KUALA LUMPUR 2012 WORLD GAS CONFERENCE

25th world gas conference

"Gas: Sustaining Future Global Growth"

The role of CCS in a sustainable Gas Industry

By: Gro J.T. Amundsen, Statoil
Jacques Grappe, Geostock

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Venue: PGCA & WOC2 Expert Forum, WGC2012 Kuala Lumpur

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EXPERT FORUM 6.B/ 2.A:
The role of Carbon Capture and Storage in a sustainable Gas Industry (2 hours)

- Introduction to various aspects of Carbon Capture and Storage by Gro J. T. Amundsen, Statoil (PGCA SGA 1.3) & Jacques Grappe, Geostock (WOC 2D) (20 min)
- Presentation of 4 papers (80 min)

Presenter	*Title*	*Company*	*Country*
Mr. Mario Tot	CCS Options for Electric Generation in South Easter Europe	IAEA	Austria
Mr. Abel Lins	A field case of CO2 storage and EOR	Petrobras & University	Brazil
Ms. Vera Khvostova	Setting up electronic data bases of global CO2 sequestration project	Gazprom	Russia
Mr. Fadhli Hadana Rahman and Mr. Faudzi Mat Isa	Development of Polymeric hollow fibre membrane for offshore application	Petronas & Cameron	Malasya+USA

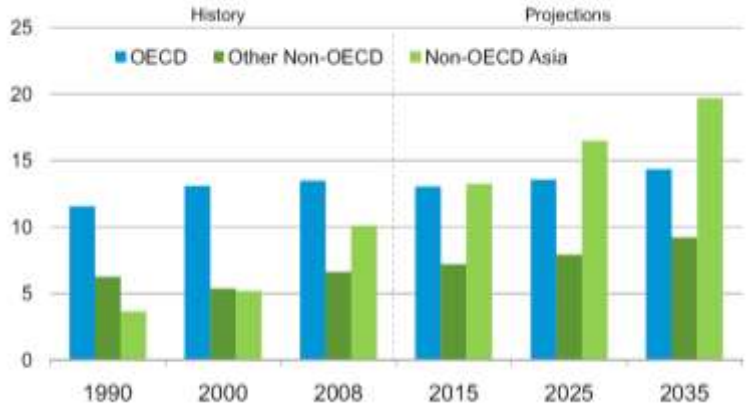
- Q&A panel of presenters (15 min)
- Short wrap up (5 min)

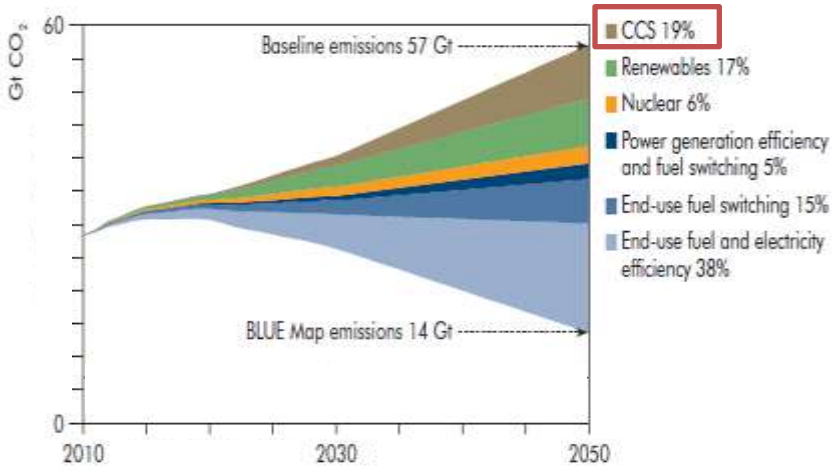
The role of CCS in a sustainable gas industry
PGCA SGA1.3
WOC2 SG2D

CCS can play an important role

As we continue to progress, the world CO_2 emissions is expected to continue rising

CCS is expected to help mitigate almost 20% of the CO_2 emissions by 2050



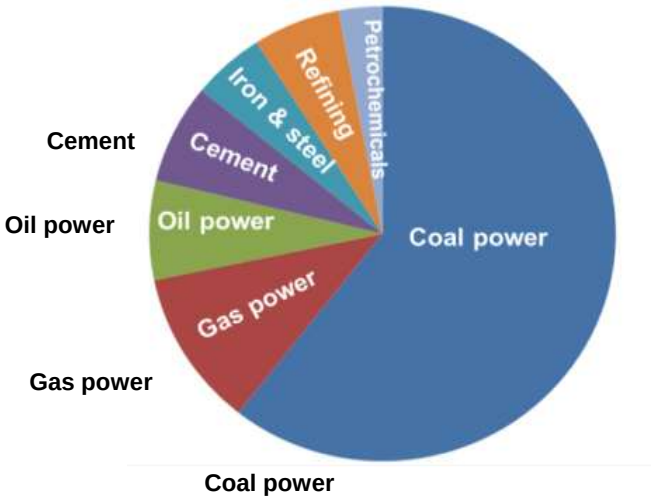


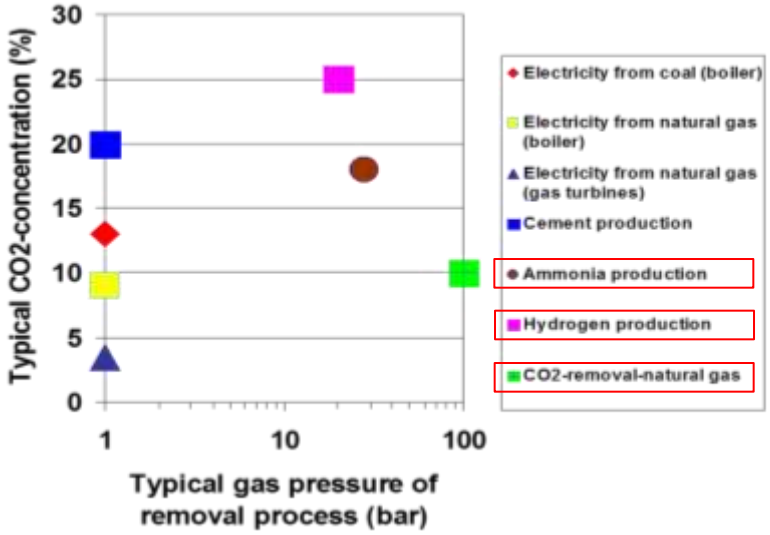
CO2 sources fit for CCS

Coal is the biggest contributor of CO_2 emissions, but gas is also a contributor

The more attractive conditions for CO_2 capture are in gas streams with high concentration of CO_2 and high pressure

About 7500 large point sources in industry

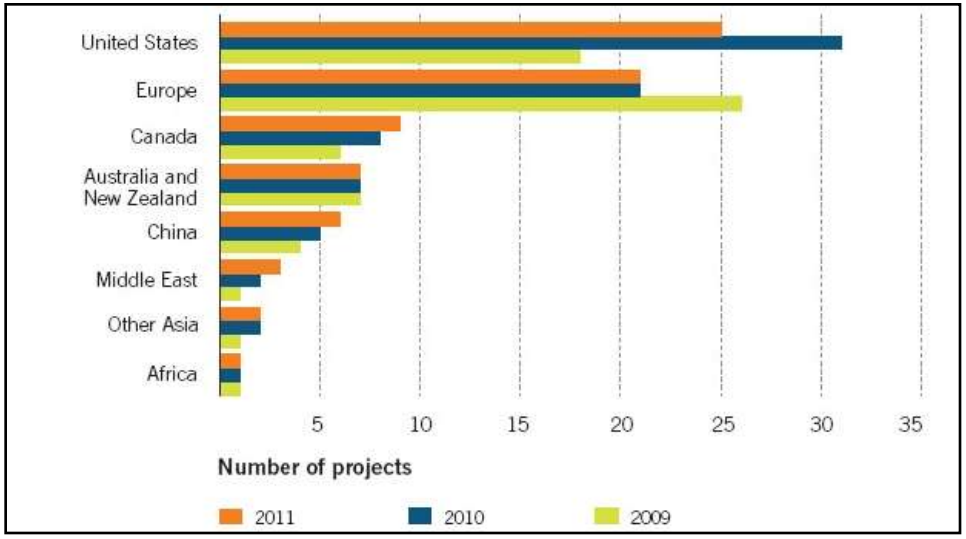




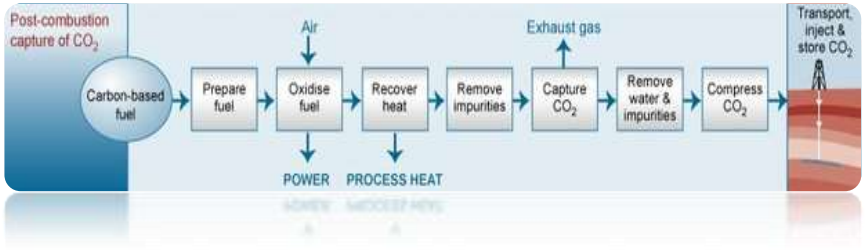
Global CCS Project Status

- Currently 70-80 projects at different stages of maturity
  - 8 in operation
  - 7 under construction

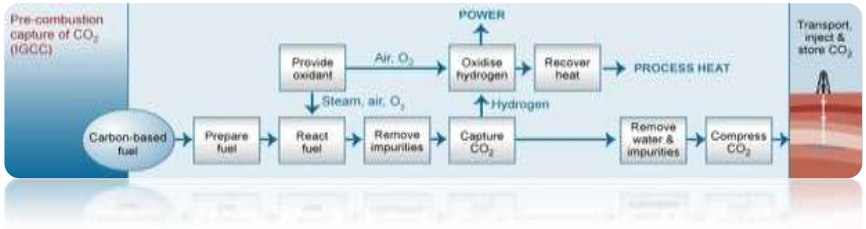
- Most projects registered in USA and Europe
- Most projects in EOR, in the power sector, but also in gas processing industries.



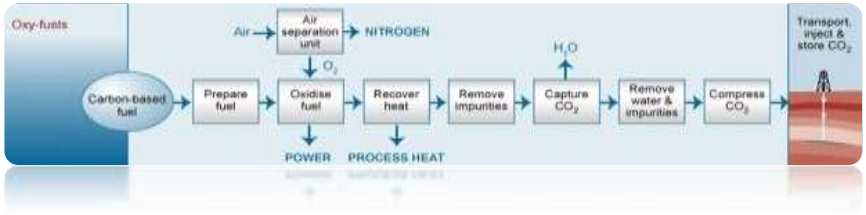
Technologies for CO_2 capture



Post combustion



Pre combustion



Oxy-fuels

Technology Centre Mongstad, Norway
The world's largest carbon capture test facility

Transport connects CO_2 capture site and storage site by pipeline or shipping

CAPTURE
for example

Power plants

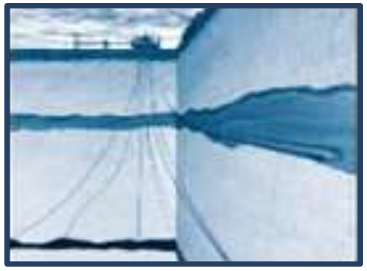
Gas processing

TRANSPORT

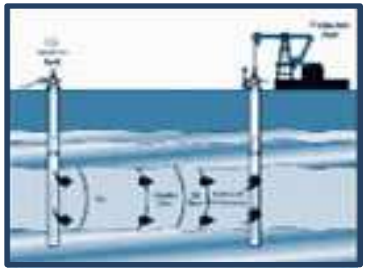
Pipelines

Ships

STORAGE
for example

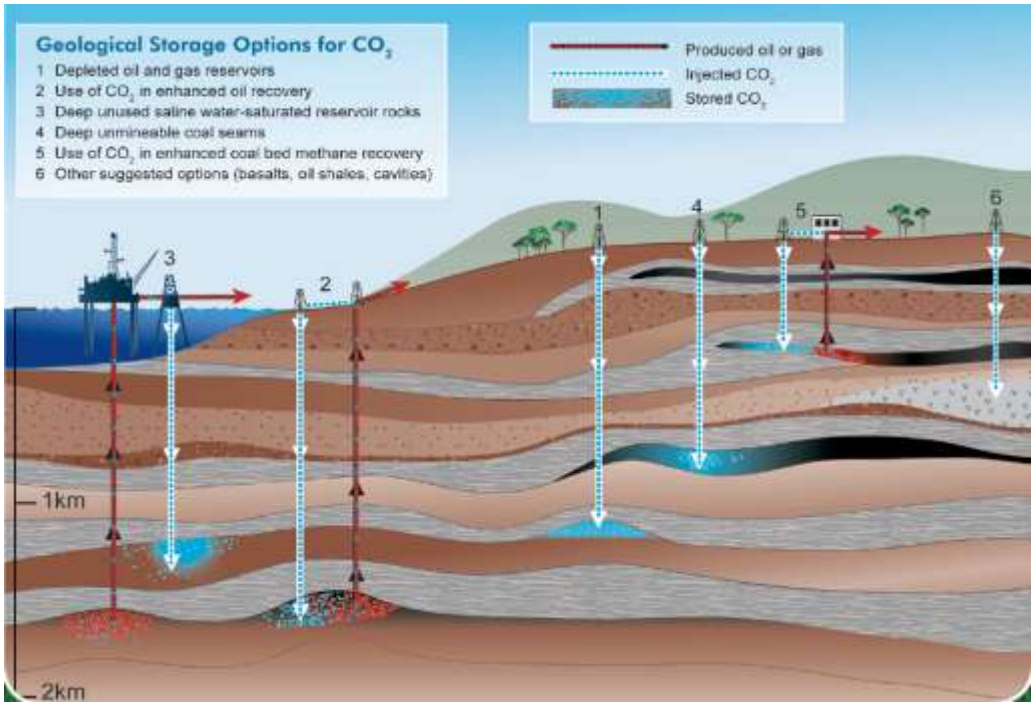


Storage in saline aquifers



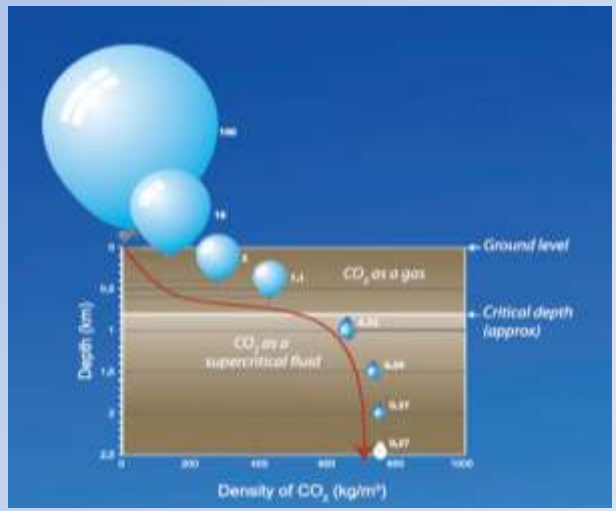
Enhanched all recovery

There are several types of CO_2 storage sites;
and large-scale demonstrations have already started

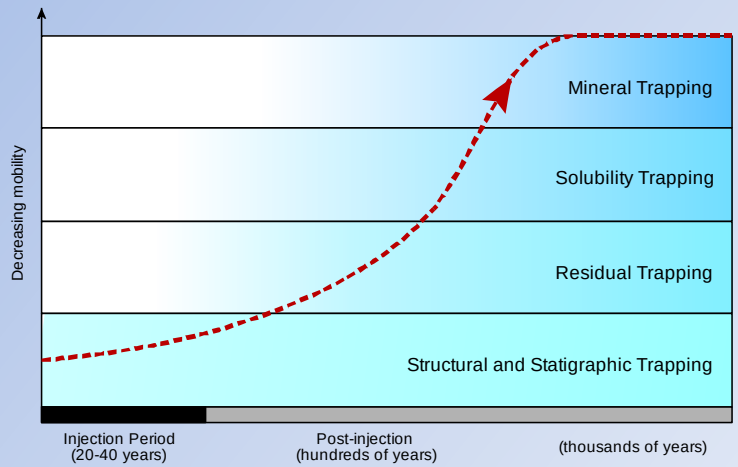


- **EOR, EGR and ECBM**
  - Weyburn (Canada), In Salah (Algeria)
- **Deep Saline Aquifers**
  - Sleipner, Snøhvit (Norway), Illinois (USA)
- **Depleted Oil & Gas Fields**
  - Altmark (Germany), Rousse (France)

CO_2 is injected under pressure as a supercritical fluid, which takes up less space and diffuses well in storage rocks



Injected CO_2 becomes less and less mobile, but it needs a long time.



Underground Natural Gas storage operators can contribute a lot to future CO2 Underground Storage

- Nearly a century engineering practice and operating experience of underground storage facilities
- Well established Safety culture
  - risk evaluation and mitigation approaches
  - qualification and training of personnel
- Management of transportation infrastructure
- Monitoring practice
- In depth practice of day to day interaction with Administrations, and communication with neighboring communities
- Operation of multi-clients facilities

A high level of technological readiness; and some challenges to overcome

The technologies for underground storage of natural gas and EOR have much in common with CO2 storage, in spite of some differences which have triggered extensive R&D work:

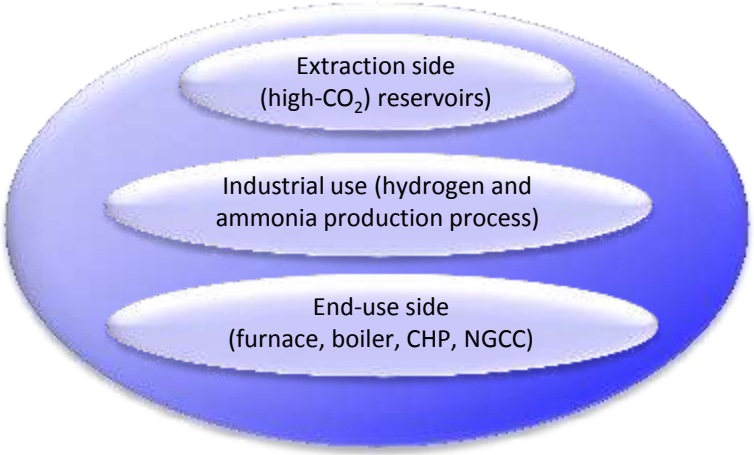
- Time frame: yearly cycles vs. thousands of years
- Size of the reservoir: much smaller for natural gas UGS than for CO2
- CO2 is reactive as compared to Natural Gas (specific materials for wells construction, reaction with reservoir components)

Some of the main challenges for new CO2 storage projects include:

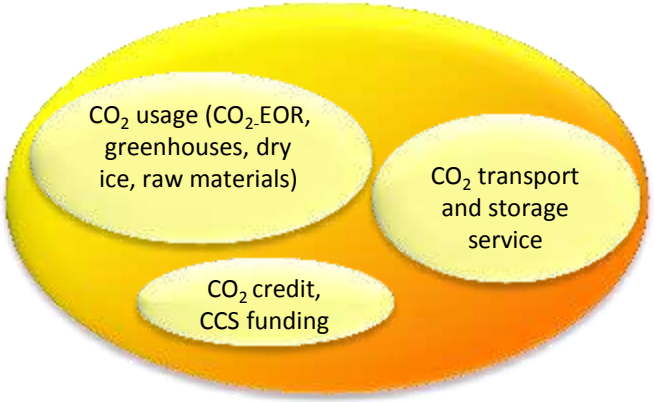
- Minimum level of CO2 purity required for injection into the reservoir
- Site selection and evaluation (large acreage to be investigatd, competing use of the subsurface space, inventory and characterization of legacy wells)
- Permitting and Public acceptance issues (onshore projects mainly)
- Economics

The Role of CCS in a sustainable gas industry

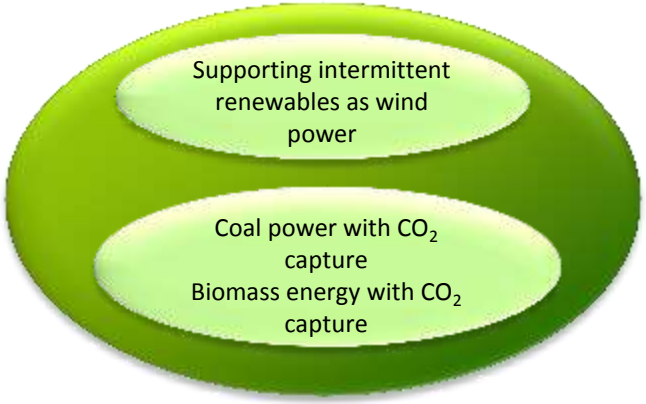
Cut CO_2-emissions from gas industry itself and natural gas consumers



Expanding the business of gas industry by creating new value



Help formation of a low carbon energy portfolio



Overcoming Challenges for CCS

Lack of commercial incentives
Incentive mechanism for CCS is needed.

The high cost of CCS
Capture 60-75%, Transport 10-15%, Storage 10-25%
Gas industry can focus on lowering capture cost for
"Low hanging fruits" (Hydrogen, Ammonia, Gas purification) .

Acceptance from the public
Communication. Work closely with the stakeholders to increase knowledge on CCS, benefits and risk management.

The need for a stable, workable legal framework, including standards and norms
Support the establishment of industry guidelines and standards for parts of the CCS-chain.


CCS can be the natural progression
for a sustainable gas industry
Thank you for your attention

Capture and Transportation

Geological Storage

The Role of CCS in a sustainable gas industry