effective, safe and timely CO_2 storage solution
- Infrastructure development maturity of the CO_2 transport, export/conditioning & Storage
- Acceptable and standardized CO_2 specification, considering the entire value chain
- Favorable project economics at FID

Go4ECOPlanet

www.go4ecoplanet.com

Co-funded by
the European Union

HOLCIM

Beccs Stockholm

Objective: Capture of 800 kt biogenic CO_2 from an existing bio-fuel fired heat & power plant (KVV8)

Location and participants: Located at Värtaverket, Stockholm, in the heart of Stockholm's district heating system. Implemented by Stockholm Exergi, Sweden's largest district heating company. (Owned by the City of Stockholm and Ankhiale.)

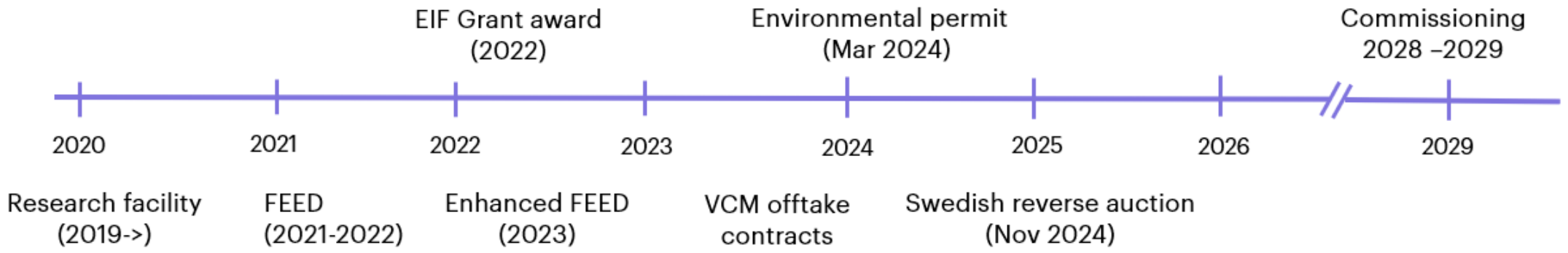
Project overview: *Investment in a post-combustion Carbon Capture facility based on HPC technology, as well as liquefaction and intermediate storage for further transport of the* CO_2

Beccs Stockholm

Funded by the European Union

CO2 transport and storage needs

- The project will capture 140 t per hour or ~100 kt per month at full load. 800 kt on a full season due to seasonality (lower summer load)
- Project financing in a combination of EiF grant, the voluntary carbon market (VCM) and the Swedish reverse auction
- Final storage site not yet appointed/selected. Coordination of time-lines, project milestones and conditions crucial
- Pre studies on further CCS implementation on two WtE-plants in Stockholm Exergi´s network initiated



Beccs Stockholm

Funded by the European Union

TotalEnergies

Carbon Capture and Storage Business Unit

October 2th, 2024

Deploying CCS strategy

Reducing emissions and developing profitable business

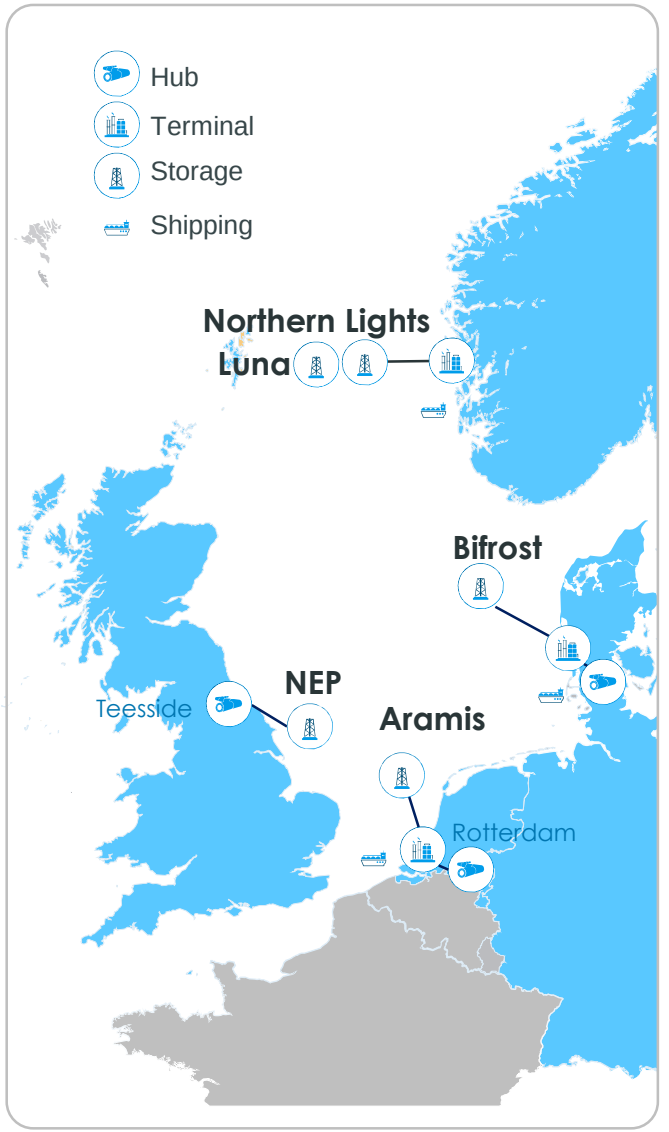
CCS for our assets

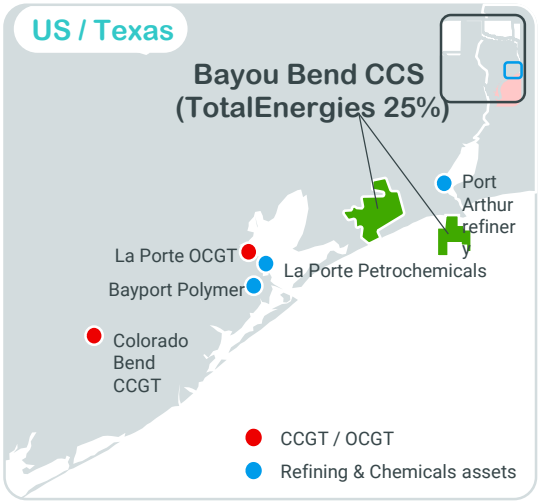
- Reduce emissions from existing assets
  - Ichthys (Australia)
    awarded GHG storage assessment permit
  - Cameron LNG (US)
    Hackberry Carbon Sequestration project under development
  - Refineries
- Avoid emissions in greenfield projects
  - North Field East & South (Qatar)
  - Papua LNG (Papua New Guinea)

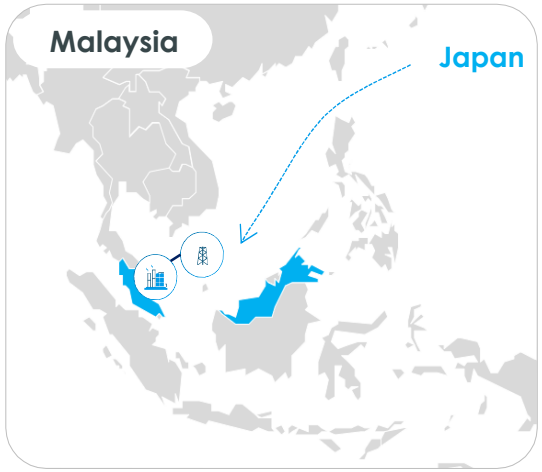
Offering CCS services

- Build a profitable, scalable business and offset Scope 3 emissions by offering CCS solutions to our customers
- North Sea core area
  - Under Construction, **Northern Lights**
  - Under development
    - Focusing on our depleted assets and saline aquifers
    - **Aramis (NL, op.), Bifrost (Denmark, op.), NEP (UK), Luna (Norway)**
- Worldwide growth
  - **Bayou Bend (US), Southern Cluster (Malaysia)**

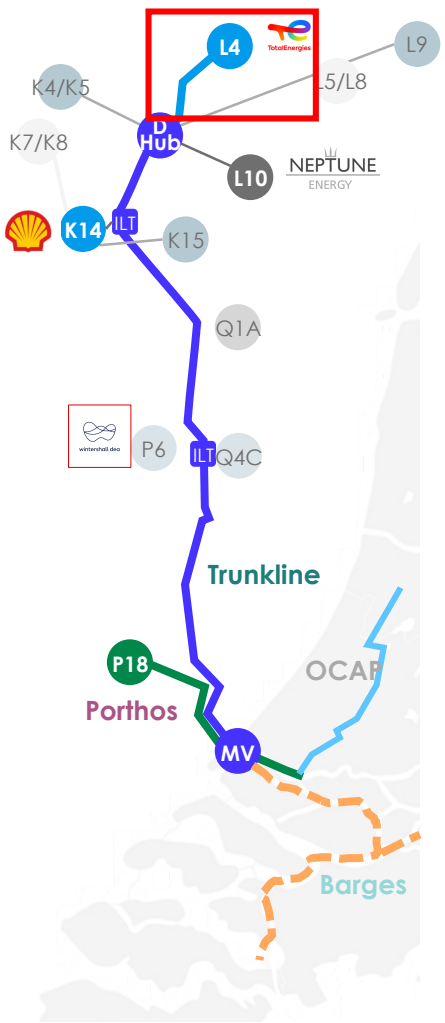
2030 target (Company share)
> 10 Mt/y







TotalEnergies CO_2 Storage Development Aramis connected



FEED studies are ongoing:

- Reservoir Monitoring studies, incl. monitoring equipment – prep. of seismic survey
- Wells and completion definition
- Spurline / Module design & integration with external FEED contractor
- Issue Call for Tenders in Q1-25

Storage License Application

- Mining Council (12 Sept), license text under preparation by Ministry Climate & Green Growth
- Liabilities: remains with Storage licensees until 20 years after end of injection can be shortened. Request to limit to end of injection, in case of no leakage during operational life.
- NZIA rights should be 100% for TTE as sole license holder

Permits - Public Consultation ongoing (6 wks up to end of Oct)

- Environmental Impact Assessment report for the whole Aramis value chain
- L4A Mining Environmental Permit
- Spurline permit will be under public consultation in Q1-25

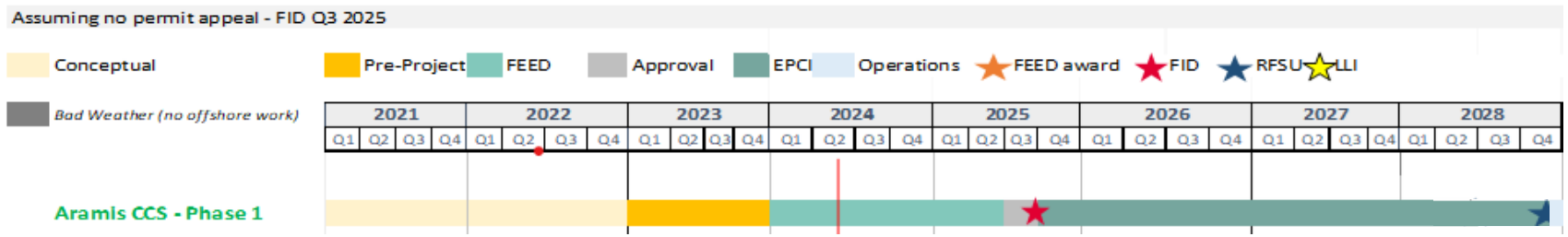
IF Subsidy Application

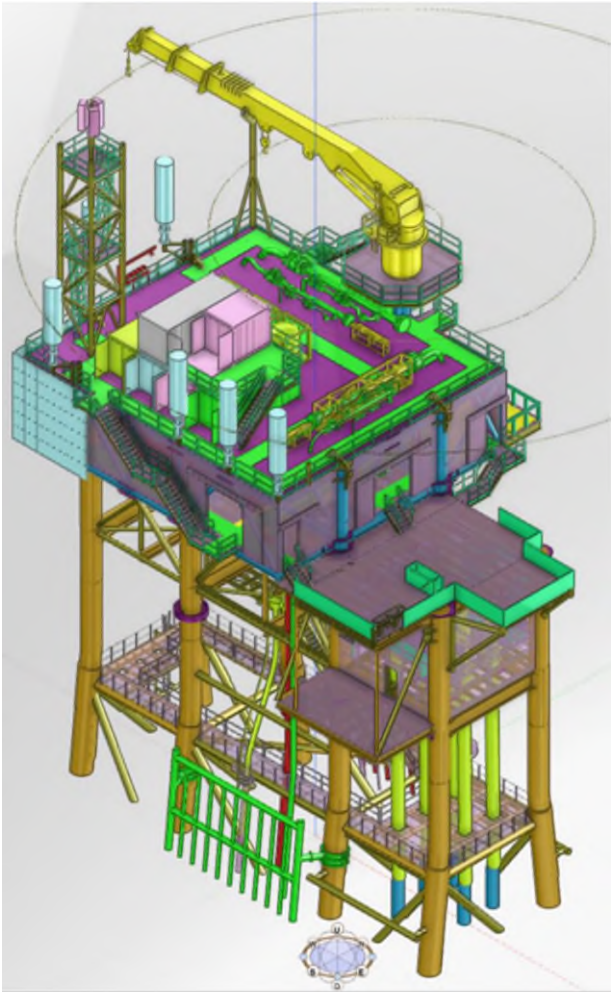
- IF subsidy requested for 59 M€, official results Nov 24

Marketing

- Order book is full for 2,6 Mtpa, combination of gaseous and cryogenic customers
- Fully termed Transport & Storage Agreement under negotiation with customers

Overall Project Timeline : end Q3 2025 FID / end 2028 RFSU if no appeal to permitting





L4A Injection facility

CCS Bifrost project development

Maturity	RFSU	Capacity$_{100\%}$	Transport & Storage
Appraisal	**2030**	**5.5 MTPA**	**80% (op)** nordsø fonden 20%

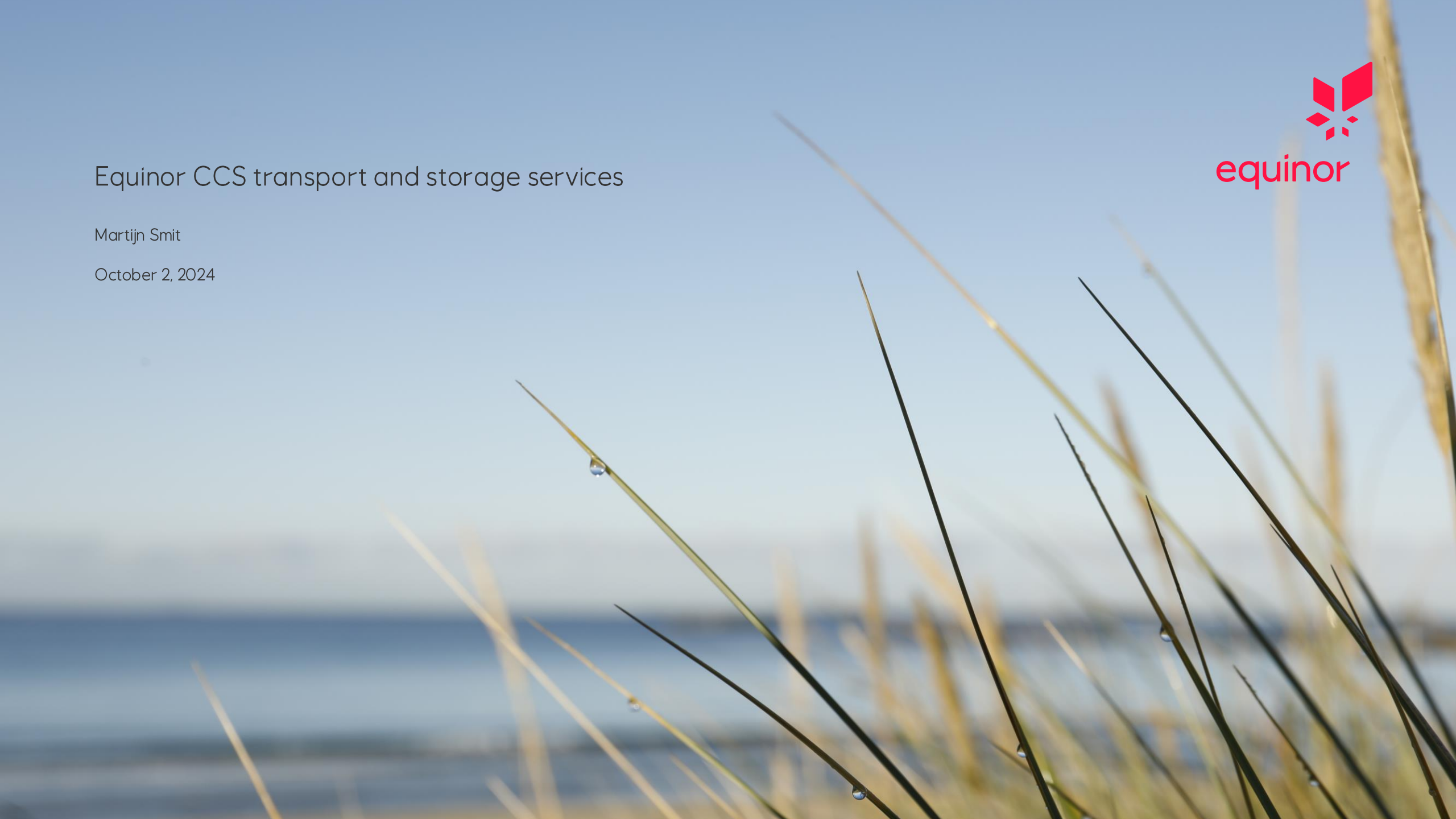
Bifrost	2022				2023				2024				2025				2026	2027	2028	2029	2030	2031
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4
	J F M A M J J A S O N D				J F M A M J J A S O N D				J F M A M J J A S O N D				J F M A M J J A S O N D									
Studies	Preliminary				Feasibility			…	Conceptual				pre-FEED				FEED ★ FID	EPCI			★ RFSU	
Licence	Licence application		◆Application		◆Licence award				Exploration period				Storage licence extension		◆Application		◆Approval	Storage period				
			Tender process										Drafting				Approval process					
Dagny Aquifer appraisal phase	Data				Seismic		Processing					Inversion		✖ Well								
	Interpretation/storage models				Appraisal well location/resources																	

- 2 exploration licences awarded.
- **CO2 storages appraisal planning on track.**
  - 3D seismic full processing by end Dec. 2024.
  - Well preparation (Permitting, Geophysical/tech site survey and LLI in 2024) with the target to be ready to drill the Dagny-1 appraisal well in April 2025.
  - Storage licence application : Nov. 2025.
  - Conceptual study phase Jun. 2024 to Dec 2025.
- PCI status
- **Project critical path : transportation and onshore infrastructures.**

Equinor CCS transport and storage services

Martijn Smit

October 2, 2024



Equinor A LEADER in transport and storage services

30-50

MILLION TONNES/ANNUM

CO_2 transport and storage capacity by 2035

Equinor share

4-8

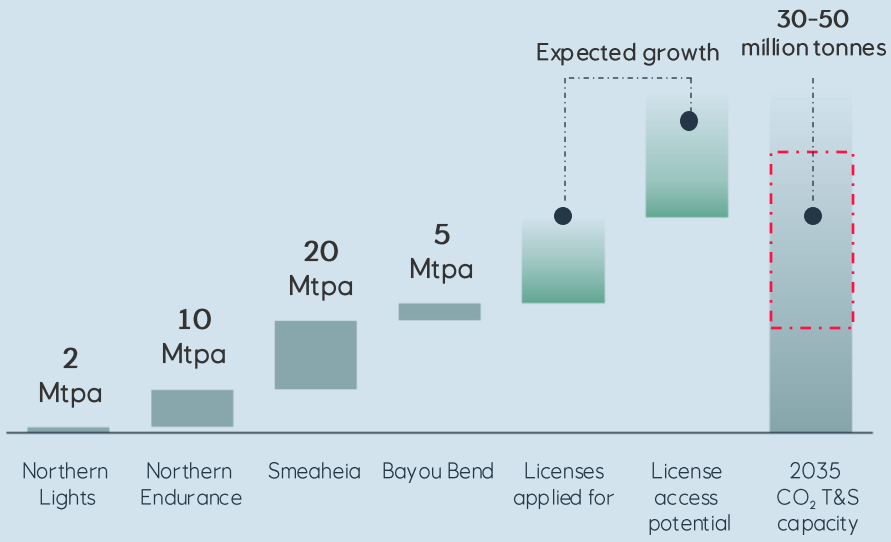
PERCENT

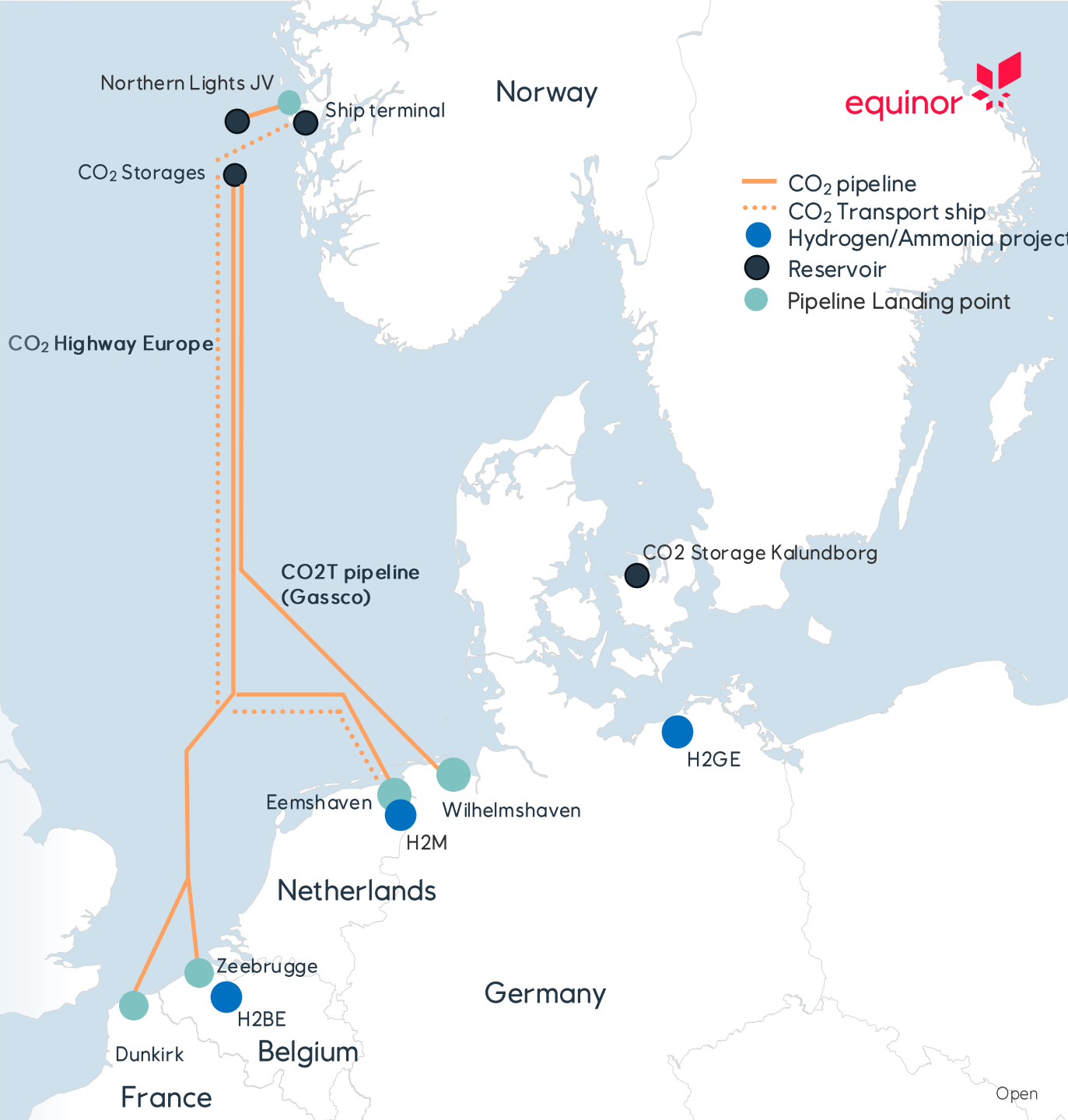
Real base return

Excluding effects from farmdowns and project financing

CO_2 transport and storage portfolio in 2035

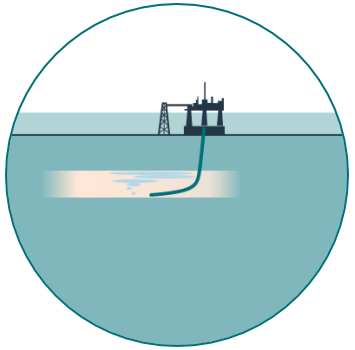
Equinor share, unrisked





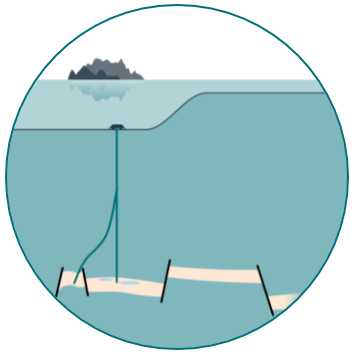
CCS in Equinor | Stepwise build of new industry

Sleipner | 1996



CCS works!

Snøhvit | 2008

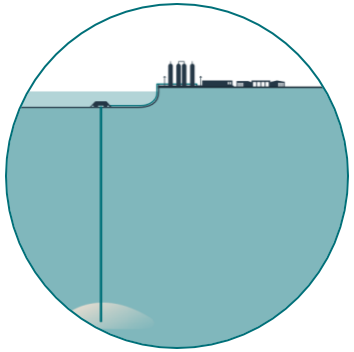


Expand technologies

TCM | 2012

Reduce capture cost

Northern Lights | 2024

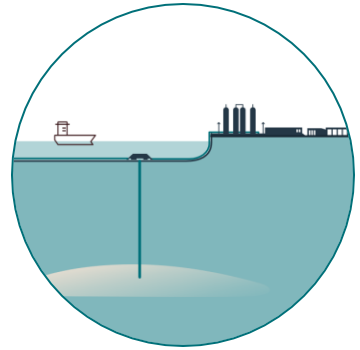


Market opener

NEP | 2027
Bayou Bend | 2028

Beyond NCS

Smeaheia | 2028
CO2 Highway | 2030
Kinno, Albonidigas | 2030
CO2 Storage Kalundborg | 2030



Bring costs down through scale-up

Future potential

NSB & US

28 year of experience

- Nearly 30 Mt stored to date
- Wide range of concepts

Future CCS ambitions

- 30 – 50 Mtpa by 2035 (Equity)
- Focus in the North Sea Basin (including Denmark) and Texas coastal area

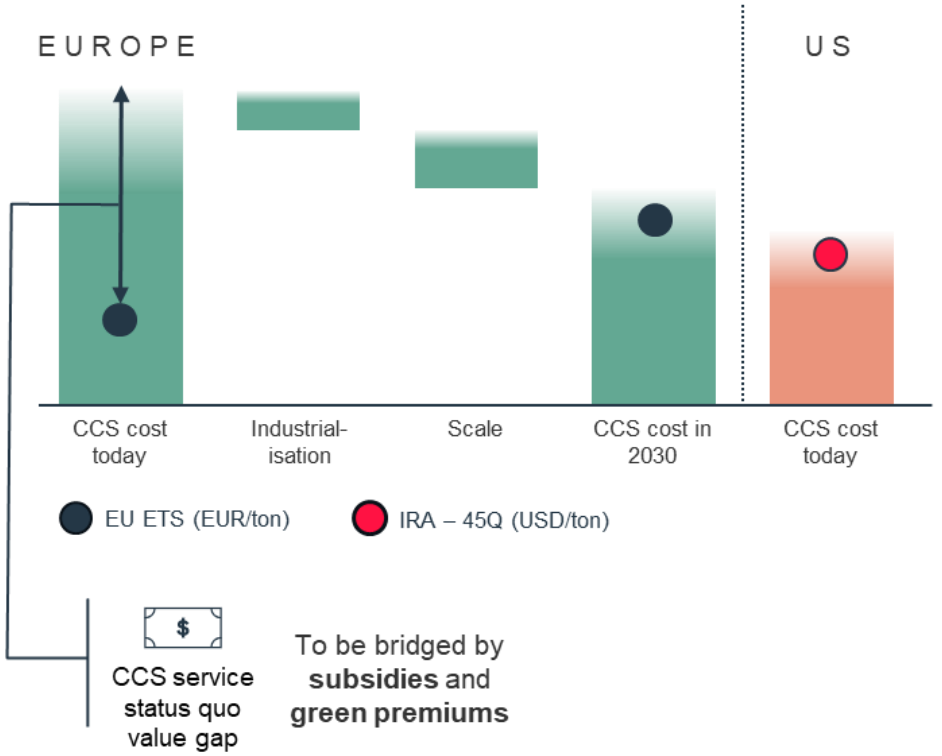
Storage project	country	Ownership share	Capacity* (100% basis)	Start date**
Smeaheia	Norway	100%	20 Mtpa	2028
Kinno	Norway	100%	5 Mtpa	2030
Albondigas	Norway	100%	5 Mtpa	2030
CO2 storage Kalundborg	Denmark	60%	12 Mtpa	2030
Northern Lights	Norway	33.33%	5.5 Mtpa	2028/9
Northern Endurance Partnership	UK	45%	25 Mtpa	2028
Bayou Bend	USA	25%	20 Mtpa	2028
CO2 Highway		100%	25 – 35 Mtpa	2030
Vessel transport		100%	10 Mtpa	2029

*Capacities are unrisked and subject to further subsurface evaluations and may change
** Start dates are project start dates that may change due to customer commitments and e.g. permitting timelines

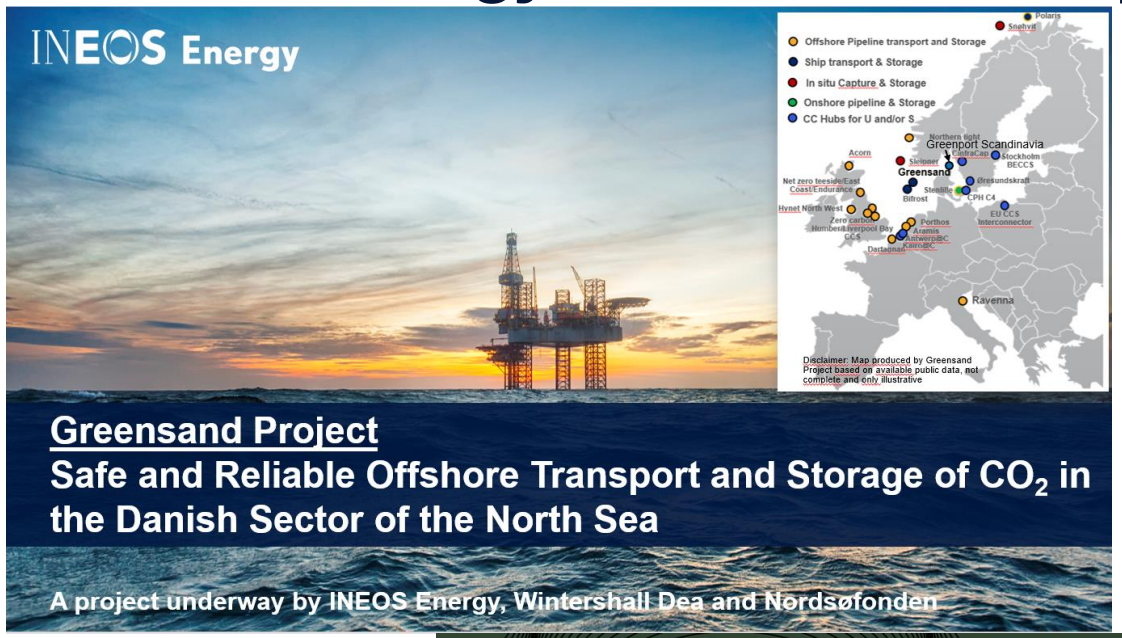
Next steps for CCS – making it happen

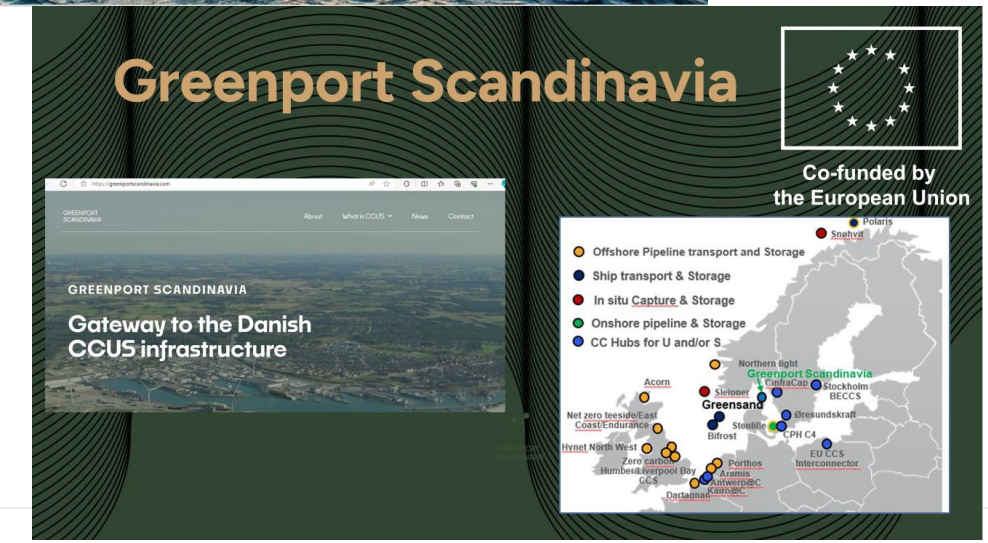
- **Value gap**; emitting is cheaper than CCS solutions, ETS price and allowance fail to provide sufficient incentives to industry to decarbonize.
- **Keep momentum** for climate solutions, over concerns of the impact of high energy costs on competitive position of EU industry and security of energy supply.
- A future sustainable CO2 storage business needs to be based on market value principle (not cost plus**)** i.e. promote the development of **green premium products for steel and cement and carbon credits**
- Governance of the **value chain, alignment of FID.** Value chain collaboration and integration is important. The less parties involved the easier an FID alignment becomes
- **Public acceptance** varies across countries, also Government commitment/acceptance and involvement varies (which is fine)
- **Regulations** & permitting processes and procedures should be stable and predictable to enable investments.
- **Soft side of the business**, first mover (dis)advantages, trust and communication are real (underestimated) challenges

Narrowing gap over time between cost of emitting (EU ETS) vs CCS cost

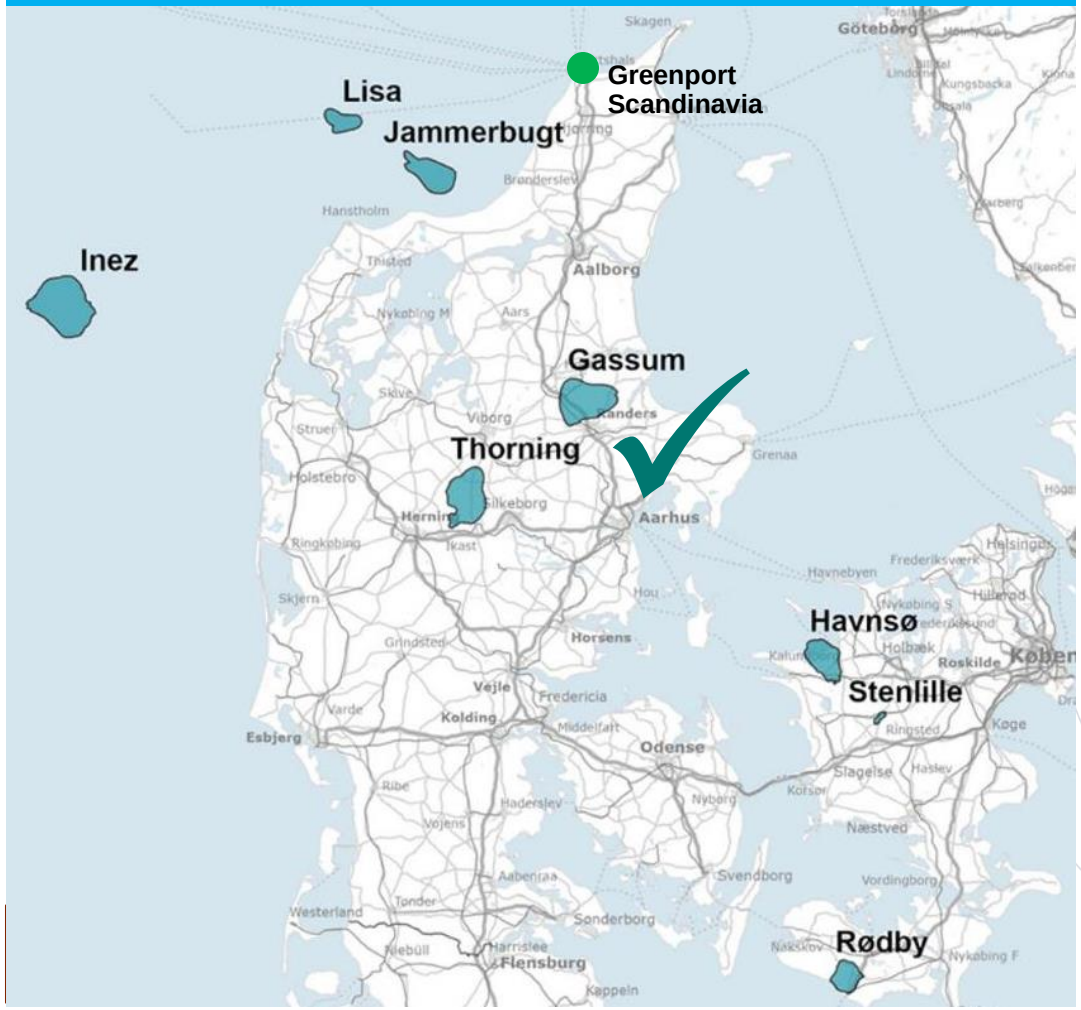


INEOS Energy efforts to Develop the CCS Value Chain in Denmark





CO2 Exploration in Denmark – Gassum (now Greenstore) awarded with start-up expected 2029

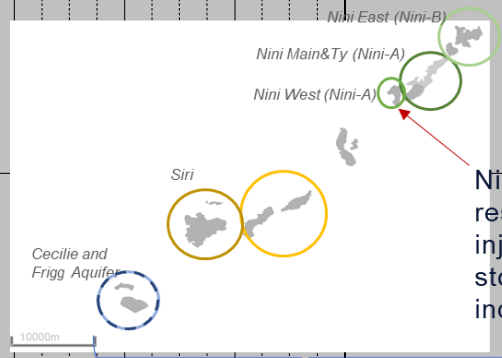


Greensand Project Developent Phases
Building competence, mitigate risks and phased economic exposure

Aktivitet	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Storage Capacity
Phase 1 **Nini West storage feasibility**												
Phase 2 **Pilot injection and Monitoring in Nini West Storage Site**		Funding	Execution									
Proof of commerciallity and next commercial projects Storage in Nini/Cecilie Area				1st ship 5500 tons					Ship 2 Start-up		Ship 3 Start-up	Up to 0.45 MTPA /ship (scalable concept)
Economies of Scale **Store CO2 in Greensand Expansion Area**				Maturation of further store storage sites and larger ships						Start-up		Up to 8 MTPA

Offshore operations

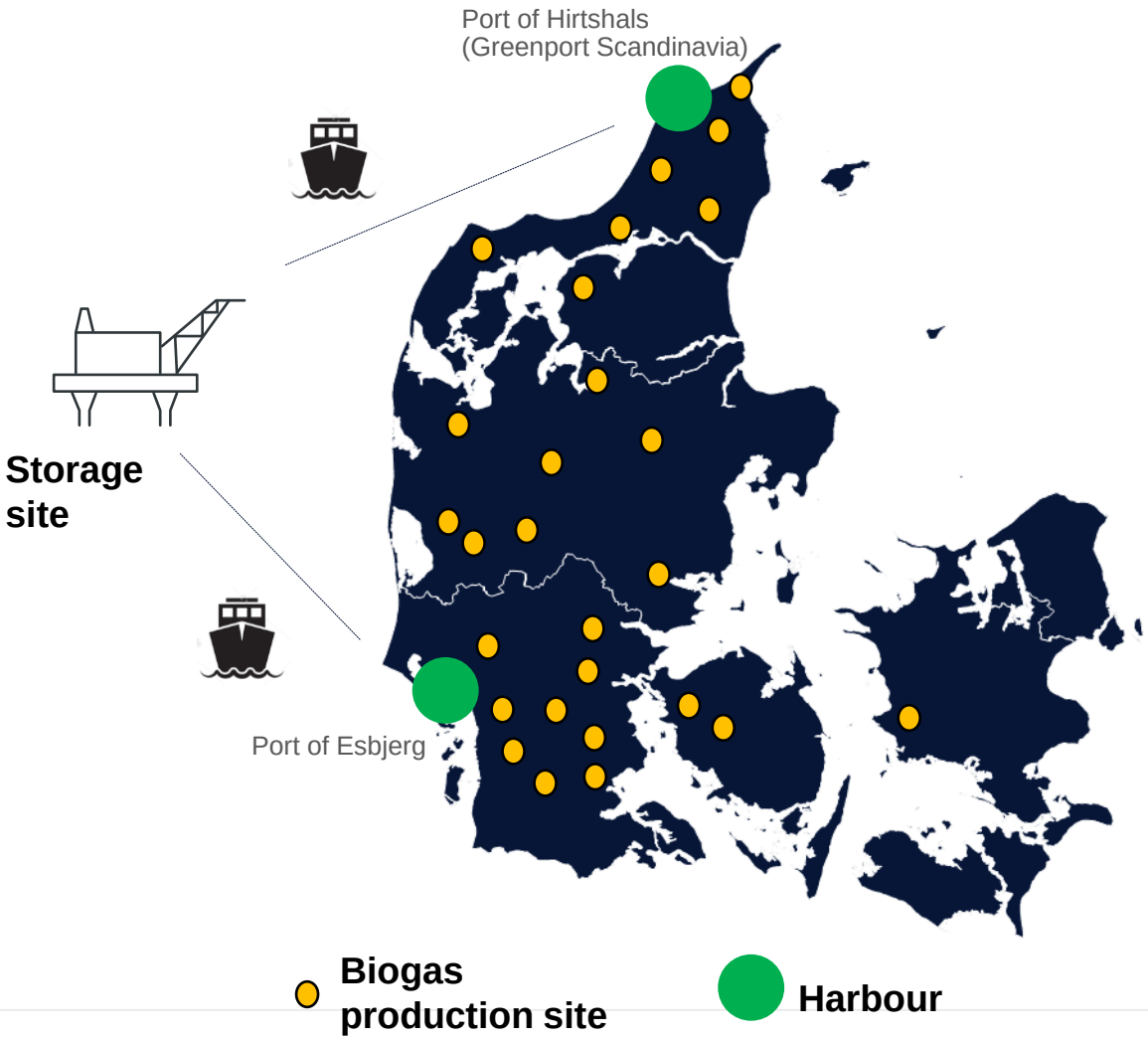
Start Storage



Nini West reservoir – pilot injection test and storage site for industrial scale

Greensand Greater Expansion Area

Proof of Industrial Scale – Potential Commercial Project #1
Building competence, mitigate risks and phased economic exposure



Opportunity:

- Build on Phase 2 pilot learnings – hardware and operation
- Short delivery time for first CO2 carrier ship
- Further derisking (storage capacity and operation)
- Relatively low CAPEX investment
- Early storage of available biogenic CO_2
- Negative emissions tapping into the voluntary CC market
- Up to 450 kTon CO2 per year

Key milestones:

- ✓ Submission of storage site application February 2024.
- ✓ DnV: Certificate of Conformity – Site Endorsement and Storage Site compliant with ISO 27914 obtained
- Funding application submitted to EUIF
- End 2024: Project sanction expected, pending necessary approvals
- End 2025/Start 2026: First CO_2 injection and permanent storage.

INEOS | Energy

Net-zero Strategic Projects in the Danish context

October 2 2024

Danish Ministry of Climate, Energy and Utilities

Net-zero Strategic Projects and CCS

- Implementation still ongoing in Denmark.
- We are clarifying if tasks should be based in the Ministry of Climate, Energy and Utilities or the Ministry of Industry, Business and Financial Affairs.
- CCS differs from other technologies in NZIA. We are trying to clarify how the implementation of the CCS regulation is done best.

Questions/clarfications

- How do we define the criteria for capture and infrastructure projects that should be recognised as Net-zero strategic projects? What does it entail to be ”related to” or ”necessary for” a CO_2 storage site?
- What if all CO_2 storage projects in Denmark become Net-zero Strategic Projects? Will that reduce the effect of the benefits?
- Will it only be Net-zero Strategic Projects that can use the single point of contact/one-stop shop? Or will all CCS projects be able to benefit from this?

Danish Taskforce for Authorities

- Established with Agreement on Strengthened Framework Conditions for CCS in Denmark 20 September 2023.
- Members of the taskforce are eight relevant authorities for CCS projects in Denmark.
- Purpose:
  - Knowledge-sharing and mutual updates on CCS developments with a particular fokus on regulation to enhance knowledge and understanding
  - Identification of gaps in regulation (CCS is a brand new area, thus largely not covered by existing regulation)
  - Enhanced coordination between authorities as regards of permitting and identify possibilities for advancing and speeding up permitting procedures.
  - Development of a step-by-step guides for permitting procedures across the value chain (the first guide for onshore storage almost done).

- In addition, we have fora for regular dialogue with market actors.

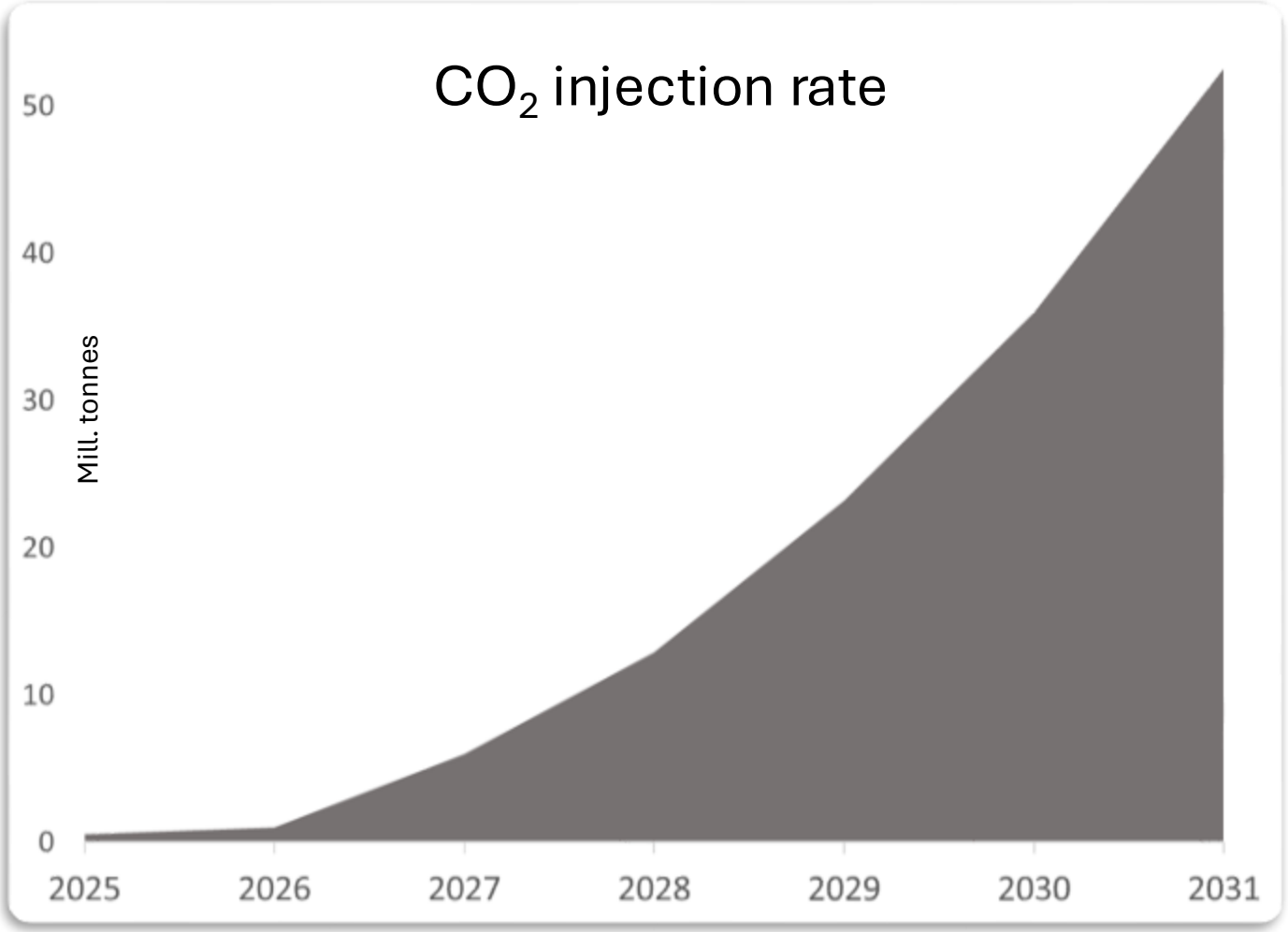
Norwegian Ministry of Energy

CCS – status in Norway

M.Agerup & A.Engh

Brussels Oct 2, 2024

Ambitions behind awarded exploration/exploitation licenses

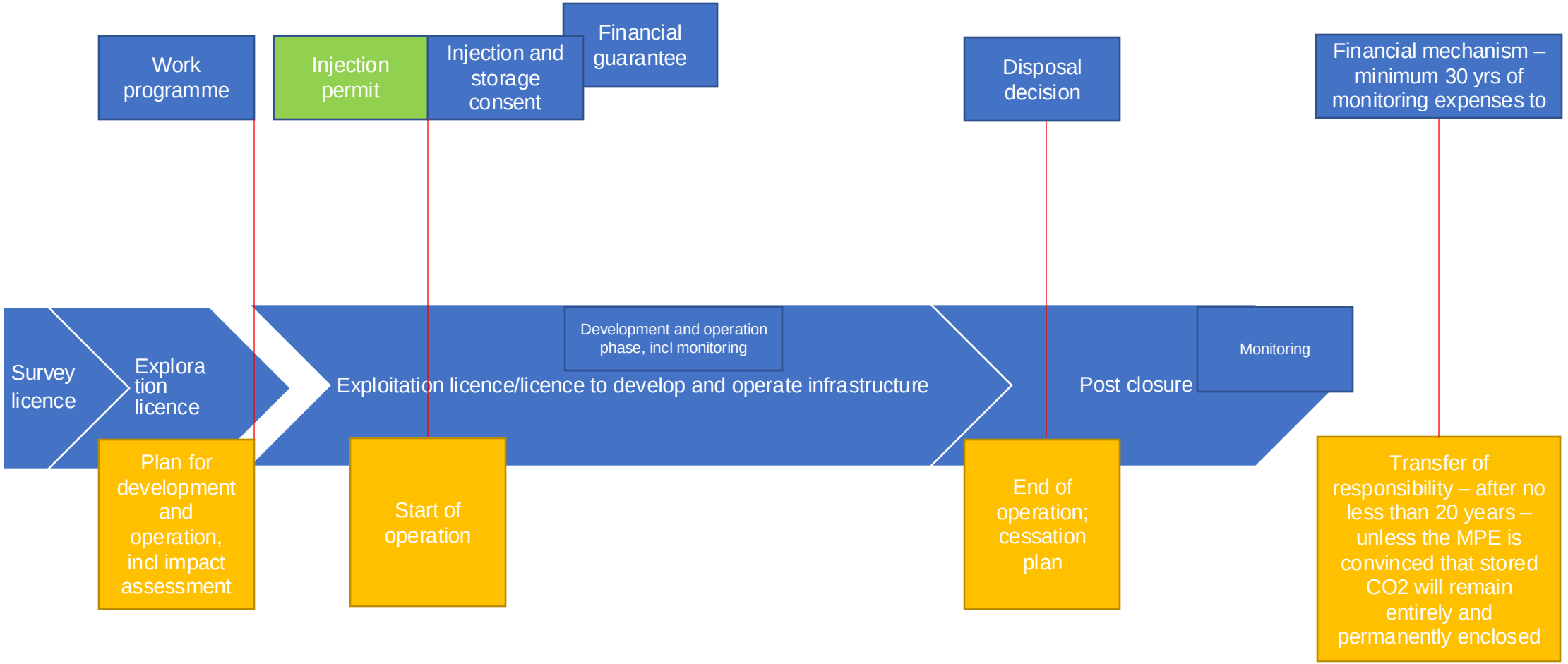


Source: Norwegian Offshore Directorate

Norwegian CO_2 regulatory regime

- An offshore licensing regime
- The State owns the resources; the resources are the storage sites below the seabed
- Licence provides access to resources
- Key licences: exploration licence and exploitation licence
- Open door policy
  - Interest in an area kicks off the licensing process
  - Public invitation to apply for licences – ensure competition
- Main licence terms; work program, geographical and stratigraphic limitations, duration

The licensing regime



Regulatory authority on CO_2 storage and transportation is shared

- The Ministry of Energy – licensing – approval of development of storage sites/infrastructure (resource management)
  - The Offshore Directorate
  - The Ocean Industry Agency

- The Ministry of Climate and Environment - pollution control and protection of the environment
  - The Environment Agency

- 2014 – Regulation relating to exploitation of subsea reservoirs on the continental shelf for storage of CO_2 and relating to transportation of CO_2 on the continental shelf
- 2014 – Chapter 4A of the Petroleum Regulation – Storage of CO_2
- 2020 - Regulation relating to safety and working environment for transport and injection of CO_2 on the Continental Shelf

- 2014 – Part 7A Chapter 35 of the Pollution Regulation – Storage of CO_2 in geological formations

Main elements of the Storage Regulation

- Requirements for selection of storage sites
  - To achieve the objective of environmentally safe storage and good resource management
- Provisions on licensing of storage operators, incl qualification
  - Objective, published and non-discriminatory
  - «…financial strength, technical and geological competence and reliability deemed necessary…»
- Liability
  - Financial guarantee during operations
  - Financial security mechanism – long term (post closure) liability
- Requirements for reporting, measuring, monitoring etc.

Licences awarded till now

- One exploitation licence (Longship – Equinor, Shell, TotalEnergies)
- 10 exploration licences (Equinor, Horisont Energi, Harbour, TotalEnergies, AkerBP ASA, OMV (Norge) AS, Stella Maris CCS AS, Sval, Storegga, Vår Energi CCS, Lime Petroleum)
- New applications recently received for three new exploration areas

Works in progress:

- NZIA EEA relevance assessment
- Assessment of policy toolset for CO_2 capture in Norway
- Infrastructure development
- Update of storage regulations
- Longship development in its final stages