CO_2 Capture and Storage
Current Status and Future Challenges

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Introduction

- Review of the status of International Acceptance of CCS
- Current CCS project status worldwide
- Move forward to wide scale implementation
  - Challenges we need to address
  - Efforts underway to address them

International Acceptance

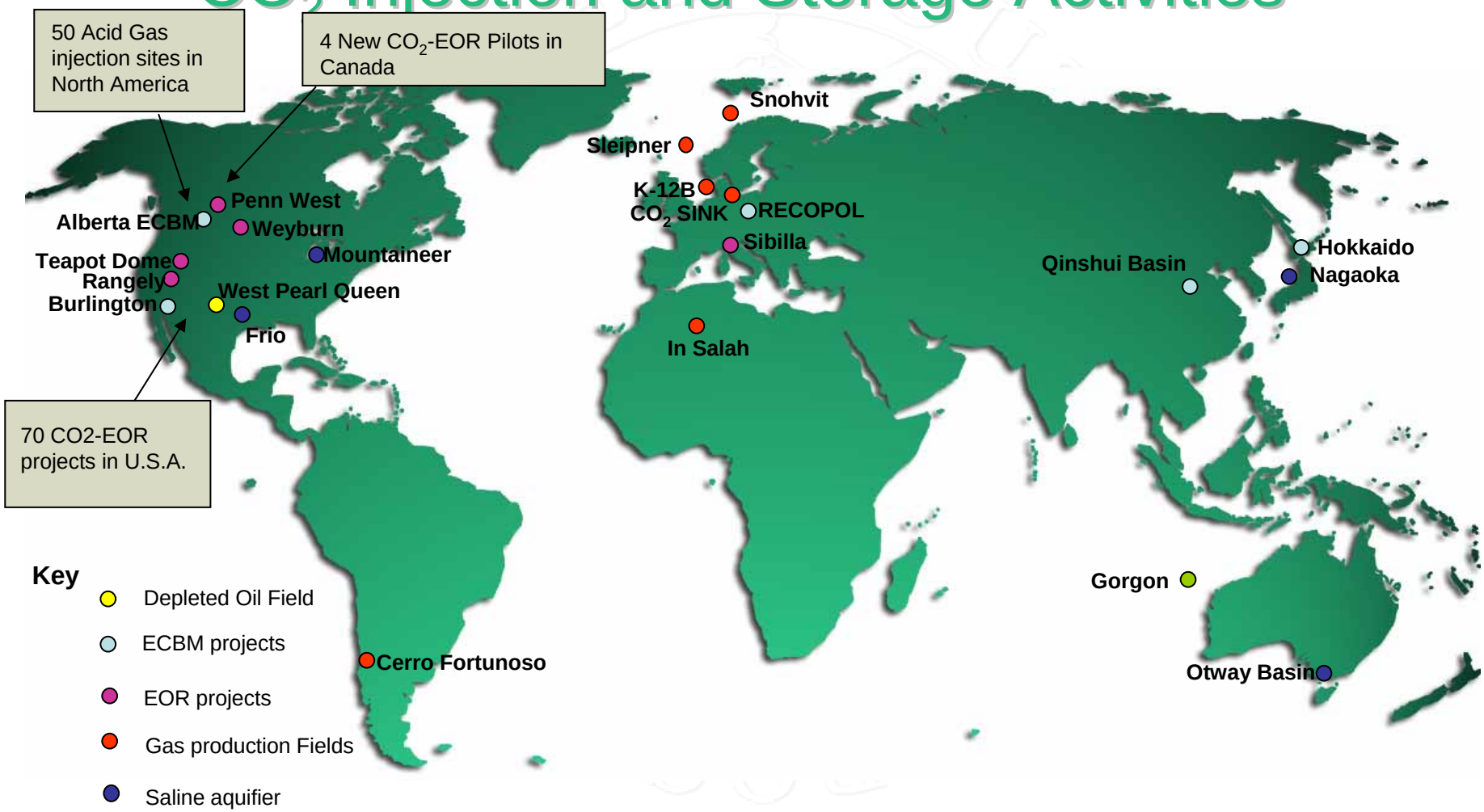
- Considerable progress has been made:
  - Acceptance of CCS as a mitigation option under Kyoto Protocol at COP11/MOP1
    - IPCC SRCCS
  - Acceptance of amendment to London Convention to permit storage
    - Sub sea geological structures
    - Predominantly CO_2
  - No progress on acceptance of CCS as a CDM option at COP12/MOP2

CCS Project Proliferation

- Commercial activity primarily in oil and gas sector
- Number of research projects injecting/capturing CO_2 increasing
  - Expect up to 10 more in USA in coming years as part of Regional Partnership programmes
- Now seeing pre-commercial/commercial developments for power sector projects
  - Australia, Canada, Germany, Norway, UK & USA
  - No direct financial incentives

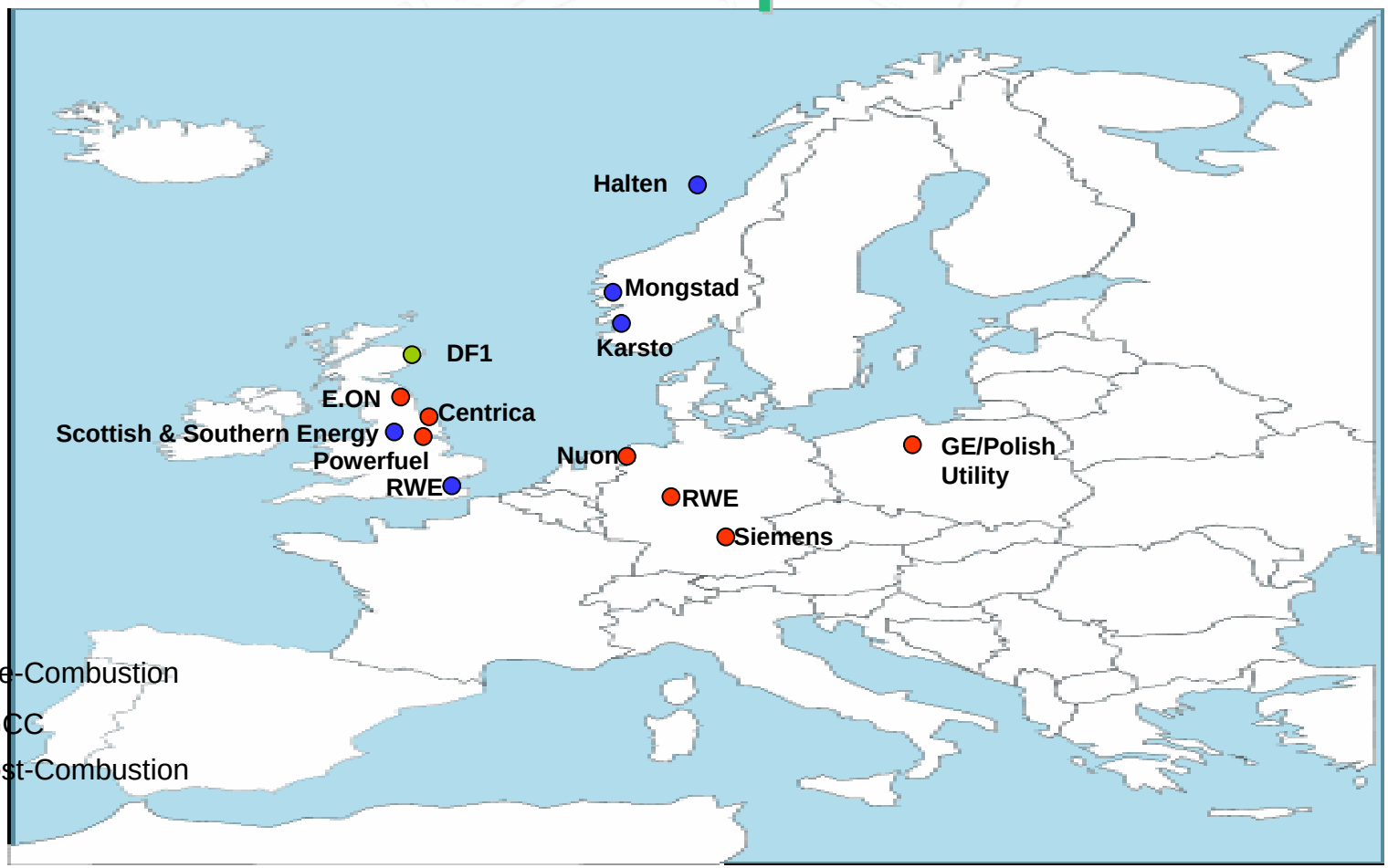
CO2 Capture Facilities

CO_2 Injection and Storage Activities



Proposed Integrated CCS Projects

Proposed Integrated CCS Projects- Europe



Developing Country Activities

- China
  - EC/UK funded nZEC project
  - EC funded COACH project
  - EC funded GEOCAPACITY
- India
  - IEA GHG/DEFRA funded source/store matching study
  - US DOE funded Basalt study
  - Indian funded CO_2 capture test facility proposed
- Asia Pacific Partnership
  - Australian Government $6m programme to support research on CCS developments in China and India

Moving Towards Implementation

- Issues that need to be addressed
  - Safety/permanence
  - Developed regulatory system
  - Market for CCS
  - Public Awareness/Education

Safety/Permanence

- For a CCS operation we cannot say there will be never be leakage
- Industry statistics show there will be fugitive emissions from pipelines and surface facilities
  - Low level and intermittent
  - Can quantify such emissions
- These emissions are distinct from the storage formation
  - If they occur these will be very low level (seepage) and occur over long time periods
  - Likely to cause local environmental impacts only

Safety/Permanence

- Need to engineer for zero leakage from the storage formation
- 5 component plan:
  - Detailed site characterisation
  - Reservoir simulation
  - Risk assessment
  - Monitoring programme
  - Remediation programme

Summary of Monitoring Experience

- No firm evidence from any of the large scale projects that leakage is occurring
  - Weyburn (3 years), Sleipner (10 years), Rangeley (20 years)
- Only one project has any surface seepage and there are doubts about the data
- Monitoring lifetimes are short <25 years
- Cannot quantify seepage
  - Nor determine a generic leakage rate

Regulatory Developments

- Need for regulatory systems essential to implement projects in near term
- Quicker to amends existing regulations than develop new ones
  - Europe
    - Netherlands - adapted existing laws
    - UK - regulatory task force established
    - Norway - permitting CCS under existing petroleum laws
  - USA
    - Adapting UIC programme legislation
  - Australia
    - State and Federal Governments involved
    - Gorgon review under way

Regulatory Developments

- London Convention
  - CO_2 Working Group established in June 2006
    - Produce Guidelines for CCS in sub sea geological structures
    - Guidelines are to be used by national bodies regulating disposal of CO_2 storage offshore
    - Guidelines incorporate:
      - Best available science
        - IPCC SRCCS
      - Risk Assessment and Management Framework for CCS-SSGS
      - Best available knowledge from demonstration projects
    - Draft set of guidelines developed and out for comment
    - Guidelines approved in November 2007

Regulatory Developments

- Guidelines require:
  - Waste prevention audit/Waste management option review
  - Characterisation of waste stream
  - Site characterisation
  - Impact assessment
  - Permit Issue
  - Compliance monitoring
  - Performance monitoring
  - Mitigation plan

Regulatory Developments

- European Commission
  - Development of guidelines for national regulatory bodies
  - Based on a petroleum licence application
  - On and Off shore CCS
  - Activity through CO2REMOVE
  - Guidelines include:
    - Site characterisation/monitoring requirements etc.,
    - Assessment of legal requirements and future liability

CCS Market Drivers

- Currently high oil and gas prices will drive some CO_2 injection projects
  - Low incremental cost for storage
    - Sleipner, In-Salah, Snohvit
  - Economic incentive through increased hydrocarbon production
    - Weyburn, K-12B
- Norwegian situation
  - Tax incentives for offshore emission reduction driving project development

CCS Market Creation

- Long term CO_2 market needs to be created
- Emissions Trading Scheme
  - European system immature
  - Current trades will not finance CCS projects
    - €3.3/t CO_2 as of 27/01/07
  - Current volatility will not encourage long term investment
    - €3-24€/t CO_2
- Need to drive down cost of CCS
  - 20-40% cost reductions achievable through replication
- In short term projects may need government support
- Longer term; a stable trading market must establish itself
  - CO_2 supply/storage infrastructure needs to develop

Norwegian Initiative

- New initiative in Norway to create a CO_2 supply infrastructure
  - Part public sector/part private sector enterprise
  - Establish a CO_2 supply infrastructure for Norway to realise it CO2-EOR potential
  - Leave behind a supply infrastructure that can then be used for CO_2 storage
  - Announced in Autumn 2006

Public Awareness

- Public awareness of climate change impacts is growing
  - Focus of considerable media attention
- NGO's can influence public opinion
  - NGO's in Europe and USA generally in favour of CCS
- Public awareness on CCS is currently limited
- Need to build public awareness to ensure projects do not meet public resistance

Public Awareness

- Need to urgently start a public education programme
  - Open and transparent
  - Happening at pilot project scale in some countries
    - Australia, Europe, Canada and USA
  - Need more concerted engagement programmes
    - CATO programme and Japan
  - Need more demonstration projects with public engagement
    - In-Salah
  - Need to be aware that local issues could dominate in planning reviews
    - Local issues have caused rejection of wind farms in many European countries despite public acceptance of need for more renewables

Summary

- Implementation of CCS project is occurring in oil and gas sector
- Power sector interest is growing
- Financing CCS projects remains a major barrier
  - More work is needed
- We need to develop public confidence in CCS so that the public do not become a major barrier to future development

THANK YOU
ANY QUESTIONS?