# BEST PRACTICE FOR TRANSITIONING FROM $CO_2$ EOR TO $CO_2$ STORAGE

CCP

The study identifies key issues and discusses the conditions and changes needed to transition from EOR to CCS for existing and future operations.

PARTICIPANT ORGANIZATIONS

The CCP is a group of major energy companies working together to advance the technologies that will underpin the deployment of industrial-scale $CO_2$ capture and storage. For further information on CCP and its projects, visit www.co2captureproject.org


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## INTRODUCTION

Most of the $CO_2$ injected into the reservoir for Enhanced Oil Recovery (EOR) remains permanently trapped underground. In many instances, $CO_2$ is also recycled as it is a major cost component.

It is this characteristic of EOR operations that makes them potential candidates for CCS project designation. $CO_2$ costs are also offset by revenues generated from the sale of recovered hydrocarbons. Coupling CCS with EOR could provide a critical financial incentive to facilitate development of CCS projects in the near term.

The underground reservoir in an EOR project is pre-determined by location of the existing oil and gas producing formation – i.e., not selected from the beginning for $CO_2$ storage purposes. A separate process will then likely be required to evaluate the reservoir to determine its viability for long-term underground storage of $CO_2$ under CCS rules and regulations. Typically, EOR regulations do not account for what happens to the injected $CO_2$ after EOR activities have ceased.

**Fundamental difference of the $CO_2$ lifecycle between $CO_2$ EOR and CCS projects**

**$CO_2$ EOR** — Captured from a natural or anthropogenic source, transported, injected into the hydrocarbon-bearing formation and recycled through a closed circuit process.

**CCS** — Captured from an anthropogenic source, transported and injected into the depleted hydrocarbon formation for safe and permanent sequestration.

## CONCLUSION

1. The legal and technical provisions for CCS projects to meet the requirements of the issues outlined above are such that an existing $CO_2$ EOR project may have difficulty complying – particularly in relation to site characterization and monitoring requirements.
2. A proponent of a new $CO_2$ EOR project should be in a better position to design and plan for such a project to transition to being CCS-based.
3. It is recommended that specific guidance or regulation be provided setting out the specific requirements on new and existing $CO_2$ EOR projects that may wish to transition to CCS.

## CHALLENGES OF TRANSITIONING

### Site characterization, integrity and monitoring

The appropriateness of a potential $CO_2$ storage site needs to be carefully assessed primarily by three principal requirements:

**CAPACITY** — whether there is sufficient storage volume and whether it can be accessed

**INJECTIVITY** — whether suitable reservoir properties exist for sustained injection of $CO_2$ at economical industrial supply rates

**INTEGRITY** — whether the site is secure with negligible risk of unintended migration or leakage

Given that depleted oil and gas fields are considered some of the best storage site options for CCS, capacity and injectivity are unlikely to be an issue in the transition from $CO_2$ EOR to CCS.

Integrity could be a challenge, given the need to ensure permanent storage of $CO_2$ in order to achieve climate change mitigation aims. Injection wells and abandoned wells have been identified as some of the most probable leakage pathways for $CO_2$ storage projects.

$CO_2$ EOR/CCS projects will need to ensure that appropriately robust monitoring regimes are in place to detect leakage, to account for losses in the projects over all emissions inventory and to ensure that measures are put in place to stop leaks when detected. Maintaining well integrity is important throughout the well's life cycle, from drilling to plugging and abandonment.

Any $CO_2$ EOR project seeking to transition to a CCS project will have to address the long-term monitoring requirements for CCS storage sites.

### Pore space issues likely to arise in $CO_2$ EOR transition to CCS

Address issues regarding the use of the pore space for $CO_2$ storage purposes beyond decommissioning of oil production. It will likely require addressing in the broader context of a clear, legal framework and including engagement with the pore space owner to assess and deal with concerns.

### Post-closure liability and $CO_2$ ownership

This is important in ensuring that effective measures are put in place to maintain the efficacy of the projects.

Aspects which have been considered by government authorities in the context of a liability framework for CCS include:

- Management of leakage and permanence
- Stewardship of the storage site
- Costs and financial provision(s)

### GHG emissions accounting considerations

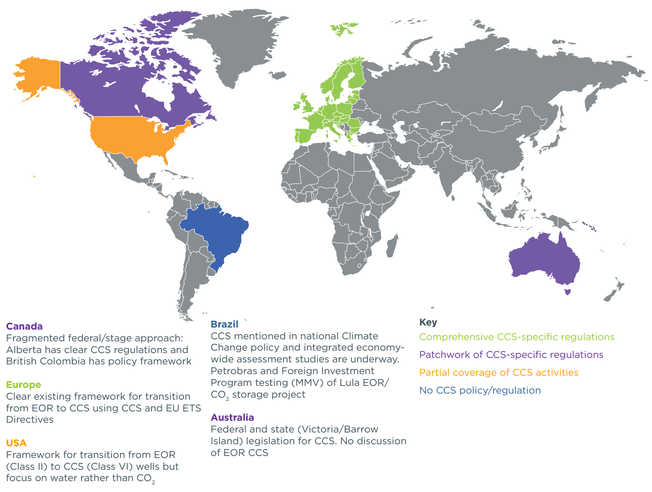
A number of GHG accounting guidelines addressing CCS and specifically, CCS with EOR, have been published in the last several years. Most of these guidelines do address accounting for emissions associated with $CO_2$ EOR, especially in the recycle phase of production, 'break through' of $CO_2$ and $CO_2$ recycle.

## DESK RESEARCH – LEGAL AND REGULATORY REVIEW AND GAPS ANALYSIS

Experience has been gained from over 130 commercial $CO_2$ EOR operations globally. Active $CO_2$ EOR projects exist primarily in the United States and Canada, with further commercial and demonstration projects, operating in Asia, Middle-East and the North Sea. The legal and regulatory review focused on the regimes in the USA, Canada, EU, Australia and Brazil.

| Type of Regulation | USA | Canada | | | European Union | Australia | Brazil |
|---|---|---|---|---|---|---|---|
| | | Alberta | Saskatchewan | British Columbia | | | |
| EOR | | | | | | | |
| Transition | | | | | | | |
| CCS | | | | | | | |

No information available
Regulations/guidance in development
Policy discussions underway
Regulations/process in place



**Canada**
Fragmented federal/stage approach: Alberta has clear CCS regulations and British Colombia has policy framework

**Europe**
Clear existing framework for transition from EOR to CCS using CCS and EU ETS Directives

**USA**
Framework for transition from EOR (Class II) to CCS (Class VI) wells but focus on water rather than $CO_2$

**Brazil**
CCS mentioned in national Climate Change policy and integrated economy-wide assessment studies are underway. Petrobras and Foreign Investment Program testing (MMV) of Lula EOR/$CO_2$ storage project

**Australia**
Federal and state (Victoria/Barrow Island) legislation for CCS. No discussion of EOR CCS

**Key**
Comprehensive CCS-specific regulations
Patchwork of CCS-specific regulations
Partial coverage of CCS activities
No CCS policy/regulation

## - KEY FINDINGS

**The analysis conducted and the information compiled in this research support the 2013 CSLF finding that:**

*"There are no specific technological barriers or challenges per se in transitioning and converting a pure $CO_2$ EOR operation into a $CO_2$ storage operation. The main differences between the two types of operations stem from legal, regulatory and economic differences between the two."*

**There is a clear regulatory framework for $CO_2$ EOR in most regions but there are insufficient provisions that would allow a $CO_2$ EOR operator to follow a clear transition pathway for legal and regulatory approval of a CCS project.**