

Life Cycle Assessment of CO₂ Capture and Storage Technologies

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Introduction

- Difficulties to shift to renewable energies
- Fossil fuel for energy production
- European project: MATESA

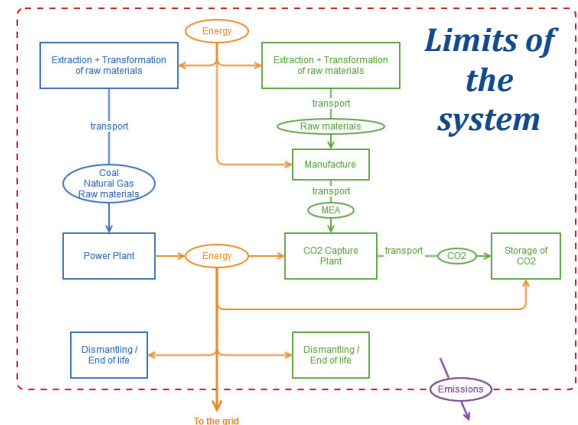
Objectives

- Efforts to reduce CO₂ emissions in the atmosphere
- Compare 4 different strategies of energy production

Function create energy from coal or natural gas, with or without a technology to capture CO₂

Functional unit 1 kWh of energy produced

	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Energy production	Coal	Coal	Natural gas	Natural gas
Capture of CO ₂	-	MEA	-	MEA
Storage of CO ₂	-	Geological sequestration	-	Geological sequestration



Capture

- Infrastructure of the capturing facility
- Manufacture of Monoethanolamine (MEA)
- Operation of the facility

IMPACTS

Scenario 4

Acidification 21%
Terrestrial Eutrophication 39%

Scenario 2

Mineral, fossil and ren resource 13%
Terrestrial Eutrophication 22%

Technologies other than MEA are researched (MOF, zeolites) in order to reduce these impacts.

Transport

- Compression at capturing facility
- Pipeline transport: 50 kilometers
- Leakage of CO₂

IMPACTS

Scenario 4

Human toxicity 1.5%
Mineral, fossil and ren resource 1%

Scenario 2

Mineral, fossil and ren resource 2%
Human toxicity 0.5%

Results are not relevant here. Very few impacts BUT distance chosen is very short !! Better choice : 500 km

Geological storage

- In depleted gas field (depth of 2500 m)
- Injection wells construction
- Operation (energy consumption)

IMPACTS

Scenario 4

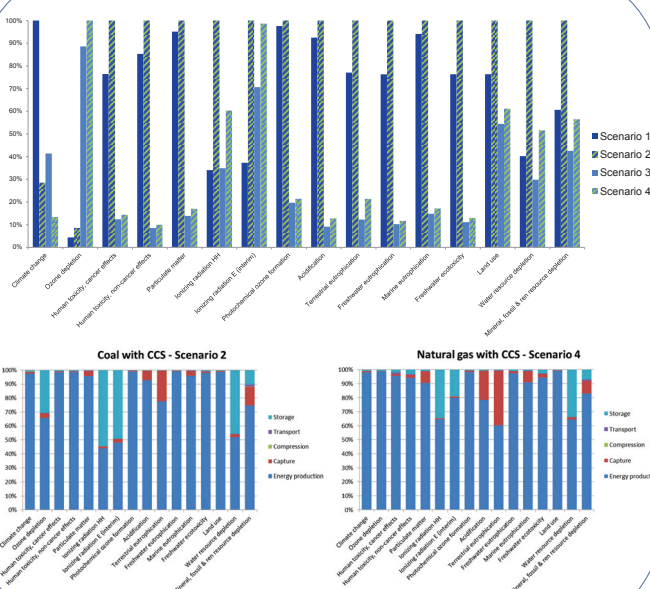
Ionizing radiation 35%
Water Resource depletion 34%

Scenario 2

Water Resource depletion 46%
Ionizing radiations 50-55%

Storage in exploited reservoir → enhanced oil recovery (EOR)
→ Improve oil uptake = reduce impacts by improving yield

Global Results



Interpretation

- Impacts on climate change **divided by 3** when CO₂ is captured
- Impacts in other categories increase :

Coal

Ionizing radiations x 3
Water res. depletion x 2.5
Ozone depletion x 2
5 other categories x 1.3

Natural gas

Ionizing radiation HH x 1.73
Water res. depletion x 1.73
Terrestrial eutroph. x 1.75
1 other categorie x 1.4

Main impacts due to storage

Impacted by capture and storage

Conclusion

- Goals of carbon capture and storage (CCS) technologies are achieved! CO₂ emissions are reduced.
- CCS technology better adapted with production of energy from natural gas (not so much with coal-fired power plant).
- Impacts on environment of CCS technology are not negligible in other categories → explore other alternatives of technologies.