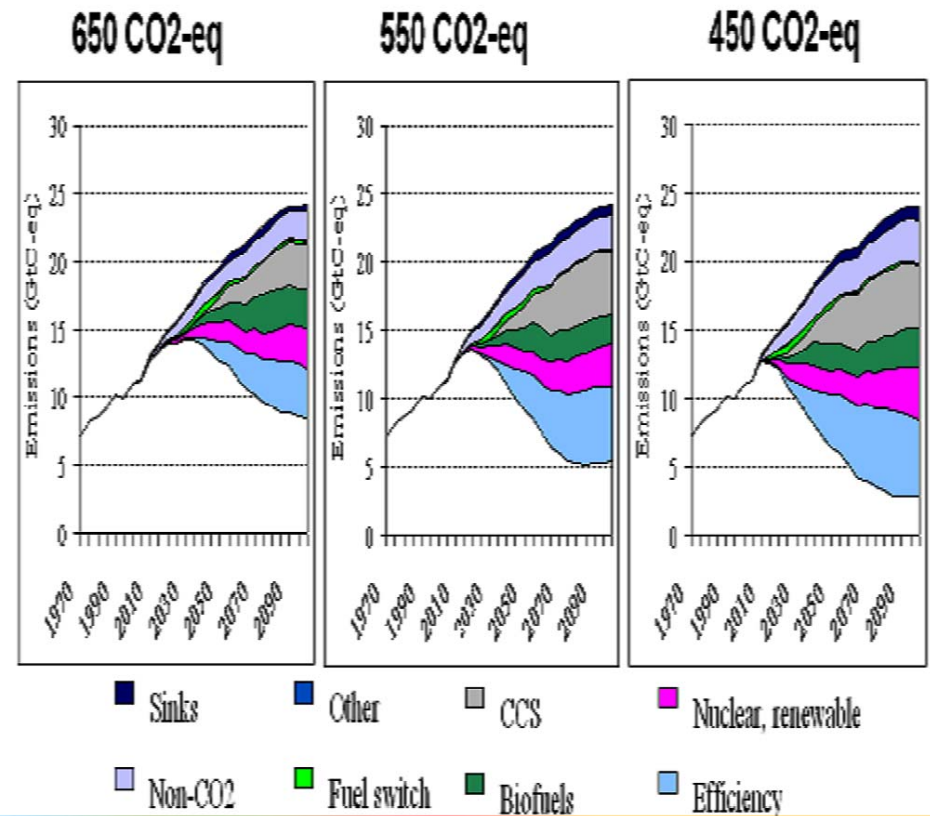


Overview of International Experiences

Malcolm Wilson
Office of Energy and Environment
University of Regina

Why CO₂ Capture and Storage?

- Climate change is occurring
- Need to reduce greenhouse gas (GHG) emissions
- Fossil fuels will continue to be the major energy source
- All international scenarios for deep GHG reductions include CCS
- CCS is one of a portfolio of mitigation options
- All options are needed



Source: IPCC (2007)

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 CO₂
 - OSPAR changes also
 - 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 CO₂ 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

Proposed Integrated CCS Projects



Proposed Integrated CCS Projects- Europe



Key

- Pre-Combustion
- IGCC
- Post-Combustion

Carbon Capture and Storage

Three Options;

- Post Combustion
- Pre Combustion
- Oxy fuel

Two Options;

- Pipelines
- Ships

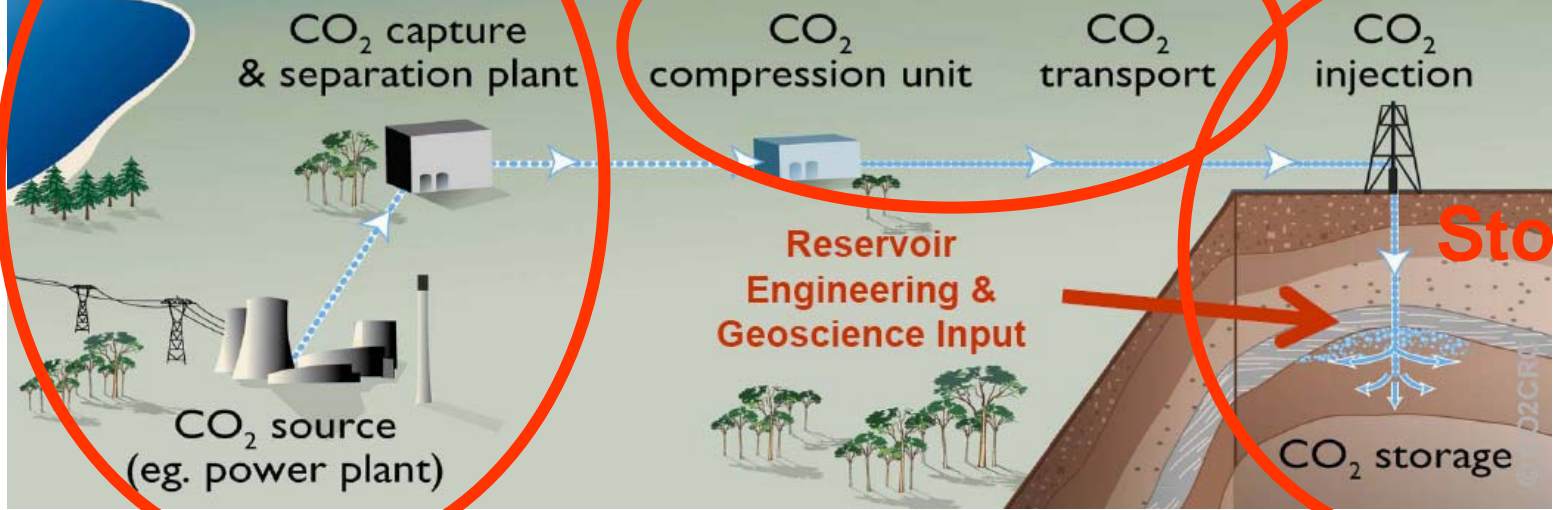
Three Options;

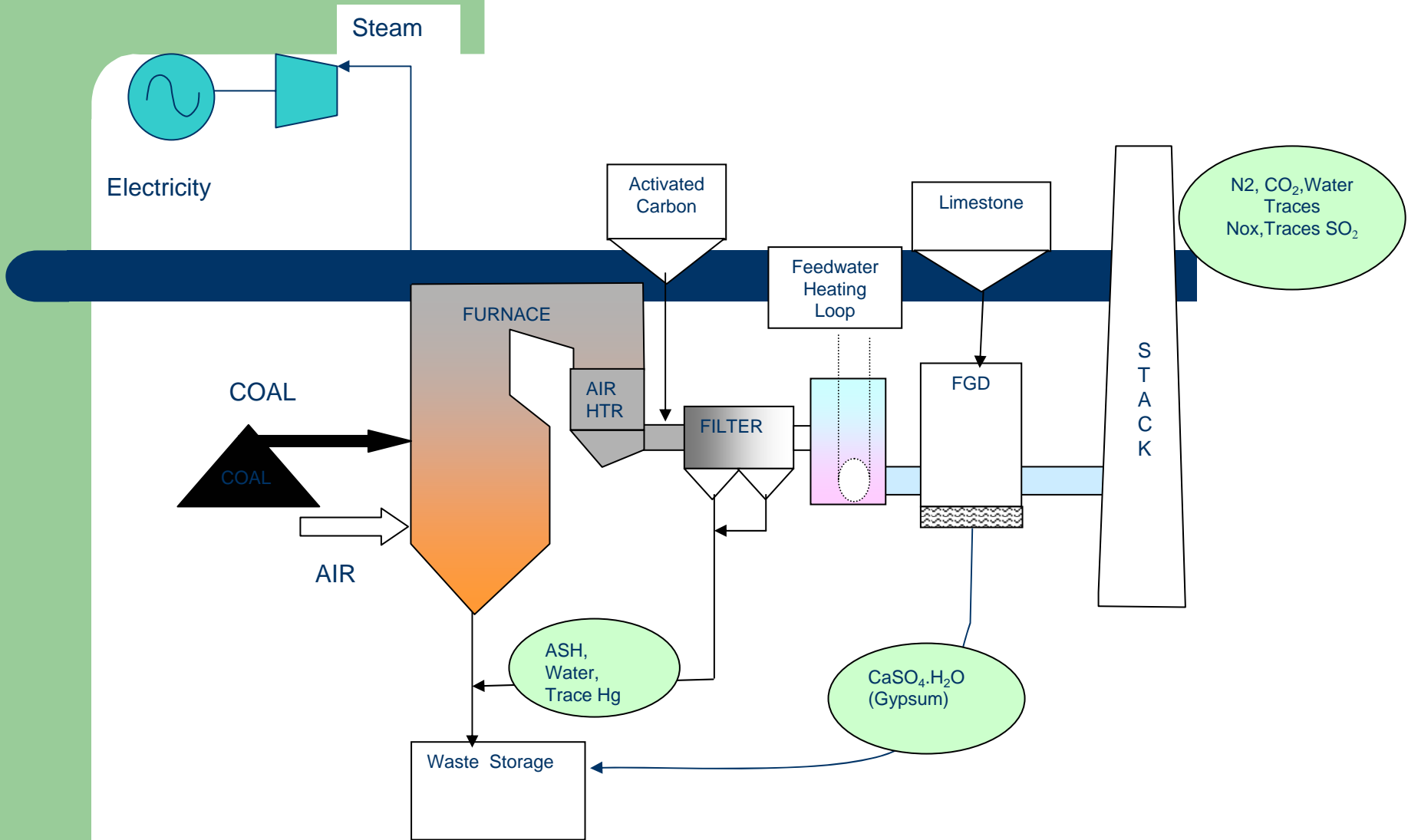
- Coal seams, 40 Gt CO₂
- Oil and gas fields, 1,000 Gt CO₂
- Deep saline aquifers – up to 10,000 Gt CO₂

Capture

Transport

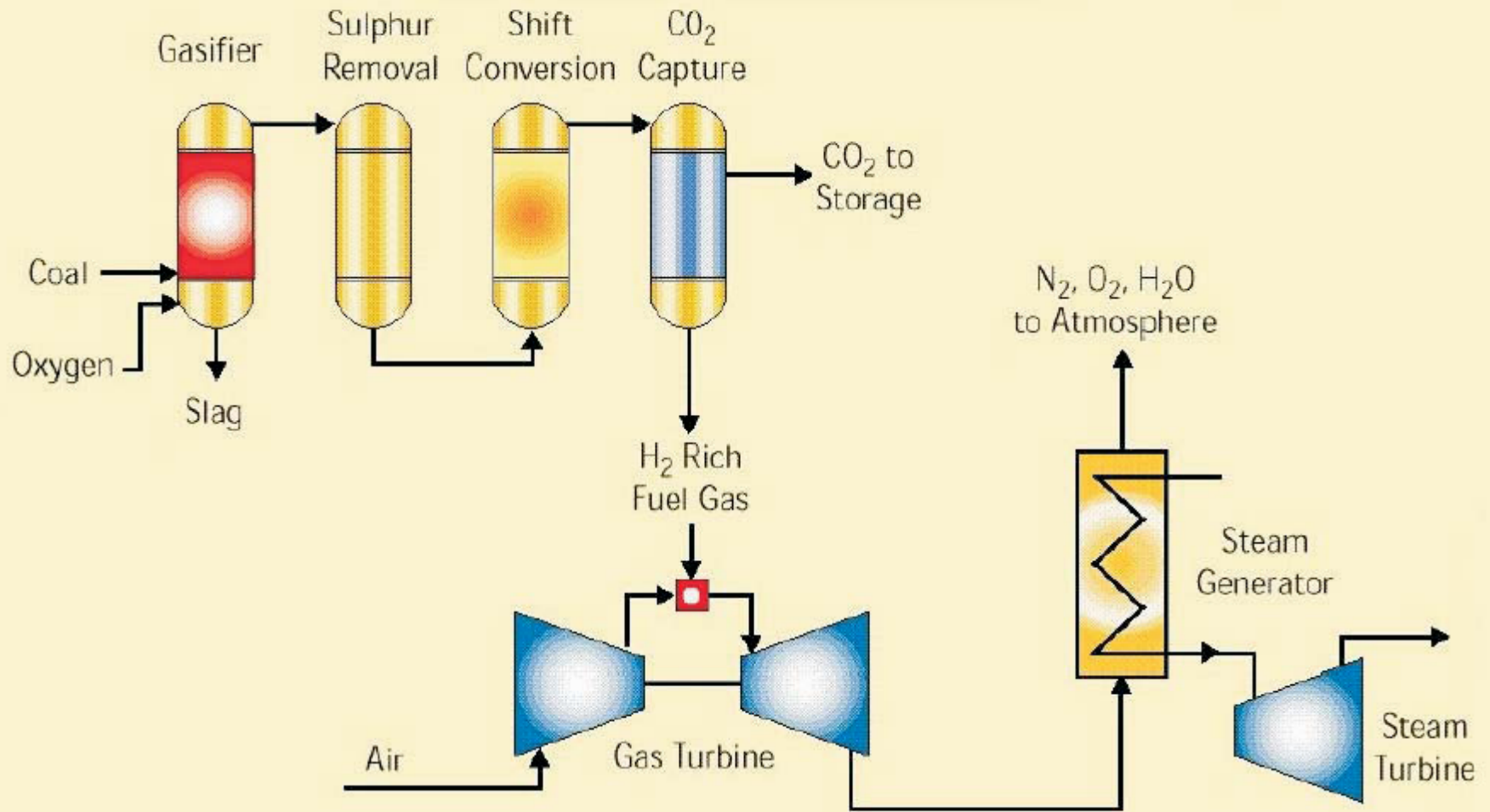
Storage





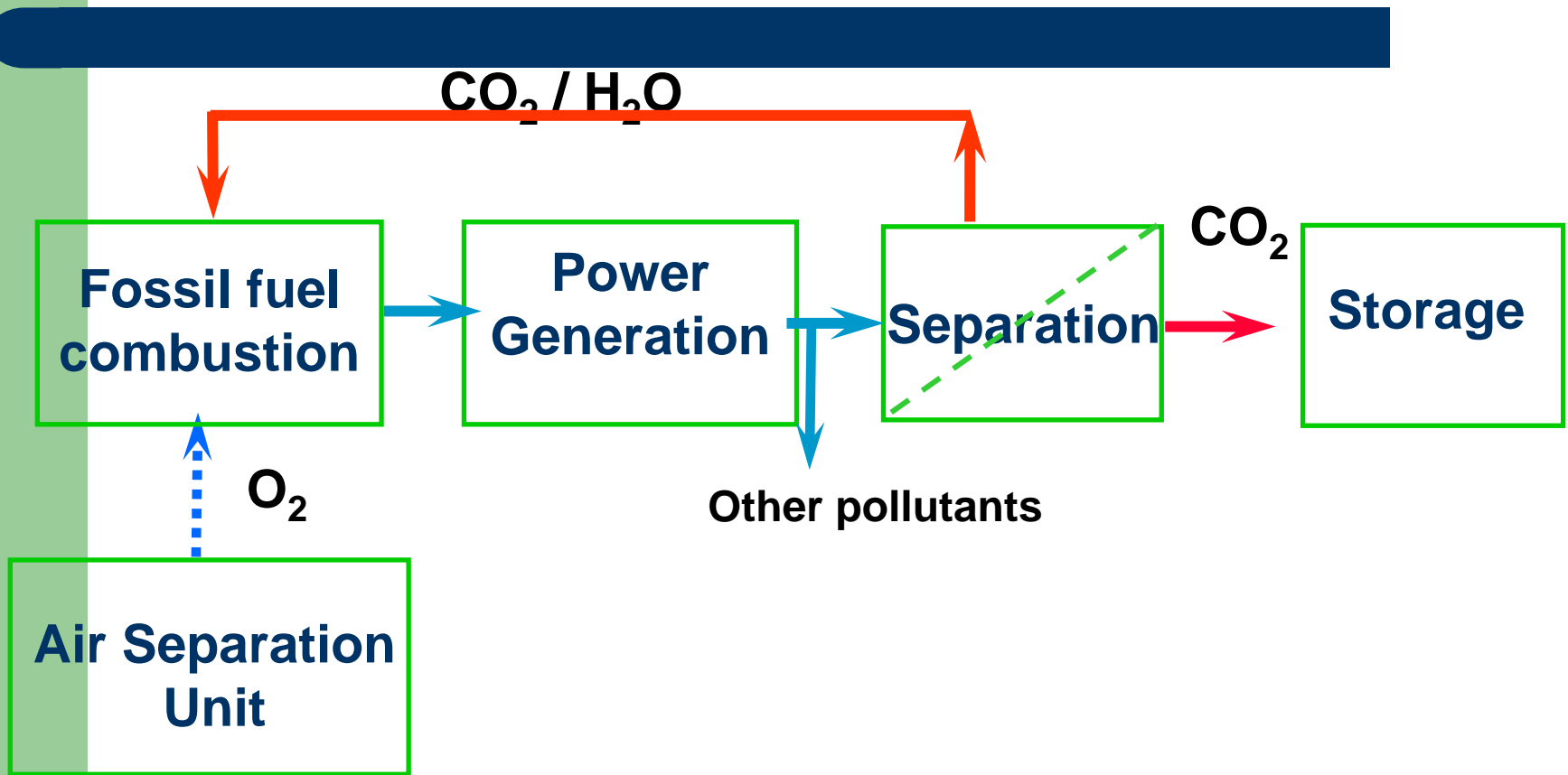
Pre-combustion capture

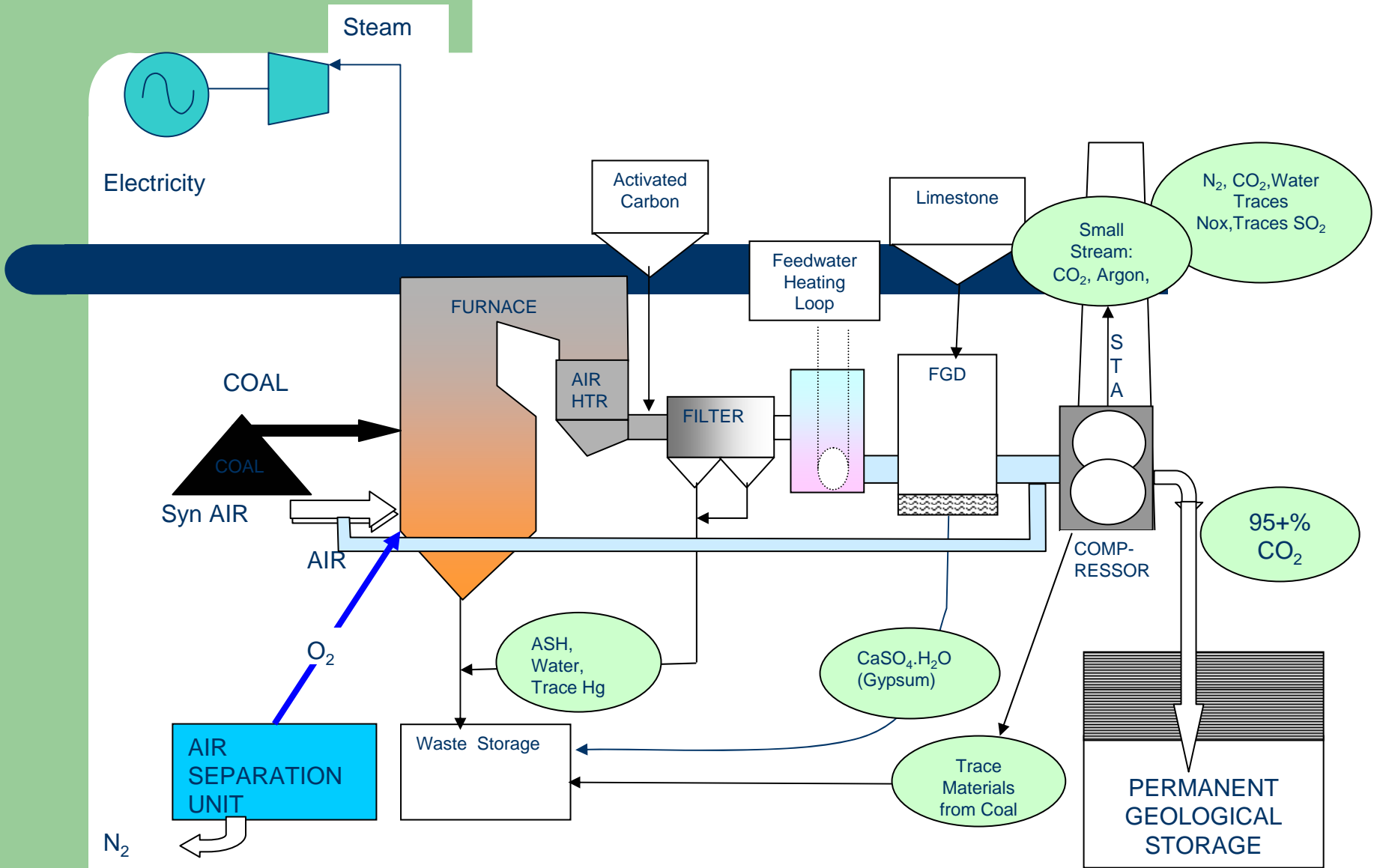
(IEA GHG www.ieagreen.co.uk)



Oxyfuel combustion

- Power generation plant

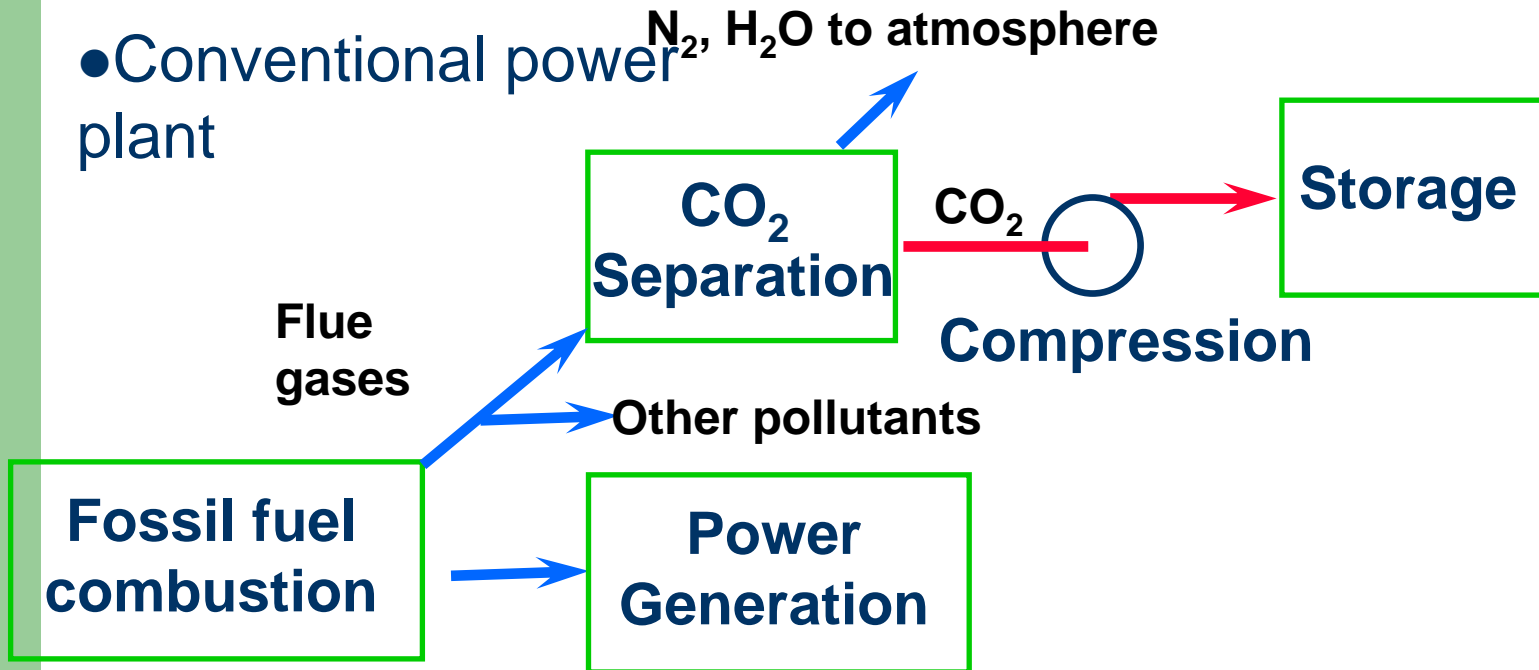




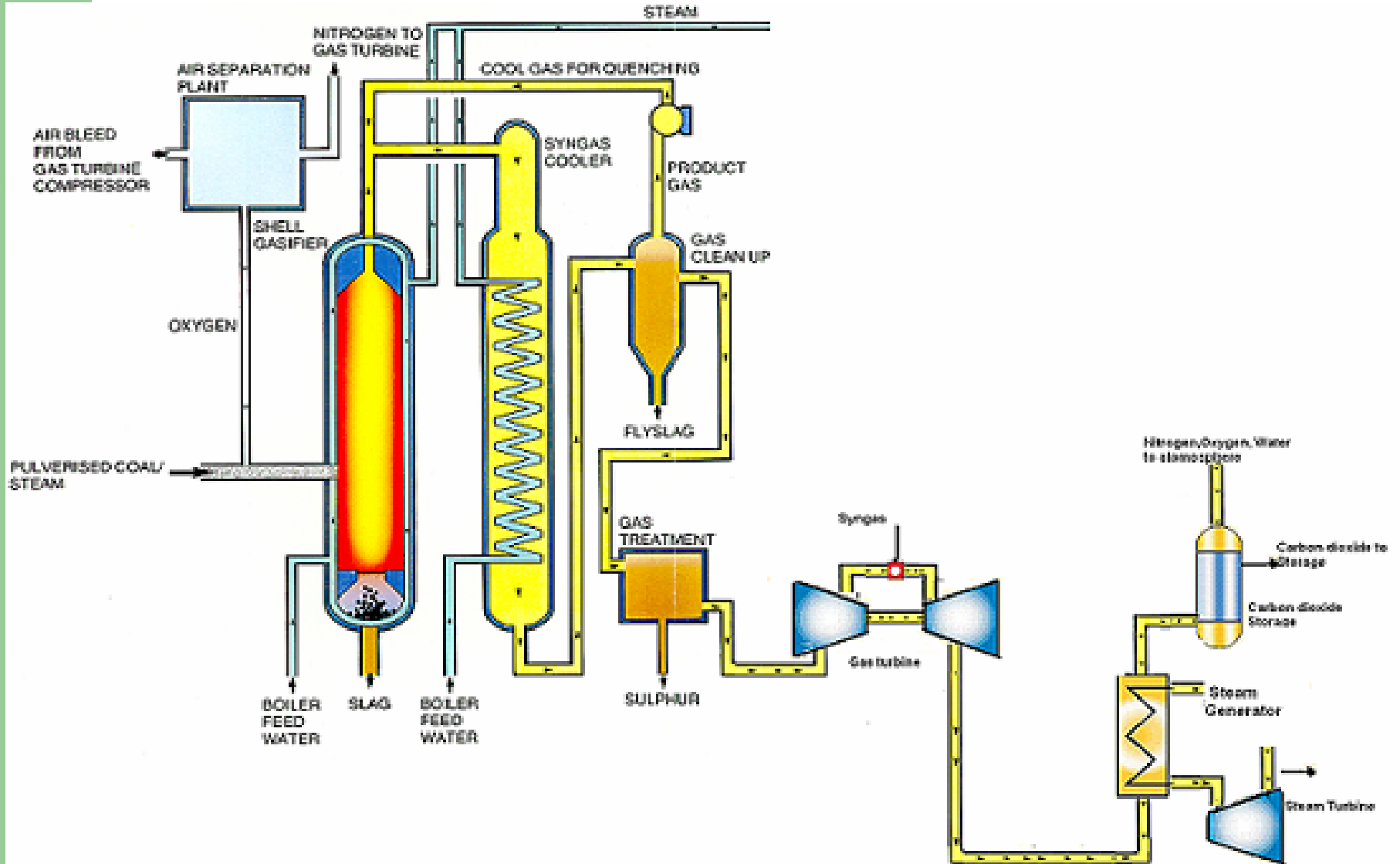
SaskPower Oxyfuel Process

Post combustion capture

- Conventional power plant

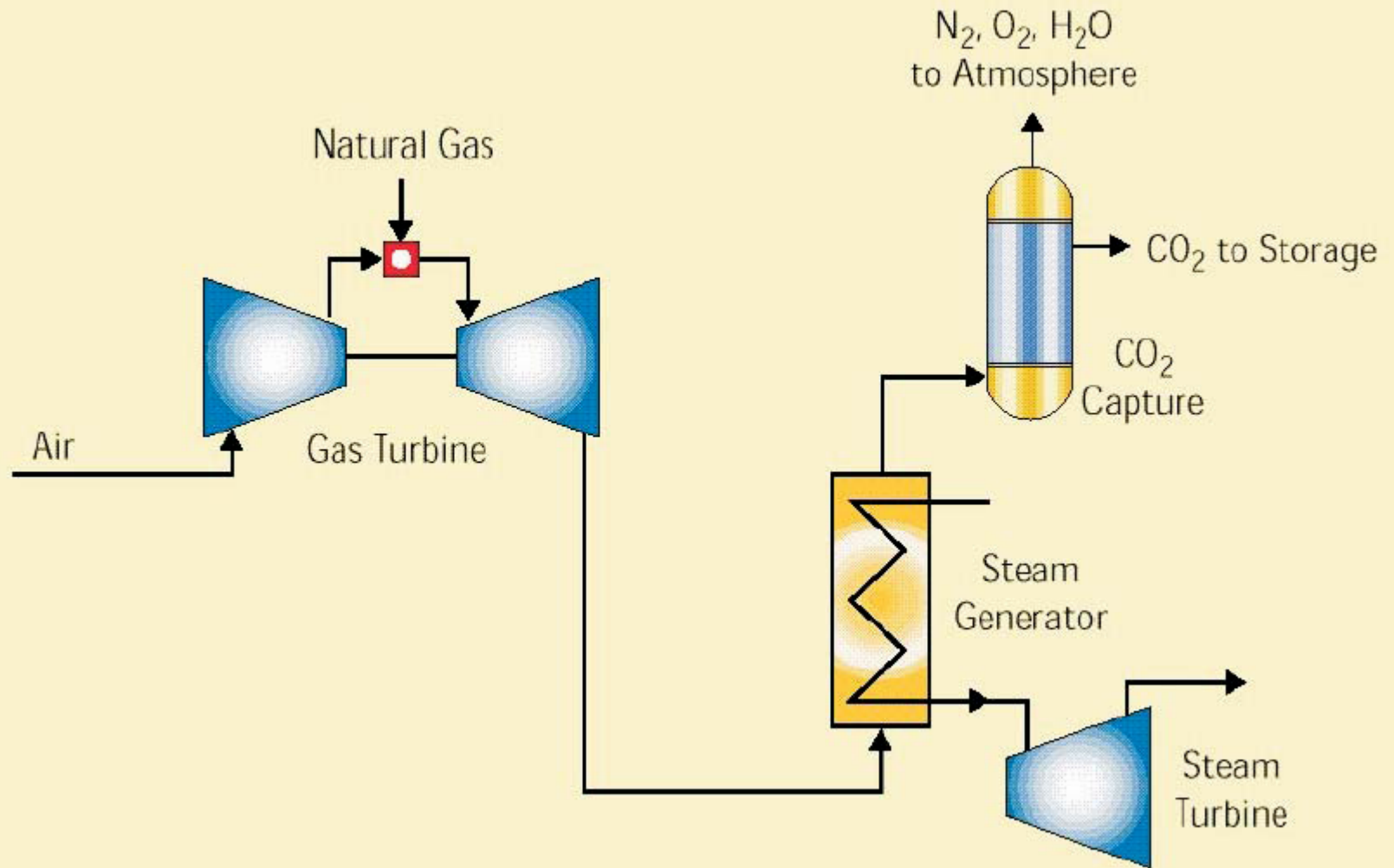


Gasification with Post combustion



Post-combustion capture

(IEA GHG www.ieagreen.co.uk)



Post-Combustion CO₂ Capture



- Warrior Run power plant, USA
- 180 MW_e coal fired circulating fluidised bed combustor
- 150 t/d of CO₂ captured from a slipstream
 - About 5% of the total

CCS Pureenergy 1000



CCS Market Creation

- Long term CO₂ market needs to be created
- Emissions Trading Scheme
 - European system immature
 - Current trades will not finance CCS projects
 - €3.3/t CO₂ as of 27/01/07
 - Current volatility will not encourage long term investment
 - €3-24€/t CO₂
- 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
 - CO₂ supply/storage infrastructure needs to develop

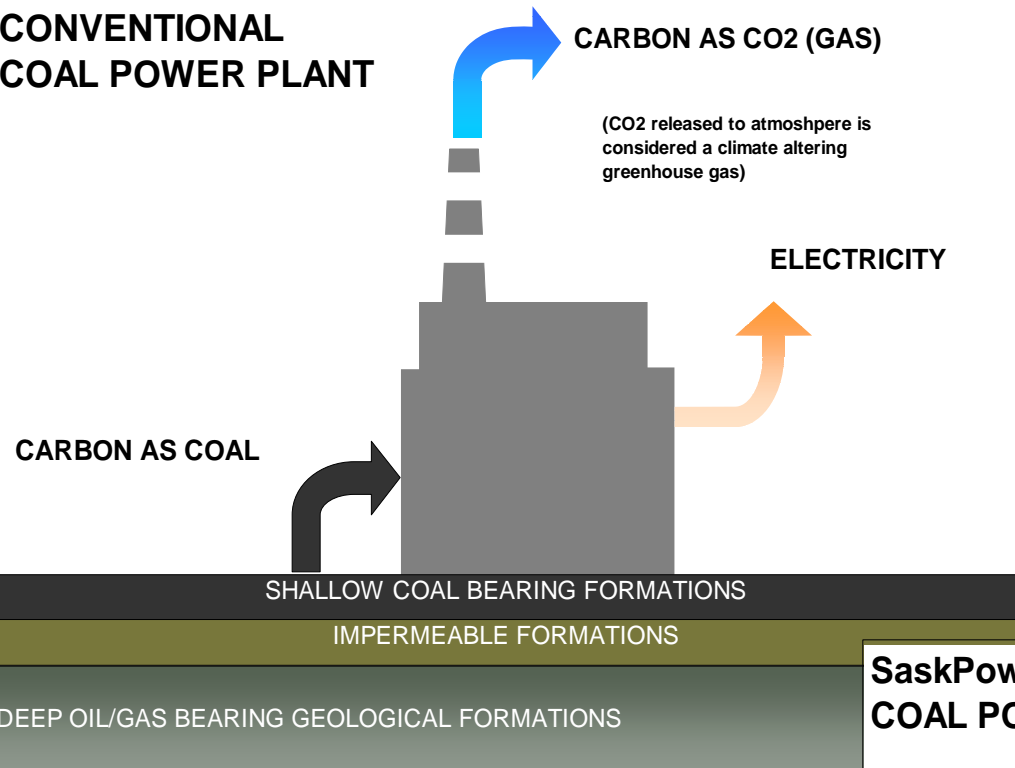
Issues

- Cost affecting all technology
- Lack of definitive rules also affecting the move to full commercial deployment
- All technologies have a niche
- Gasification – the future
 - Reliability
 - Cost
 - Turbine development

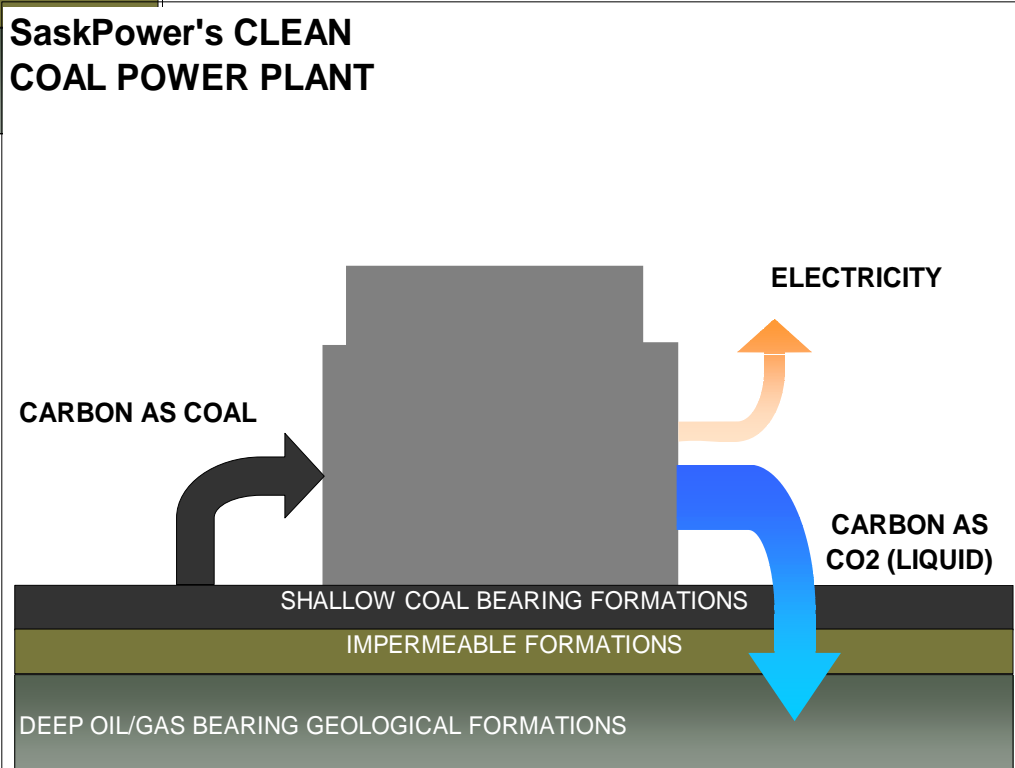
Issues (cont)

- Oyfuel
 - All or nothing
 - Potential for multi-pollutant capture
 - Unknown performance
- Post combustion
 - Incremental build
 - Reliable – numerous examples globally
 - Can be shut down and restarted quickly
 - Great strides in research
 - Home grown technology

CONVENTIONAL COAL POWER PLANT



SaskPower's CLEAN COAL POWER PLANT



International Research Networks

CAPTURE

- International Network for CO₂ Capture
- Oxy-fuel Combustion Network

-
- International Network on Biofixation of CO₂ and Greenhouse Gas Abatement with Microalgae

STORAGE

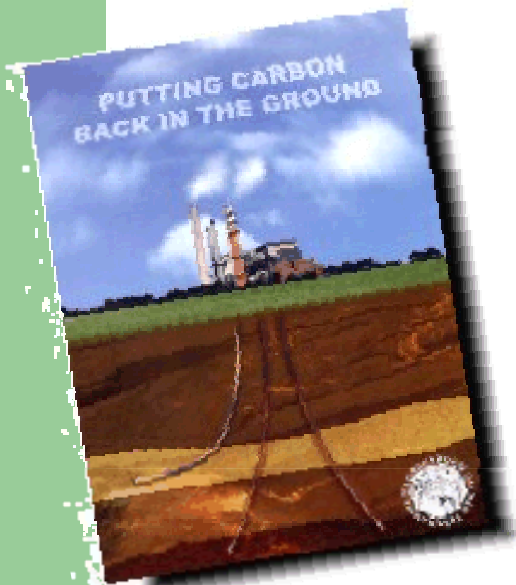
- Risk Assessment Network
- Monitoring Network
- Well Bore Integrity Network



Information Dissemination

Quarterly newsletter

Topical Reports



GHGT-9

16th – 19th

November 2009

Washington D.C.

www.mit.edu/ghgt9

New Capacity Building Initiative

- New annual Initiative launched in Germany in August 2007
- Annual summer school on CCS for 60 invited students
 - 24 countries represented in Germany
 - 4 Chinese students
- Annual summer schools will rotate between Europe, North America and Asia/Australasia
 - Next planned for Canada in 2008
 - 2009 proposed for Australia – to be confirmed
- Details and presentations can be found at:

www.ieagreen.org.uk/summerschool



QUESTIONS?

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www.ptrc.ca, www.co2-research.ca, www.ieagreen.org.uk