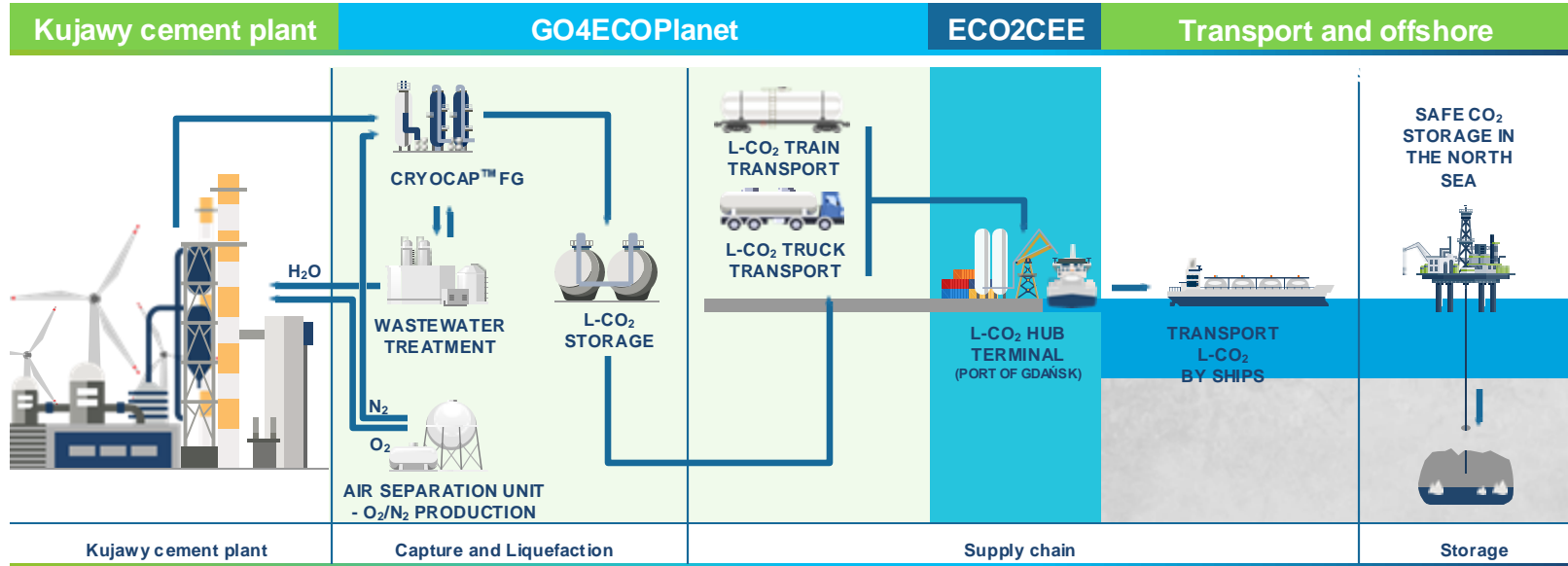


# GO4ECOPLANET KUJAWY - VALUE CHAIN

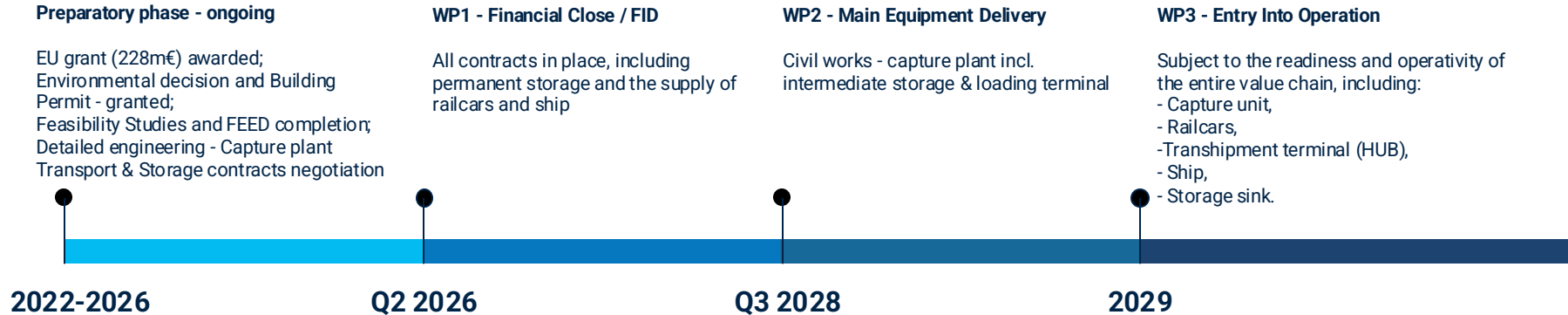
## FROM CAPTURE TO STORAGE



- 1.1 mtpa CO<sub>2</sub> 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



## Critical areas

- Alignment of FID and Start of Operations across the CCS value chain
- CO<sub>2</sub> Export terminal ready on time
- Cost effective, safe and timely CO<sub>2</sub> storage solution
- Infrastructure development maturity of the CO<sub>2</sub> transport, export/conditioning & Storage
- Acceptable and standardized CO<sub>2</sub> specification, considering the entire value chain
- Favorable project economics at FID

# Go4ECOPlanet

[www.go4ecoplanet.com](http://www.go4ecoplanet.com)



Co-funded by  
the European Union



# Beccs Stockholm

**Objective:** Capture of 800 kt biogenic CO<sub>2</sub> from an existing bio-fuel fired heat & power plant (KVV8)

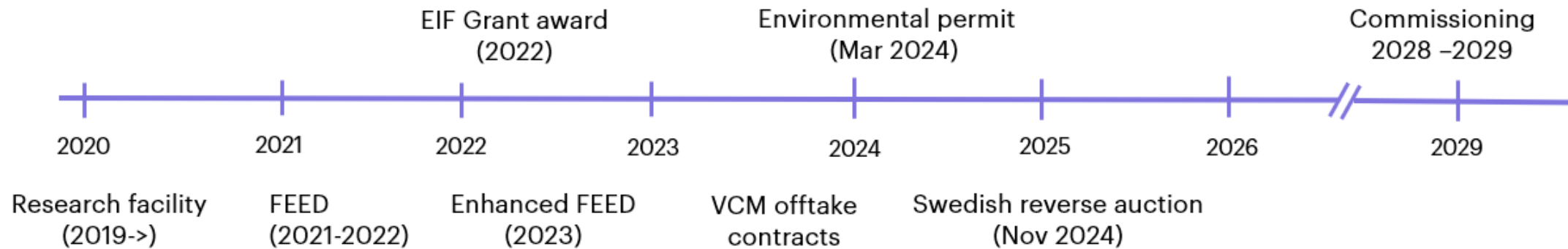
**Location and participants:** Located at Värtaverket, Stockholm, in the heart of Stockholm's district heating system. Implemented by Stockholm Exergi, Sweden's largest district heating company. (Owned by the City of Stockholm and Ankhiale.)

**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<sub>2</sub>



# 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





TotalEnergies

# Carbon Capture and Storage Business Unit

October 2<sup>th</sup>, 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)

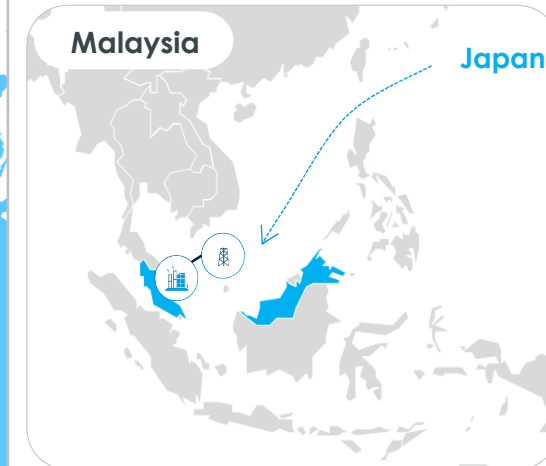
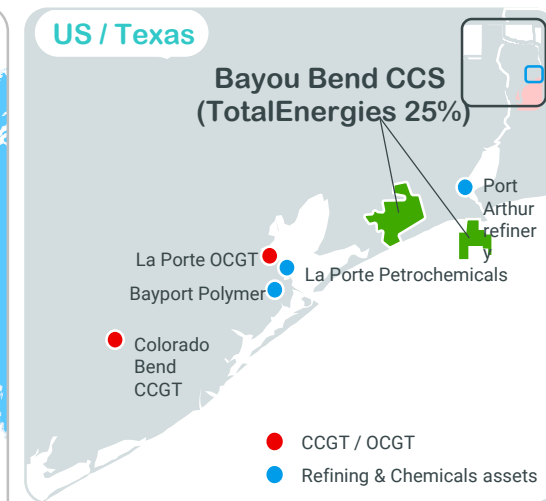
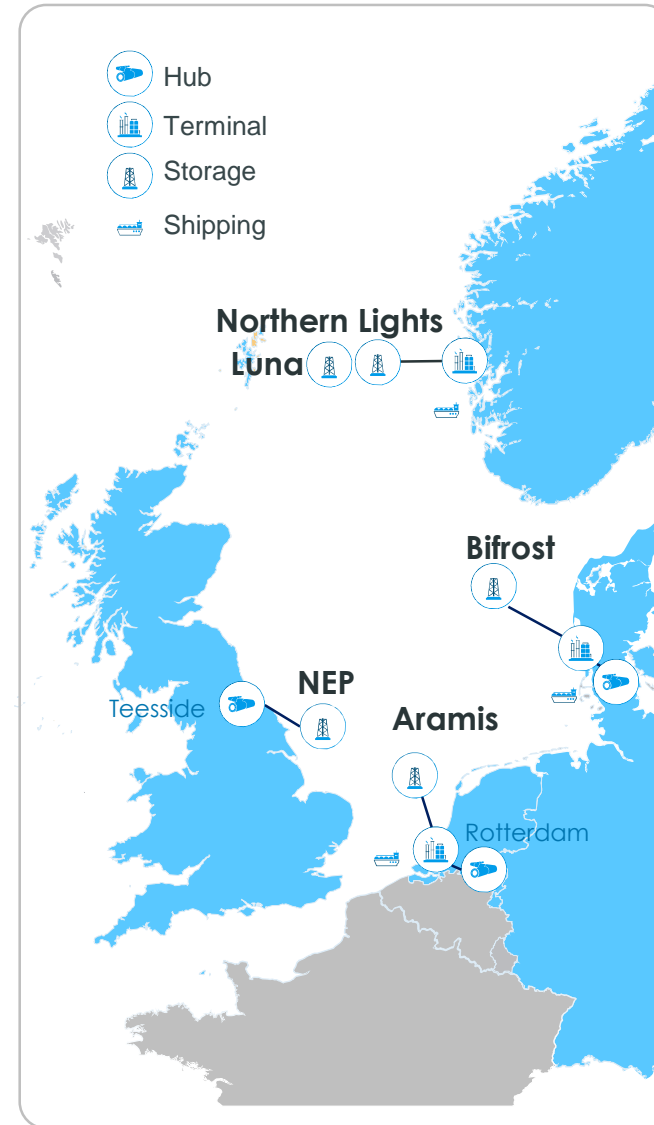
### Offering CCS services

- 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<sub>2</sub> 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

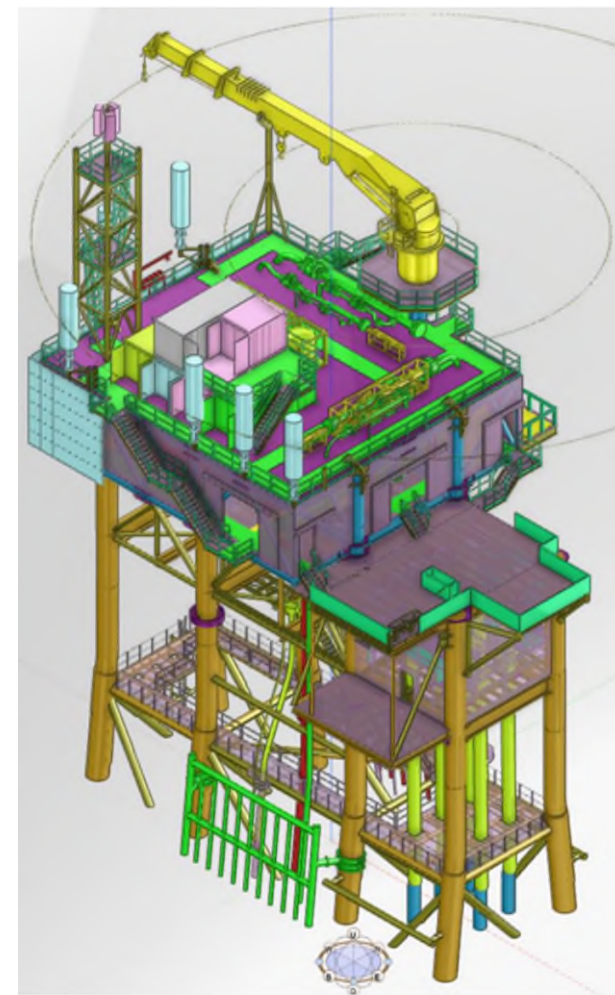
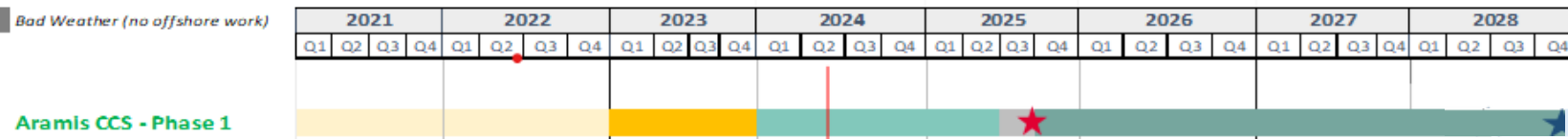
- Order book is full for 2,6 Mtpa, combination of gaseous and cryogenic customers
- Fully termed Transport & Storage Agreement under negotiation with customers

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

Assuming no permit appeal - FID Q3 2025

Conceptual
Pre-Project
FEED
Approval
EPCI
Operations
★ FEED award
 ★ FID
 ★ RFSU
 ★ LLI

Bad Weather (no offshore work)



**L4A Injection facility**



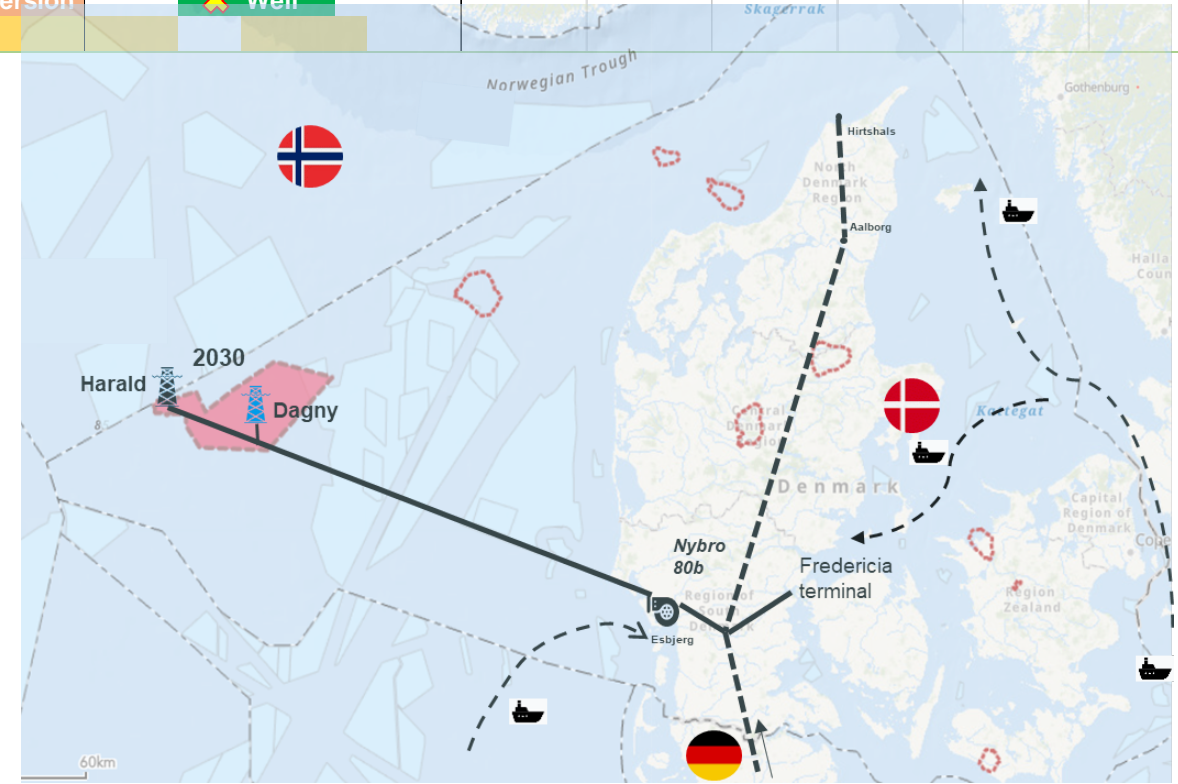
# CCS Bifrost project development



Maturity: **Appraisal**  
 RFSU: **2030**  
 Capacity<sub>100%</sub>: **5.5 MTPA**  
 Transport & Storage: **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 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                                      | 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 |      |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <u>Studies</u>                       | Preliminary                        |   |    |   | Feasibility   |   |    |   | ...                               |   |    |   | Conceptual         |   |    |   | pre-FEED       |   |    |   | FEED                      |   |    |   | ★ FID         |   |    |   | EPCI       |   |    |   | ★ RFSU |   |    |   |      |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <u>Licence</u>                       | Licence application                |   |    |   | ◆ Application |   |    |   | ◆ Licence award                   |   |    |   | Exploration period |   |    |   | Storage period |   |    |   | Storage licence extension |   |    |   | ◆ Application |   |    |   | ◆ Approval |   |    |   |        |   |    |   |      |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <u>Dagny Aquifer appraisal phase</u> | Data Interpretation/storage models |   |    |   |               |   |    |   | Seismic Processing                |   |    |   | Inversion          |   |    |   | Drafting       |   |    |   | Approval process          |   |    |   |               |   |    |   |            |   |    |   |        |   |    |   |      |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                                      |                                    |   |    |   |               |   |    |   | Appraisal well location/resources |   |    |   | ✗ Well             |   |    |   |                |   |    |   |                           |   |    |   |               |   |    |   |            |   |    |   |        |   |    |   |      |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

- 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

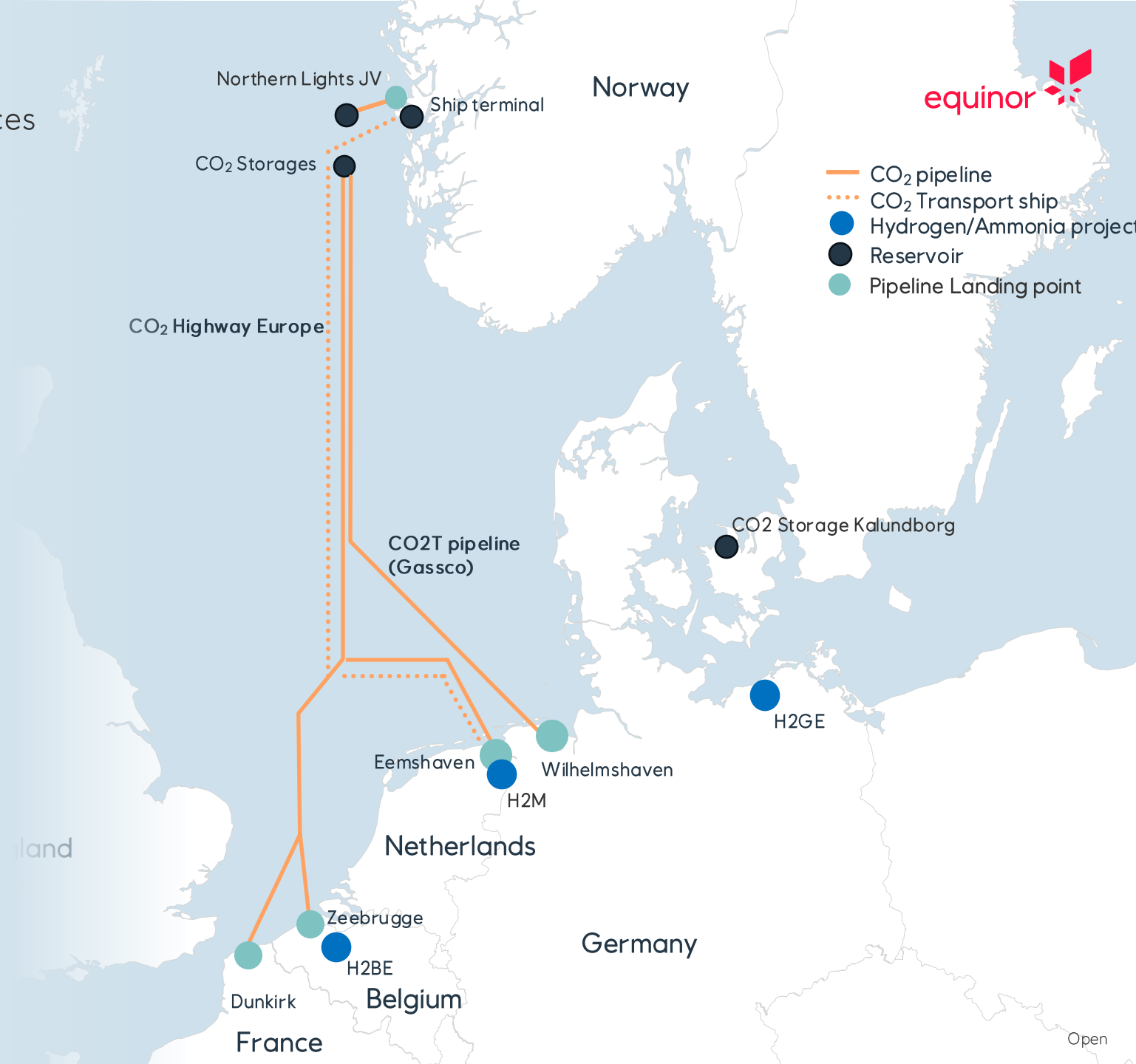
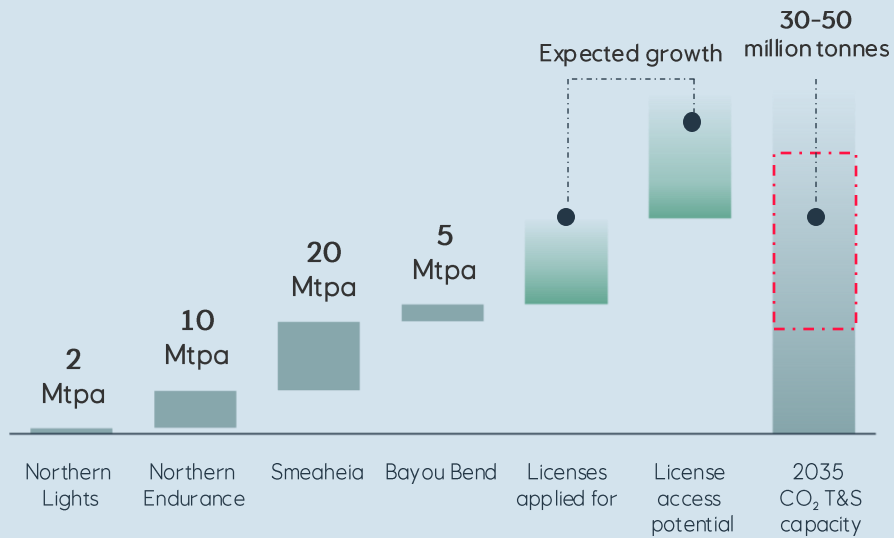


**30-50**  
MILLION TONNES/ANNUM  
**CO<sub>2</sub> transport and storage capacity by 2035**  
Equinor share

**4-8**  
PERCENT  
**Real base return**  
Excluding effects from farmdowns and project financing

## CO<sub>2</sub> transport and storage portfolio in 2035

Equinor share, unrisked

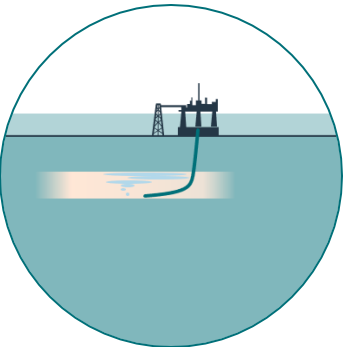


# CCS in Equinor | Stepwise build of new industry

## 28 year of experience

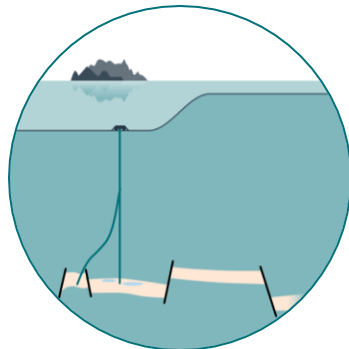
- Nearly 30 Mt stored to date
- Wide range of concepts

Sleipner | 1996



CCS works!

Snøhvit | 2008



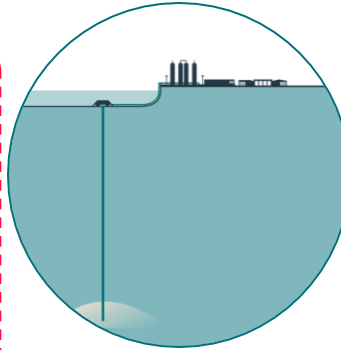
Expand technologies

TCM | 2012



Reduce capture cost

Northern Lights | 2024



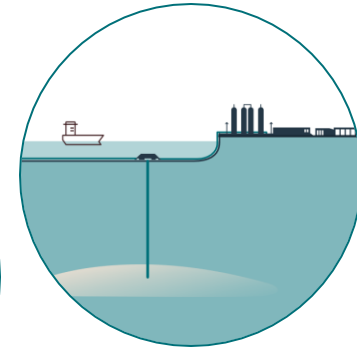
Market opener

NEP | 2027  
Bayou Bend | 2028



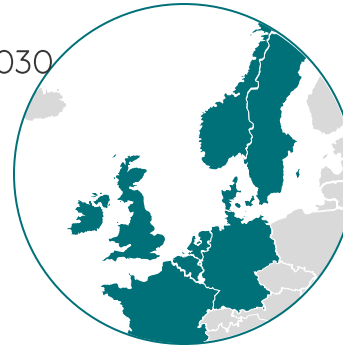
Beyond NCS

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



Bring costs down through scale-up

Future potential



NSB & US

## 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*<br>(100% basis) | Start date** |
|-----------------------------------|---------|-----------------|---------------------------|--------------|
| Smeaheia                          | Norway  | 100%            | 20 Mtpa                   | 2028         |
| Kinno                             | Norway  | 100%            | 5 Mtpa                    | 2030         |
| Albondigas                        | Norway  | 100%            | 5 Mtpa                    | 2030         |
| CO2 storage<br>Kalundborg         | Denmark | 60%             | 12 Mtpa                   | 2030         |
| Northern Lights                   | Norway  | 33.33%          | 5.5 Mtpa                  | 2028/9       |
| Northern Endurance<br>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         |

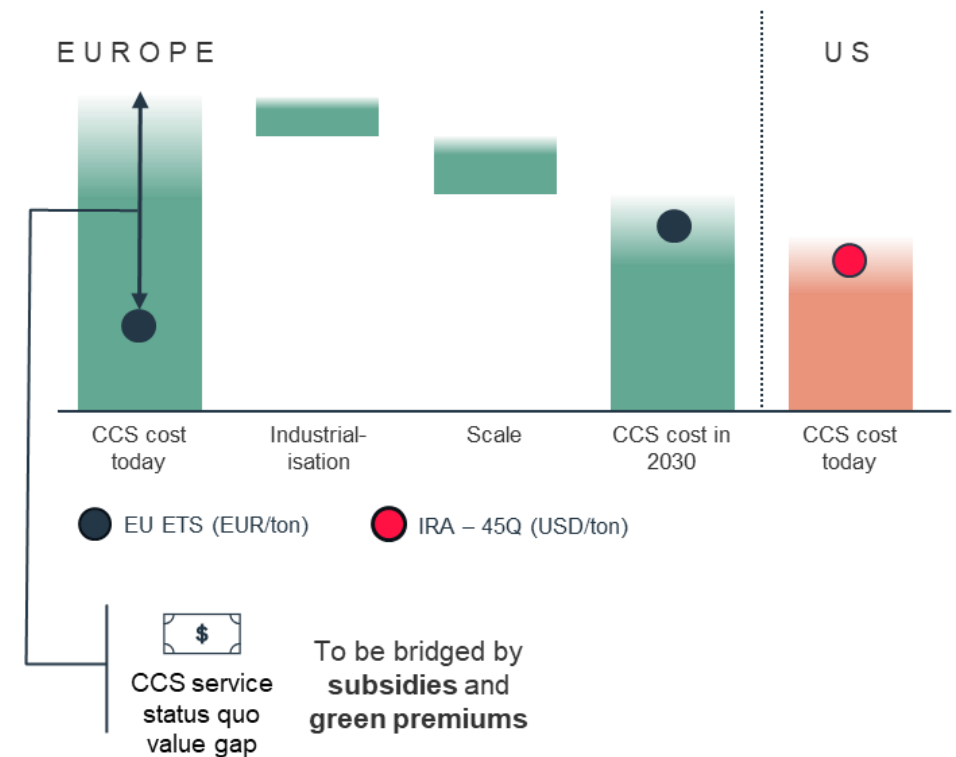
\*Capacities are unrisked and subject to further subsurface evaluations and may change

\*\* 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



**INEOS Energy**

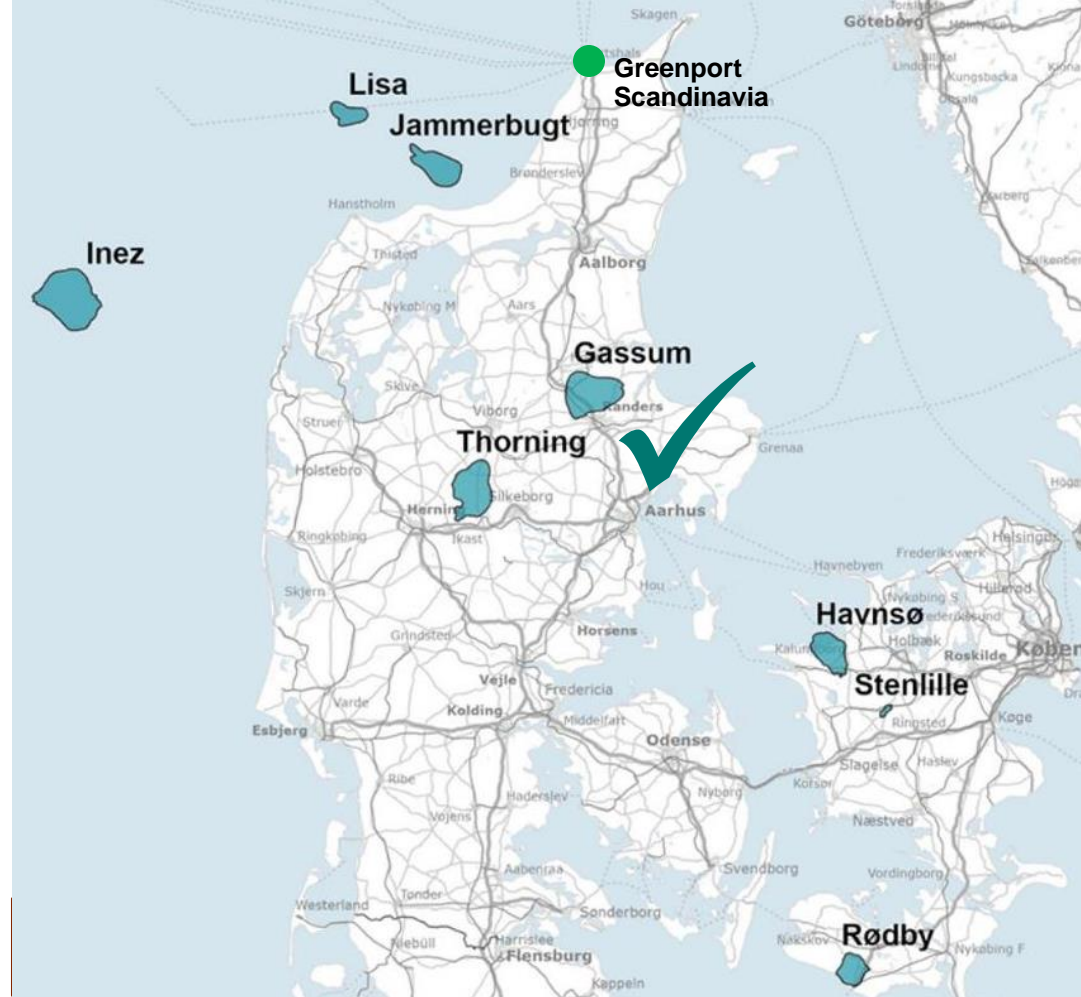
**Greensand Project**  
Safe and Reliable Offshore Transport and Storage of CO<sub>2</sub> in the Danish Sector of the North Sea

A project underway by INEOS Energy, Wintershall Dea and Nordsøfonden



Disclaimer: Map produced by Greensand Project based on available public data, not complete and only illustrative

CO<sub>2</sub> Exploration in Denmark – Gassum (now Greenstore) awarded with start-up expected 2029



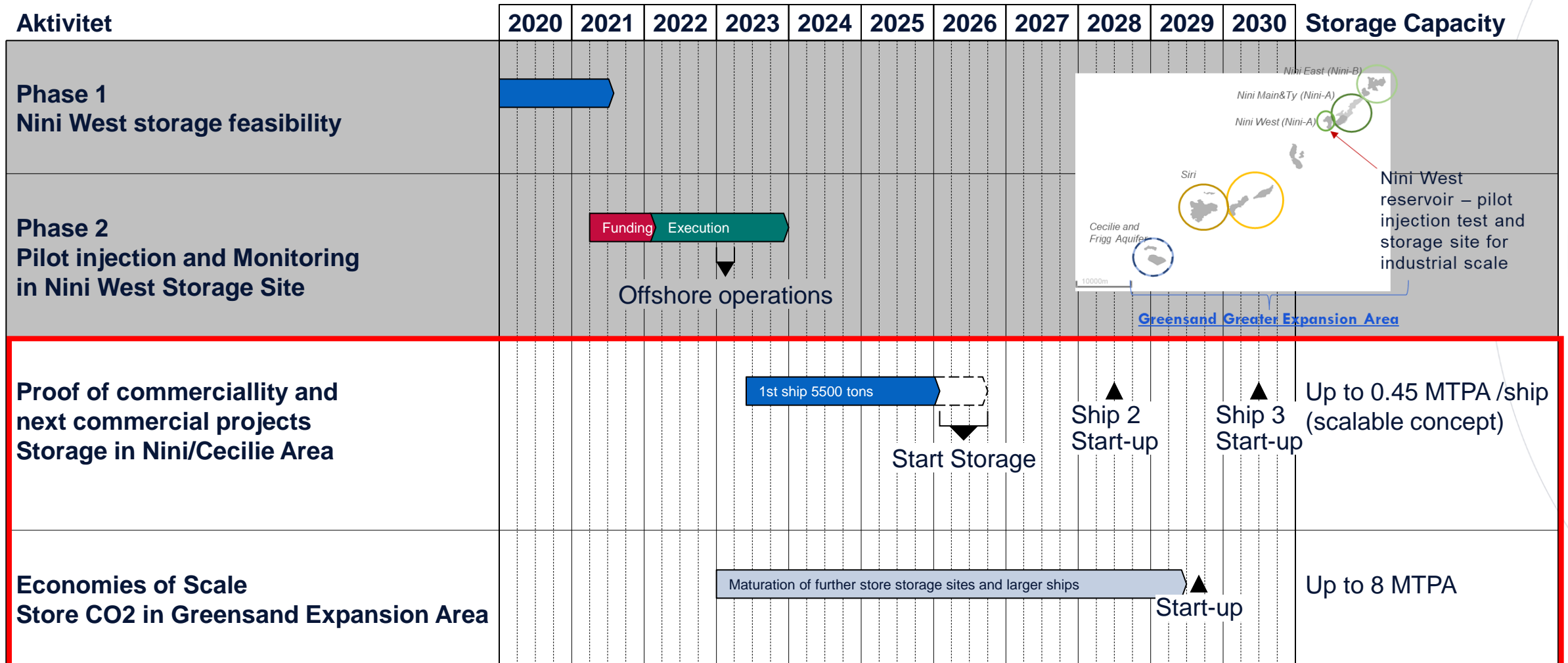
**Greenport Scandinavia**

Co-funded by the European Union




# Greensand Project Development Phases

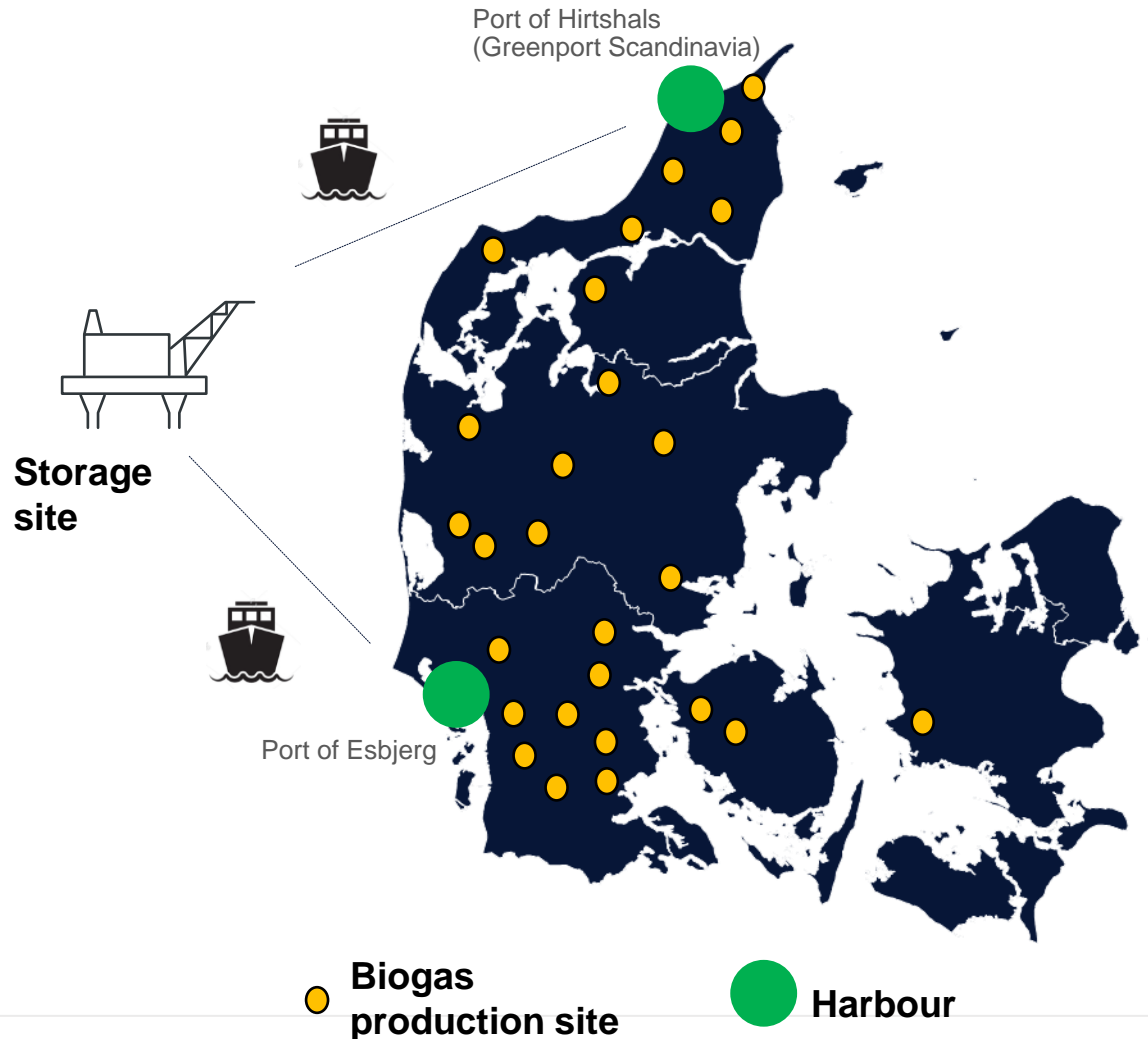
Building competence, mitigate risks and phased economic exposure





# 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 CO<sub>2</sub> carrier ship
- Further derisking (storage capacity and operation)
- Relatively low CAPEX investment
- Early storage of available biogenic CO<sub>2</sub>
- Negative emissions tapping into the voluntary CC market
- Up to 450 kTon CO<sub>2</sub> 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<sub>2</sub> injection and permanent storage.



# 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/clarifications

- 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<sub>2</sub> storage site?
- What if all CO<sub>2</sub> 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.



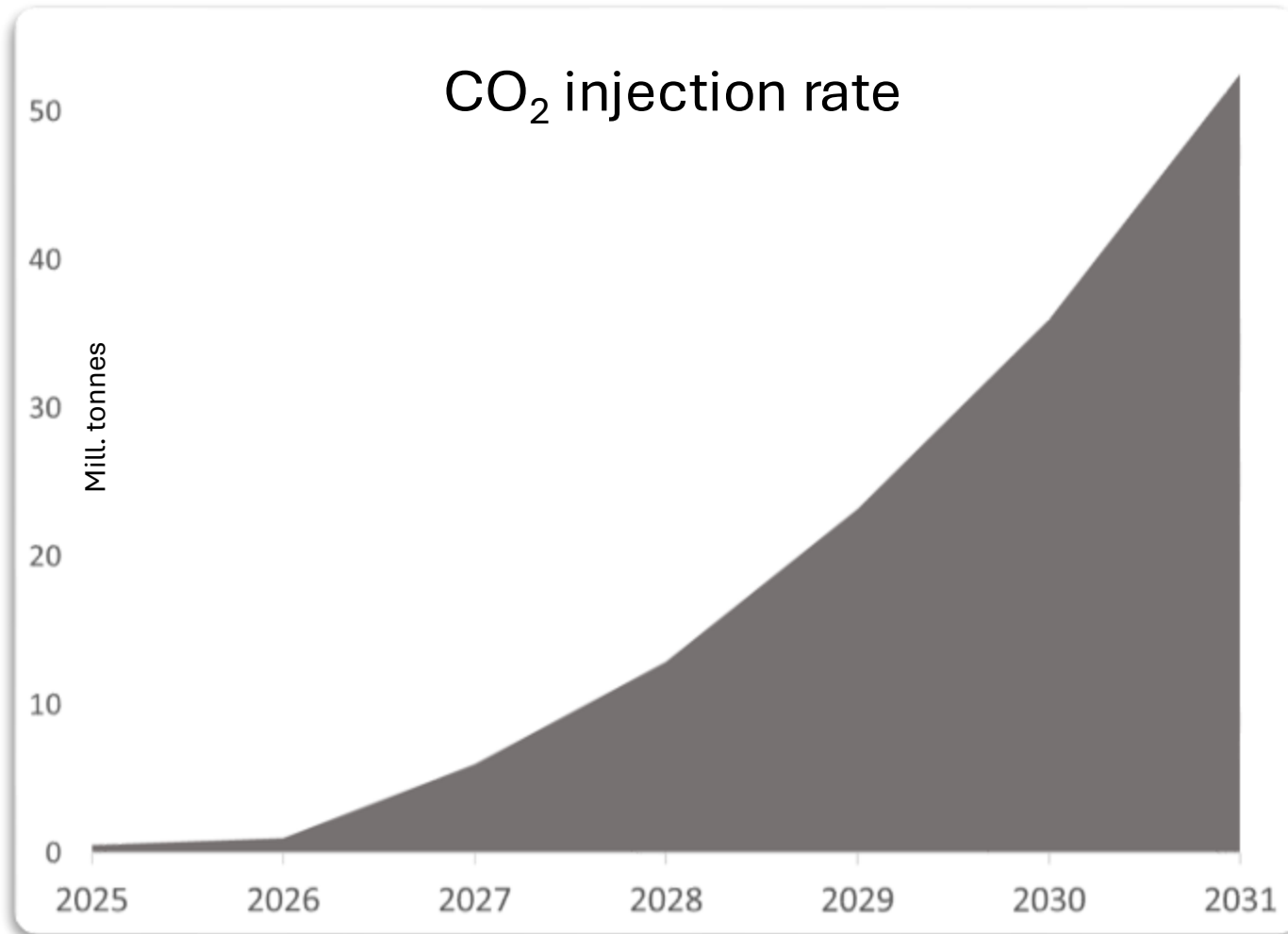
# CCS – status in Norway

M.Agerup & A.Engh

Brussels Oct 2, 2024



# Ambitions behind awarded exploration/exploitation licenses



Source: Norwegian Offshore Directorate



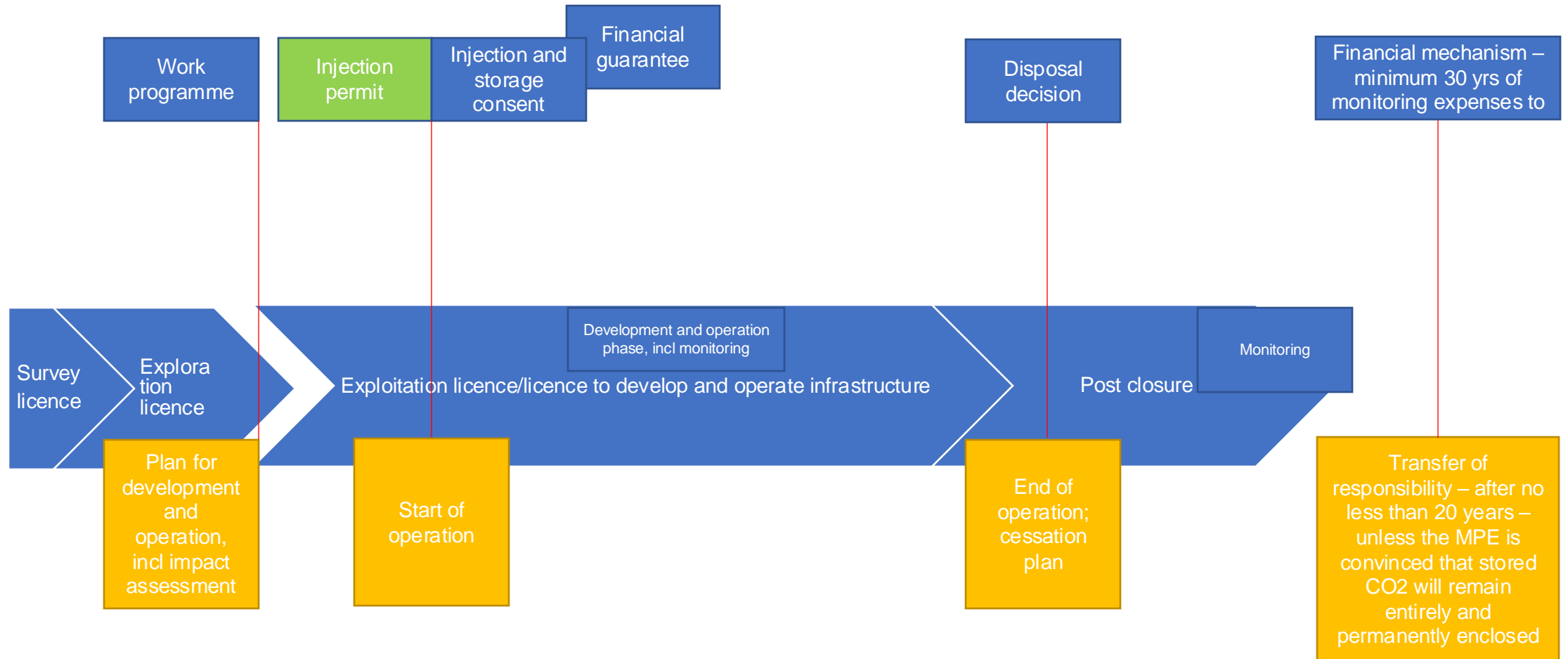
# Norwegian CO<sub>2</sub> regulatory regime

- 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<sub>2</sub> 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<sub>2</sub> and relating to transportation of CO<sub>2</sub> on the continental shelf
  - 2014 – Chapter 4A of the Petroleum Regulation – Storage of CO<sub>2</sub>
  - 2020 - Regulation relating to safety and working environment for transport and injection of CO<sub>2</sub> on the Continental Shelf
  - 2014 – Part 7A Chapter 35 of the Pollution Regulation – Storage of CO<sub>2</sub> 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<sub>2</sub> capture in Norway
- Infrastructure development
- Update of storage regulations
- Longship development in its final stages

