



CO<sub>2</sub> Capture Project



# Progress of the CO<sub>2</sub> Capture Project (CCP) and Technology Development

*Gardiner Hill, BP*

Second Annual Conference on Carbon Sequestration -  
Developing and Validating the Technology Base to  
Reduce Carbon Intensity.

[www.Co2captureproject.org](http://www.Co2captureproject.org)

3<sup>rd</sup> – 5<sup>th</sup> May, 2003

# Introduction

- Background on the CO<sub>2</sub> Capture Project
  - Opportunities and challenges
  - Project objectives and who is involved
- Project progress and time line
- CCP technology development
  - Capture & separation areas being worked and technology development
  - Geologic storage and technology development status
- Progress of other program areas
  - Common economic model, policy and incentives, communication, costs
- Conclusions



# Background on the CO<sub>2</sub> Capture Project

## **Why focus on capture and geologic storage?**

- Fossil fuels will be required to meet the worlds energy needs for the foreseeable future
- Possible to achieve material reductions in CO<sub>2</sub> emissions & provide a bridge to a lower carbon future
- Applicable to broad range of industry sectors
- Cost of decarbonising fossil fuels is currently to high
- Carbon sequestration is needed to make H<sub>2</sub> possible in near/medium term with no/low GHG emissions
- Can provide a win ~ win for both energy security and environment



# CO<sub>2</sub> Capture Project



# CO<sub>2</sub> Capture Project objectives

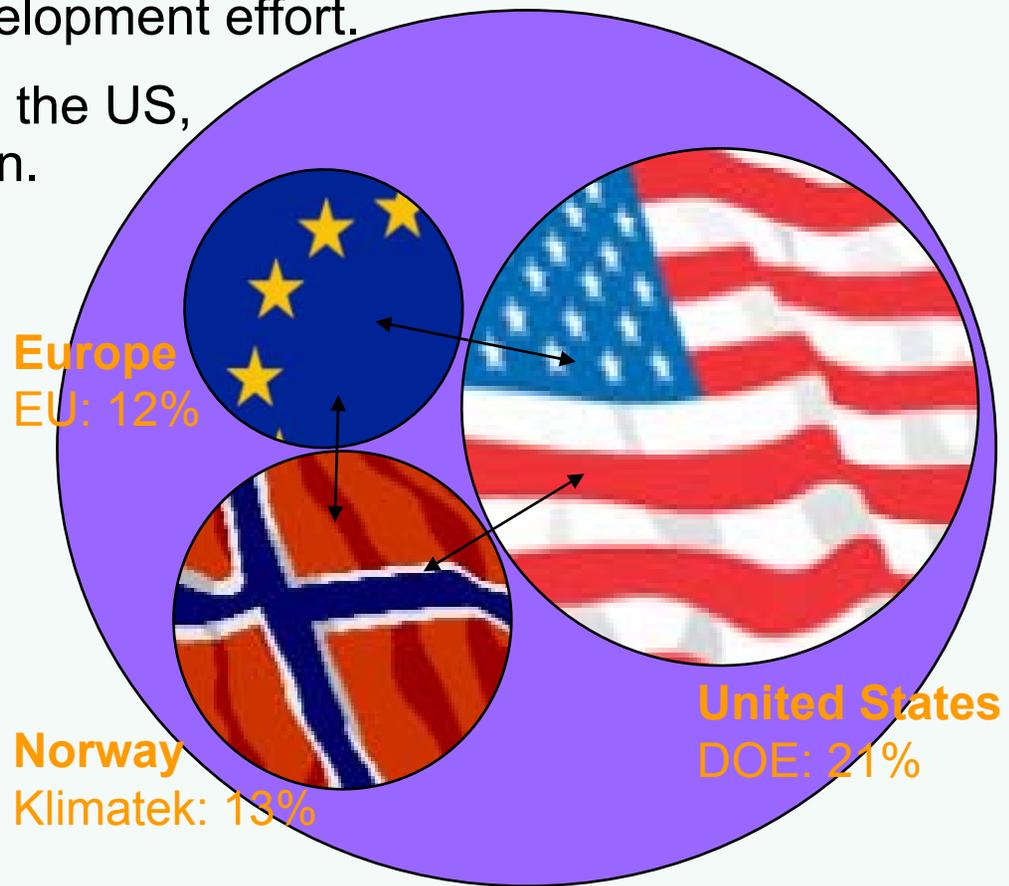
- Achieve major reductions in the cost of CO<sub>2</sub> capture and storage:
  - 50% reduction when applied to a retrofit application.
  - 75% reduction when applied to a new build application.
- Demonstrate to external stakeholders that CO<sub>2</sub> storage is safe, measurable, and verifiable.
- Progress technologies to:
  - 'Proof of concept' stage by 2003/4.



## Program structure

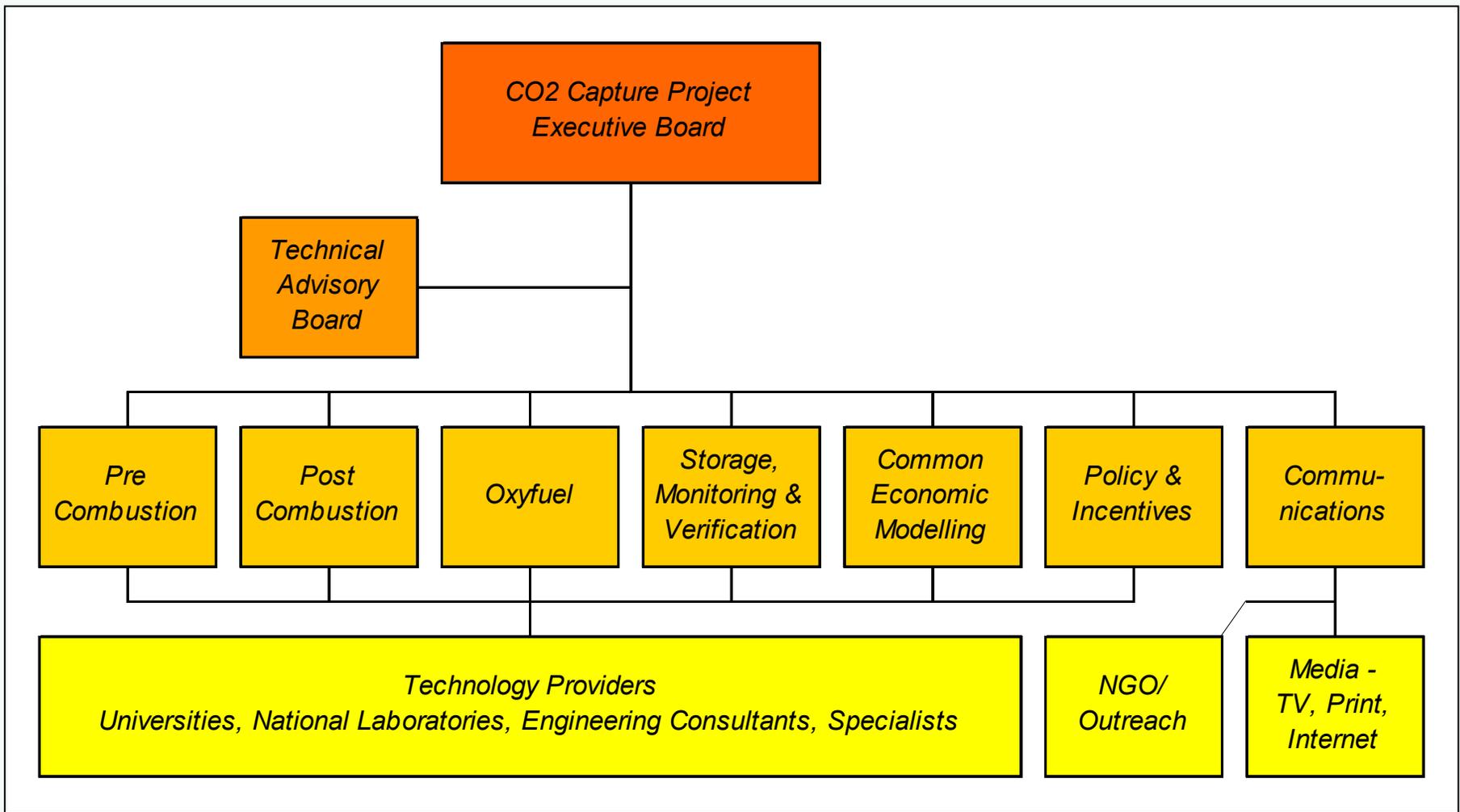
- International technology development effort.
- Distinct *regional* programs in the US, Norway, and European Union.
- Sharing among programs to leverage results and reduce duplication.
- Project funding \$25mm
- Project cost \$50mm

**Industry**  
Eight Participants: 54%





# CO<sub>2</sub> Capture Project

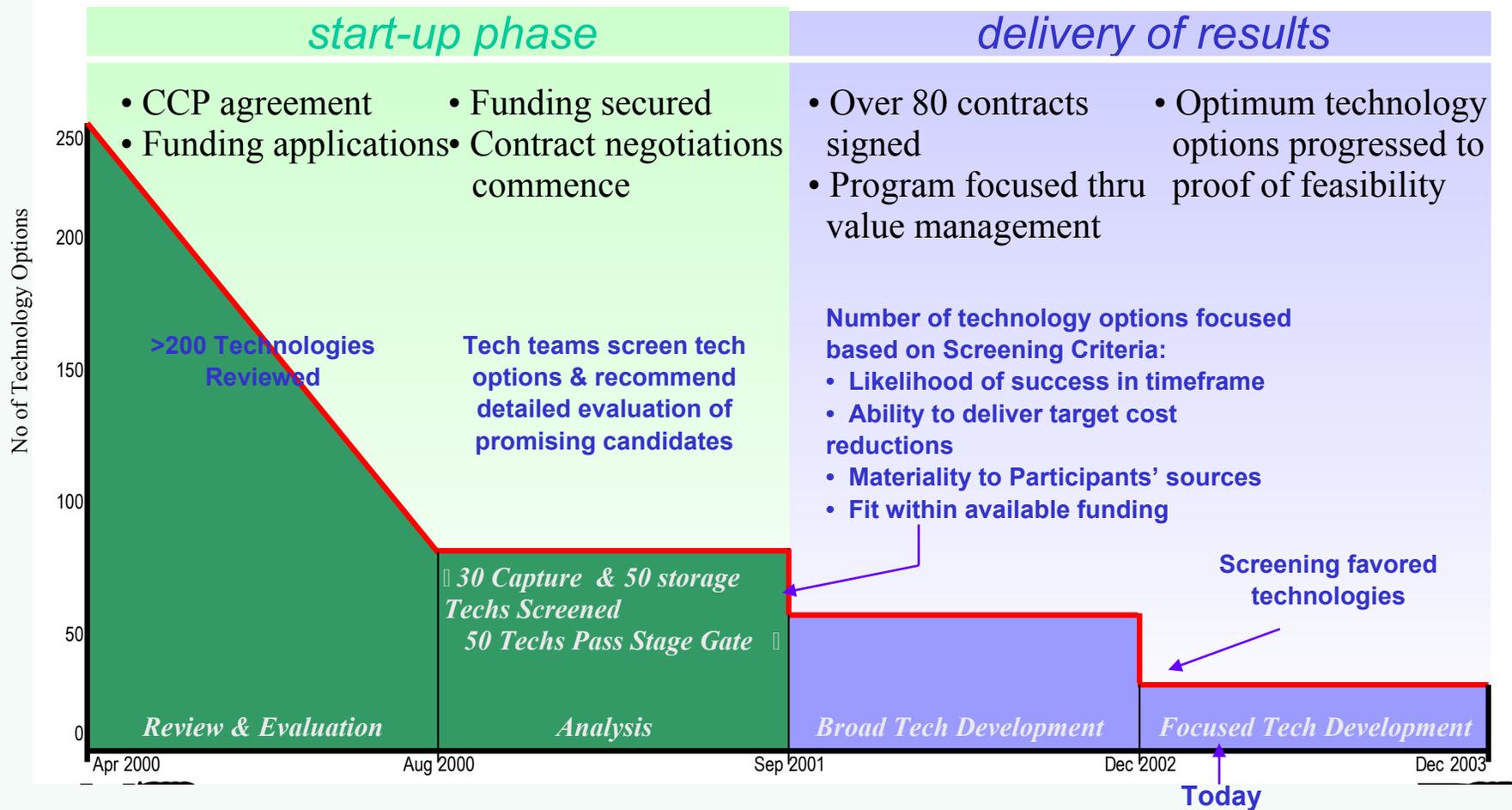




# CCP project progress and time line



## Project overview- we've come a long way!





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



# CO<sub>2</sub> Capture Project

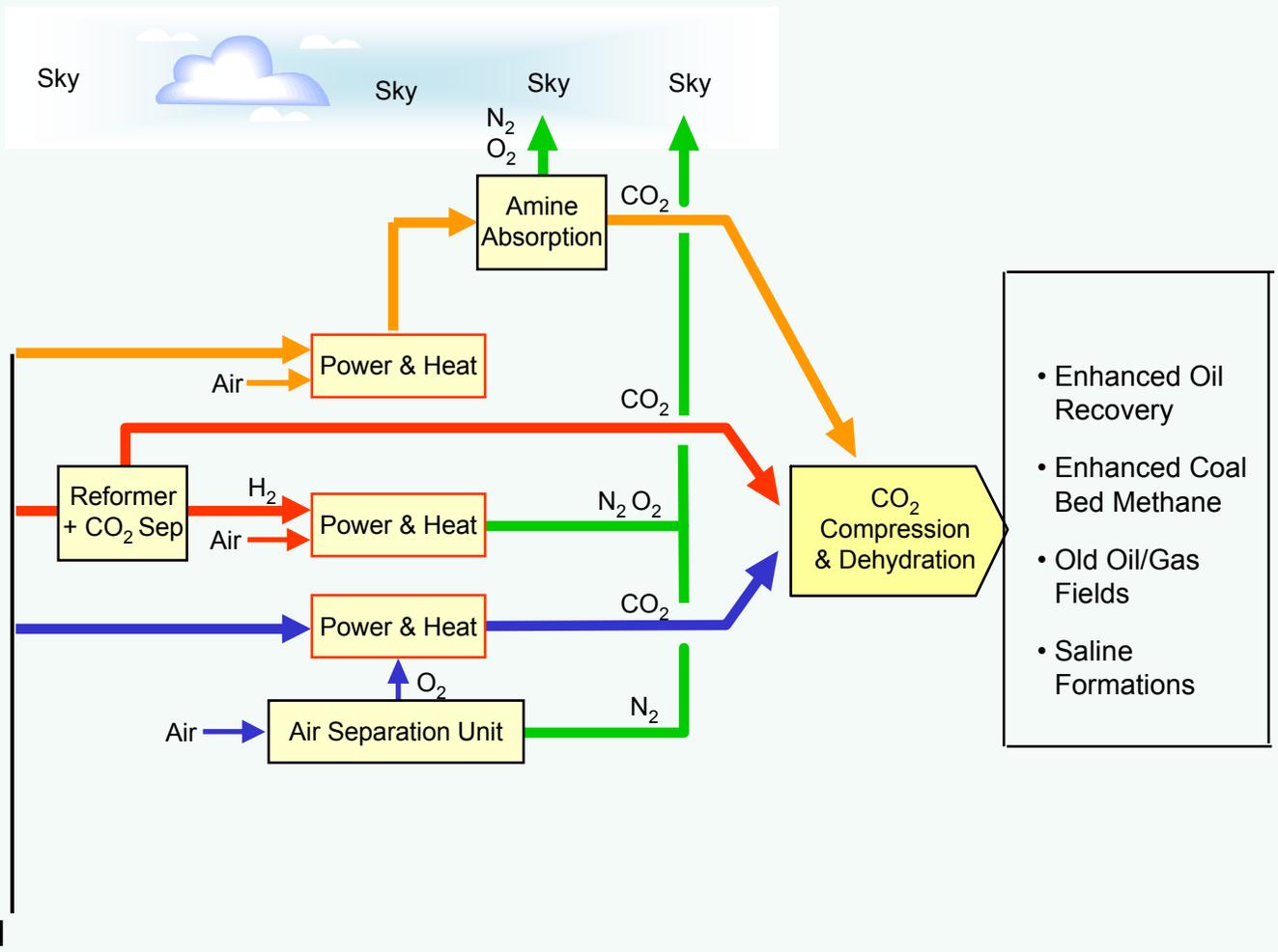
## Capture technologies

Post Combustion Decarbonisation

Precombustion Decarbonisation

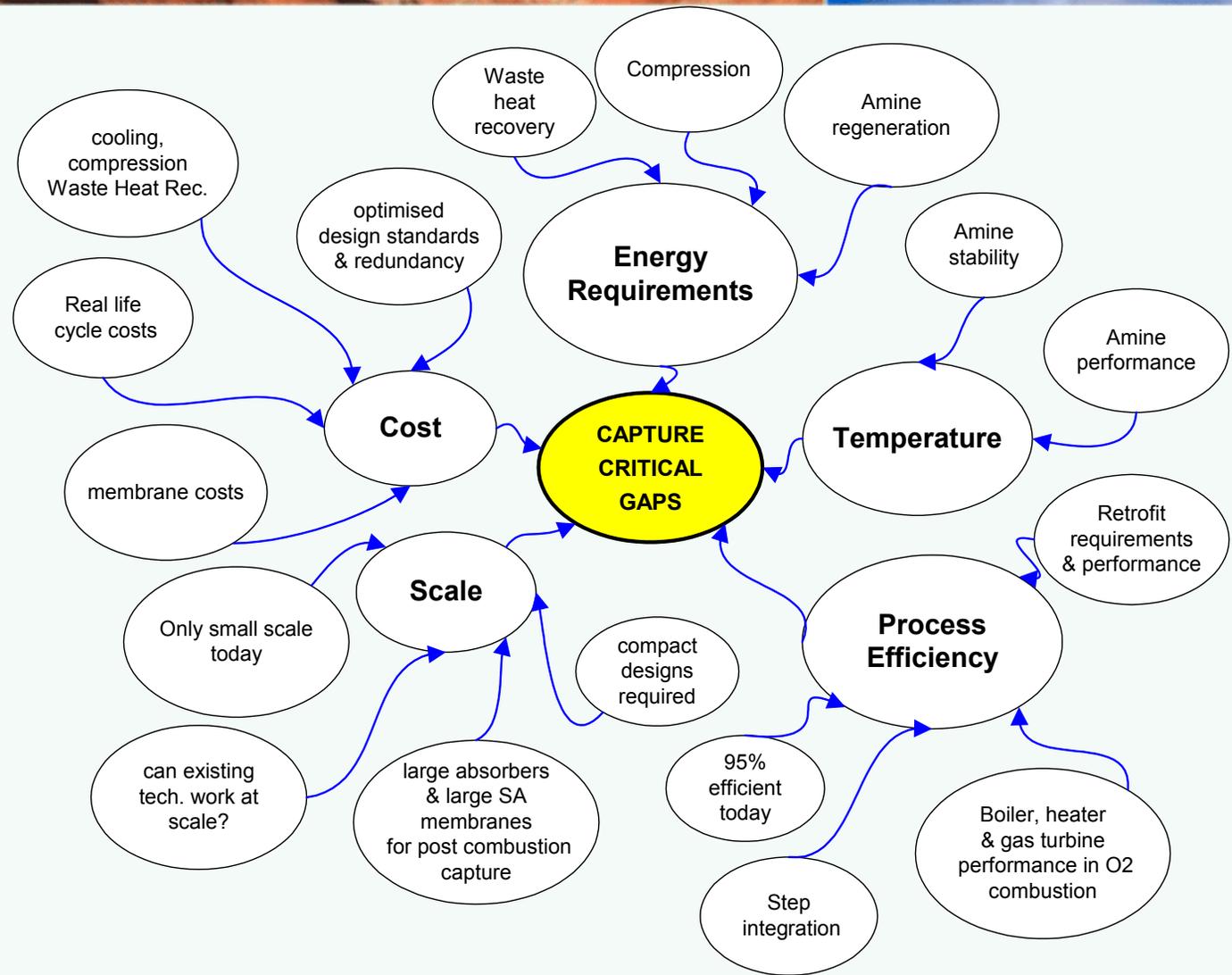
Oxyfuel

Fossil Fuel





## Capture Gaps

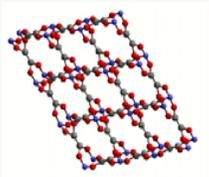
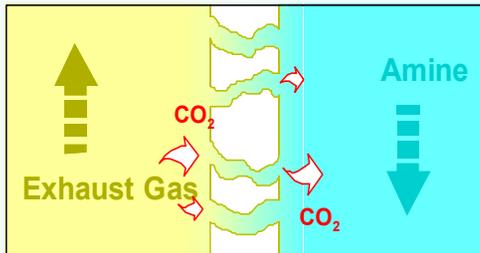




## Capture: Summary of Progress

### Post Combustion studies in progress

Process integration and standards review started  
 Membrane separation & advanced solvents pilot study completed  
 Specific, stable solid adsorbents designed and under test



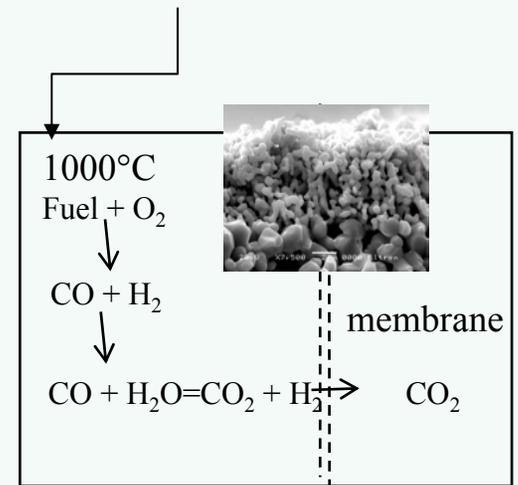
Example of solid adsorbent

### Pre-Combustion studies in progress

VLS autothermal reforming study complete  
 Gas turbine retrofit study to begin  
 Compact reformer with PSA study to begin  
 4 major step reduction & integration studies in final phase. I.e. membrane water gas shift, SEWGS, H<sub>2</sub> membrane tech. for gas turbines, H<sub>2</sub> membrane reformer, heaters/boilers

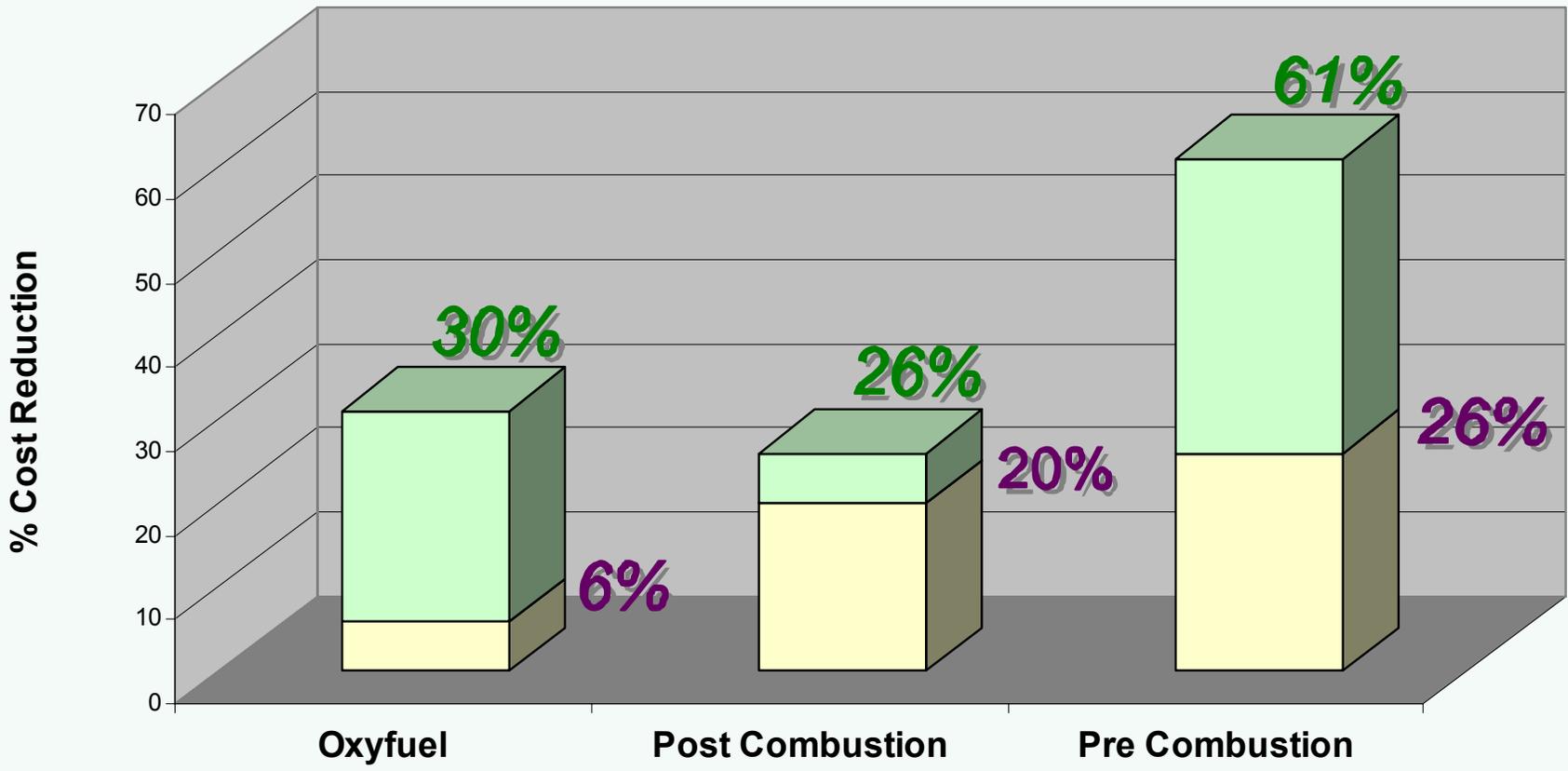
### Oxyfuel studies in progress

Chemical looping, particles developed for O<sub>2</sub> generation in-situ. Pilot rig tests begun  
 Heaters and boilers conversion study almost complete





## CO<sub>2</sub> Avoided Cost Reductions

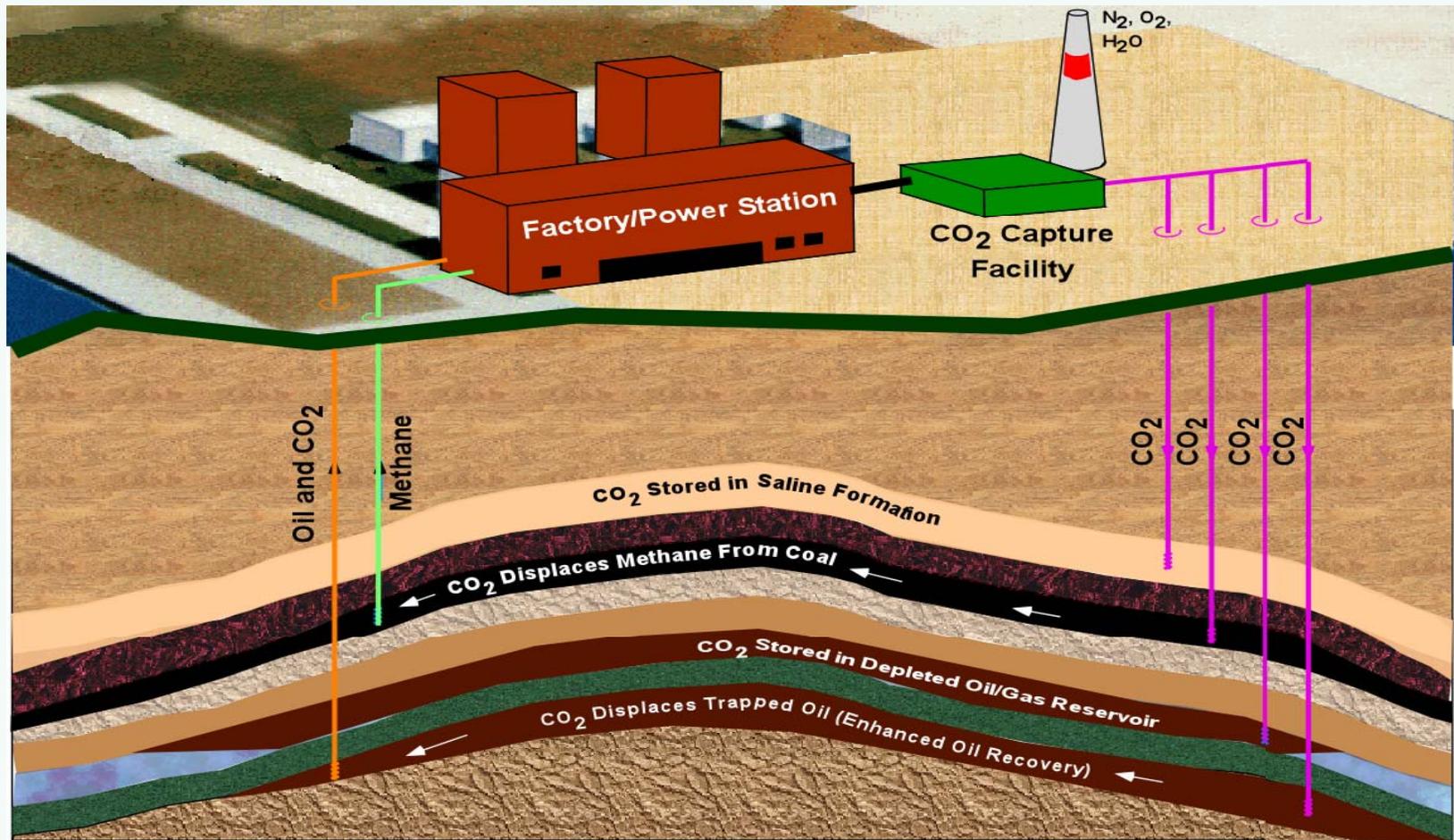




# CO<sub>2</sub> geologic sequestration



## Storage technology





# Gaps: Storage Monitoring and Verification

- Cost
- HSE risk assessment barely being addressed;
  - Leakage
  - Contamination
  - Mitigation
- Maximising sequestration
- Long term monitoring standards and tools
- Verification
- Certification



Probability based RA in CBM

Safety assessment methodology

**Legal analysis**  
**London Convention**

**Risk Analysis**

Reactive transport model  
for LT caprock integrity

**Lessons from nuclear  
material storage**

Leakage & seepage from  
Geologic Sites

**Lit. Search HSE RA**

**& Others**

Geophys. techniques

Isotopic studies

**Monitoring**

**LT tech.**

CO<sub>2</sub> charged systems

Natural  
analogs

Miscibility studies

Rev. Atmospheric  
monitoring

Phys. props.  
caprock

**Integrity**

**Optimization**

Depleted gas  
reservoirs

LT sealing wells

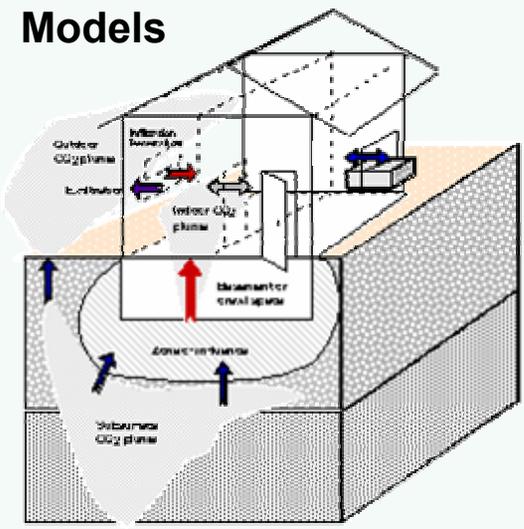
Natural gas storage

Transportation  
& material selection

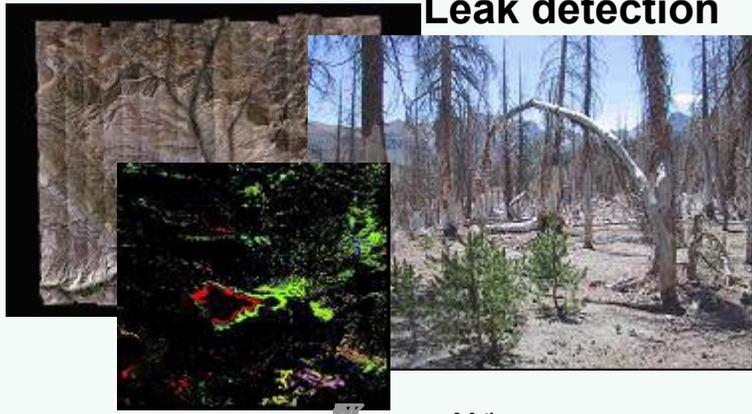


# CO<sub>2</sub> Capture Project

## Models



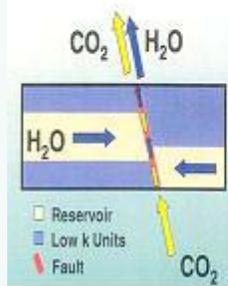
## Leak detection



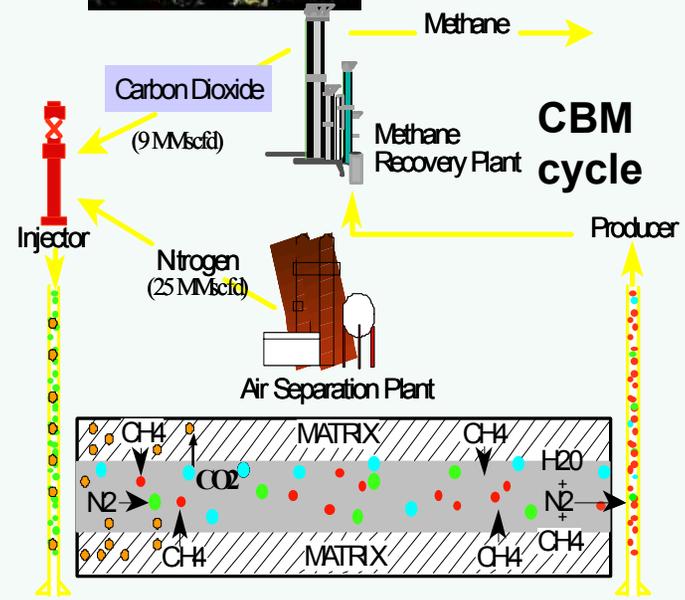
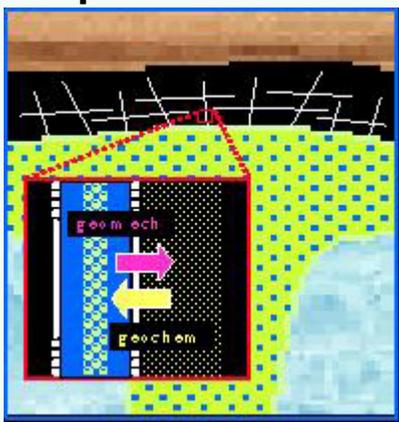
## Natural analogs

### Reservoir Leakage

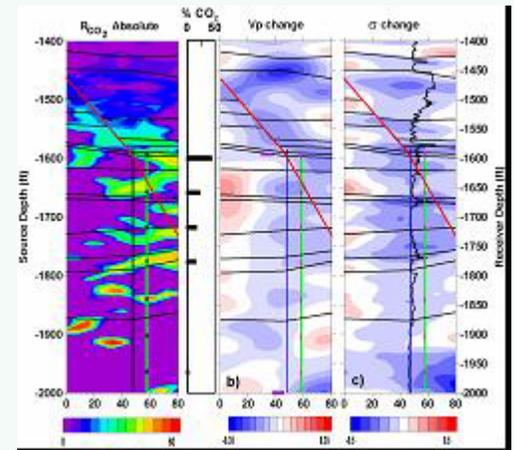
Crystal Geyser at the Little Grand Wash Fault



## Caprock mechanics



## Reservoir movement





# Progress in other program areas

## Progress in other program areas

- **Common Economic Model** - methodology developed and used for cost comparison and technology selection
- **Policy and Incentives** - conducted review of current policy matters and identified opportunities and barriers for technology development and application
- **Technology Advisory Board** – meets regularly to review technology and progress
- **Communications** – Undertaken outreach activities and ramping up communications effort



## CO<sub>2</sub> cost chain

Power & Industrial processes with CO<sub>2</sub> capture and conditioning

CO<sub>2</sub> export terminal and pipeline infrastructure



**Cost**

\$3 – 160 /t



\$1 - 15/t



\$2 - 5/t\*

=

**\$6 – 180/t\***

\*long term monitoring costs?

\* These numbers are indicative only



## Conclusions



## Conclusions

- Industry and Governments have come together, on an international scale to provide strong leadership on Technology Development
- A portfolio of technologies with broad application are being developed
- Technology R&D is producing step reductions in cost
- CO<sub>2</sub> Sequestration must be proactively managed to reduce risks and ensure public acceptance
- Further outreach and communication of results is planned
- CCP launching communications phase at 2<sup>nd</sup> Annual National Conference on Carbon Sequestration
- Visit [www.co2captureproject.org](http://www.co2captureproject.org) for more information