

# 26<sup>th</sup> World Gas Conference

1 – 5 June 2015 – Paris, France



*TS PGC A-1*

## Capturing the Future of Natural Gas

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Statoil



# Contents

- Energy realities
- Statoil CCS experience
- Natural Gas and CCS



# The world needs more and cleaner energy

- Population
- Poverty
- Energy
- Climate change

## THE WORLD NEEDS MORE ENERGY

### GLOBAL POPULATION GROWING

The current world population of 7.2 Bn is projected to increase to 9.6 Bn by 2050



### PEOPLE ARE MOVING OUT OF POVERTY

Three billion people will enter middle class by

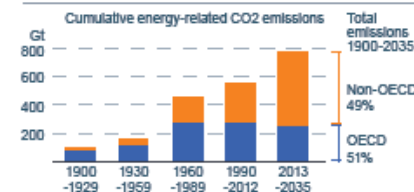
# 2035

### ENERGY GAP WIDENING

# 1 IN 5

People lack access to electricity

### EMISSIONS RISING



Source: United Nations

Source: World Bank

## TACKLING THE CARBON CHALLENGE IN THREE CORE AREAS

We are a technology focused upstream company active in three core areas:

### OIL

Vital to powering transport but must be produced and used with consideration for the climate



### GAS

A valuable lower carbon partner to support growth in renewables



### TECHNOLOGY AND INNOVATION

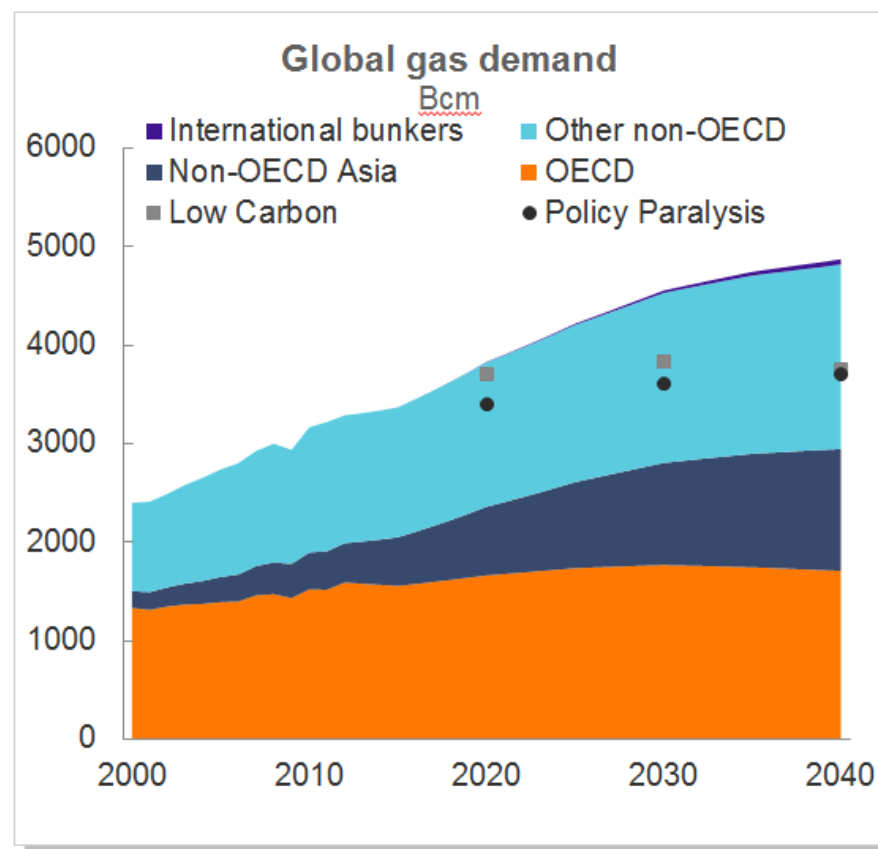
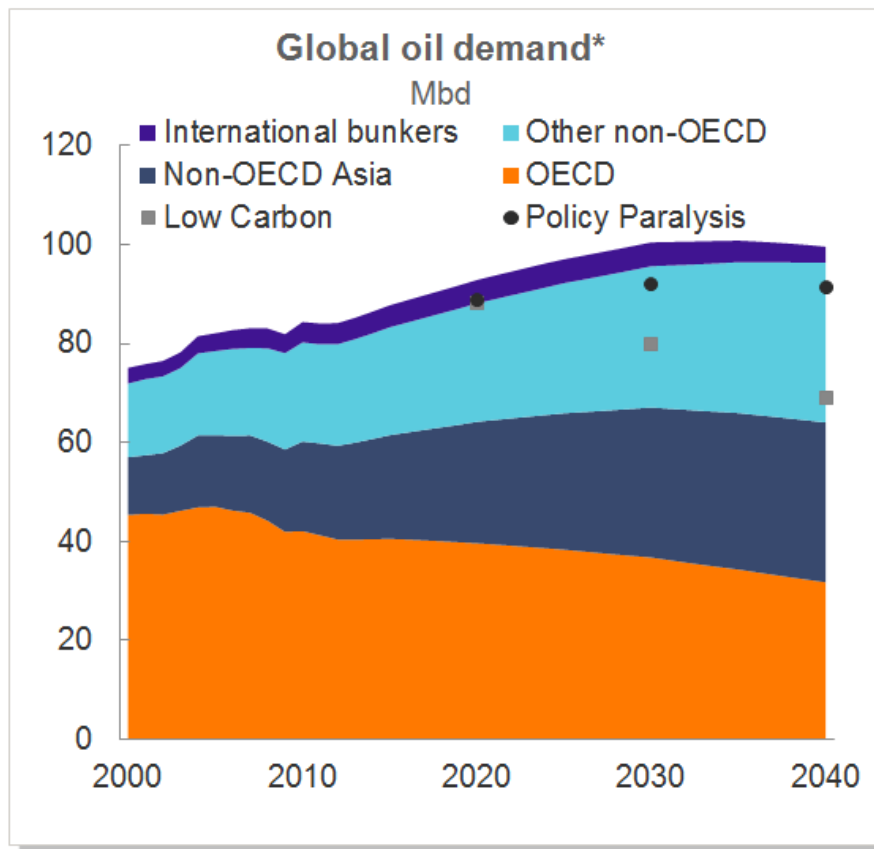
New, effective and scalable solutions to a range of energy challenges:

- CCS
- Energy Efficiency
- Wind



# Fossil fuels are here to stay

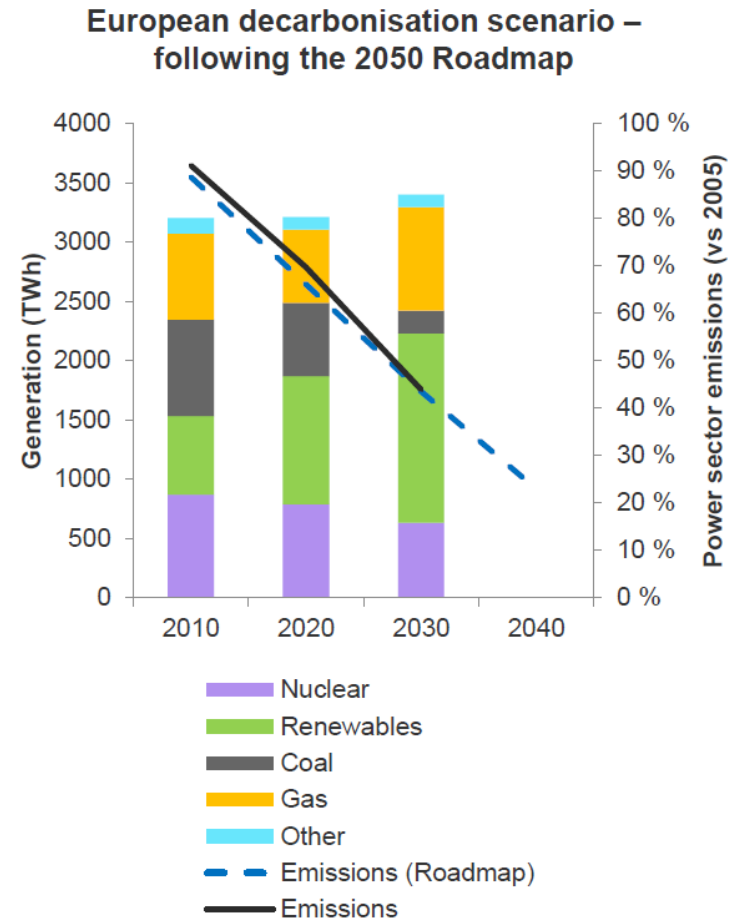
Considerable need for investments, irrespective of scenario



\* Excl. Bio-fuels  
Source: IEA (history), Statoil (projections)

# Gas is key to European de-carbonisation

- Europe's largest climate challenge is to phase out coal
- Coal to gas switch is essential to stay on track with 2050 roadmap
- EU's emissions trading system (ETS) is the best instrument to ensure cost-efficient carbon cuts



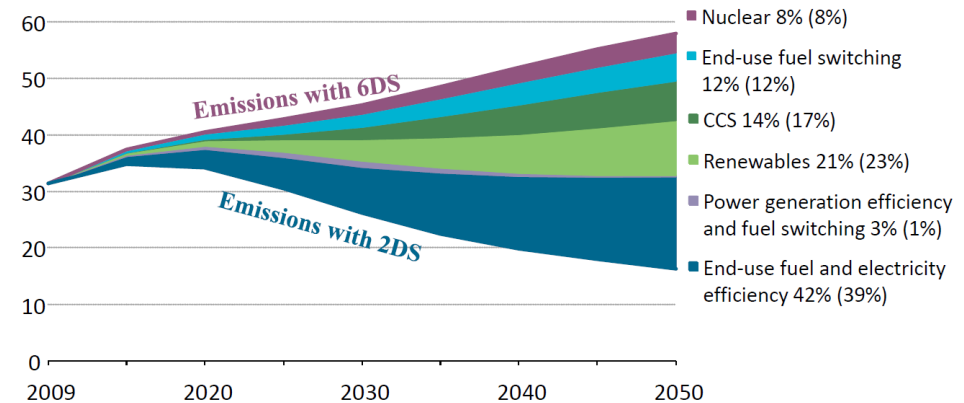
Sources: IHS CERA,  
Statoil internal analysis

# Carbon Capture and Storage to take its share

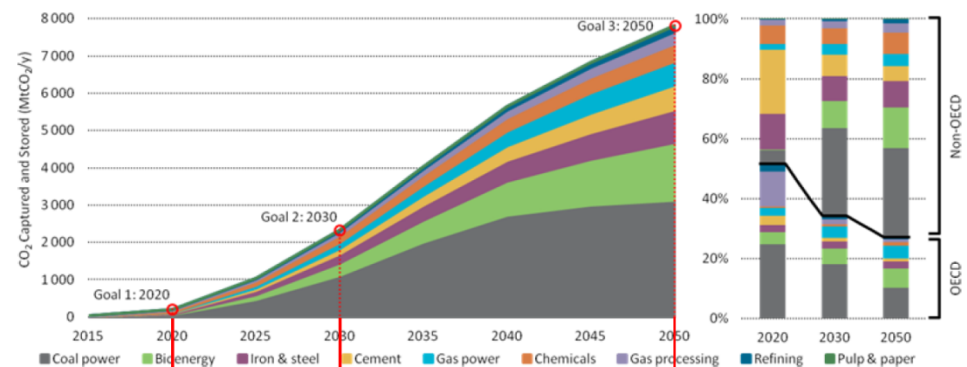
- IEA's CCS-target: 7-8 Gt CO<sub>2</sub> reduction by 2050
- 50/50 split power/ non-power industry CCS

## Portfolio of decarbonising measures

Emissions Reductions (Gt CO<sub>2</sub>)



## IEA vision: 120 Gt of CO<sub>2</sub> stored by 2050



Source: IEA

**Goal 1: 2020:**

Over 30 large projects are in operation in power and across a range of industrial processes, storing 50Mt CO<sub>2</sub> per year.

**Goal 2: 2030:**

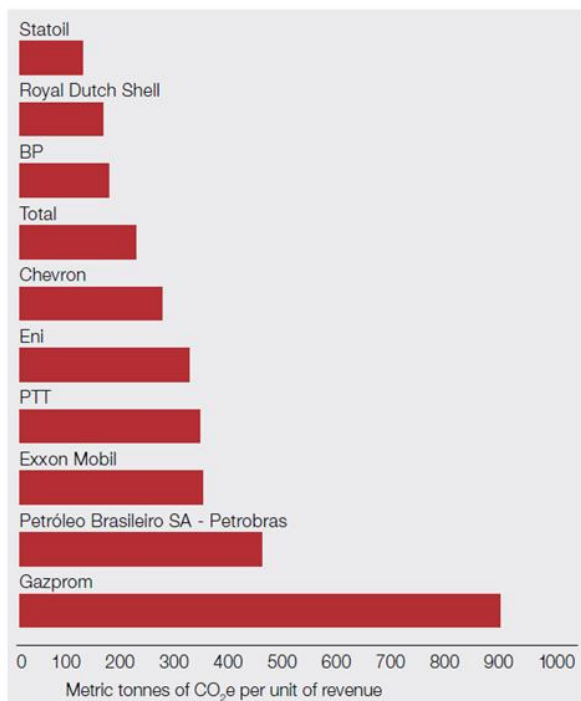
Over 2Gt of CO<sub>2</sub> is stored per year. CCS is routinely used in power and certain industrial applications.

**Goal 3: 2050:**

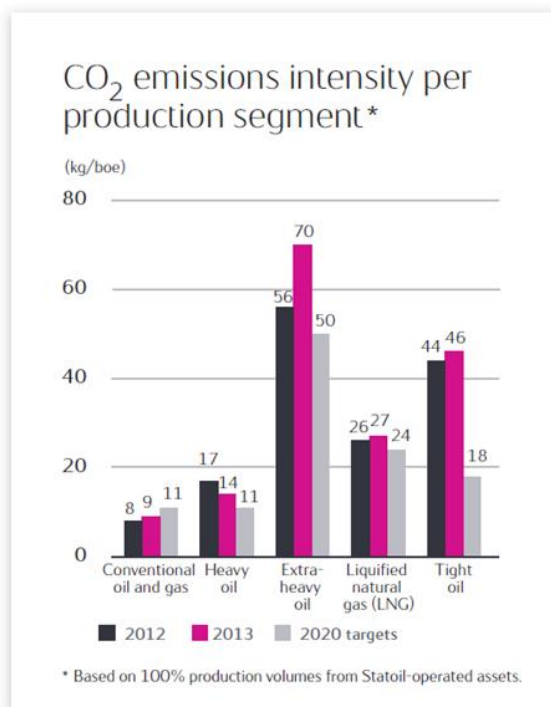
Over 7Gt of CO<sub>2</sub> is stored per year. CCS is routinely used in all applicable power and industry.

# Statoil – improving our carbon efficiency

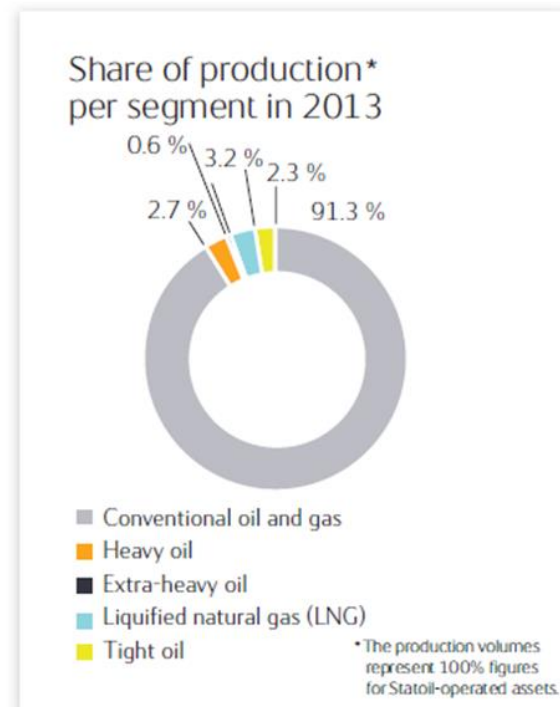
- Statoil 2013:
  - 16 mt CO<sub>2</sub>eq GHG-emissions
  - 10-11 kg CO<sub>2</sub>eq/ boe



Source: CDP Global 500 Report 2013



Source: Statoil Sustainability Report 2013

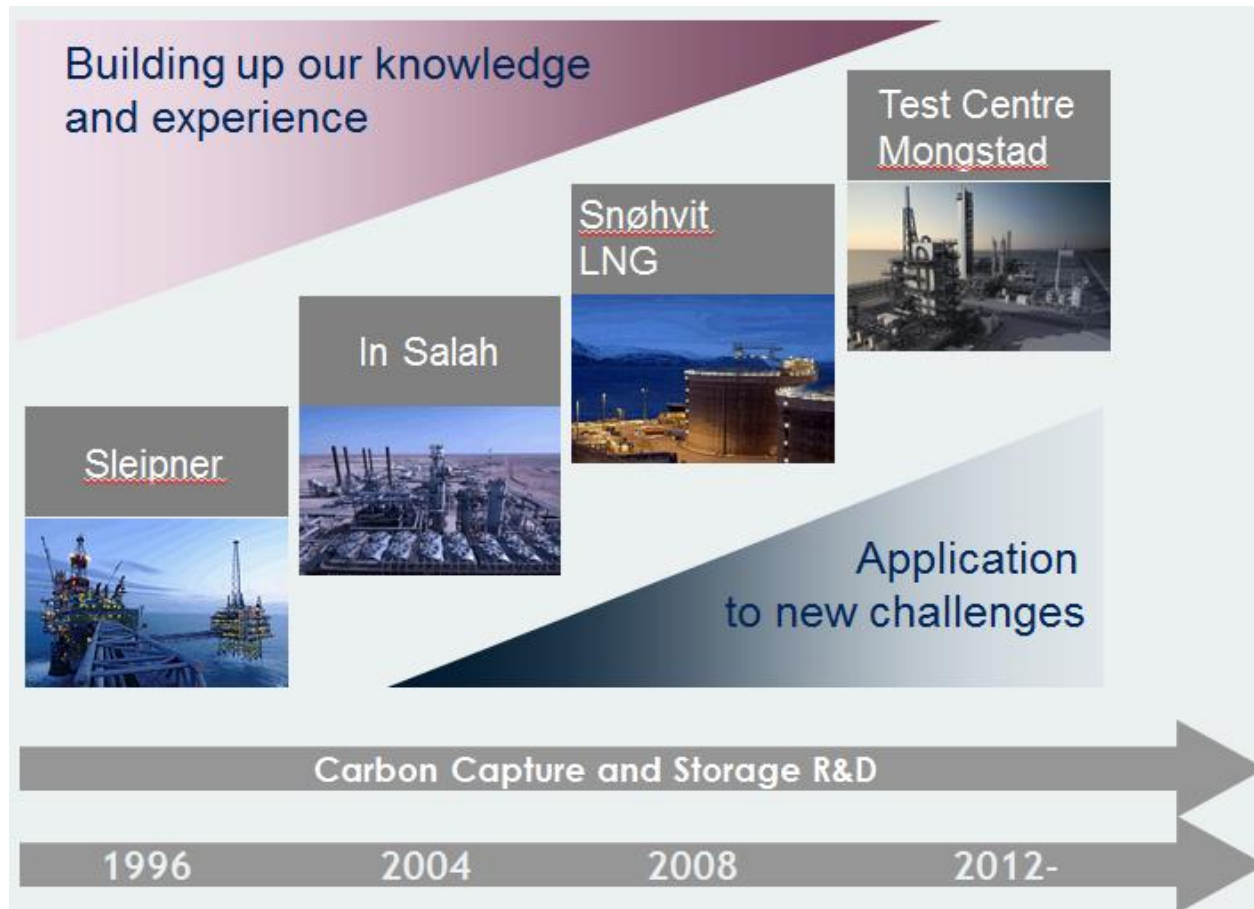


Source: Statoil Sustainability Report 2013



# Statoil CCS-experience

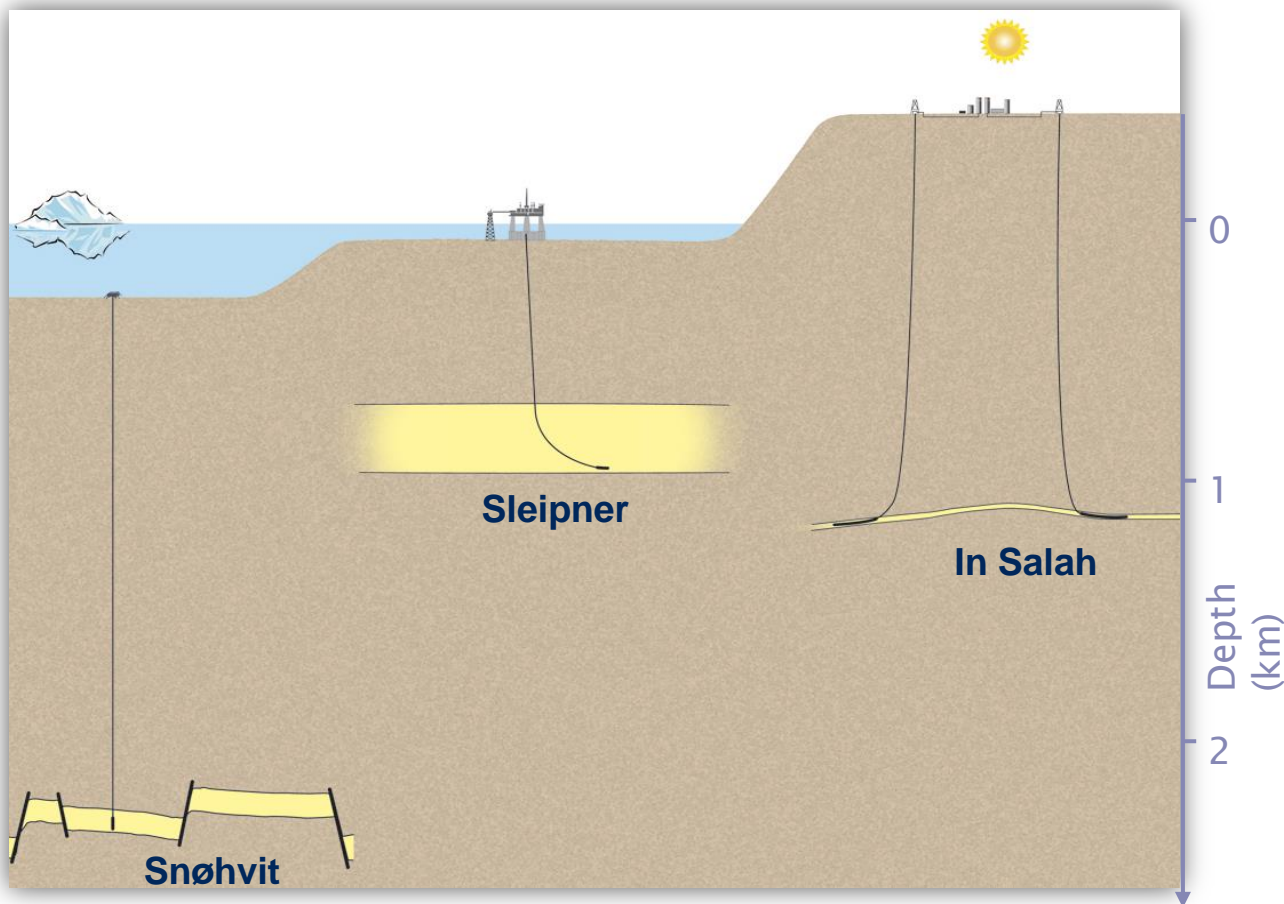
- CO<sub>2</sub> storage operations and mapping
- CO<sub>2</sub> capture tech R&D, project feasibility and TCM Mongstad
- CCS-policy and incentives advocacy



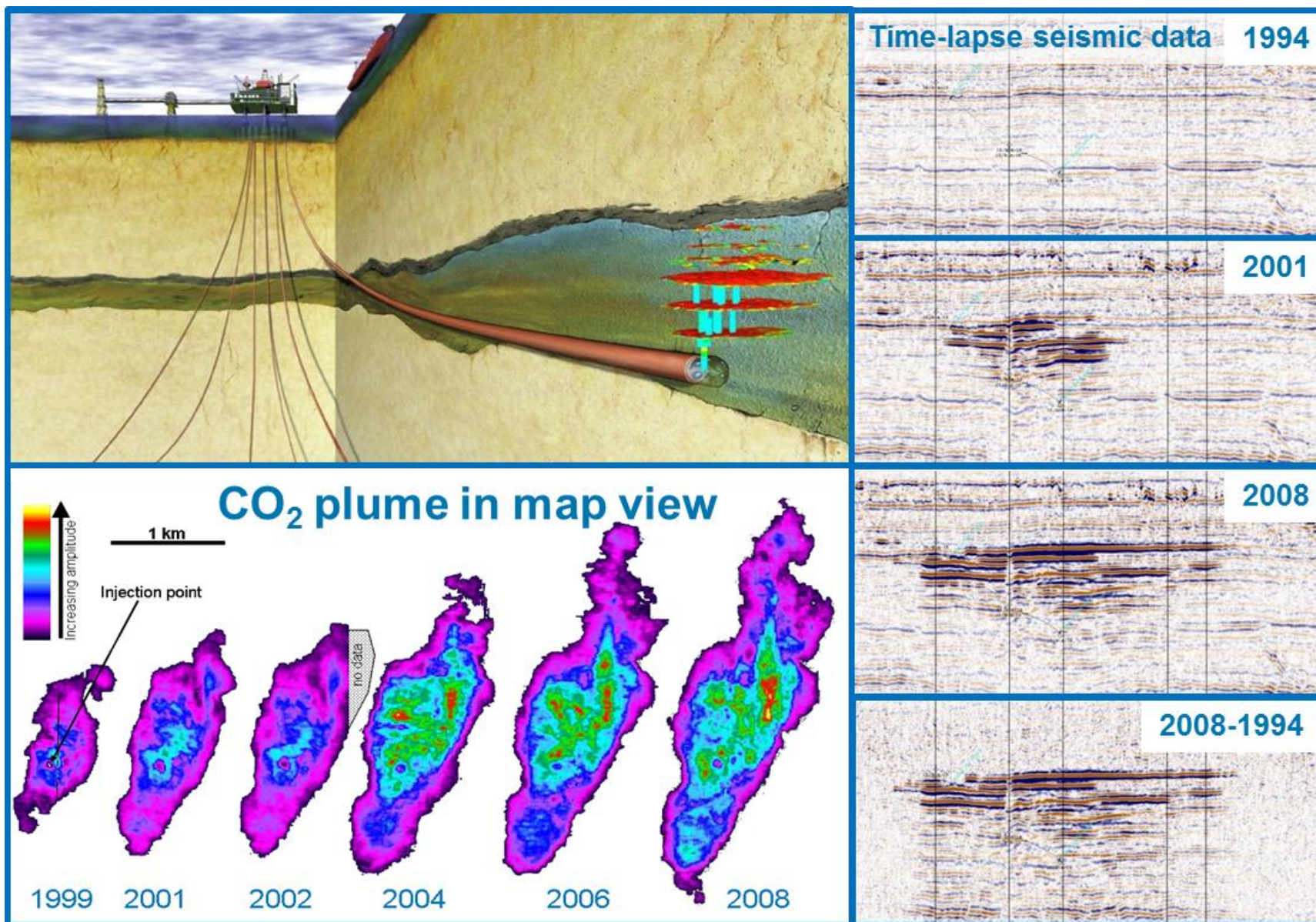


# Unique non-EOR CO<sub>2</sub> Storage Operations

- Sleipner from 1996
- In Salah from 2004
- Snøhvit from 2008



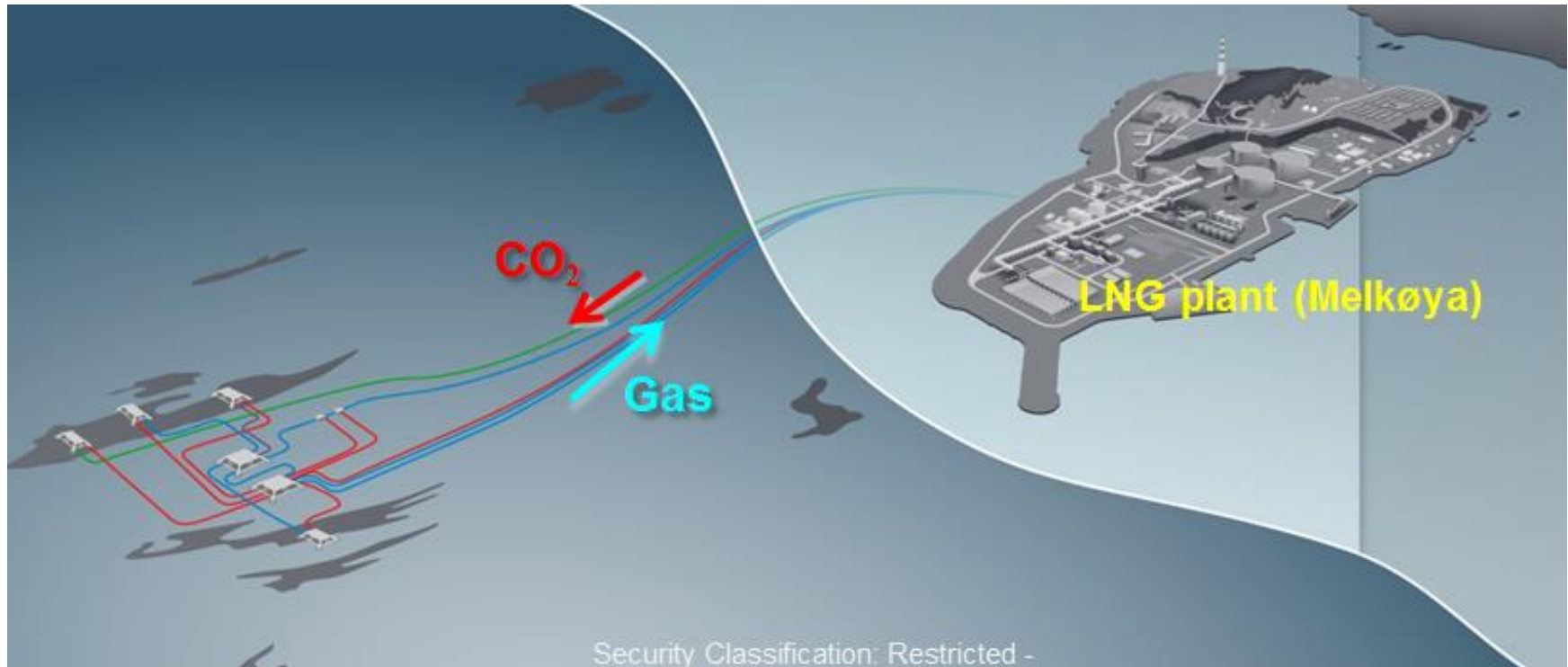
# Sleipner - Safe storage operations demonstrated





# Snøhvit – Arctic LNG production with CCS

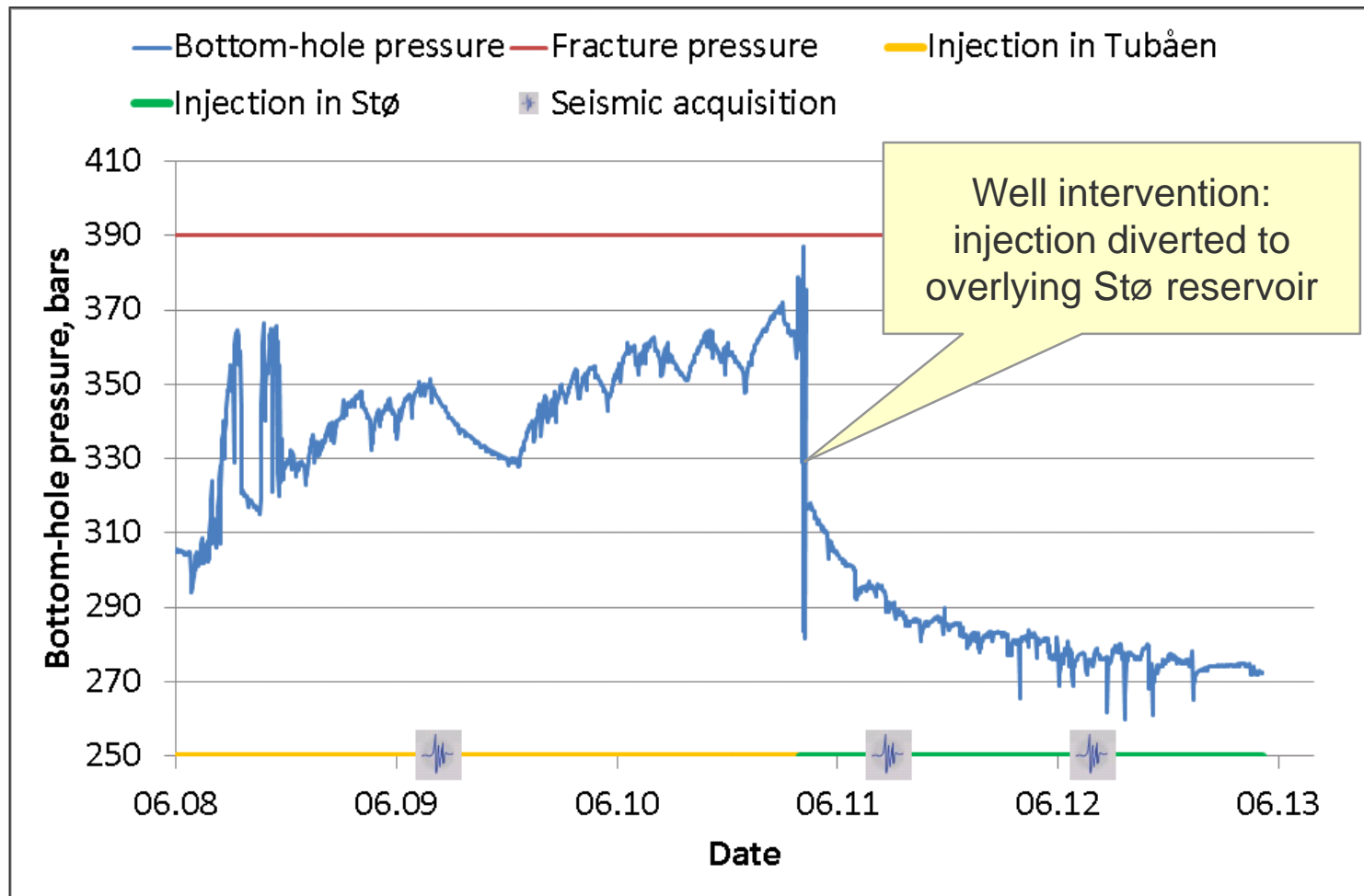
- First onshore capture / offshore storage project CO<sub>2</sub>
- First subsea CO<sub>2</sub>-injection operations
- CO<sub>2</sub> transport 150 km pipeline



Security Classification: Restricted -

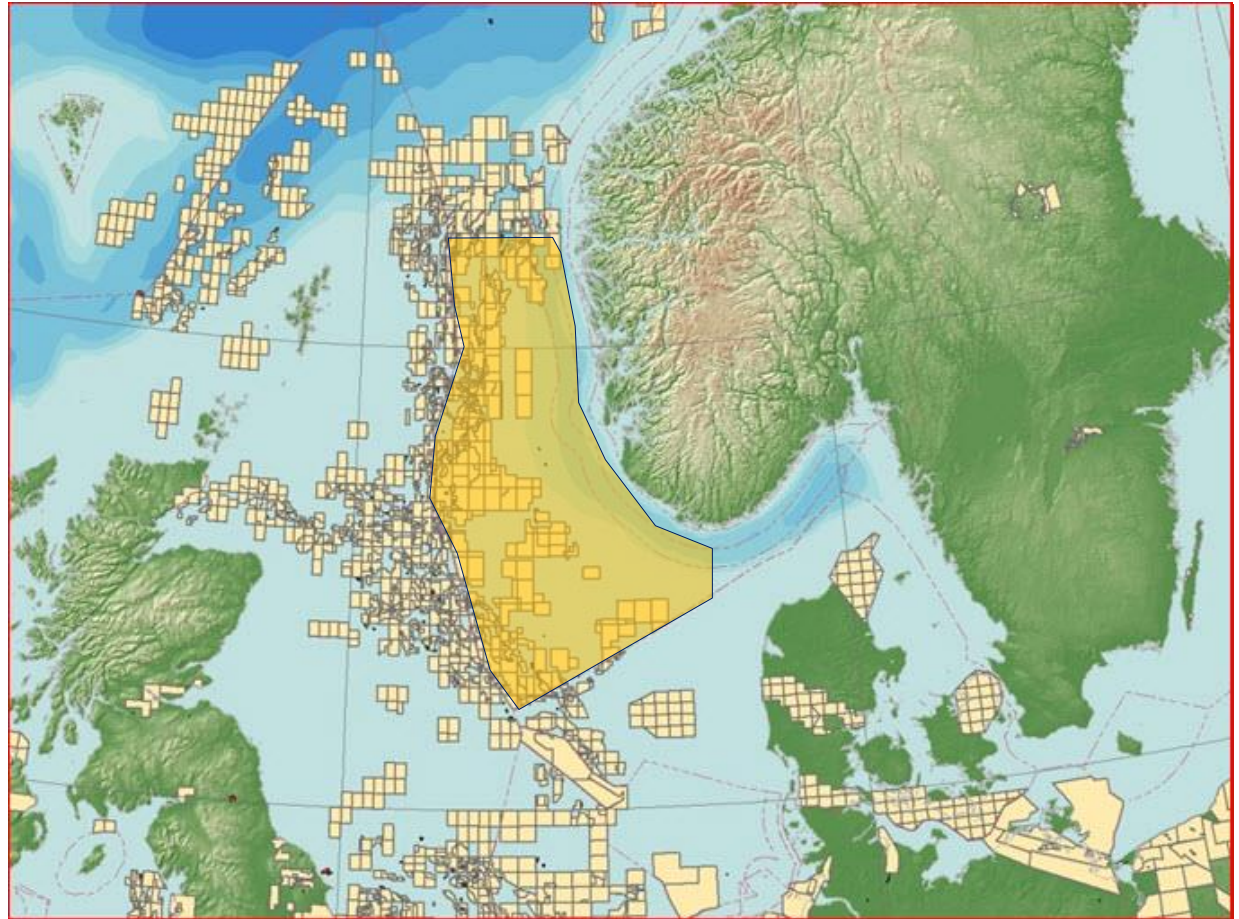
# Snøhvit CO<sub>2</sub> reservoir management

- Pressure build-up in initial Tubåen storage reservoir
- Well intervention, shifting CO<sub>2</sub> injection to Stø reservoir



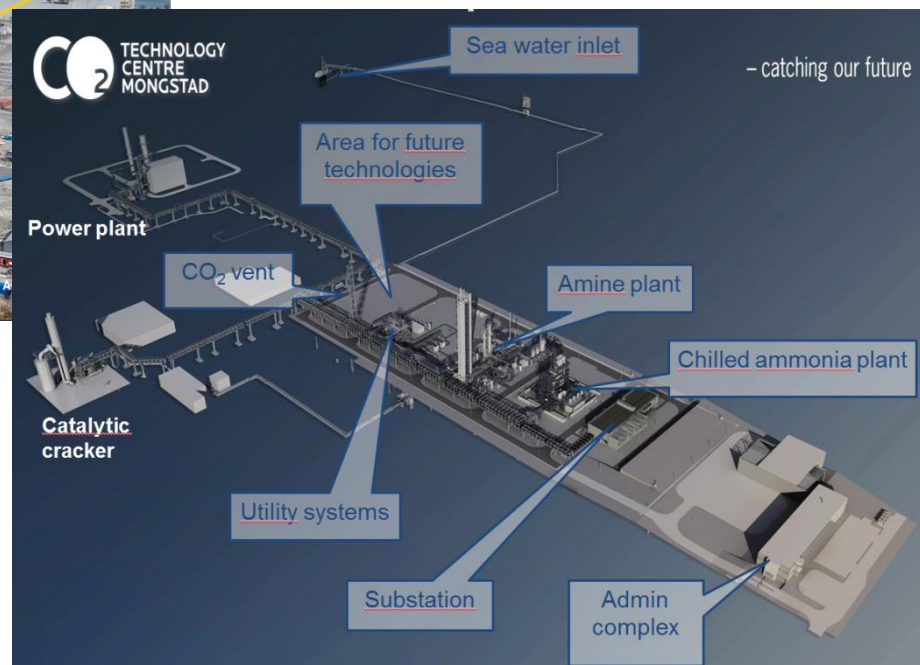
# CO<sub>2</sub> storage mapping on the Norwegian Continental Shelf

- Point sources of CO<sub>2</sub>
- Oil and gas fields
- Well data
- 2D – seismic data
- 3D – seismic data
- Licences
- Mapping area



# Qualifying CO<sub>2</sub> capture technologies

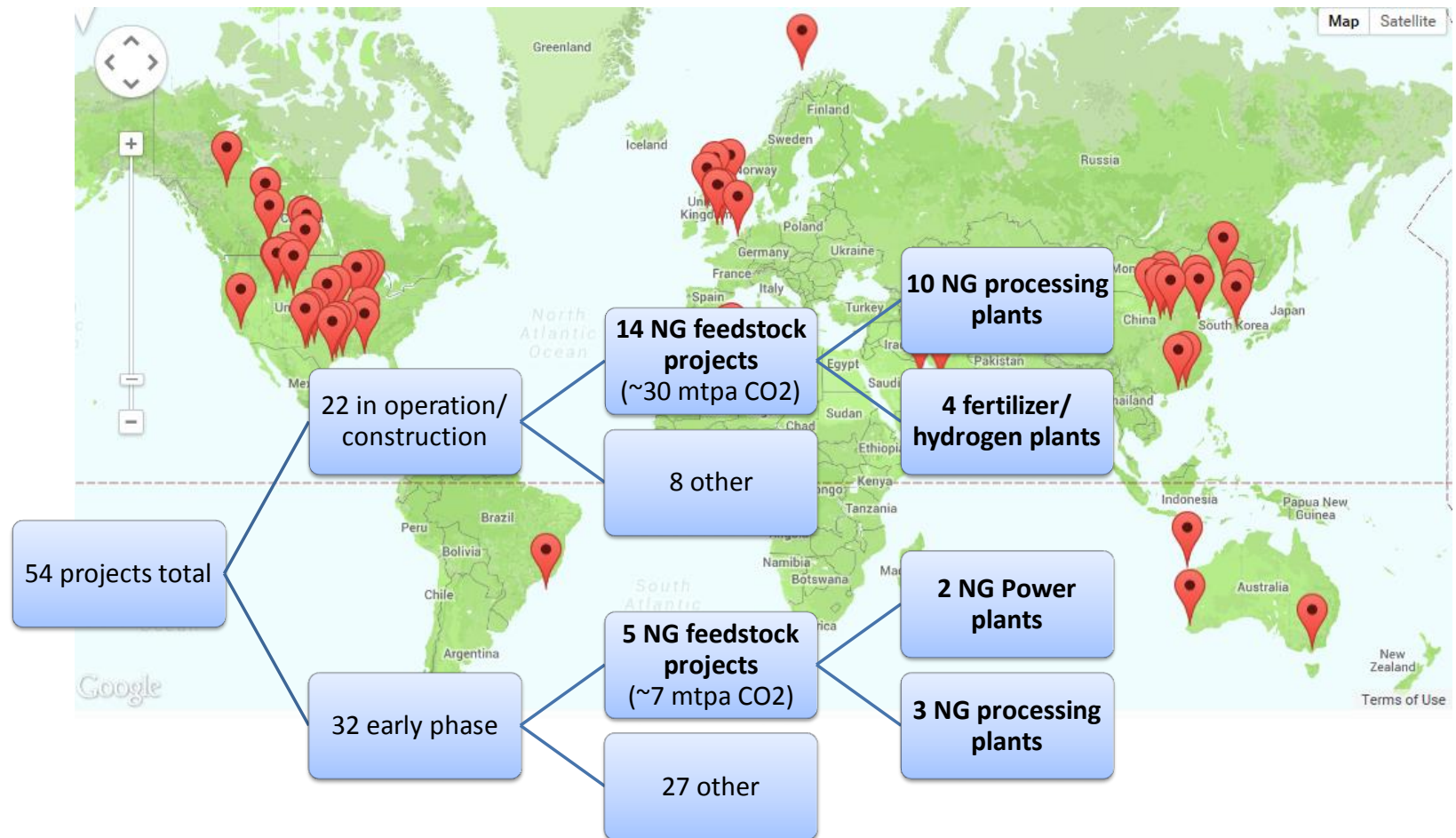
- Technology Center Mongstad (TCM) - large scale testing of post-combustion capture technologies





# Natural Gas Industry - experienced CCS operators

- 19 of 54 world-wide CCS-projects separate CO<sub>2</sub> from Natural Gas feedstock
- World large scale CCS-projects (GCCSI, feb 2015)





# Varying drivers for CCS in Natural Gas business

## ■ Natural Gas processing

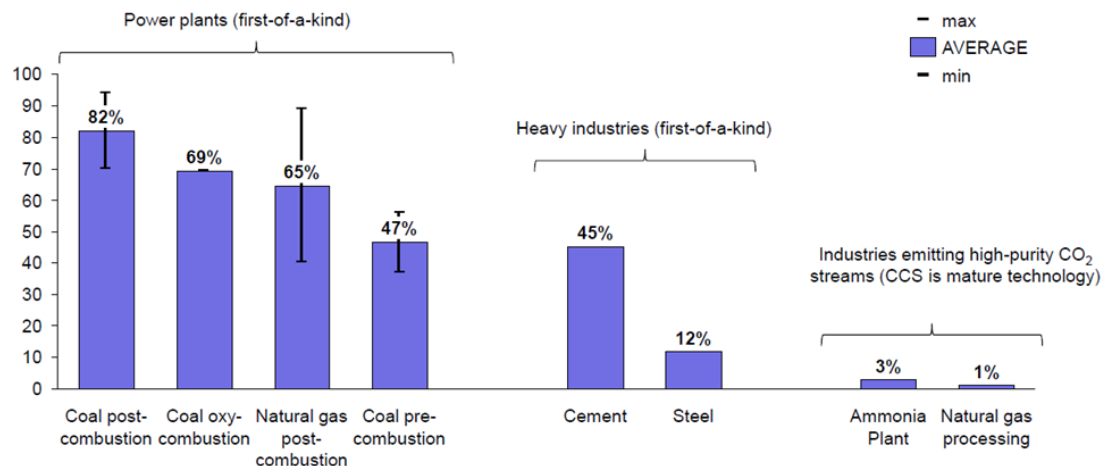
- CO<sub>2</sub>-separation integrated with basic processes
- Additional CCS-cost on tail-end handling of separated CO<sub>2</sub>

## ■ Power Generation

- Carry cost of full CCS-chain
- Gas w/CCS power competitive with coal w/CCS per MWh

### INCREASE IN LEVELIZED COST OF PRODUCTION FOR CCS PLANTS

Based on current technologies in the US, with storage site at 100 km by pipeline in an identified aquifer



Notes: Natural gas plant uses combined cycle technology (NGCC). Post-combustion and oxy-combustion base plant are supercritical pulverized coal. Pre-combustion base plant is an integrated gasification combined-cycle unit.

Source: Global CCS Institute, "Economic Assessment of Carbon Capture and Storage Technologies" 2011 update; Bloomberg New Energy Finance 2012

# CO<sub>2</sub> separation technologies

- CO<sub>2</sub>-separation technologies commercially available for Natural Gas sweetening and LNG-processing
- Capture technologies for CO<sub>2</sub> from power plants/flue gas are developing

		Syngas-hydrogen capture	Post-process capture	Oxy-fuel combustion	Inherent separation
First-phase industrial applications	Gas processing	-	-	-	Sweetening
	Iron and steel	direct reduced iron (DRI) <sup>*</sup> , smelting (e.g. Corex)		-	DRI <sup>*</sup>
	Refining	-	-	-	Coal-to-liquids; synthetic natural gas from coal
	Chemicals	-	-	-	Hydrogen production
	Biofuels	-	-	-	Ammonia/methanol
Power generation	Gas	Gas reforming and combined cycle	Natural gas combined cycle	Oxy-fuel combustion	Ethanol fermentation
	Coal	Integrated gasification combined cycle (IGCC)	Pulverised coal-fired boiler	Oxy-fuel combustion	Chemical looping combustion
	Biomass	IGCC	Biomass-fired boiler	Oxy-fuel combustion	Chemical looping combustion
Second-phase industrial applications	Iron and steel	Hydrogen reduction	Blast furnace capture	Oxy-fuel blast furnace	-
	Refining	Hydrogen fuel steam generation	Process heater and combined heat and power (CHP) capture	Process heater and CHP oxy-fuel	-
	Chemicals	-	Process heater, CHP, steam cracker capture	Process heater and CHP oxy-fuel	-
	Biofuels	Biomass-to-liquids	-	-	Advanced biofuels
	Cement	-	Rotary kiln	Oxy-fuel kiln	Calcium looping
	Pulp and paper	Black liquor gasification	Process heater and CHP capture	Process heater and CHP oxy-fuel	-

Legend: technical maturity of operational CO<sub>2</sub> capture plants to date.

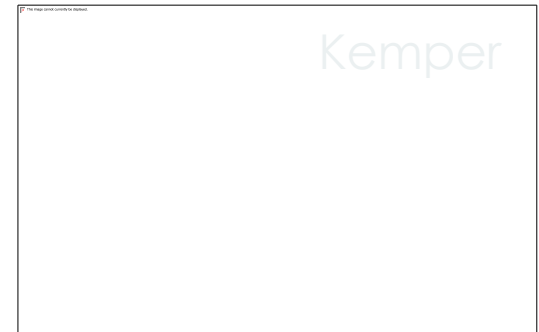
Commercial
  Demonstration
  Pilot
  Lab or concept

<sup>\*</sup> Capture approach is dependent on DRI technology used.

# 1<sup>st</sup> generation CCS in power

## Enabled through dedicated policy and funding schemes

- Boundary Dam; Coal-Postcomb-EOR project; Saskatchewan, Canada
- Kemper County; Coal-IGCC-EOR project; Mississippi, US
- Petra Nova; Coal-Postcomb-EOR project; Texas, US
- Peterhead; Gas-Postcomb-Storage project; Scotland, UK
- White Rose; Coal-Oxyfuel-Storage project; Yorkshire, UK
- ROAD; Coal-Postcomb-Storage project; Netherlands



# CCS deployment requires long-term incentives

- UK is developing long-term CCS policies



## Next steps in CCS: Policy Scoping Document

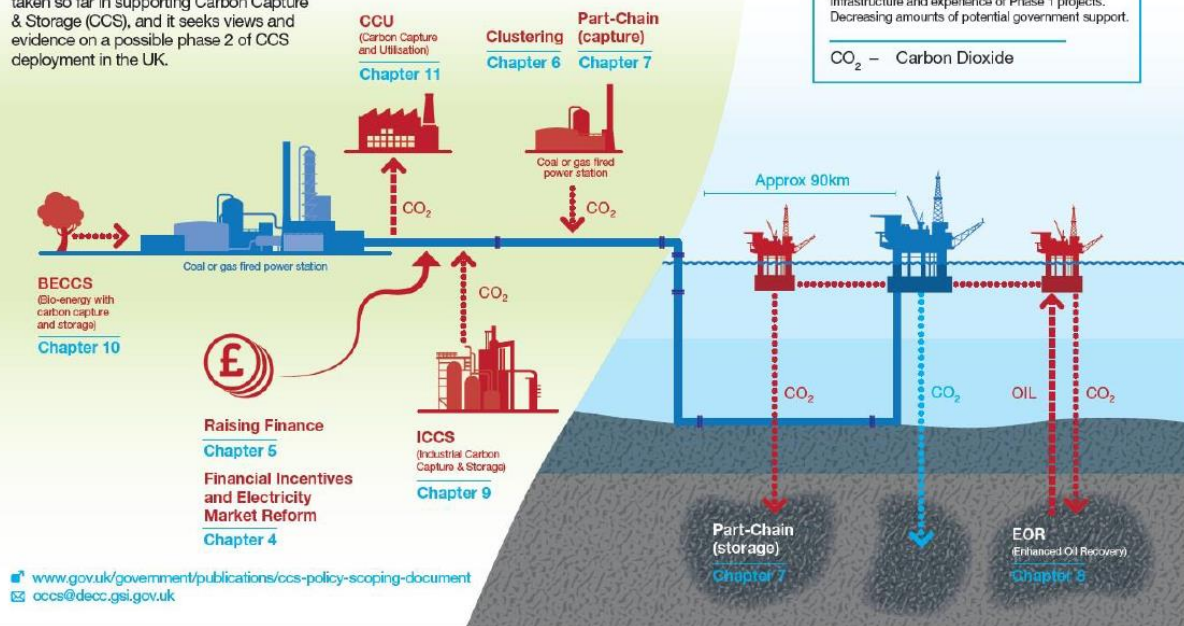
Developing an approach for the next phase of  
Carbon Capture & Storage projects in the UK

August 2014

### Next Steps in CCS: Policy Scoping Document

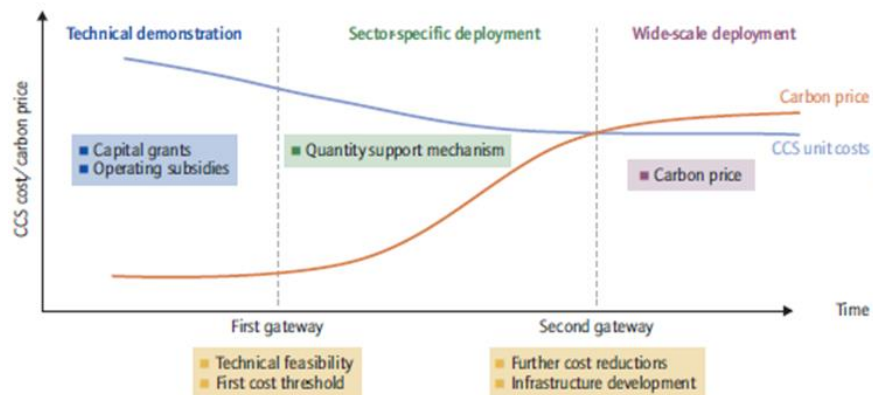
August 2014

The Policy Scoping Document summarises the Government's policies and actions taken so far in supporting Carbon Capture & Storage (CCS), and it seeks views and evidence on a possible phase 2 of CCS deployment in the UK.



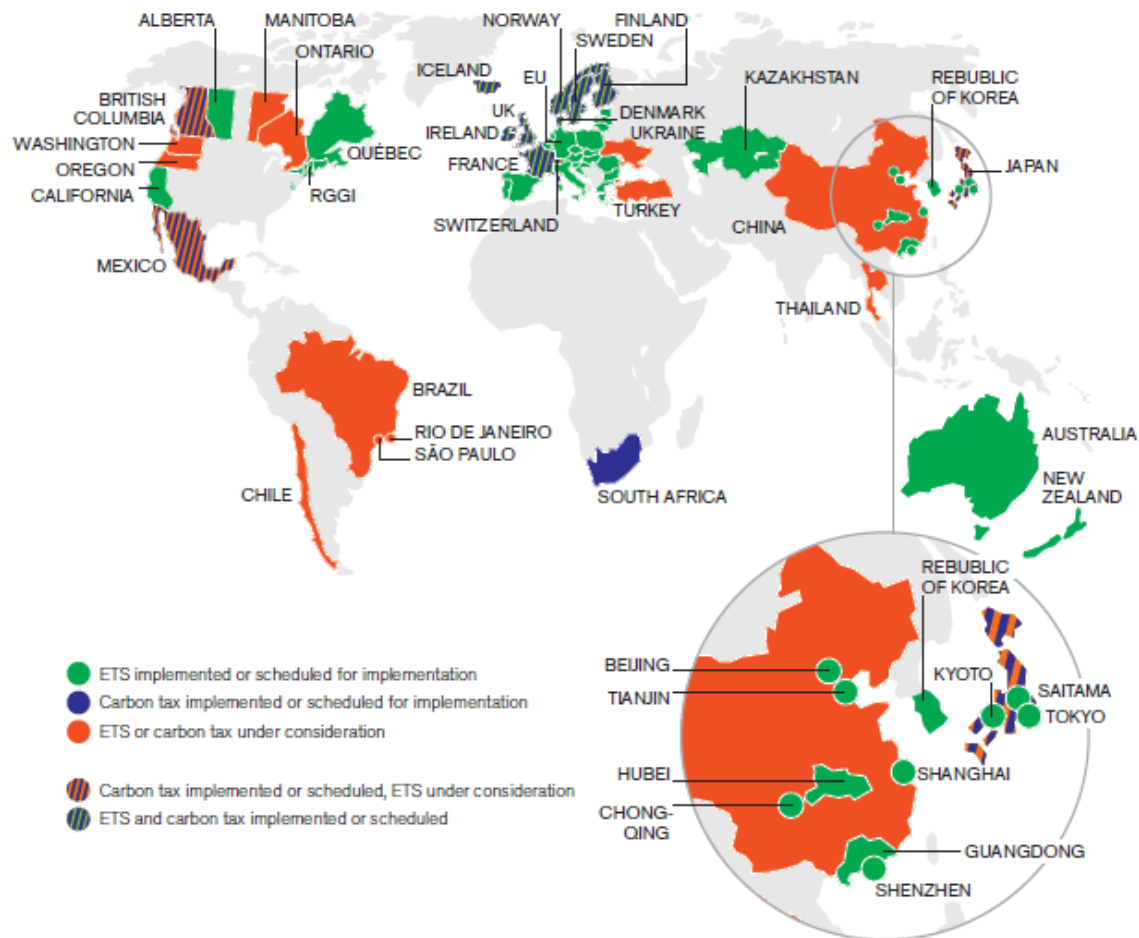
# Regulatory requirements – what do we need?

- All risk quantifiable, manageable, predictable and in balance with expected revenues
- Manageable liabilities
- Flexible support mechanism(s)
- Sufficient rate-on-return
- CCS policies with scalability (long-term vision)
- Unnecessary barriers re-moved
  
- Complexity of CCS-value chains require high involvement of government (Public Private Partnership)



# Carbon pricing – key to secure long-term decarbonisation

- Regional CO<sub>2</sub> pricing schemes and pilots underway
- Currently too weak to trigger CCS deployment





# Capturing the Future of Natural Gas - takeaways

- CCS key for a low carbon pathway
- Safe CO<sub>2</sub> storage
- Regulatory framework essential
- Multi-stakeholder collaboration required
- 1<sup>st</sup> generation CCS in power sector under way
- Cost reductions along with deployments
- Robust and widespread carbon pricing essential
- Gas power w/CCS is competitive

