

Climate MRV for Africa – Phase 2 Development of National GHG Inventory Carbon Capture & Storage (CCS)



NIRAS
Lead partner

GreenStream

TÜVRheinland[®]
Precisely Right.

camco
clean energy

Project of the European Commission
DG Climate Action
EuropeAid/136245/DH/SER/MULTI

Amr Osama Abdel-Aziz, Assen Gasharov, Mike Bess
and Laura Lahti
Team Leader and Key Experts
April 2017

IPCC 2006 – 1.C
Carbon Dioxide Transport and Storage

Energy: CCS

National GHG Inventory Objective

- Primary objective of CCS national GHG inventory & MRV is to calculate emissions from:
 - ▣ Capturing CO₂ at source (industrial facility, well-head, etc.)
 - ▣ Transporting CO₂ from source to storage point;
 - ▣ CO₂ injection into storage facility; and,
 - ▣ Any CO₂ leakage from storage facility.

- While CCS, in form of EOR, EGR & ECBMR has existed for long time, CO₂ storage for reducing atmospheric carbon is new – IPCC process is to determine CO₂ losses in the capture-transport-injection-storage cycle.



Energy: CCS

Summary Concept & Terminology

- Carbon capture, transport & storages (CCS) has existed for over 40 years.
- CCS is used for
 - ▣ Enhanced Oil Recovery (EOR)
 - ▣ Enhanced Gas Recovery (EGR)
 - ▣ Enhanced Coal Bed Methane Recovery (ECBMR)
- Pumping CO₂ into oil & gas wells, & coal mines/seams is cost-effective way to increase production



Energy: CCS

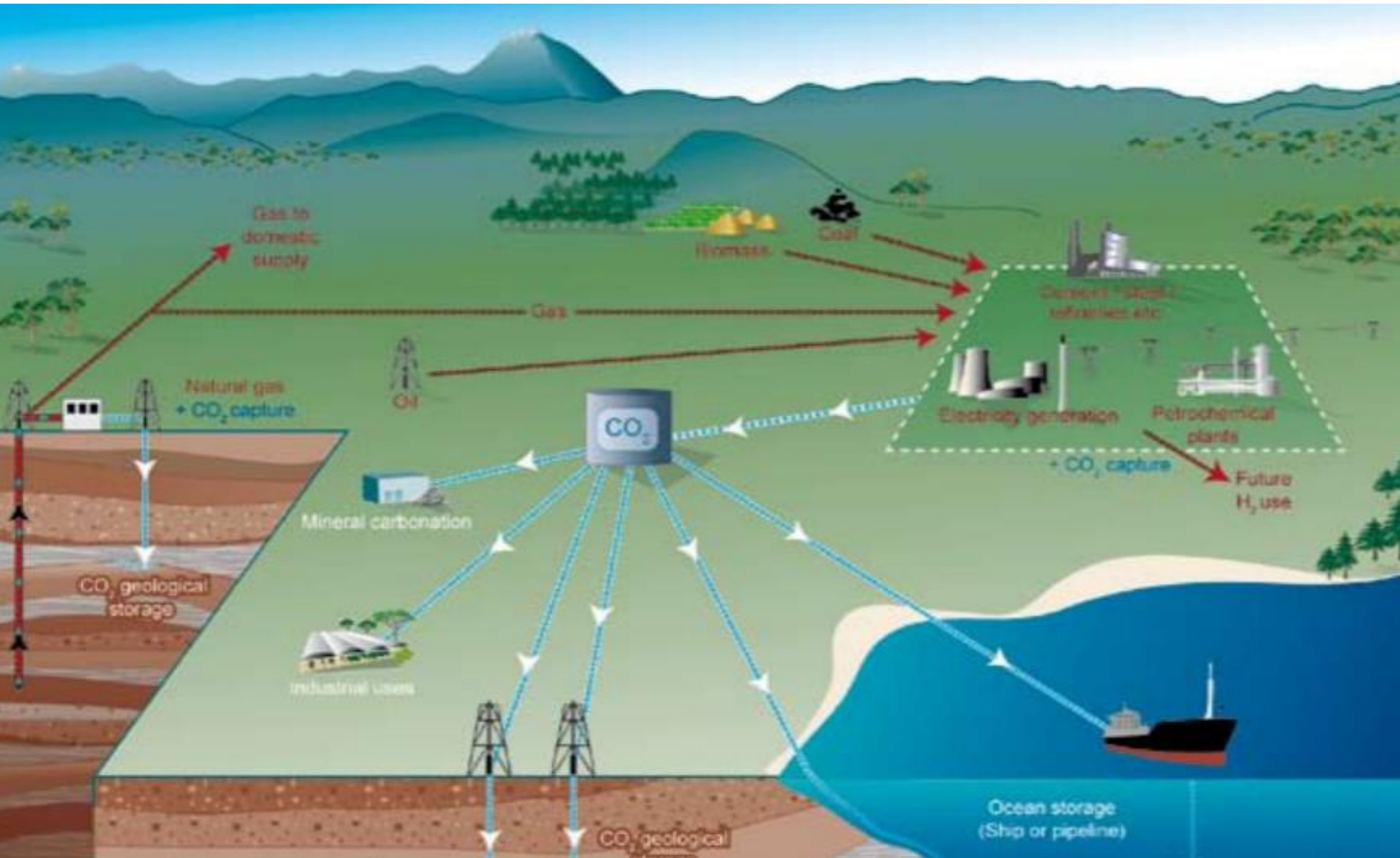
Technical Process

- Effectively CCS has three steps:
- Capture/recover CO₂ from:
 - ▣ Oil or gas wells, refineries, etc.
 - ▣ Large combustion plants (e.g., electricity, fertilizer, petrochemical)
 - ▣ Other
- Transport CO₂ (by pipeline, ship, etc.) – over 6,500km pipeline in US alone.
- Inject into oil/gas well, coal seam, other geological structure
- Store



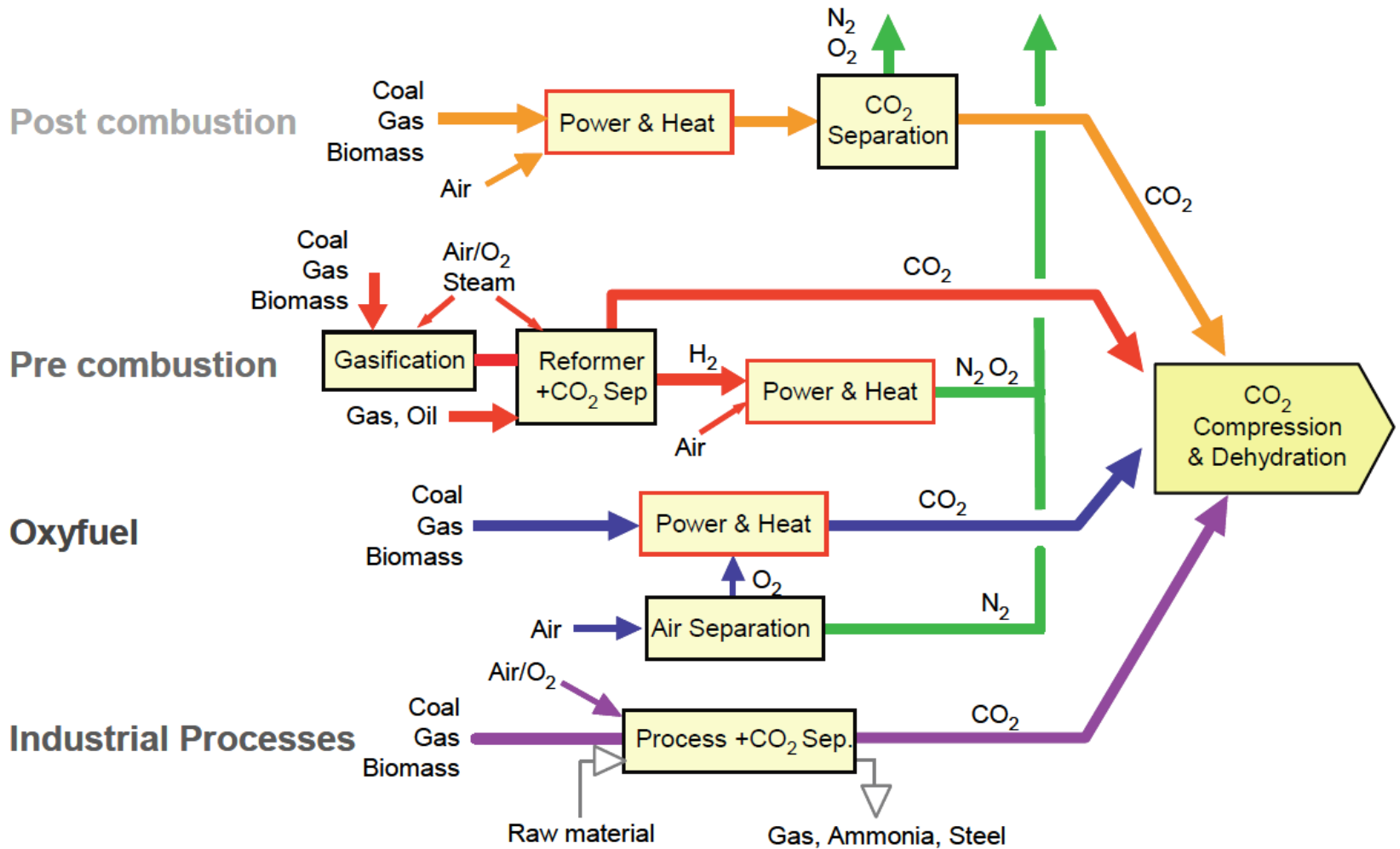
Energy: CCS

CO₂ Capture, Transport & Storage



Energy: CCS

Carbon Capture – Sources & Processes



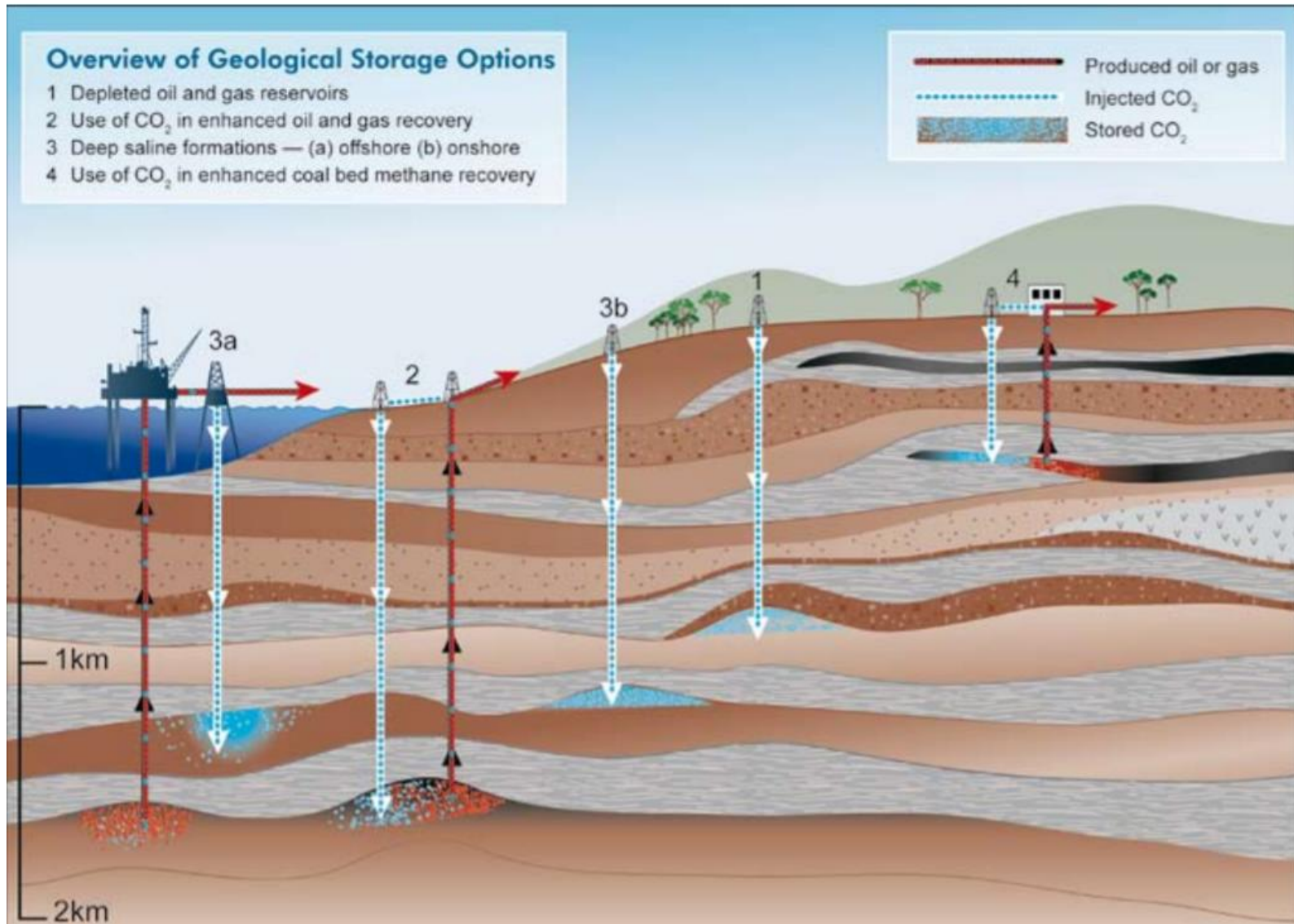
Energy: CCS

CO₂ Geological Storage Options

- Deep saline formations. These are porous and permeable reservoir rocks containing saline water in their pore spaces.
- Depleted or partially depleted oil fields - either as part of, or without, enhanced oil recovery (EOR) operations.
- Depleted or partially depleted natural gas fields – either with or without enhanced gas recovery (EGR) operations.
- Coal seams - either with or without enhanced coalbed methane recovery (ECBM) operations.

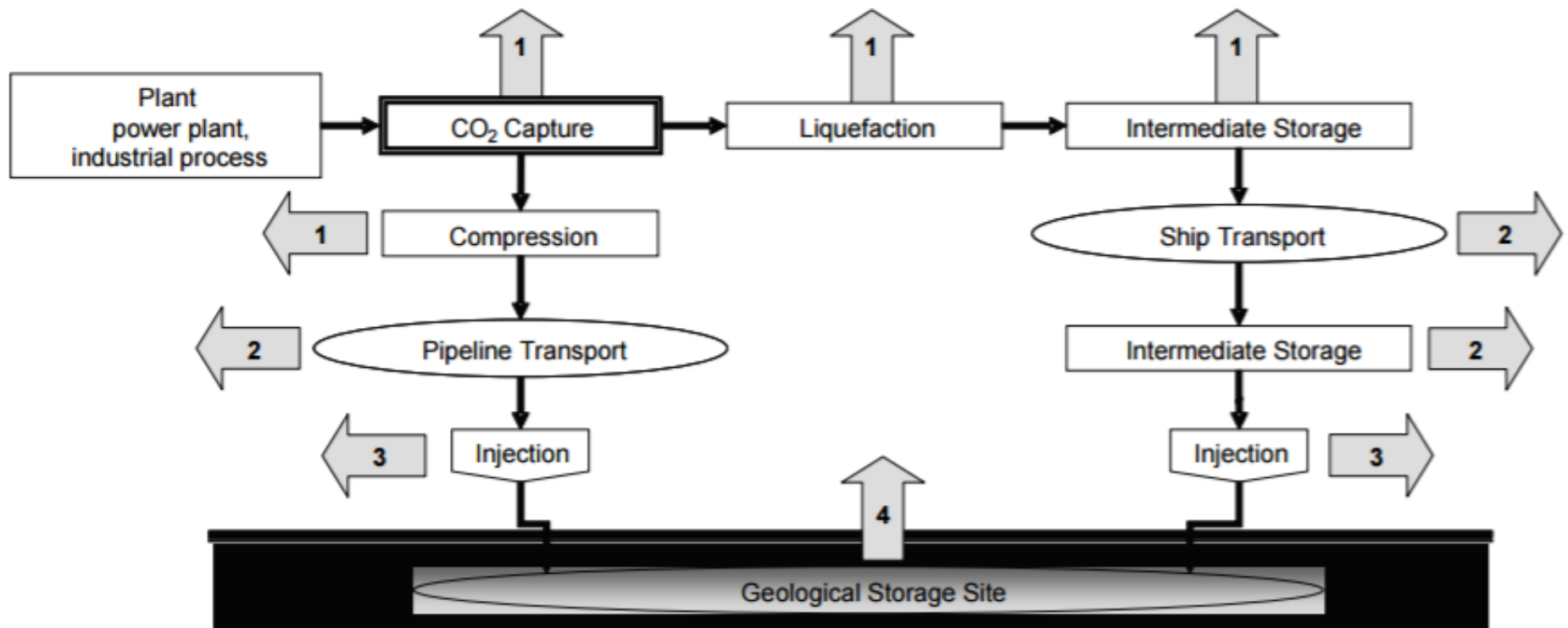
Energy: CCS

Geological Storage



Energy: CCS

CO₂ Geological Storage Schematic



Possible Emissions (emission values linked to Table 5.1)

Energy: CCS

IPCC CCS CO₂ Inventory QA/QC

A		B		C		D		E
Total amount CO₂ capture for storage	+	Total amount CO₂ import for storage	=	Total amount CO₂ export for storage	+	Total amount CO₂ injected at storage sites	+	E4 = Total amount CO₂ leakage

Where: E4 = Total amount of CO₂ leakage = E1 (Leakage during transport) + E2 (leakage during injection) + E3 (leakage from storage sites)

Energy: CCS

Carbon Capture & Storage EF Calcs

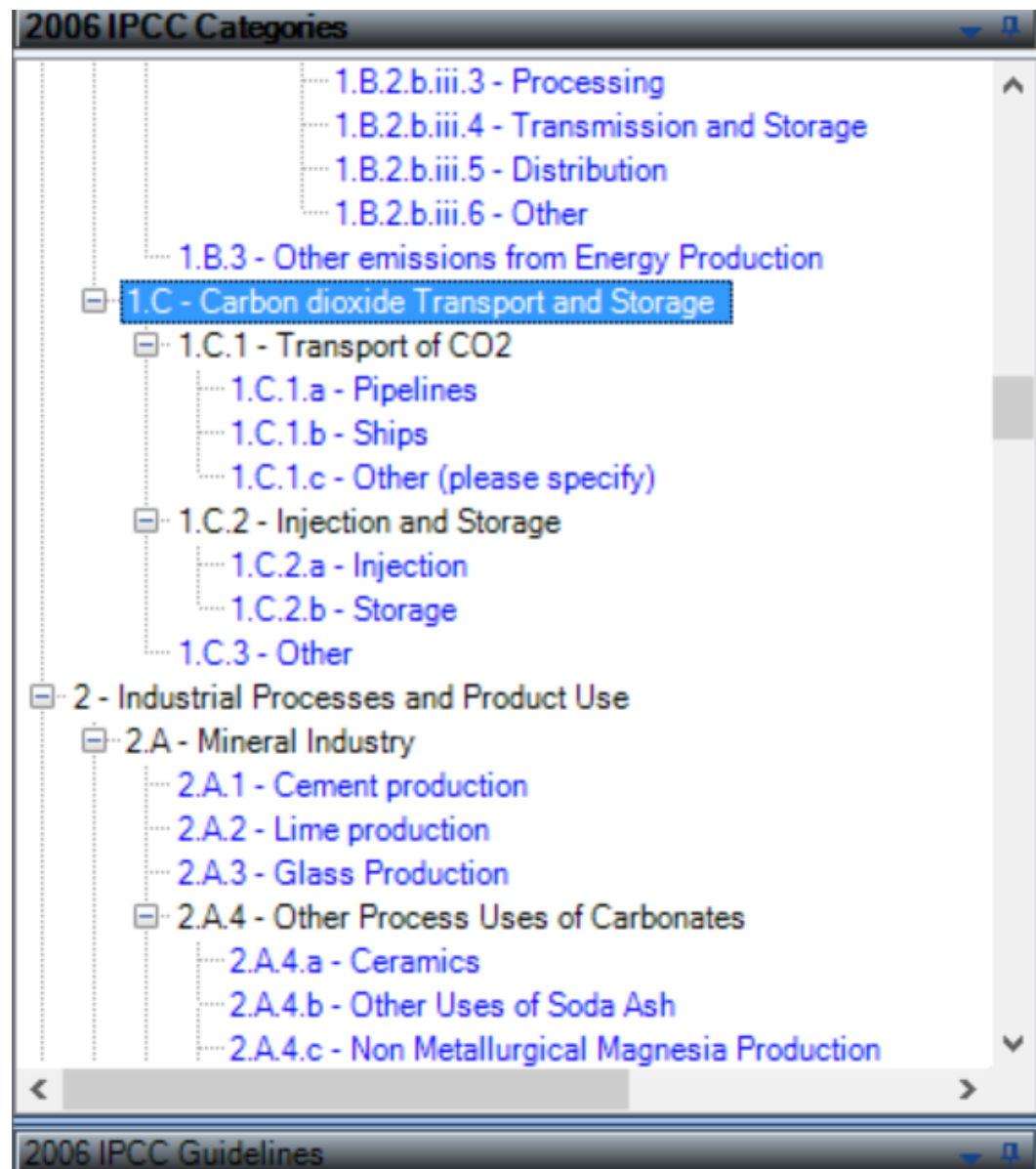
Emission Source	Value			Uncertainty	Units of Measure
	Low	Medium	High		
Fugitive emissions from CO ₂ transportation by pipeline	0.00014	0.0014	0.014	± a factor of 2	Gg per year and per km of transmission pipeline

- Worksheets for fuel combustion activities also cater for CO₂ capture from sub-categories 1A1 (Energy Industries & 1A2 (Manufacturing Industries & Construction



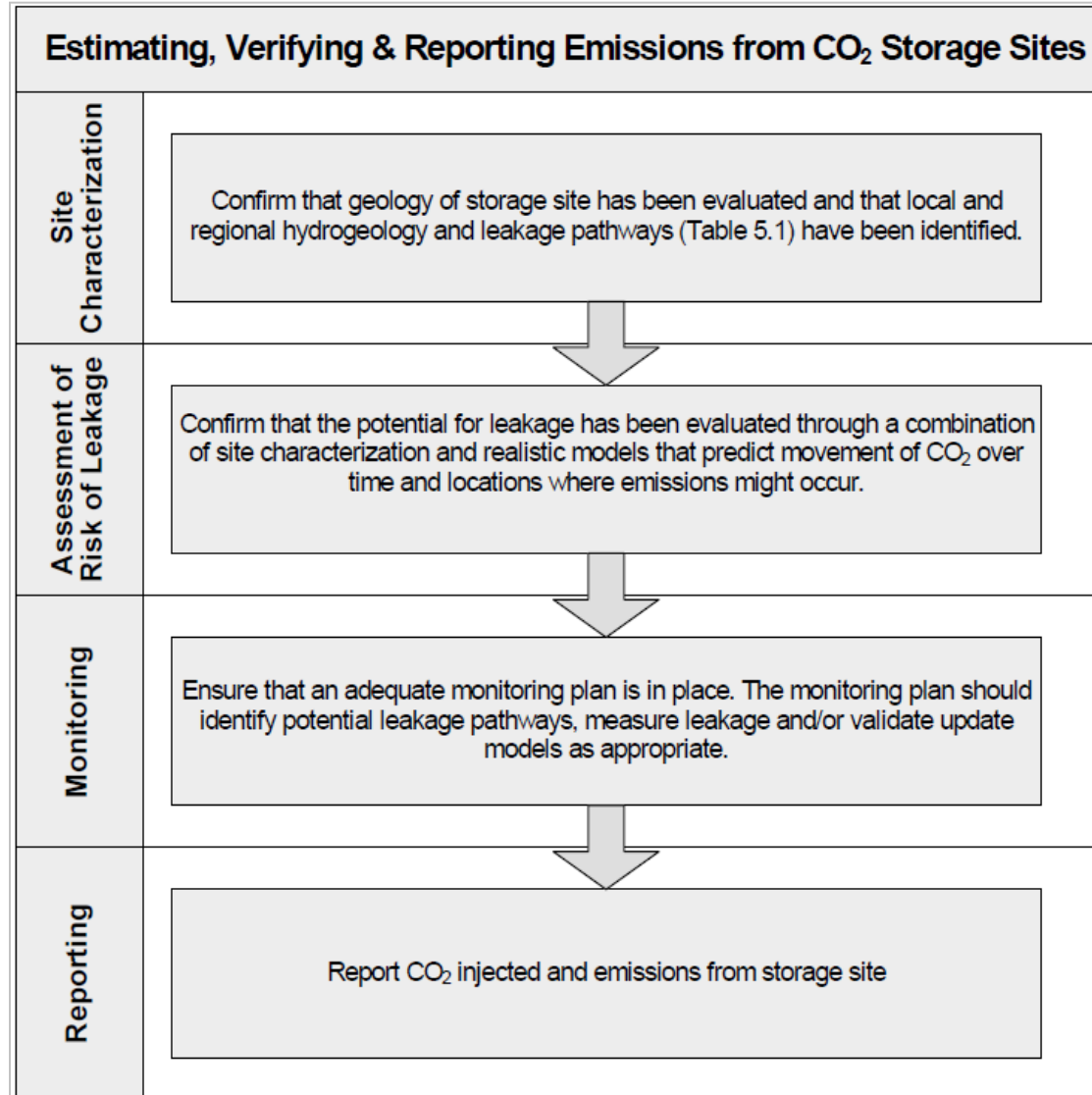
Energy: CCS

IPCC 2006 Software - Calculations



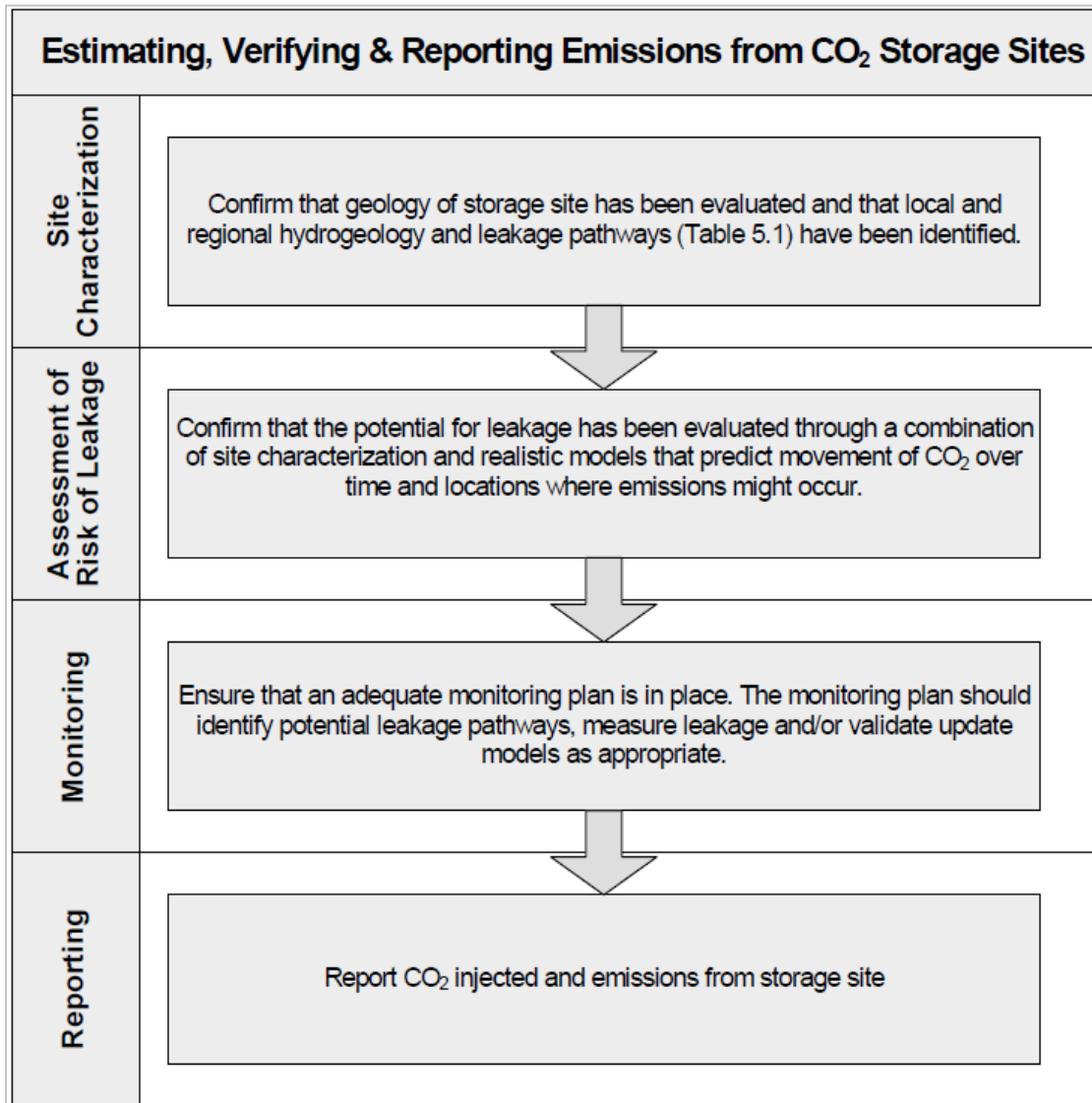
Energy: CCS

Estimating, Verifying, Reporting Emissions



Energy: CCS

Estimating, Verifying, Reporting Emissions



Discussion

- What is EOR?
- How is the majority of carbon dioxide transported for CCS?
- What makes CCS economically/commercially viable today?
- What are the major sources of CO₂ currently being transported and stored?
- What types of places account for almost all carbon dioxide storage?
- What are the major concerns about CCS?
- How are those concerns addressed?

Thank you!

Amr Osama Abdel-Aziz, Assen Gasharov, Mike Bess and Laura Lahti