



CO₂-EOR: Accounting for emissions reductions in international greenhouse inventories

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Overview

- Status of CO₂-EOR worldwide
- National reporting methods for CO₂-EOR (IPCC)
- UNFCCC Parties implementation of CO₂-EOR measurement, reporting and verification (MRV)
- Challenges for CO₂-EOR emissions accounting

Focus is on how countries account for CO₂-EOR in national GHG inventories for UNFCCC/KP purposes

Some *limited consideration* of project based accounting rules

CO₂-EOR is widespread



But limited in scale

Location	Projects	Duration	Tonnes CO ₂ injected/stored*
North America	>100 active CO ₂ floods/80 facilities	Early 1970s to present	~ 50 MtCO ₂ /yr (US) ~ 3 MtCO ₂ /yr (CA)
South America & Caribbean	10's small floods	Mid 1970's (Trinidad) Early 1990's (Brazil)	Trinidad unknown ~1-4 ktCO ₂ /yr (Brazil)
Europe	1-2 small scale tests North Sea plans	-	~ 10's ktCO ₂ /yr (Croatia)
Asia	Several test injections (China, Turkey). Proposals in others (SE Asia)		~10's ktCO ₂ /yr (PRC) ~ 10's tCO ₂ /yr (Turkey)
Australasia	Gippsland (proposed)	-	-
TOTAL	<150		< 80 MtCO₂/yr

* Volumes injected can include recycled CO₂, which can be 50% of the total
Majority of injected CO₂ sourced from natural reservoirs – c.80% in US

GHG accounting and MRV

- Measurement, reporting and verification (MRV) key to recognition of GHG reduction benefits (for any activity)
- MRV principles apply at project, sector, organisation or national-level inventories. Principles include:
 - Transparency
 - Completeness
 - Consistency
 - Comparability
 - Accuracy
 - etc.
- Other factors which are key to MRV, especially when linked to carbon finance/emissions trading, include requirements that GHG reductions are:
 - Real
 - Additional
 - Measurable
 - Permanent
 - etc.

CO₂ EOR in national inventories

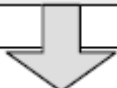


- International MRV rules set out in **IPCC Guidelines for National Greenhouse Gas Inventories** (1996, 2000, 2006). Under IPCC GLs:
 - Inventories established by sector and source categories
 - Captured CO₂ for us in GS or EOR falls across a range of categories for sources, *inter alia*:
 - “Stationary Combustion” – Vol. 2, Section 2.3.4
 - “Fugitive Emissions” – Vol. 2, Chapter 4
 - “CO₂ Transport & Geo-Storage” – Vol.2, Chapter 5
 - “Minerals Industry” – Vol. 3, Section 2
 - “Chemical Industry” – Vol. 3, Section 3
 - “Metal Industry” – Vol. 3, Section 4 etc.
 - CO₂ leaks incorporated into relevant sector or under *CO₂ Transport & Storage* – Vol. 2, Chapter 5.
 - CO₂ breakthrough/vented captured in *Fugitive Emissions* – Vol.2, Chapter 4
- Countries use GLs for National Inventory Reports (NIRs)

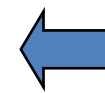


IPCC GLs (2006) - Capture

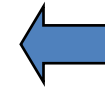
- General rule for sources which capture CO₂
$$Emissions_s = Production_s - Capture_s$$
- Seems fairly obvious, *but....* QA/QC rules require that:
 - CO₂ capture be reported **only when linked to long-term storage (Energy Sector Vol.2) / or suggest that it is *good practice* to do so (IPPU Vol.3)**
- The implications for CO₂-EOR is that:
 - Any anthropogenic sources which capture CO₂ for use in EOR operations may only subtract the captured CO₂ (and be reported as such) where long-term storage is carried out and “MRV-ed” in accordance with IPCC GLs, Vol.2, Chapter 5.
- IPCC GLs: national CCS regs can provide basis for collecting appropriate data (e.g. tCO₂ injected) where they meet GLs
- But in essence, this is a *de facto* rule for regulating CO₂-EOR operations (where reduction credit to be claimed)

IPCC GLs (2006) - Storage

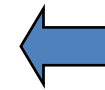
Estimating, Verifying & Reporting Emissions from CO ₂ Storage Sites	
Site Characterization	<p>Confirm that geology of storage site has been evaluated and that local and regional hydrogeology and leakage pathways (Table 5.1) have been identified.</p> 
Assessment of Risk of Leakage	<p>Confirm that the potential for leakage has been evaluated through a combination of site characterization and realistic models that predict movement of CO₂ over time and locations where emissions might occur.</p> 
Monitoring	<p>Ensure that an adequate monitoring plan is in place. The monitoring plan should identify potential leakage pathways, measure leakage and/or validate update models as appropriate.</p> 
Reporting	<p>Report CO₂ injected and emissions from storage site</p>



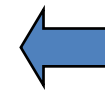
Site characterisation



Risk assessment



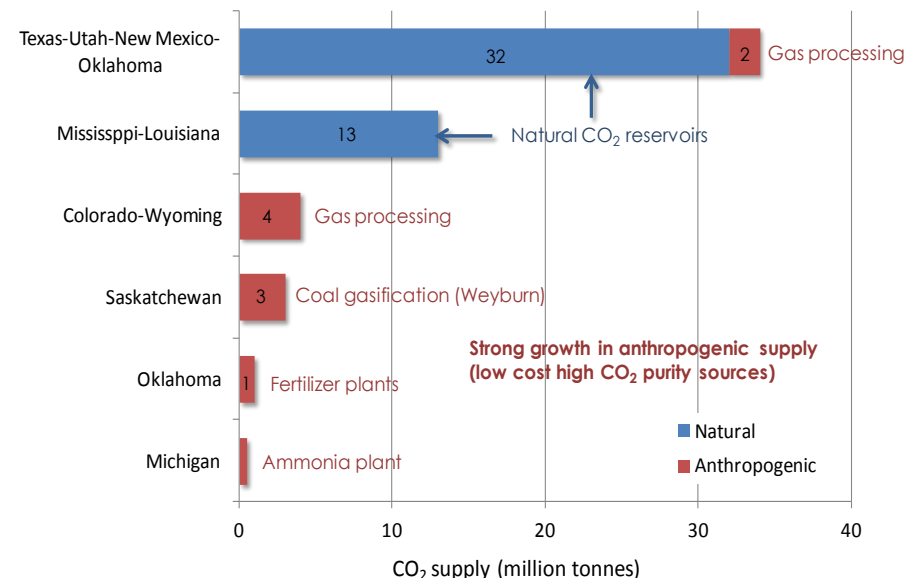
Risk management (monitoring)



Risk management (reporting)

NIRs and CO₂-EOR - USA

- 12 MtCO₂/yr captured from anthrop. sources
 - Reported as *emitted* because site-specific MRV data not available
 - From 2011, GHGRP invites operators to report geological sequestration (GS) to enhance quality of NIR
 - EPA believes that this will meet the requirements of 2006 IPCC GLs standard
 - Tiered approach sets differential obligations, esp. for EOR*; Part UU (EOR) unlikely to meet IPCC standard
 - CO₂ from Dakota Gas Company subtracted from NIR (as exported to Canada)
- 34 MtCO₂/yr mined from natural sources
 - Reported as *sequestered*
 - Basis unclear – GHGRP Part UU may change the approach



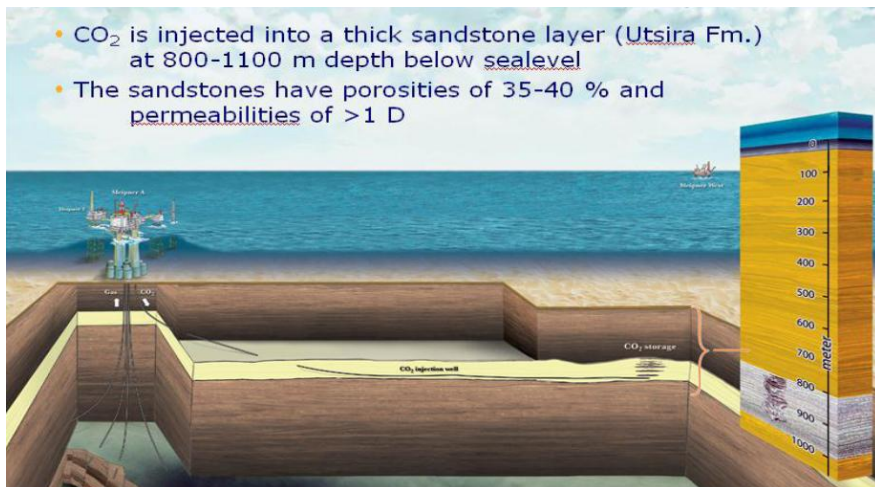
* EOR is assumed not be GS unless operators applies to EPA with MRV plan consistent with GHGRP (apply Part RR as opposed to Part U)

NIRs and CO₂-EOR - Canada

- 2.8 MtCO₂/yr received from Dakota Gasification Company (US)
 - Weyburn: 7 000 t/d (20 Mt since 2000)
 - Midale: 2 000 t/d (2 Mt since 2005)
- NIR 2012 reports that:
 - modelling by PTRC indicates 98% of injected CO₂ will remain trapped in Weyburn reservoir after 5,000 years, and only 0.14% released*
- However, NIR doesn't provide *any* detail on how IPCC accounting rules applied to injected CO₂
- Since US reports the Dakota Gas Co. emissions as exported to Canada (and subtracted from US Inventory), *but* Canada does not provide any info on how emissions at Weyburn/Midale are addressed, enhancement to *transparency* seem warranted



NIRs and CCS - Norway



- **1.1 MtCO₂/yr injected**
 - Sleipner Vest : 600-900 kt/yr (12 Mt since 1996)
 - Hammerfest LNG (Snøhvit): 200-300 kt/y (966 kt since 2008)

- All vented/flare CO₂ at these sites reported under apt source category (1.B.2.c) – injected CO₂ not included and therefore reported as *not emitted*
- Extensive monitoring programmes reported as evidence base for non-emission
- These efforts allow Norway to use CCS to meet KP “QELRO” and potentially *trade* carbon (“AAUs”) under KP Art.17

NIRs and CO₂-EOR/CCS - Others

- Annex I Parties:
 - Croatia mentions future role that CO₂ injection could play in mitigating national GHG emissions, linked to proposed CO₂-EOR projects
- Non-Annex Parties:
 - Algeria
 - No data on “CO₂ decharge” (venting)
 - Limited mention of In Salah “CO₂ stockage” (storage) – no data on amounts injected, despite extensive monitoring efforts by In Salah JIP
 - Brazil, China, Trinidad, Turkey – National Communications make no mention of CO₂ EOR or CO₂ injection in any context
- More generally, for CCS and CO₂-EOR:
 - Poor recording of Fugitive Emissions in many national inventories
 - Large tranches of CO₂ venting not reported in NIRs/Nat Comms of Parties, especially NAI
 - Makes it challenging to:
 - **identify** problem
 - **address** issue and
 - **measure progress** (future)
- Limited incentive to identify and MRV data on venting and injection

MRV challenges – project level

- CO₂-EOR presents challenges for most of the general principles for project MRV:
 - *Real* – does CO₂-EOR lead to a net reduction of emissions? Concerns over leakage from incrementally produced oil
 - *Additional* – do the oil revenues mean the project would happen anyway? What would have happened if CO₂ was not injected?
 - *Measurable* – Can leakage be measured? Can sites be effectively monitored to allow amounts stored to be measured and determined?
 - *Permanent* – Issues of permanence may be addressed through regulatory type approaches as per the CDM modalities and procedures for CCS – extra burdens on operators which they may not be willing to take
- Comprehensive guidance on these matters in relation to CO₂-EOR yet to be established

MRV for CO₂-EOR going forward

National Inventories

- MRV discussions at the centre of negotiations of new treaty/mechanisms in UNFCCC, especially under NAMAs – *Nationally Appropriate Mitigation Actions*
- Issues around the Guidelines, Verification procedure, & frequency of MRV activities. Cancun COP16 agreed:
 - AI Parties – Annual NIRs, using *enhanced* GLs
 - NAI Parties – Biennial NIRs using various GLs:
 - Domestically-supported NAMAs – use *general* UNFCCC GLs
 - Internationally-supported NAMAs – use *international* UNFCCC GLs

Project accounting

- Broad range of issues to be addressed in order to establish acceptable approaches:
 - Baselines, Leakage, Permanence.....



Thank you

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