Carbon Life Cycle Analysis of CO2-EOR for Net Carbon Negative Oil (NCNO) Classification

DE-FE0024433

Vanessa Nuñez-Lopez
Bureau of Economic Geology
The University of Texas

U.S. Department of Energy
National Energy Technology Laboratory
DE-FOA0001110 Kickoff Meeting
December 4, 2014

Presentation Outline

- Benefit to the Program
- Goals and Objectives
- Methodology
- Expected Outcomes
- Organization Chart
- Communication Plan
- Task/Subtask Breakdown
- Milestones, Success Criteria and Decision Points
- Risks
- Proposed Schedule

Benefit to the Program

Program goals being addressed.

(4) Develop Best Practice Manuals for monitoring, verification, accounting (MVA), and assessment; site screening, selection, and initial characterization; public outreach; well management activities; and risk analysis and simulation.

In support of:

(1) Develop and validate technologies to ensure 99 percent storage permanence.

Project benefits statement.

The project will conduct research under Quantifying the Carbon Balance of CO_2-EOR Operations and Identifying “Net Carbon Negative Oil”, via development of a reliable, clear, repeatable and universal CO2-EOR mass accounting methodology. The overall impact of this study will be the economic influence that a project classified as Net Carbon Negative Oil (NCNO*) would have on a CO2-EOR operation, if future laws and regulations provide value to the emissions and/or storage of CO_2.

*NCNO is defined in the FOA as oil whose carbon emission to the atmosphere, when burned or otherwise used, is less than the amount of carbon permanently stored in the reservoir in order to produce the oil

Project Overview:
Goals and Objectives

- Identify and frame critical carbon balance components for the accurate mass accounting of a CO_2-EOR operation.
- Develop strategies that are conducive to achieving a NCNO classification.
- Develop a comprehensive, yet commercially applicable, monitoring, verification, and accounting (MVA) methodology.

Methodology

- Selected field setting: (Cranfield, Mississippi)
  - It provides the optimal mass accounting data set as it was required by its comprehensive SECARB MVA program
  - It is a desirable direct injection (no WAG), which is favorable for achieving NCNO
  - Pattern geometry and operations repeated systematically around field development
  - Provides a simpler environment than many CO2-EOR floods

Methodology

- Cranfield mass accounting, surface facility, and energy consumption data will be gathered from public sources, categorized, and stored in a database.
- Utilize Cranfield pattern calibrated models to:
  - Run numerical simulations for different novel and standard CO_2 injection scenarios (WAG, direct CO2 injection)
  - Understand the relationships between CO_2 utilization ratios, CO_2 recycling rates, methane reinjection, oil production, and the energy consumption of identified components within the framework of the project.
  - Understand the carbon balance evolution from start of injection to completion.

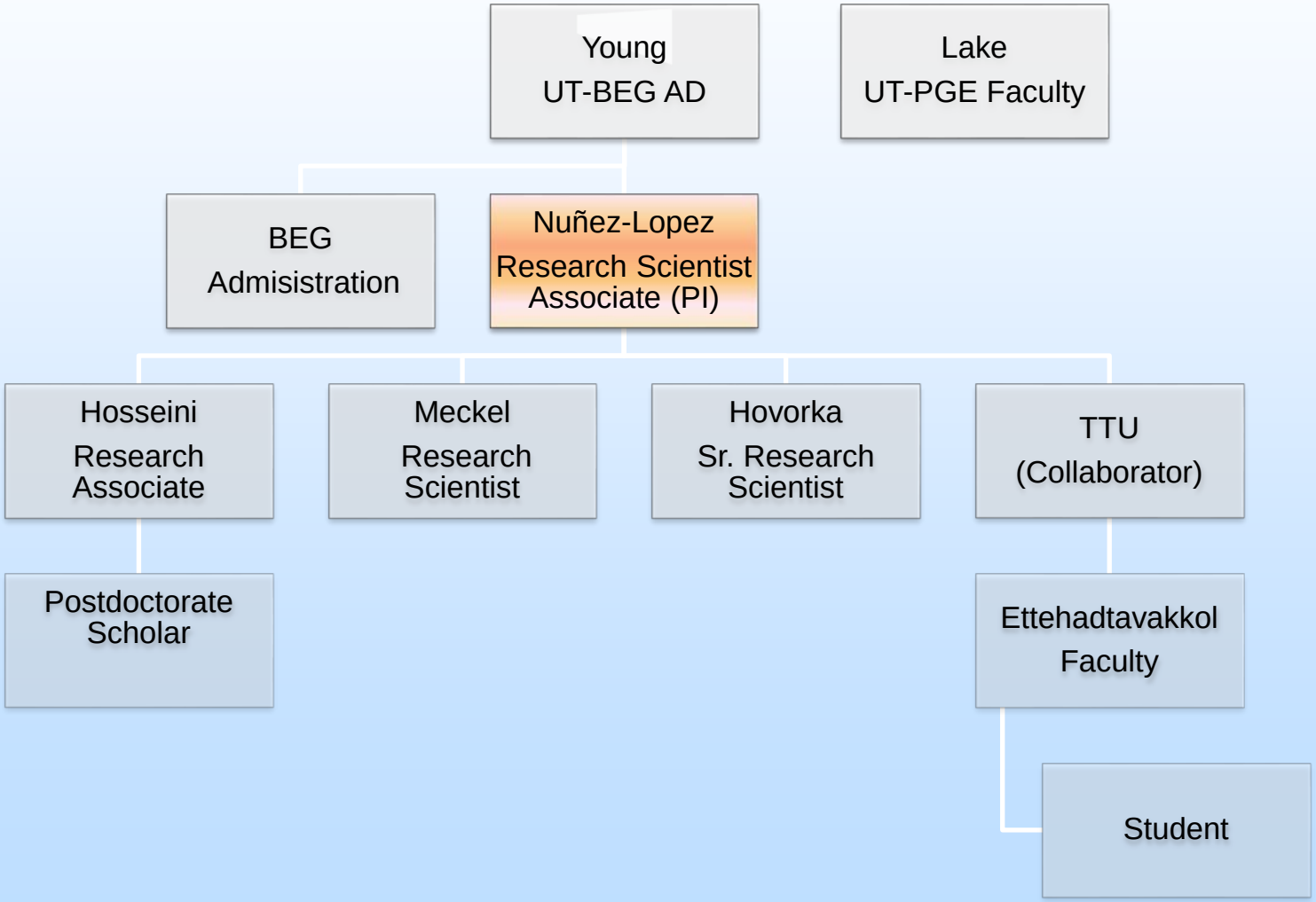
Methodology

- Use predictive flow and pressure elevation results to develop a generic but comprehensive MVA plan that is based on:
  - existing regulatory monitoring requirements
  - existing best practices
  - a number of proposed and suggested processes that are currently being considered for possible future regulatory or credit trading conditions
- Integrate results to develop a universal methodology for estimating the carbon balance of a CO_2-EOR operation for making the determination of whether the operation can be classified as Net Carbon Negative Oil (NCNO)

Expected Outcomes

- A comprehensive carbon life cycle analysis of a CO_2-EOR operation with an accurate mass accounting methodology for determining whether the operation can be classified as NCNO.
- A recommendation of CO_2 surface operation and injection strategies that are conducive to achieving a NCNO classification.
- A universal MVA methodology encompassing the entire CO_2-EOR operation and inclusive of pre CO_2 injection, injection, and stabilization periods.

Organization Chart



Communication Plan

Communication and decision making will occur in the context of weekly meetings. Quarterly meetings will be scheduled to discuss progress toward deliverables, milestones and decision points. Scientific decisions will be made by Nuñez Lopez in consultation with the project team, and administrative decisions will be made by Young as part of his Associate Director responsibilities. Communication to external stakeholders will occur via reporting, email and phone conversations as needed with the Project Manager. Other external communication strategies are indicated in the Technology Transfer Plan.

Task/Subtask Breakdown

- **Task 1.0 – Project Management and Planning**
  - Subtask 1.1: Revision and Maintenance of Project Management Plan
  - Subtask 1.2: Management and Reporting
- **Task 2.0 – Project Framework and Data Gathering**
  - Boundary definition and identification of critical components of the CO_2-EOR System, including CO_2 emitting downstream processes.
  - Relevant data will be gathered, categorized, and stored in a database

Task/Subtask Breakdown

- **Task 3.0 – Reservoir Mass Accounting Methodology**
  - Development of a widely applicable and repeatable methodology for reservoir injection-withdrawal mass accounting, which will be built on extensive previous BEG work at Cranfield developed under the RCSP program (SECARB).

  Deliverable 3.1: A detailed mass accounting methodology as a subset for determining whether the operation can be classified as NCNO.

- **Task 4.0 – Static and Dynamic Modeling**
  - Static and dynamic models will be developed for the evaluation of different operational scenarios that study the impact of variable CO_2 utilization ratios on operational aspects affecting the overall carbon balance of the EOR operation

Task/Subtask Breakdown

- **Subtask 4.1 Static model**
  - BEG will create a small volume reservoir model which will be used by our collaborators from Texas Tech University (TTU) as an input into their dynamic reservoir simulations.
- **Subtask 4.2 EOR-storage performance model development**
  - TTU will develop an EOR-storage performance software by adapting existing proposed models CO_2 emissions assessment from the EOR-storage operation
  - Cranfield pattern calibrated models and run several novel and standard injection scenarios (direct CO2 injection, WAG) that will capture the behavior of the different patterns as they mature into the different stages of operation

Deliverable 4.1: A recommendation of CO_2 surface operation and injection strategies that are conducive to achieving a NCNO classification.

Task/Subtask Breakdown

- **Task 5.0 Monitoring, Verification and Accounting (MVA) methodology**
  - The BEG team will apply its extensive experience and learnings from its DOE-NETL funded MVA commercial projects to develop a comprehensive, yet commercially applicable, monitoring, verification, and accounting (MVA) methodology, which will not only cover pre and during CO_2 injection periods, but also a critical 3-year stabilization period.

Deliverable 5.1: A comprehensive carbon balance analysis of a CO_2-EOR operation with an accurate mass accounting methodology for determining whether the operation can be classified as NCNO

Milestone Log

Budget Period	Task/ Subtask	Milestone Title	Planned Completion	Verification Method
1	1.0	Updated Project Management Plan	12/16/14	Project Management Plan file
1	1.0	Kickoff Meeting	12/04/14	Presentation file
2	3.1	Reservoir Mass Accounting Methodology	9/30/2016	Presentation file and milestone report on DVD submitted.
3	4.2	Performance Model for CO2-EOR Storage System	6/30/2017	Presentation file and milestone report on DVD submitted.
3	5.0	MVA Methodology	12/31/2017	Presentation file and milestone report on DVD submitted.

Success Criteria and Decision Points

Task/Subtask	Decision Point Description	Date	Success Criteria
1	Decision regarding revision of PMP	1/31/2015	New PMP submitted if necessary
2	Framework of EOR systems components delineated	12/31/2015	EOR framework identified and peer reviewed
3	Reservoir mass accounting methodology development	9/30/2016	EOR carbon accounting methodology developed and peer reviewed
4.2	Carbon performance model development	6/30/2017	Carbon performance model developed and peer reviewed
5	MVA methodology development	12/31/2017	MVA methodology developed and peer reviewed

Risks

- Tasks for this project will be carried out on BEG computers using existing software (the same applies to tasks carried out by TTU). Therefore, perceived technical risks related to computing resources should be minimal. List mitigation strategies for each risk.
- The BEG does not anticipate any risks associated with data availability.
- The Gulf Coast Carbon Center, a CCS research unit within the BEG, employs more than a dozen researchers with ample experience in CCS, who will be able to take over any position in the sudden absence of critical project staff.

Proposed Schedule

		BUDGET PERIOD 1				BUDGET PERIOD 2				BUDGET PERIOD 3				
		Year 2:FY 2015				Year 3: FY 2016				Year 3: FY 2017				TOTAL
		qtr4	qtr1	qtr2	qtr3	qtr4	qtr1	qtr2	qtr3	qtr4	qtr1	qtr2	qtr3	
Task	Tasks													
	Carbon Life Cycle Analysis of CO_2-EOR for Net Carbon Negative Oil (NCNO) Classification													
1	Project Management, Planning, and Reporting	$ 18,814	$ 8,780	$ 8,780	$ 8,780	$ 8,780	$ 8,780	$ 8,780	$ 8,780	$ 8,780	$ 8,780	$ 8,780	$ 18,814	$ 125,427
1.1	Revision and Maintenance of Project Management Plan	D 1.1												
1.2	Management and Reporting	Q	Q	Q	Q	Q A	Q	Q	Q	Q A	Q	Q	Q F	
2	Project Framework and Data Gathering	$41,809.00	$ 33,447	$ 33,447	$ 33,447	$ 25,085								$ 167,236
3	Reservoir Mass Accounting Methodology		$ 34,842	$ 34,842	$ 34,842	$ 34,842	$ 34,842	$ 34,842						$ 209,045
								D 3.1						
4	Static and Dynamic Modeling			$ 26,131	$ 26,131	$ 26,131	$ 26,131	$ 26,131	$ 26,131	$ 26,131	$ 26,131			$ 209,045
4.1	Static Model													
4.2	EOR-storage performance model development										D 4.2			
5	Monitoring, Verification, and Accounting (MVA) methodology							$ 20,905	$ 20,905	$ 20,905	$ 20,905	$ 20,905	$ 20,905	$ 125,427
													D 5.0	
Q = Quarterly Report; A = Annual Report; F = Final Report														
D = Deliverable		$ 60,623	$ 77,069	$ 103,199	$ 103,200	$ 94,838	$ 69,752	$ 90,657	$ 55,816	$ 55,816	$ 55,816	$ 29,685	$ 39,719	**$ 836,180**