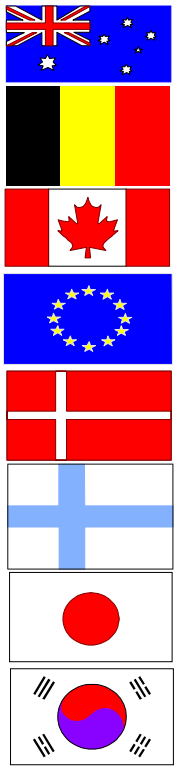
Sequestration's Role in Carbon Management - a global perspective

by Paul Freund

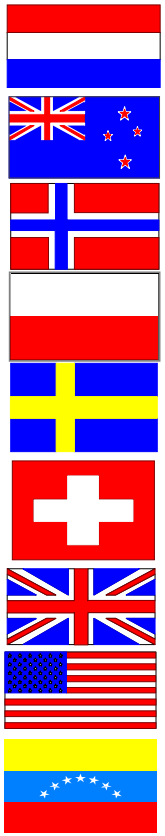
IEA Greenhouse Gas R&D Programme

IEA Greenhouse Gas Programme

Participants



Australia
Belgium
Canada
CEC
Denmark
Finland
Japan
Korea



Netherlands
New Zealand
Norway
Poland
Sweden
Switzerland
United Kingdom
United States
Venezuela

Sponsors: BP, Chevron, EniTecnologie, EPRI, ExxonMobil, RWE AG, Shell International

IEA Greenhouse Gas Programme

Objectives

- Evaluate abatement technologies
- Disseminate the results
- Identify targets for appropriate R&D and promote action

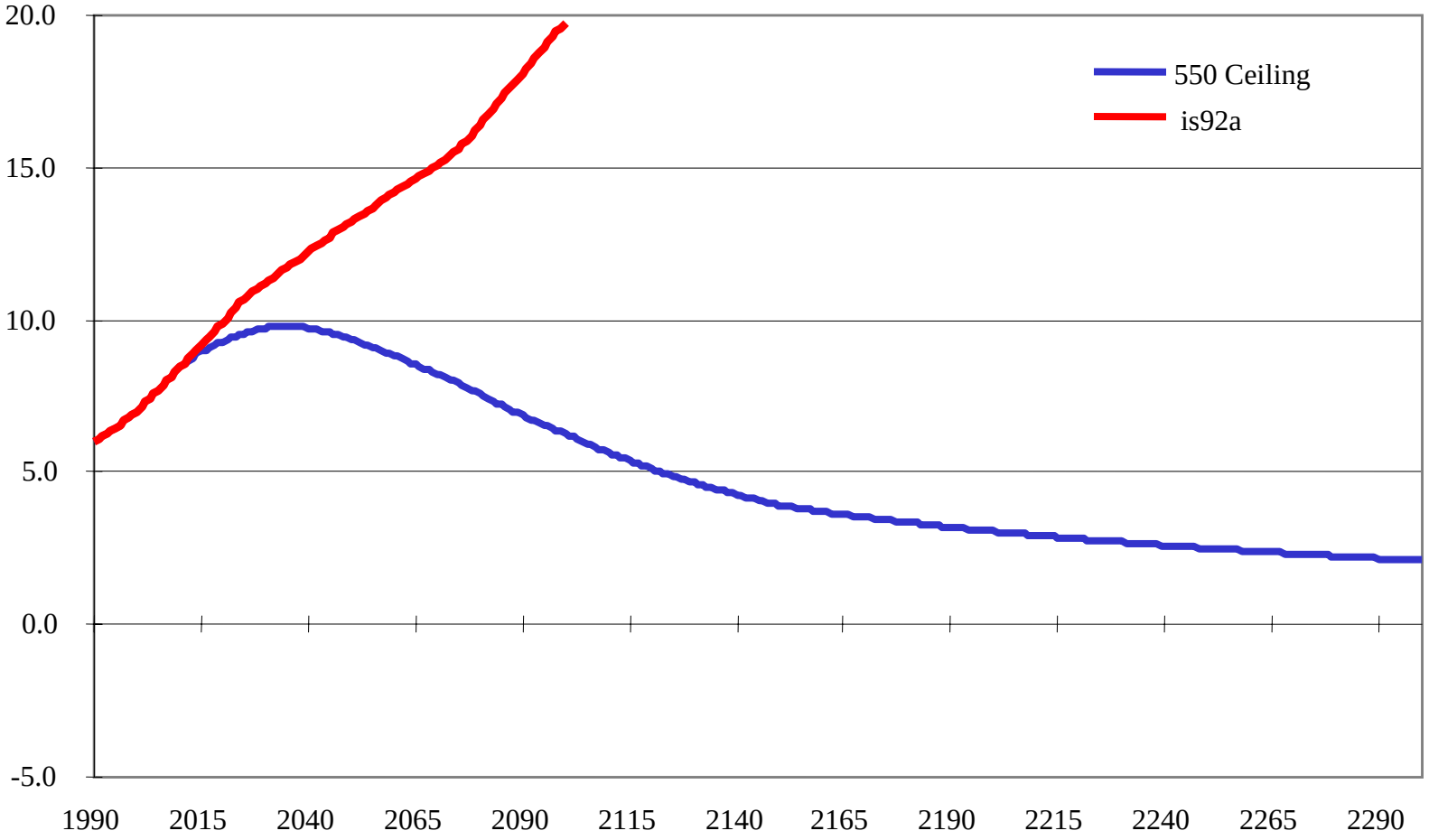
Global Perspective

Overview

- The need for deep reductions in emissions
- CO_2 capture and storage can contribute
- Where this could be used and how - many options
- Capture of CO_2 - cost implications
- Storage of CO_2 - demonstrations are essential

Deep reductions will be needed

Emissions (GtC/yr)



Achieving deep reductions

Technology Options

- Reduce energy use
- Switch to different fuels
- Sequester CO_2

Achieving deep reductions

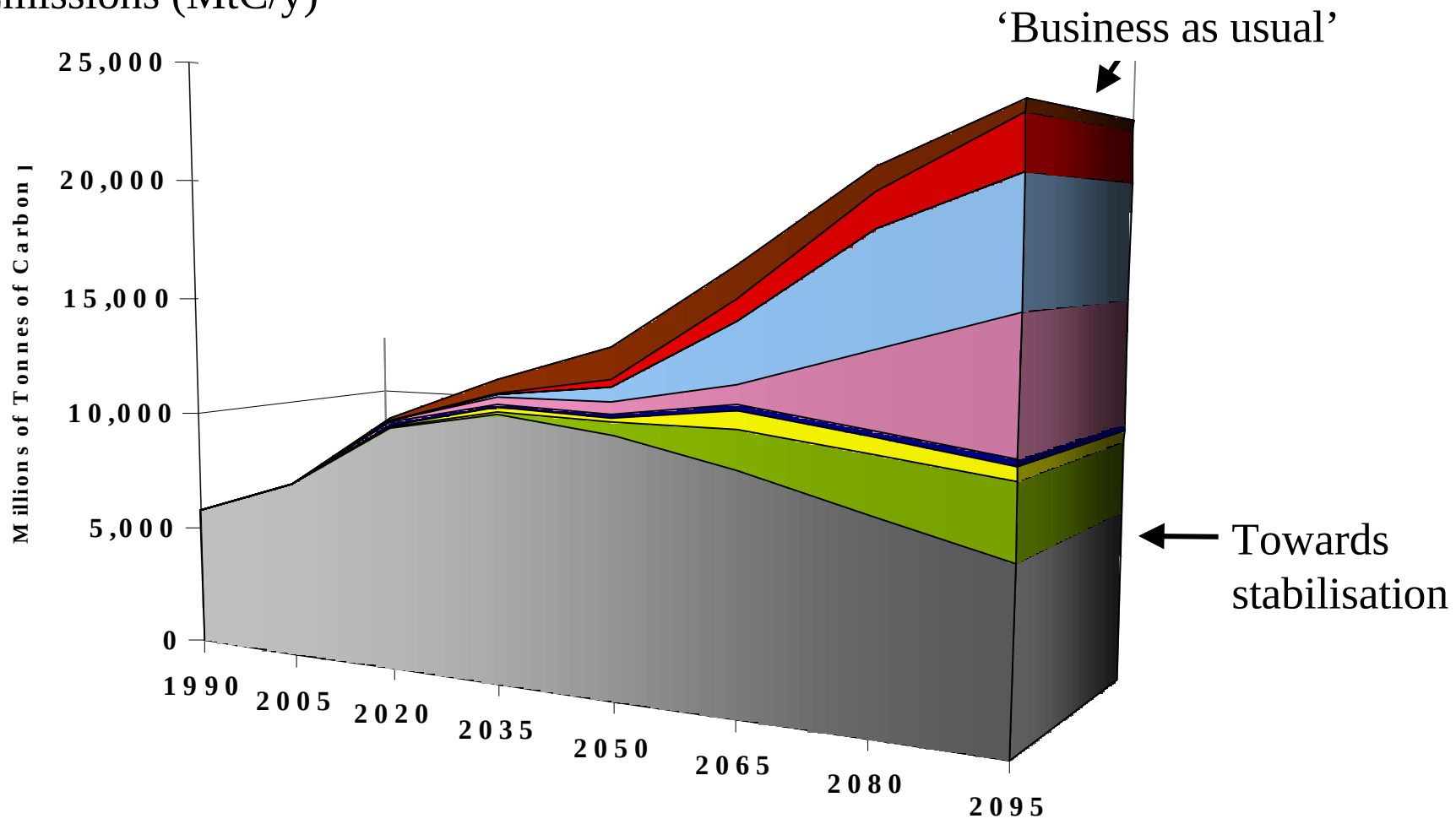
Technology Options

- Reduce energy use
  - Important but not sufficient
- Switch to different fuels
  - Gas: cost-effective where supplies available
  - Renewable supplies or nuclear can contribute
- Sequester CO_2
  - Enables continued use of existing energy supply
  - Enhancing natural sinks: limited potential
  - Capture and storage of CO_2: substantial capacity

Several options will contribute

Model results of J Edmonds (PNNL)

Emissions (MtC/y)



Is there sufficient capacity?

PNNL simulation:

- Total amount of CO_2 to be captured 1990 - 2095
  - CBF Case: 1230 Gt CO_2

- IEA GHG estimates of reservoir capacities:
  - Disused oil and gas fields 900 Gt CO_2
  - Unminable coal measures >15 Gt CO_2
  - Deep saline reservoirs 400 - 10000 Gt CO_2
  - Deep ocean >4000 Gt CO_2

Potential Applications

Capture and storage of CO_2

- Power generation
  - The “conventional” application
- Major energy using industry
  - e.g. Oil refining
- Manufacture of decarbonised fuel for transport
  - e.g. H_2 from natural gas

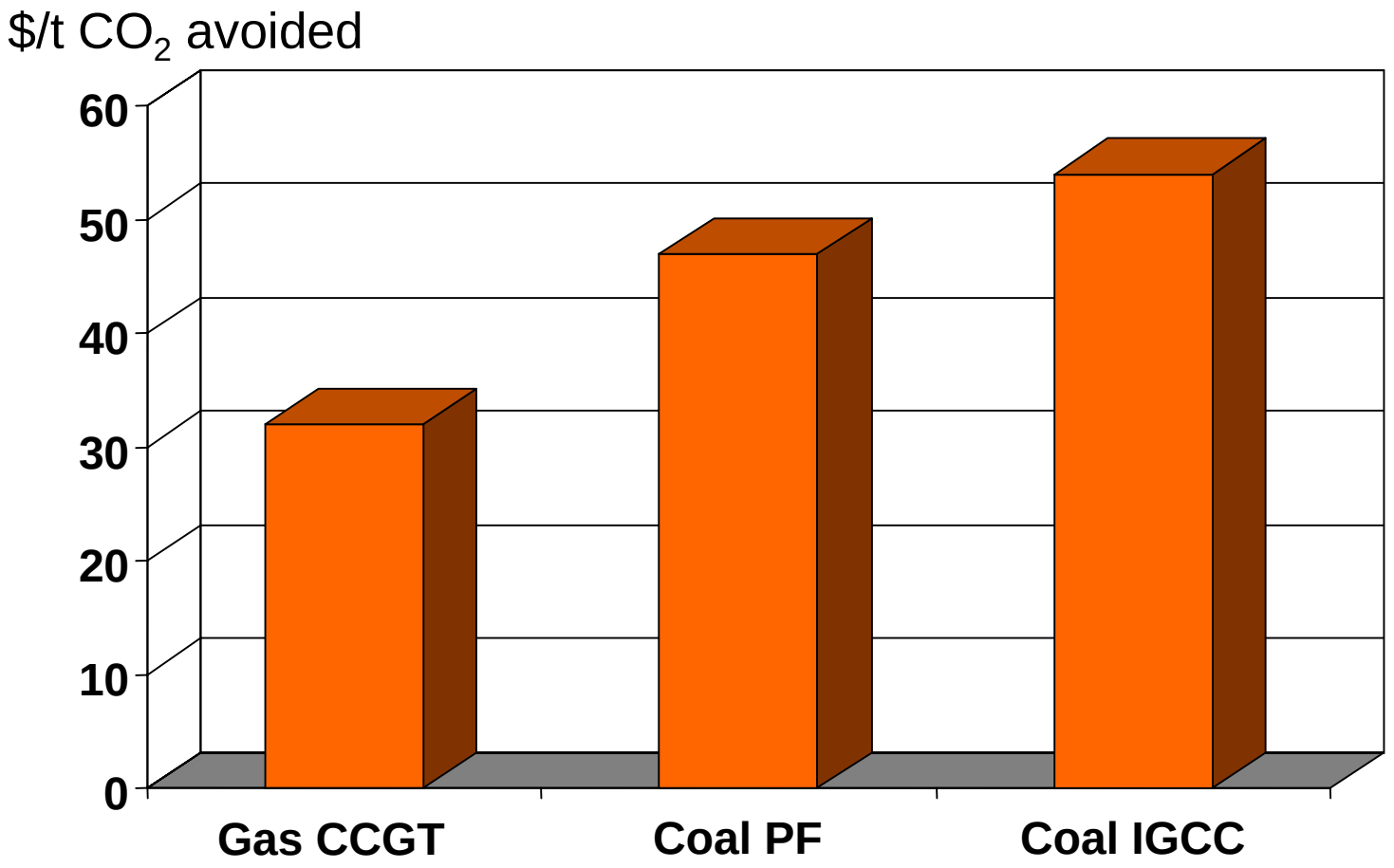
CO_2 Capture - process schemes

Application in power generation

- Existing capture technology:
  - Post combustion scrubbing of flue gases
- New processes using existing technology
  - Precombustion decarbonisation
- Processes under development:
  - Combustion in O_2/recycled-CO_2

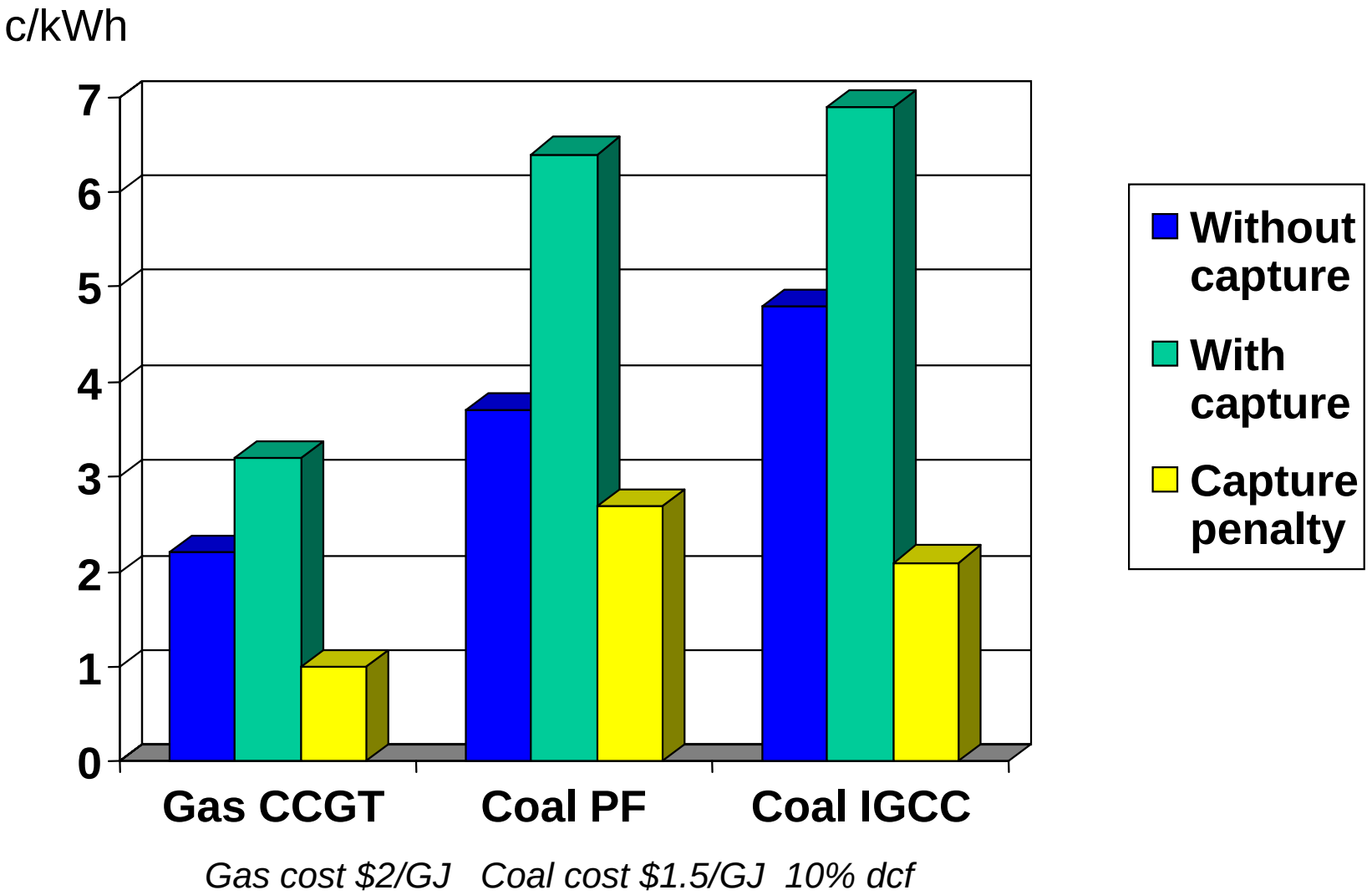
Cost of Capture

(relative to base case of CCGT for gas, PF for coal)



Coal IGCC relative to Coal PF as base case

Cost of Generation



Penalty for capturing CO_2

Several factors contribute to extra cost:

- Compensation for reduction in nominal output
- Capital and operating cost of CO_2 capture plant
- CO_2 compression

What needs to be done?

CO_2 capture

- Reduce cost to encourage early application
- Demonstrate capture in full-scale plant

CO_2 Capture

Some developments

- Solvent-assisted membrane pilot (Norway)
- Improved amine solvents (Japan)
- Novel membranes (Netherlands)
- CO_2 Capture Project (9 industrial partners)
- CO_2 Capture test network (International)

As yet, no full-scale demonstration

Options for CO_2 Storage

Storage in:

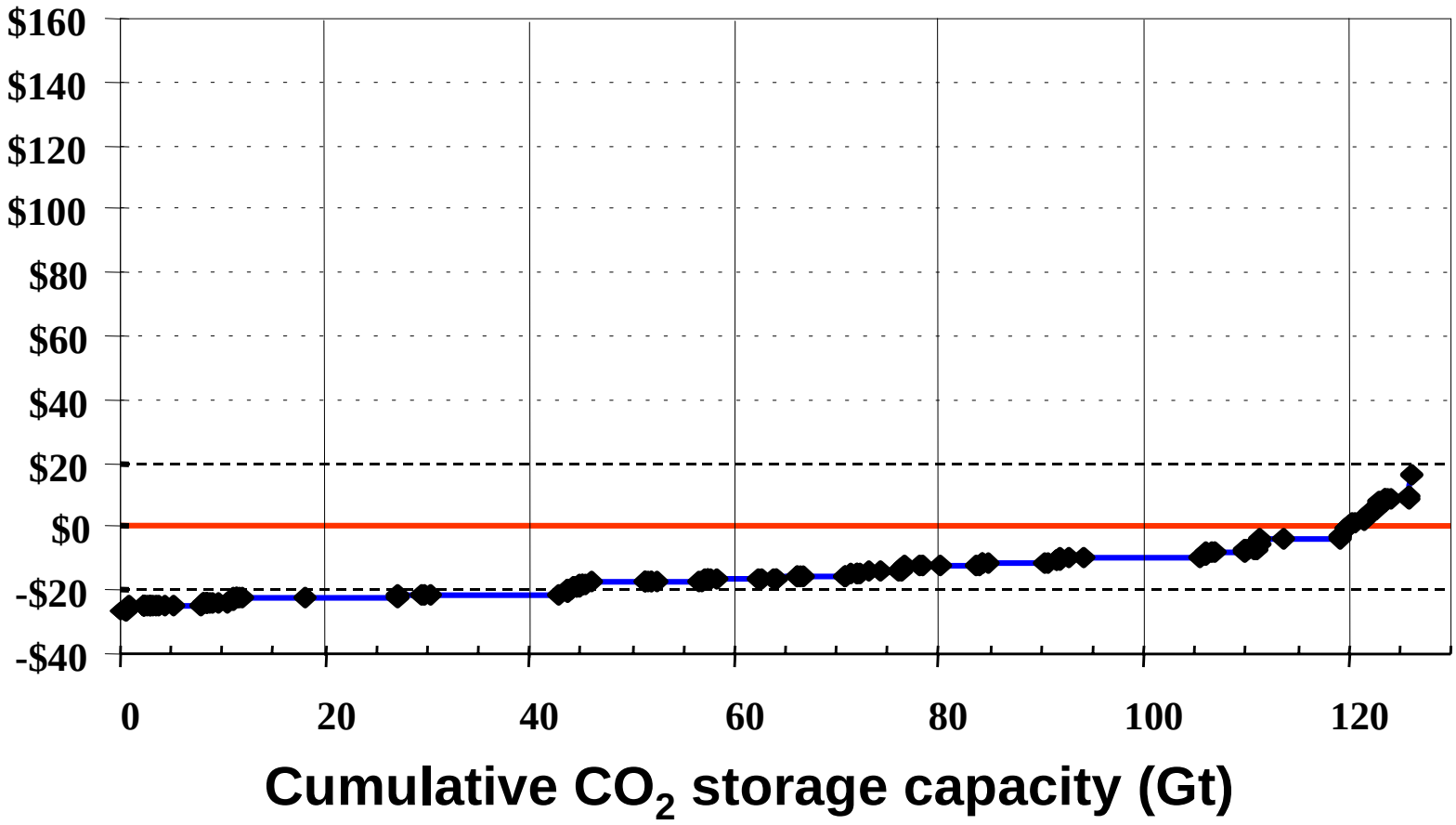
- Depleted oil and gas fields
- Unminable coal measures
- Deep saline reservoirs
- Deep ocean

Storage as:

- CO_2 hydrate, Mineral carbonate, Solid CO_2
- Conversion to chemicals
- Solid carbon

CO_2 Storage in depleted oil fields

Global potential



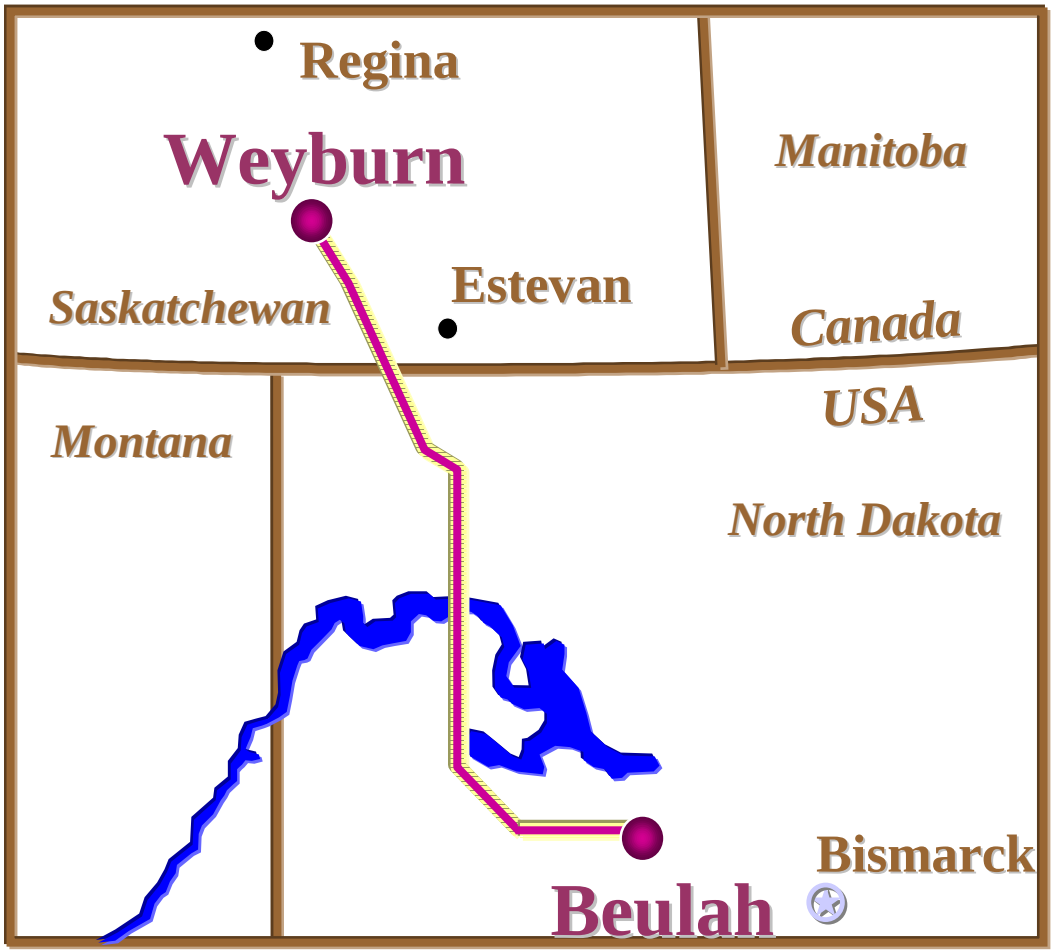
What needs to be done?

CO_2 capture and storage

- Reduce cost to encourage early application
- Demonstrate capture in full-scale plant
- Demonstrate that storage is safe and secure
- Ensure minimal environmental impact
- Verify amount of CO_2 stored

Monitoring CO_2 storage - Sleipner

Weyburn CO_2-EOR project



CO_2 supplied by Dakota Gasification in Beulah, North Dakota

What needs to be done?

CO_2 capture and storage

- Reduce cost to encourage early application
- Demonstrate capture in full-scale plant
- Demonstrate that storage is safe and secure
- Ensure minimal environmental impact
- Verify amount of CO_2 stored
- Win acceptance in international policy
- Win acceptance by the public