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Carbon sequestration: Some perspectives and prospects

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Approach to climate change mitigation

Using the Kaya Identity

CO2 emissions = GDP * Energy Intensity * Carbon Intensity

Reduction in Energy intensity → Reduced end use demand, increased efficiency (tech change)

Reduction in net CO_2 emissions → Shift towards renewables, away from conventional fuels, C sequestration

Three pronged approach to climate stabilization

(1)

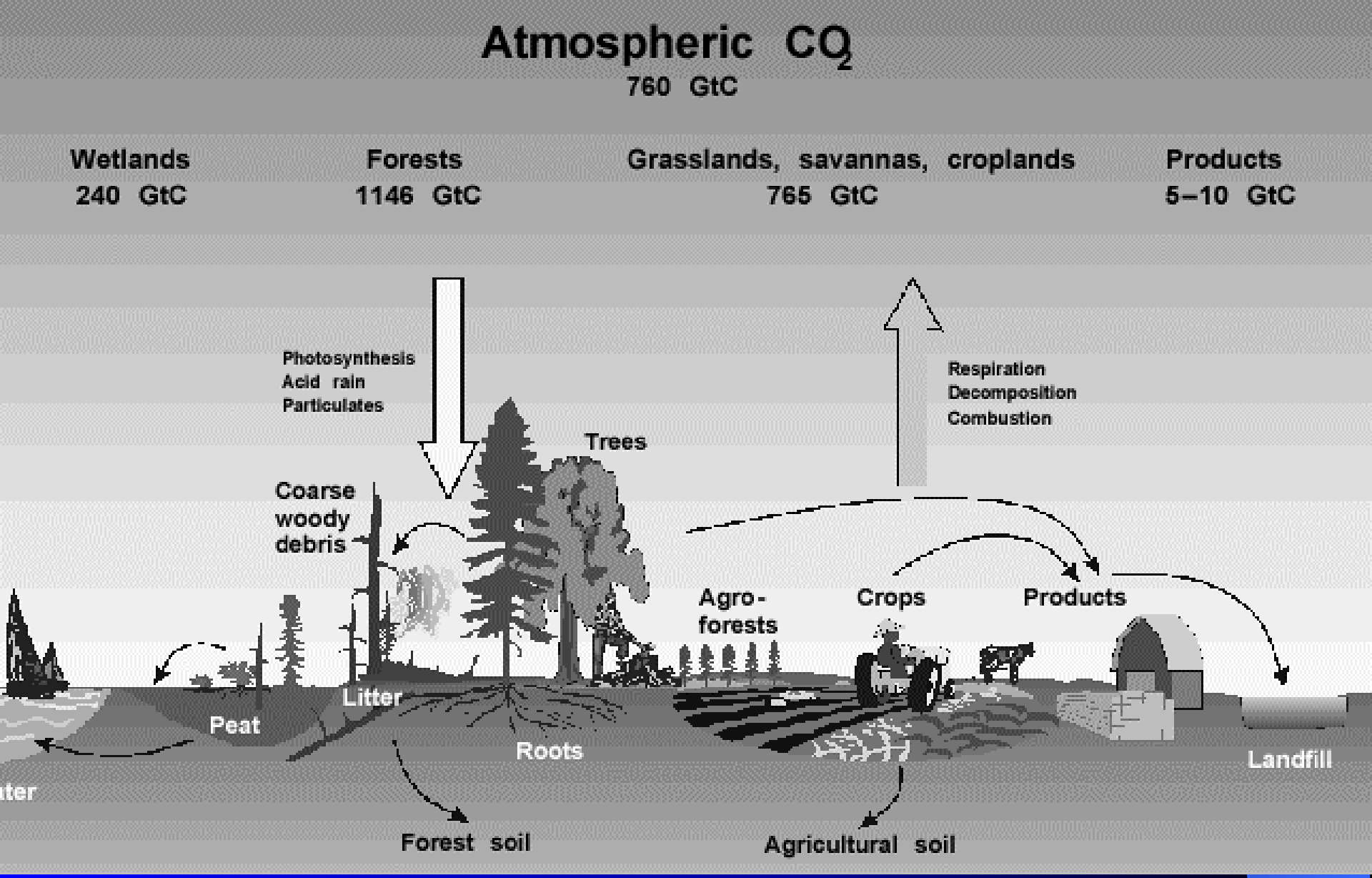
Eco friendly management of carbon pool

(2)

Increased efficiency of production and use - technological change

(3)

Development of renewable energy technologies



Carbon stocks are also present in the Tundra -127GtC, deserts and semi desert 199GtC and oceans (approx 39000GtC)

Source: IPCC TAR

Biological approaches to curb increases in CO_2 emissions

Conservation: conserving an existing C pool - thereby preventing emissions to the atmosphere

Sequestration: increasing the size of existing carbon pools thereby extracting CO2 from the atmosphere

Substitution: substituting biological products for fossil fuels, thereby reducing CO_2 emissions

Carbon Sequestration

Geologic injection

- Active and depleted oil and gas reservoirs
- Deep brine formation
- Deep coal seams and coal bed methane formations

Disposal through solidification

Deep ocean injection

Current uptake: 2±0.8GtC/ year

Potential exceeds estimated available fossil fuel resources of 5000 to 10000 GtC

Ocean fertilization

Forestry

The SAR estimated that 60 to 87 GtC could be conserved and sequestered in forests by 2050

Soil

60 to 87 GtC could be sequestered by 2050

Source: US Dept of Energy and IPCC TAR

Environmental Impacts

Deep Oceans

- Lowering of pH of sea water
- Effects on deep sea biota-
  - mortality
  - reduction in physiological functions such as reproduction and growth rates

Geological formations

- Impacts of high soil CO_2 on above ground biota
- Impacts on microbial ecology
- Impacts on mineral resources
- Impacts on acquifers and surface water

The concerns and constraints

- *Permanence of geological storage*
  - Avoidance of leakage over long periods of time seems questionable
- *Land requirements (Biological sequestration)*
  - To sequester 60-87GtC by 2050 - 700Mha of forest land is required
    - 138 Mha from slowed tropical deforestation
    - 217 Mha for regeneration of tropical forests
    - 345 Mha of plantation forests and agro forestry

Source: IPCC TAR

- *Legal implications*:London Convention (1972) prohibits the dumping of industrial waste at sea or sub seabed formations - Is there a potential conflict?
- *Legacy problem:*Future generations may be left with the cost of guarding and monitoring the deep acquifers or the progress of plumes under the ocean - likely to be substantial
- *Cost of sequestration* - The cost of mitigation was envisioned to be about 2-8US$/t C(cheapest option) but this does not include land and transactions cost (Source: IPCC TAR)

Enhancing global cooperation

- Carbon sequestration could involve developing countries
- Significant potential exists in developing countries to sequester carbon -

  By 2050 60 -87GtC can be sequestered in forests of which 45 -72 GtC is in the tropics (IPCC TAR)

- Significant possibility for geological sequestration also exists eg. Large amounts of CBM in India could be extracted by pumping in CO2

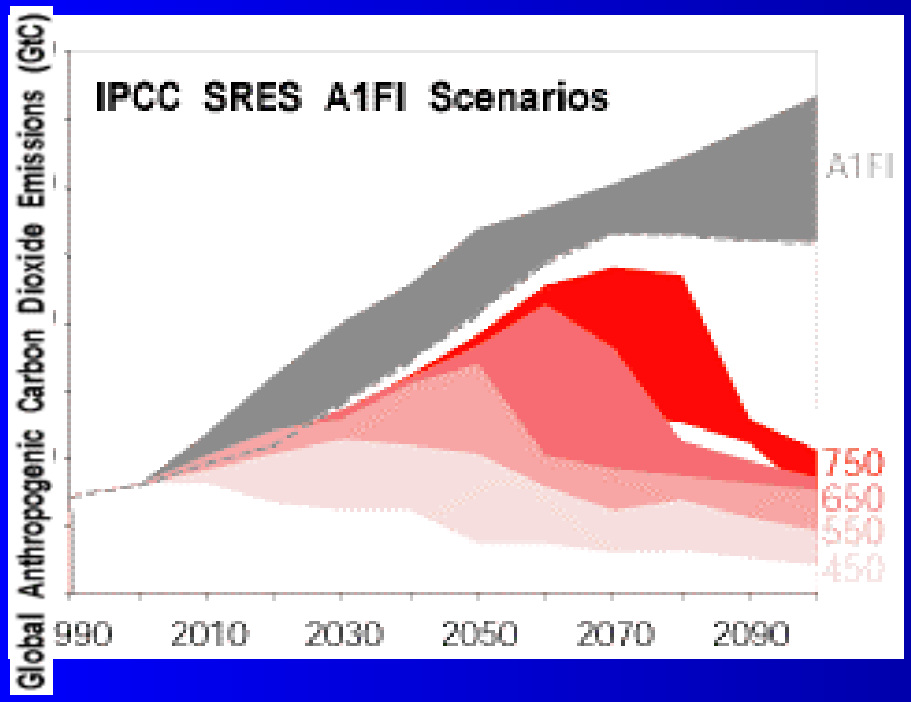
Aligning C sequestration with SD

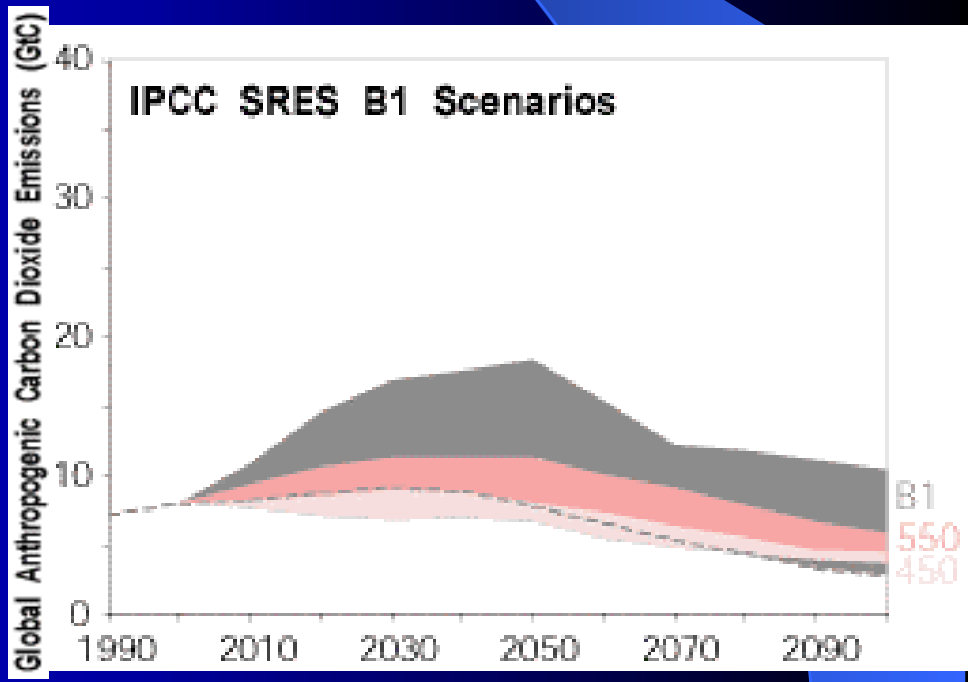
Carbon sequestration has the potential to yield ancillary benefits -economical, social and environmental

- Agro forestry: provides environmental protection from soil erosion, improved fertility
- Community land plantations : generate income for local population and meet fire wood demands
- Forest conservation through peoples participation could improve local incomes and meet firewood demand (JFM)
- Afforestation programs may be integrated with watershed management to provide beneficial hydrological effects

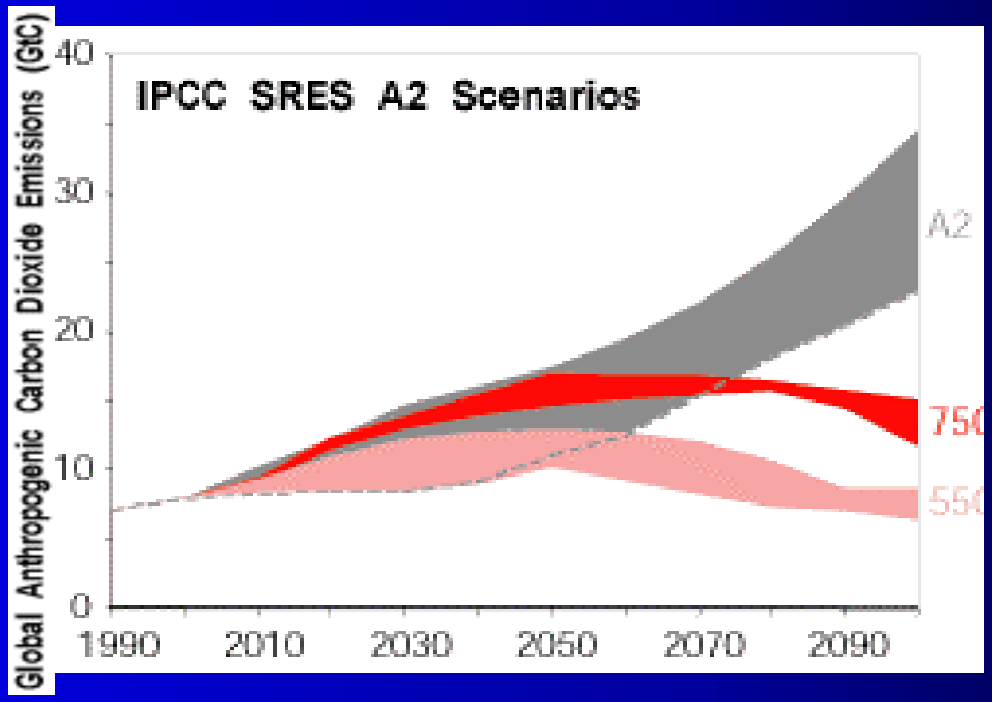
The extent to which the option of carbon sequestration would be exercised is dependent on

- baseline scenario and the gap between the baseline and the desired limit of concentration

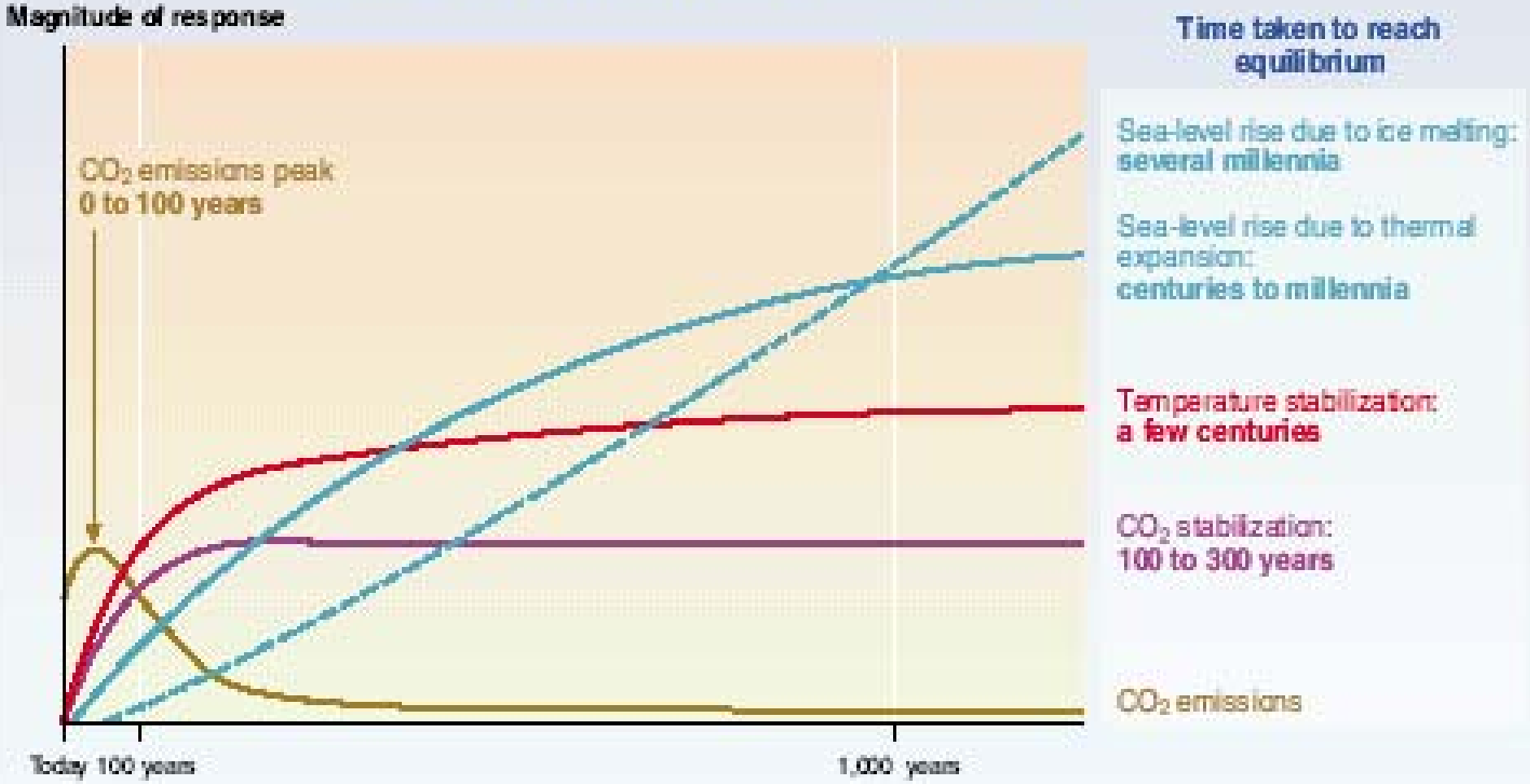




- The level of technological progress in the baseline scenario



CO_2 concentration, temperature, and sea level continue to rise long after emissions are reduced



Source: IPCC Syn report

The IPCC - Influence on policy?

- World-wide effort to gather and combine all views and information on climate change
- Broad involvement of scientists
- Extensive review process
- Based on consensus - if no consensus reached, all opinions to be reflected in report
- Report: owned by authors
- Summary for Policymakers: owned by governments

Why a Special Report on CO_2 capture and storage?

- Request by UNFCCC at COP7 for report on mitigation option of CO_2 storage
- IPCC Plenary XIX (Geneva, April 2002): Workshop to prepare discussion
- Workshop in Regina (Saskatchewan, Canada) in November 2002
- Product Regina workshop: Scoping Paper for consideration at IPCC Plenary XX (Paris, February 2003)

Why a Special Report on CO_2 capture and storage?

- Advice: Contents of Special Report
- IPCC Plenary XX: approval Special Report; publication due for 1st half of 2005

Expected deliverable:

Concise, complete, accessible and objective assessment of carbon dioxide capture and storage

A Special Report on CO_2 capture and storage - Why now?

- Only 3 pages in Third Assessment Report
- Relatively new and unknown GHG mitigation option
- Lots of new information available
- CO_2 capture and storage is or will soon be implemented in many countries, e.g. to meet Kyoto obligations
- Inclusion in the Fourth Assessment Report (2007) is too late and too little room for extensive assessment

Contents of IPCC Special Report on CO_2 capture and storage

- Starting point: chain approach
- CO_2 source $\rightarrow$ capture $\rightarrow$ transport $\rightarrow$ storage
- Context: costs, public acceptance
- Related issues: environmental impacts, safety, inventories

Contents of IPCC Special Report on CO_2 capture and storage

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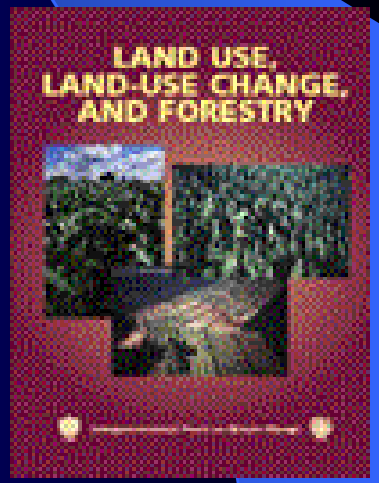
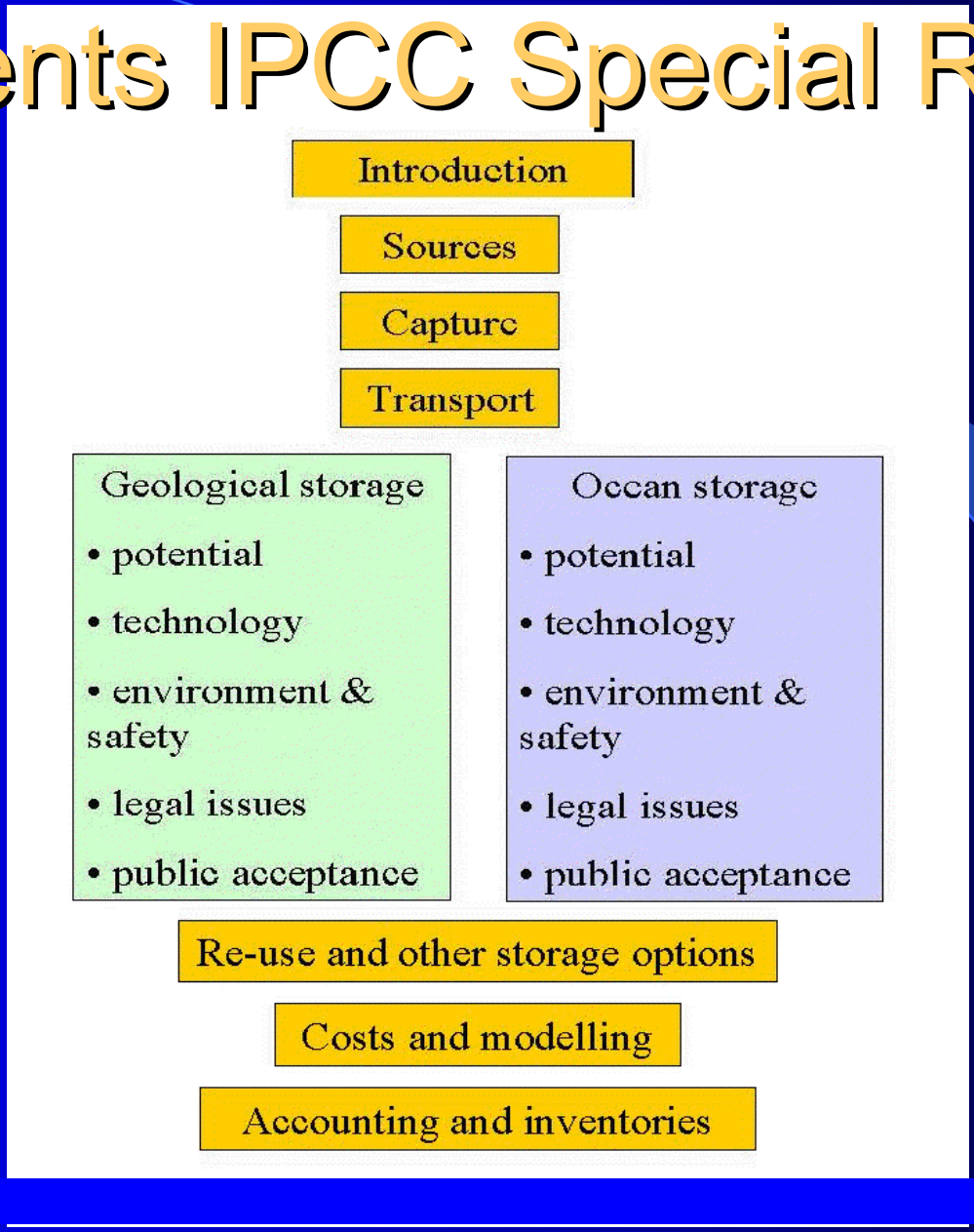
- Context: costs, public acceptance
- Related issues: environmental impacts, safety, inventories
- Not about biological sequestration of CO_2 - no terrestrial, iron fertilisation or algae



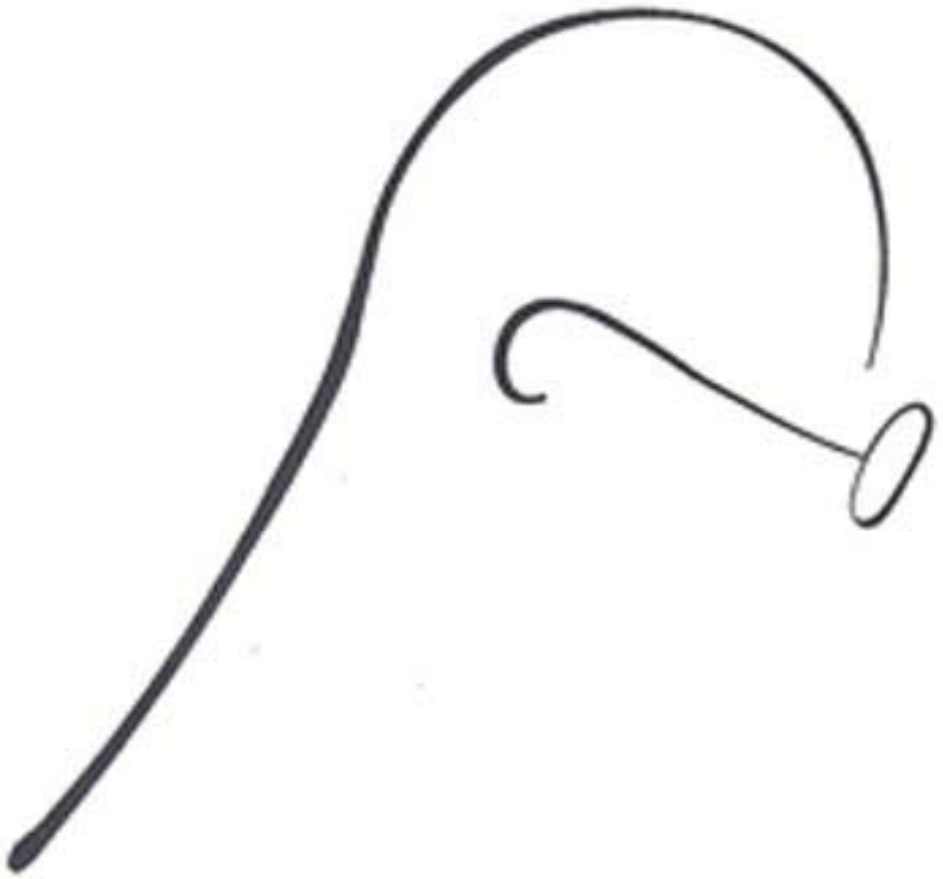
Contents IPCC Special Report



More information?

- IPCC Workshop in Regina: proceedings, detailed Table of Contents, and Scoping paper
- IPCC in general

www.ipcc.ch



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