



IEA Greenhouse Gas R&D Programme



A Brief Worldwide Look at CCS Technology & Plans

**Presented at: 5th Annual Conference on CCS
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**by
Eur. Ing. Harry Audus**

IEA Greenhouse Gas R&D Programme



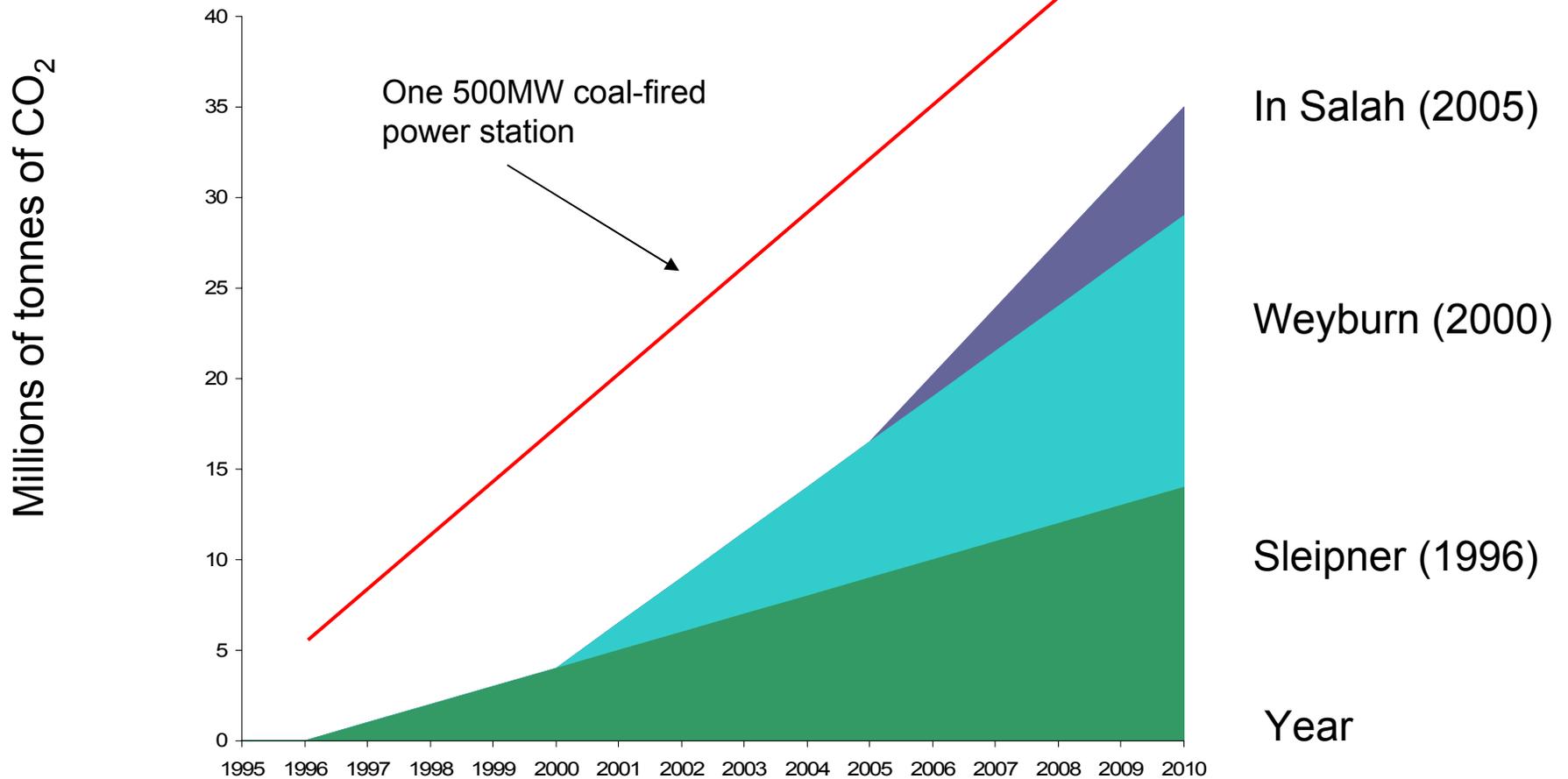
Existing CCS 'Commercial'* Projects

- There are 3 projects that can be said to be operating 'commercially' at a significant scale.
 - Sleipner
 - Weyburn
 - In Salah
- These schemes each capture and store approximately 1 million tonnes CO₂/year
- This total of 3 million tonnes CO₂/year is roughly equivalent to the annual emissions from one modern coal-fired power plant.

*'Commercial' as opposed to non-commercial demonstrations



Monitored CO₂ Stored Underground





Commercial CCS Projects



Sleipner



Snøhvit



In-Salah



Weyburn

Images Courtesy of BP, Statoil, and PTRC



These 3 'Early-opportunity' CCS Projects

- Are integrated with an existing infrastructure/project
- Have a convenient store for CO₂
- The cost of CO₂ is considerably less than the cost of capturing it at a power station.
 - Low-cost CO₂ sources:
 - Where it has to be removed from raw natural gas to meet pipeline specifications or for LNG production
 - Synthesis gas clean-up e.g. in hydrogen production.



Other Commercial CCS Projects Underway

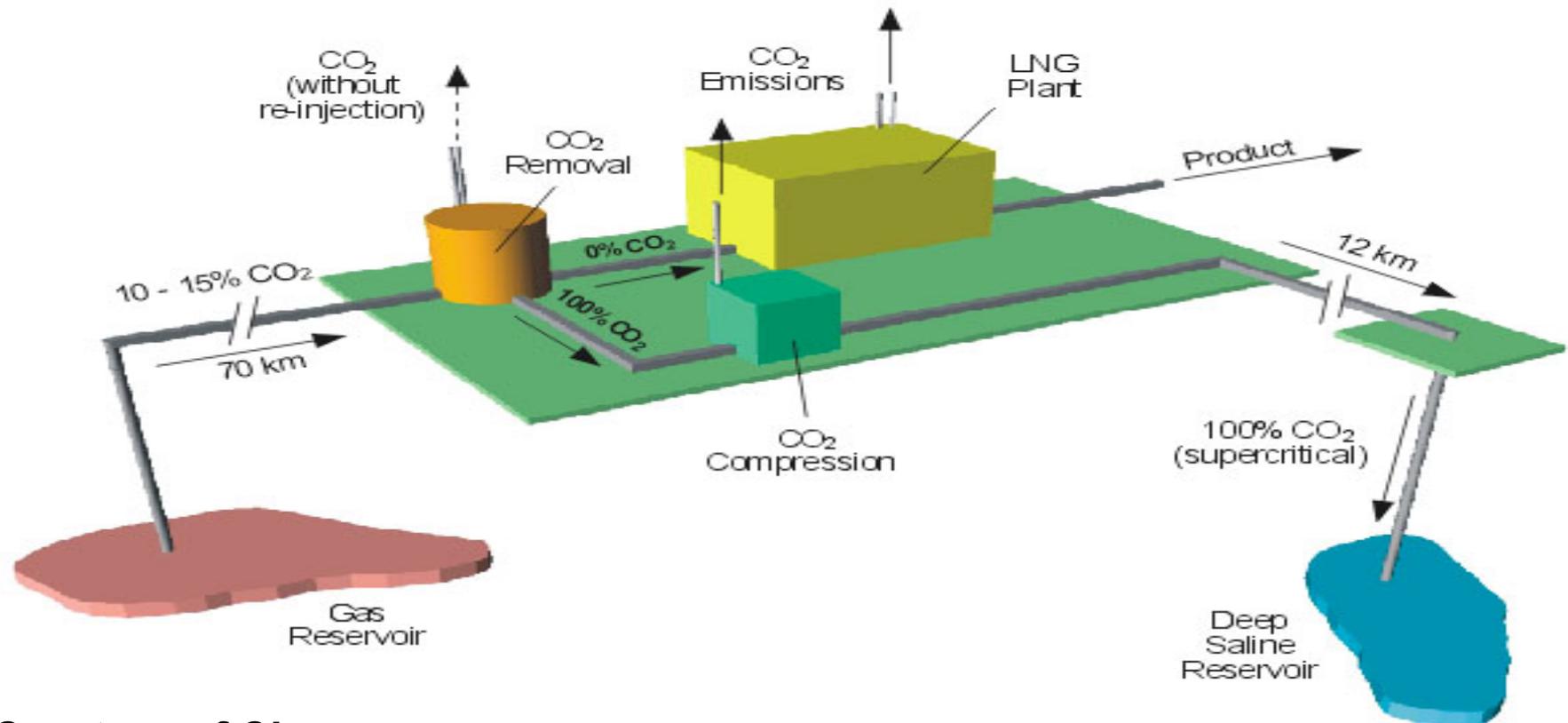
- Snøhvit (start-up 2006)
- Gorgon (operation start 2008-2010)
- Miller-Peterhead –DF1 (operation start 2009)
- Carson - DF2 (operation start 2009)
- Draugen (operation start 2010)

Total CO₂ to be stored by the above:

12.5 million tonnes CO₂ / year



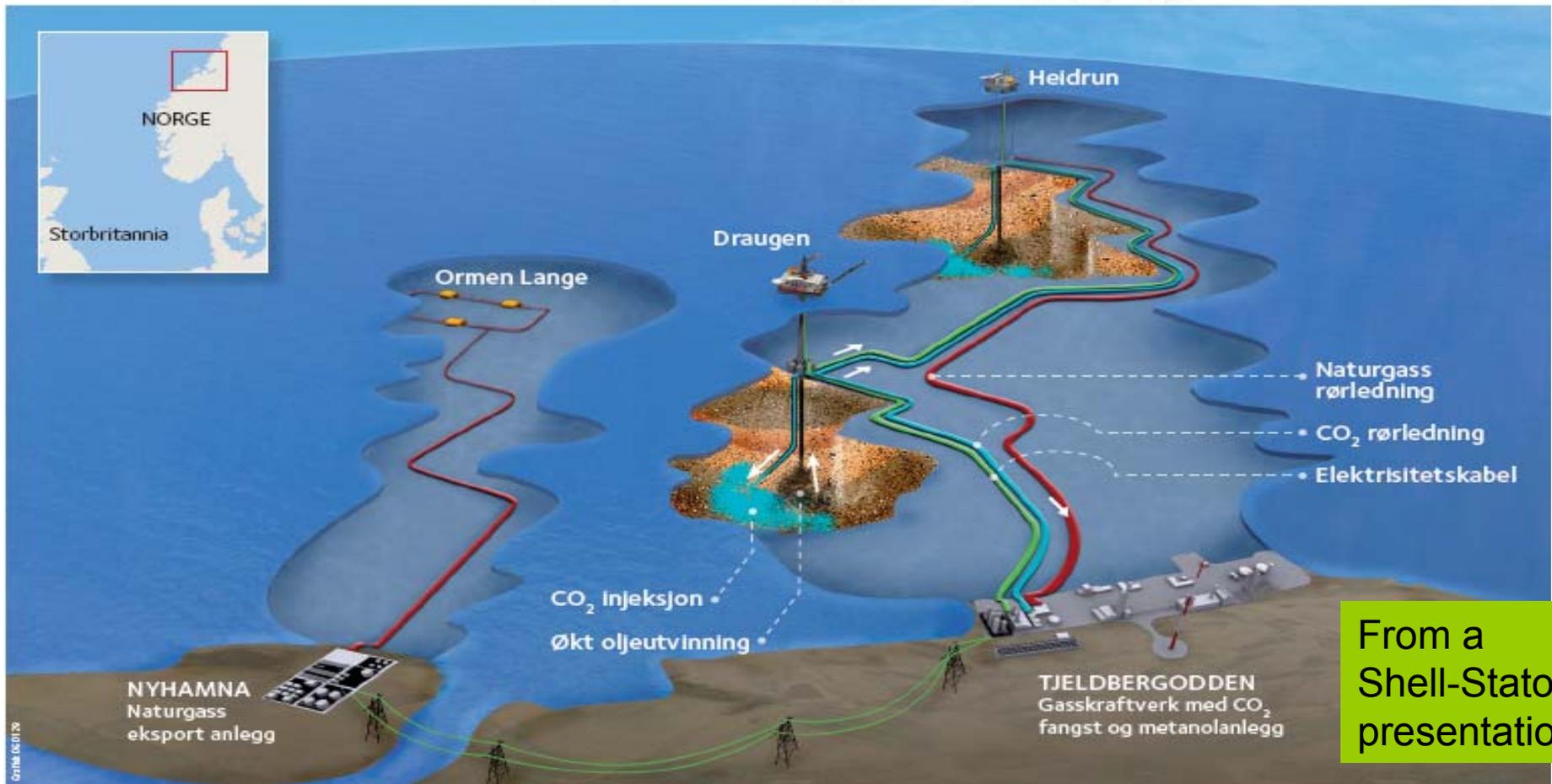
Gorgon LNG plant with CO₂ capture



Courtesy of Chevron



Schematic of the Shell/Statoil – Draugen Project



From a Shell-Statoil presentation

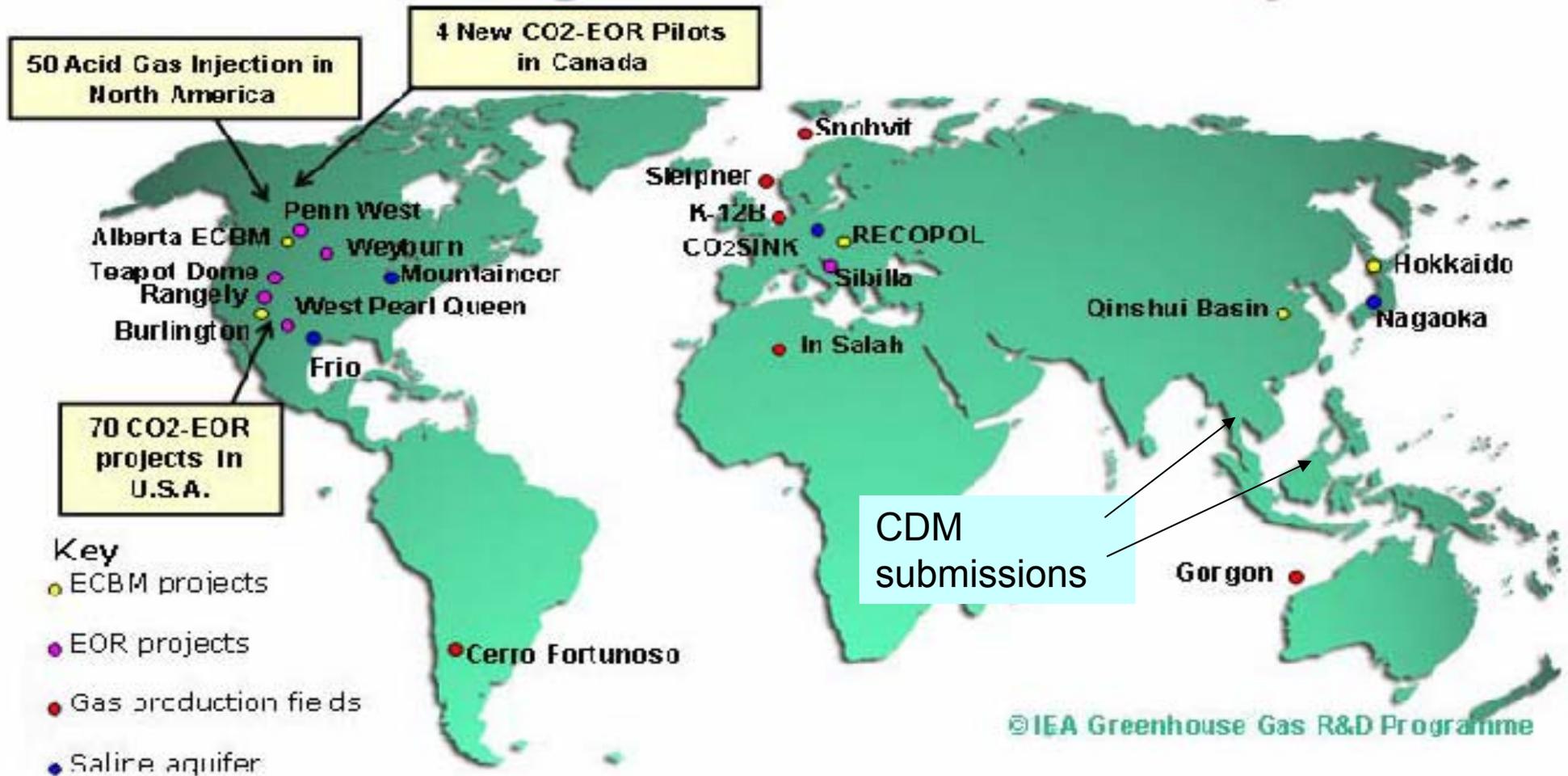


Key considerations for early-day CCS projects

- Applicable state/national/international incentives
 - 2 CCS projects have been submitted under the Kyoto CDM (Clean Development Mechanism)
- Taxes applicable to incremental oil/gas
- Risk sharing
- Finance sourcing/cost
- Long-term liability issues



CO₂ Storage Demonstration Projects



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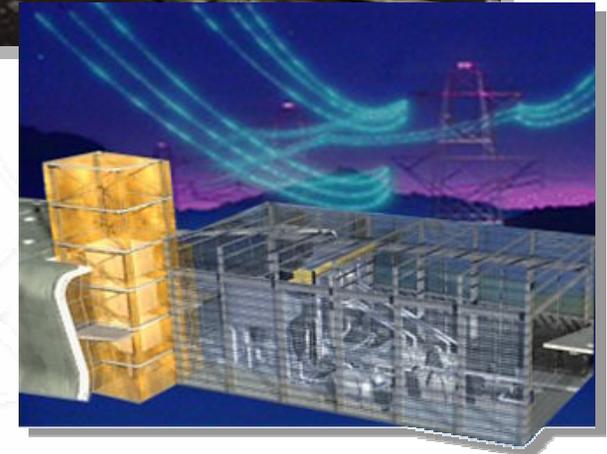
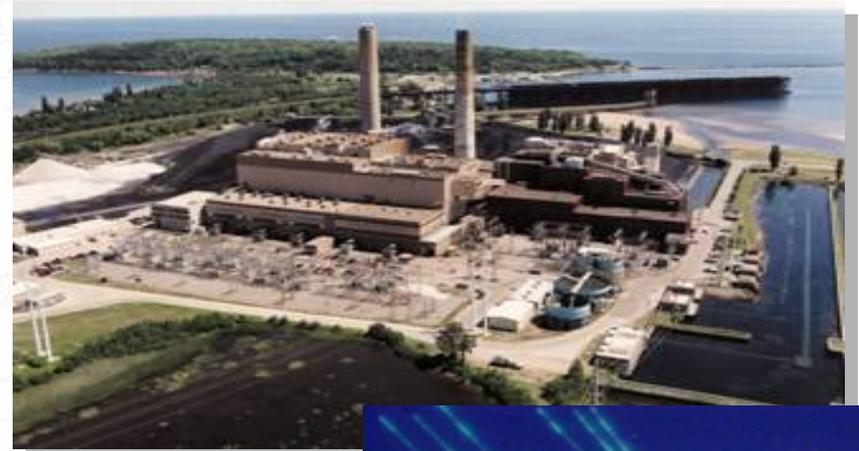
Coal-based CCS 'Demonstration' activity outside the USA

- Stanwell, Australia (operation start 2010)
- SaskPower, Canada (operation start 2012)
- HYPOGEN/DYNAMIS (operation start after 2012)
- RWE
 - Germany
 - UK
- E.ON UK



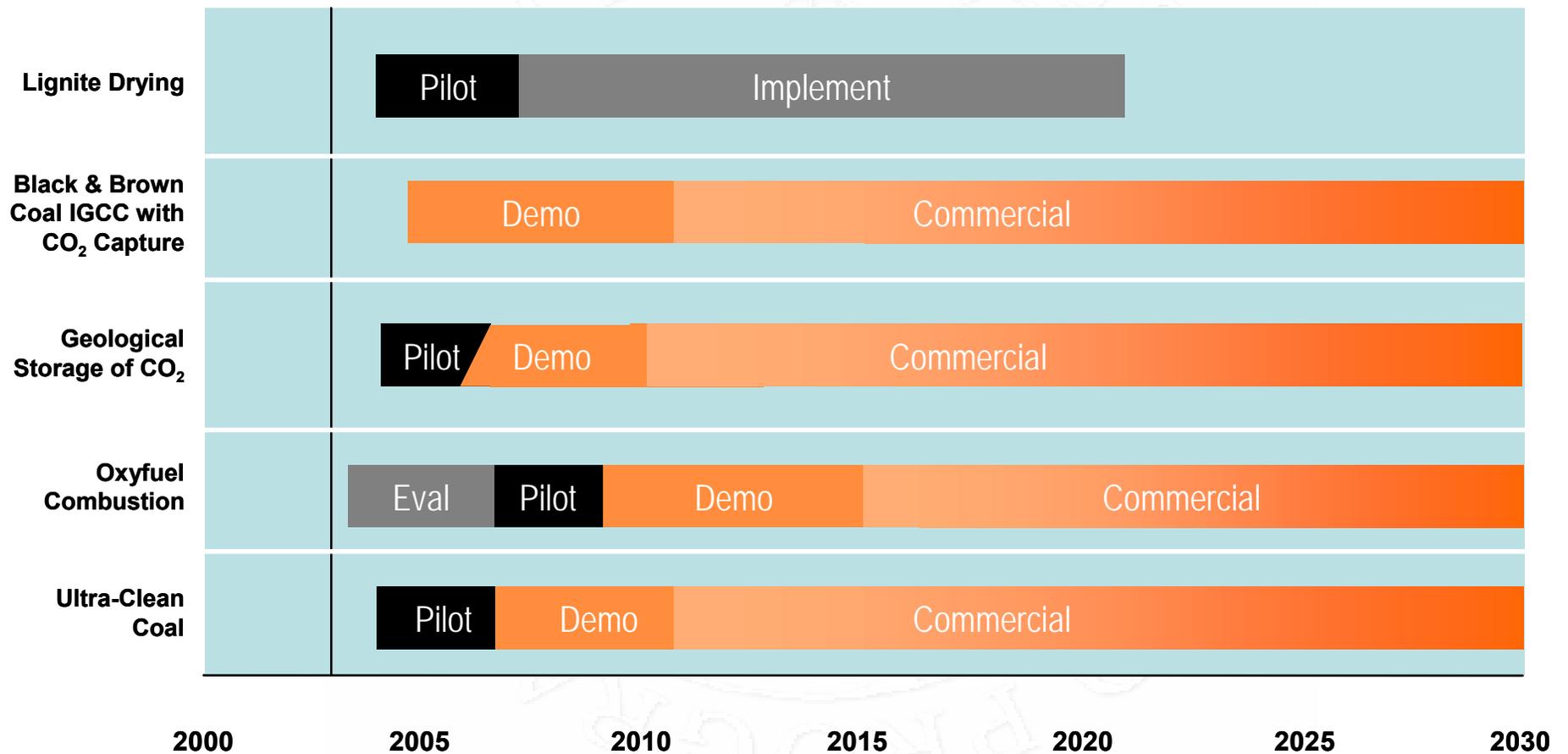
USA Roadmap Development Principle

- *Short-term:* keep existing fleet in service; prepare for transition to near-zero-emission future
 - SO₂, NO_x, Hg
 - Plant optimization and control
 - Reduced carbon intensity
- *Long-term:* add near-zero emission energy plants
 - IGCCs to market
 - Advanced materials
 - Ultra-high efficiency hybrid systems
 - CO₂ capture and storage



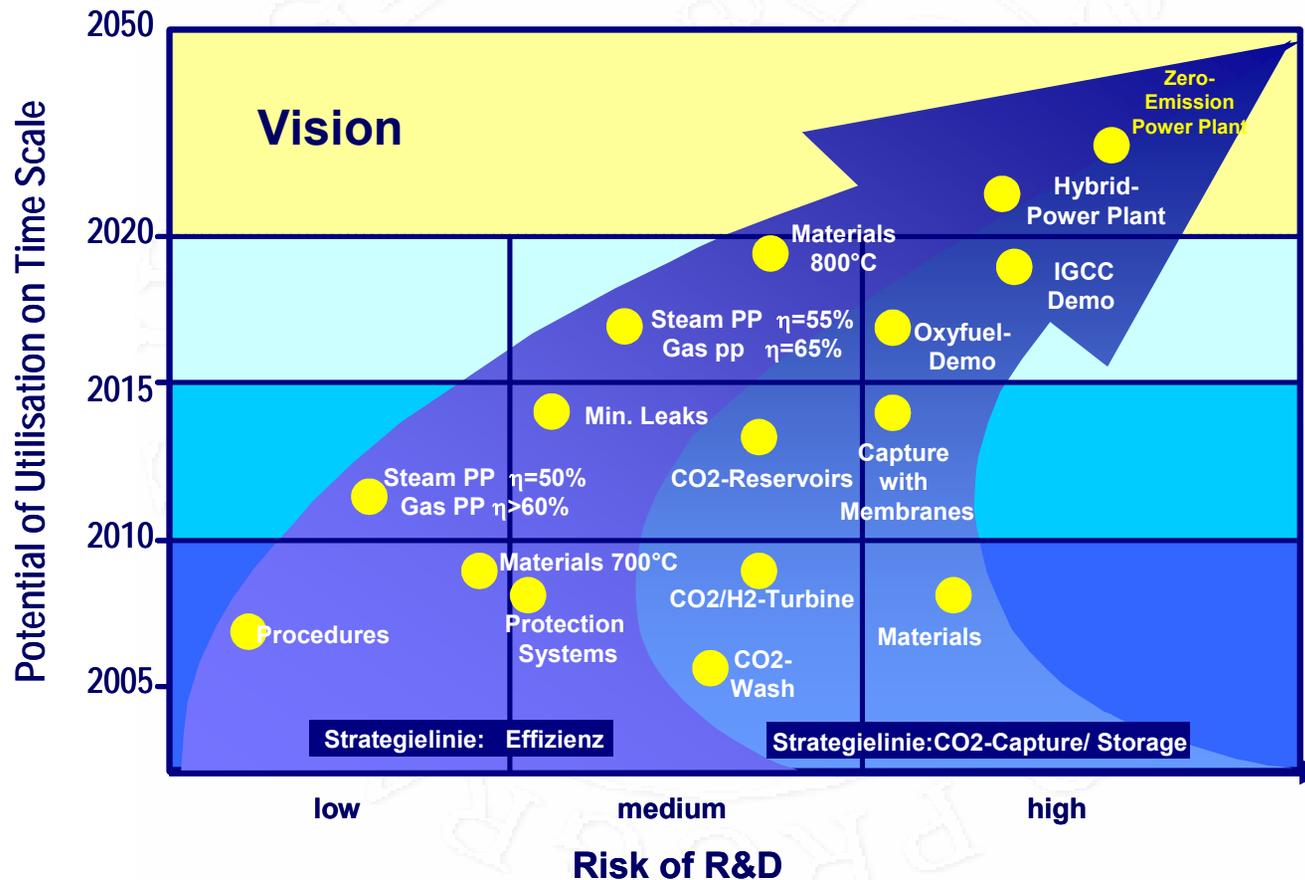


Australia – Coal21 Action Plan



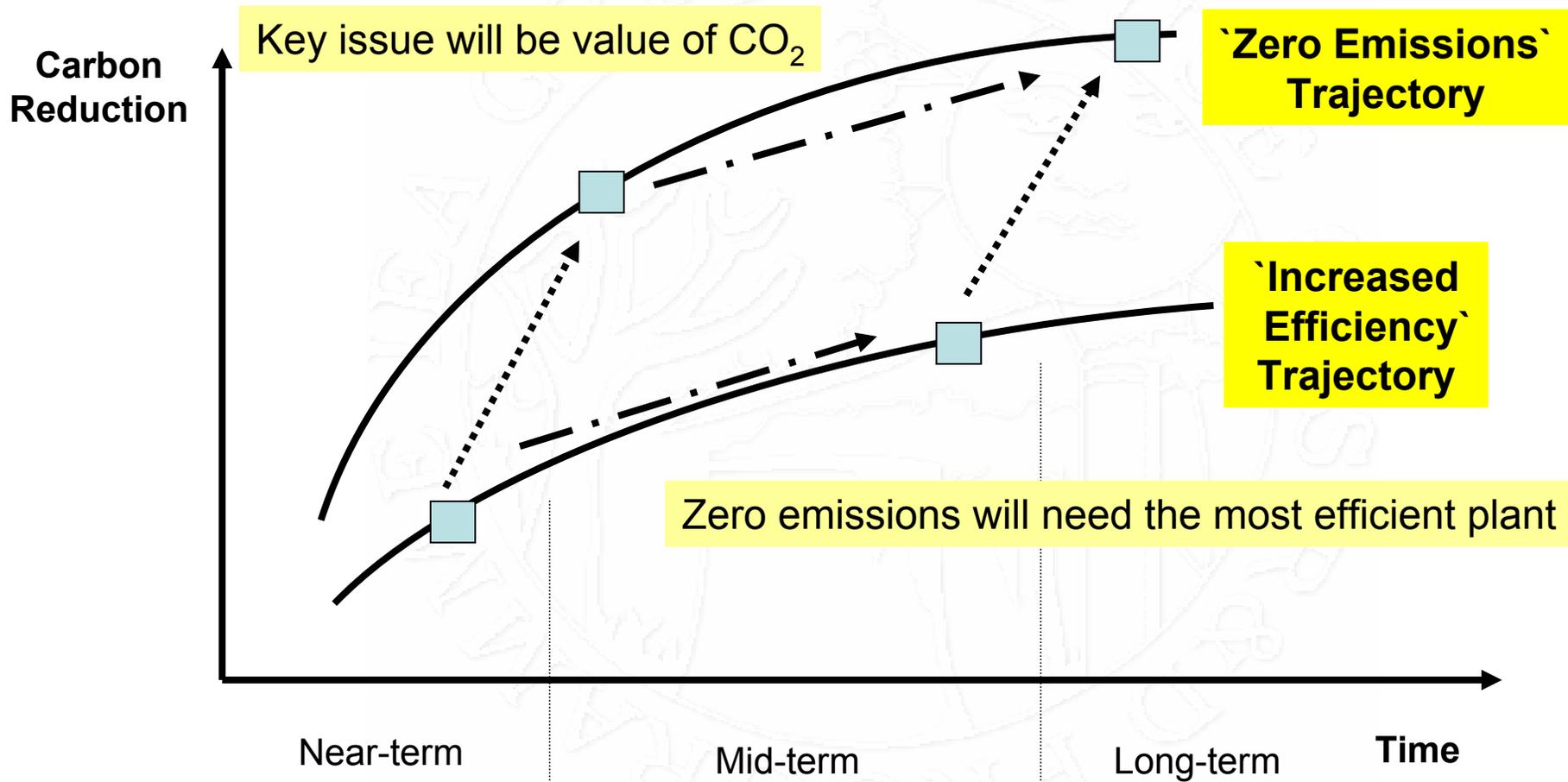


German: COORETEC Programme





UK: CAT* Options are complementary



*Carbon Abatement Technologies



Coal-based Road Maps

Coal-based road maps based on:

COMMON THEME: CLEAN COAL VISION



Components of European Commission's FP7

- Continued focus on Carbon Capture and Storage
- Re-introduction of Clean Coal Technology in recognition of the drive for greater efficiency whilst CCS is developed and deployed
- Industrial Technology Platform to advise on strategy and direction of these two elements



European Based R&D Programme

- CCS pilot plant projects
 - Enhanced Capture of CO₂ in Large Power Plant (ENCAP) Project – FP6 funded project
 - CO₂ from Capture and Storage (CASTOR) – FP6 funded project dealing with post-combustion capture
 - Vattenfall taking the initiative – 30 MWth oxyfuel pilot plant study
- Material Development Programme: us/c Pf combustion
 - Component Test Facility for a 700°C Power Plant (COMTES700) – RFCS funded project – continuation of AD700 programme



CONCLUSIONS

- CCS firmly on Worldwide policy agenda
- Significant CCS activity:
 - Oil & Gas industry – driven by ‘early opportunities’
 - Coal industry – driven by ‘clean coal’ visions



IEA Greenhouse Gas R&D Programme



ADVERT: NEW JOURNAL

 **NEW FOR 2007**
The first journal of its kind

**INTERNATIONAL JOURNAL OF
Greenhouse
Gas Control**

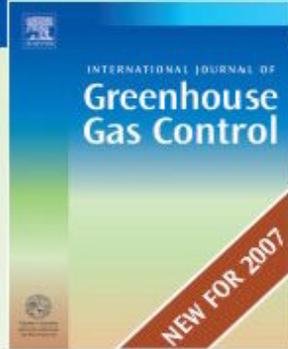
quarterly publication in print and online
■
online submission and peer review
■
online via ScienceDirect from 2007
at www.sciencedirect.com
■
international board of editors

Launching in 2007, this journal will cover developments in greenhouse gas control in the power sectors and in the major manufacturing and production industries. It will cover all greenhouse gas emissions and the range of abatement options available, and comprise both technical and non-technical related literature in one volume.

— SEE OVERLEAF OR VISIT —
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This R&D Programme

First Announcement

 **NEW FOR 2007**

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John Gale,
IEA Greenhouse Gas R&D Programme,
Gloucestershire, UK
Email: john.gale@ieaghg.org

ASSOCIATE EDITORS:

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Canada. Email: stefan.bachu@gov.ab.ca

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In this rapidly expanding field, the need for a journal focusing on greenhouse gas emissions, transmission, capture, storage and reduction has become clear. For this reason, the IEA Greenhouse Gas R&D Programme has joined forces with Elsevier to launch the *International Journal of Greenhouse Gas Control*.

THE SCOPE OF THE JOURNAL WILL INCLUDE:

<p>CO₂ Emissions</p> <ul style="list-style-type: none"> ■ Characterization of emission sources (current and future projections) including modelling analysis ■ Matching emission sources and storage opportunities <p>CO₂ Transmission</p> <ul style="list-style-type: none"> ■ Design and technical issues ■ Risk assessments and safety issues ■ Permitting and regulatory issues <p>CO₂ Capture</p> <ul style="list-style-type: none"> ■ New research results and technical advances in chemical solvents, solid sorbents, membranes and hybrid systems, PSA, PTA and cryogenics ■ Results from demonstration activities ■ Cost analysis and cost reduction strategies ■ Environmental impacts/risk and safety <p>CO₂ Storage</p> <ul style="list-style-type: none"> ■ Geological and ocean (formation) capacity assessments, research results, demonstration projects, natural analogues, environmental impact, site selection, aeration of equipment, safety/risk assessments, monitoring and verification, intervention and accounting principles, legal issues, public acceptance, regulations and cost/market potential ■ Additional carbonates (research results, safety/risk assessments, legal issues, public acceptance, regulations and costs) 	<p>Alternative mitigation options</p> <ul style="list-style-type: none"> ■ Comparison of different GHG mitigation options such as energy efficiency, renewable and nuclear power and their potential to reduce CO₂ emissions <p>Non CO₂ GHGs</p> <ul style="list-style-type: none"> ■ Characterization of emission sources (current and future projections) including modelling analysis ■ Assessment of mitigation options ■ Comparison of non-CO₂ GHG options with CO₂ emission reductions <p>Implementation</p> <ul style="list-style-type: none"> ■ Industry case studies on GHG mitigation technology implementation and financing options including the use of the Kyoto Mechanisms <p>Economic Instruments</p> <ul style="list-style-type: none"> ■ Discussion of policy options (national and international) to reduce GHG emissions including energy modeling studies and policy assessments on GHG mitigation.
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Thank You

Any Questions?

Reference material on CCS can be found at
www.co2captureandstorage.info

GENERAL WEB SITE: www.ieagreen.org.uk