Carbon Life Cycle Analysis of CO_2-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
Carbon Storage R&D Project Review Meeting
Transforming Technology through Integration and Collaboration
August 18-20, 2015

Presentation Outline

- Benefit to the program
- Project overview
  - Goals and objectives
  - Methodology
- Accomplishments to date
- Expected Outcomes
- Summary

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.

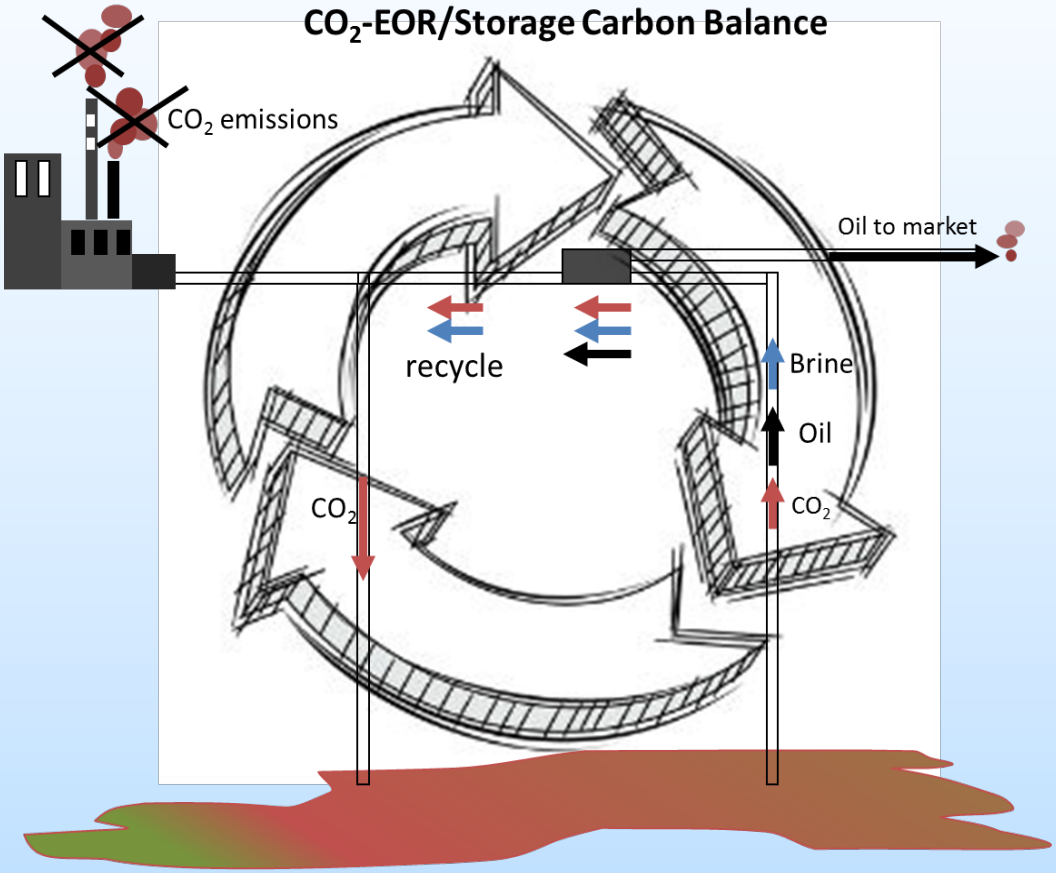
*NCNO is defined in the FOA as oil whose carbon emission to the atmosphere, when burned or otherwise used, is less than the amount of carbon permanently stored in the reservoir in order to produce the oil

Project Overview:
Goals and Objectives

Goal: To develop a clear, universal, repeatable methodology for making the determination of whether a CO_2-EOR operation can be classified as Net carbon Negative Oil (NCNO)

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: Select 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 CO_2-EOR floods

Methodology: Numerical Simulation

- Utilize Cranfield pattern calibrated models to:
  - Run numerical simulations for different novel and standard CO_2 injection scenarios (WAG, direct CO2 injection)
  - Evaluate how the variability of CO_2 utilization ratios for the different injection scenarios affects the identified system components and how EOR and saline storage can be co-managed as CCS matures.
  - Understand the carbon balance evolution from start of injection to completion.

Methodology: Develop MVA Plan

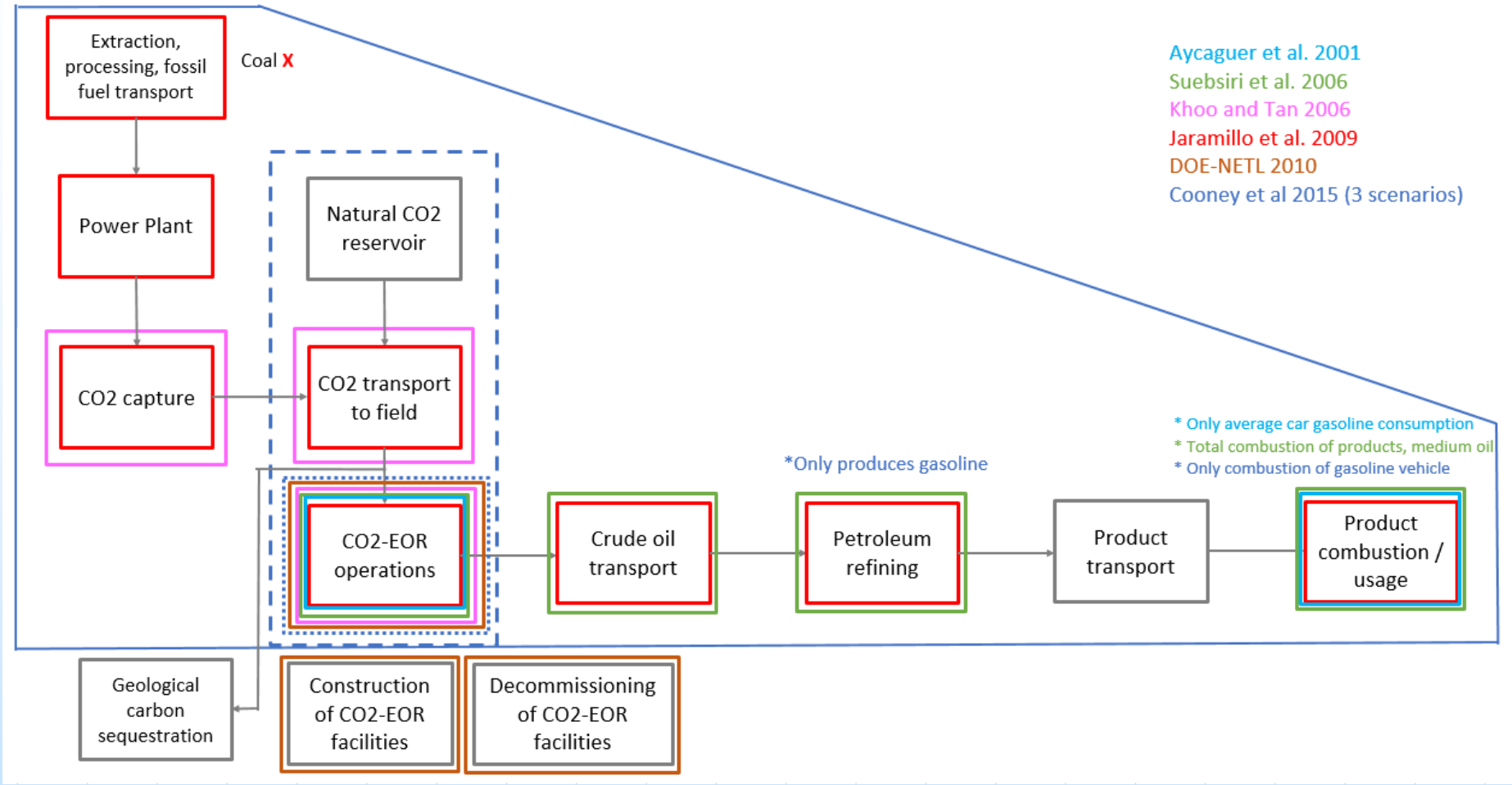
- Use predictive flow and pressure elevation results to develop a generic but comprehensive MVA plan that is based on:
  - existing regulatory monitoring requirements
  - existing best practices
  - a number of proposed and suggested processes that are currently being considered for possible future regulatory 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)

Methodology: Develop MVA Plan

- 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)

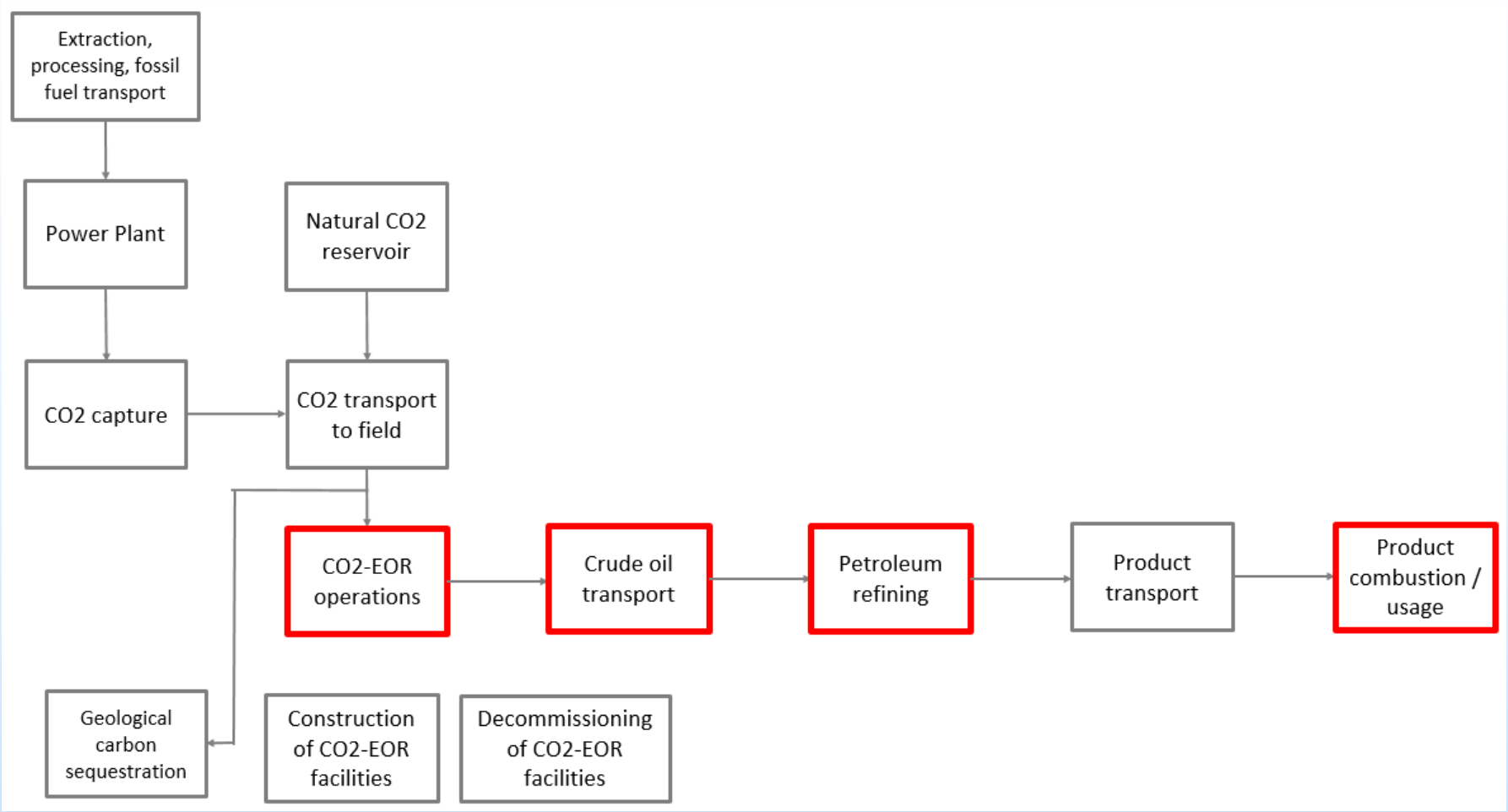
Accomplishments to Date

System boundaries of previous studies



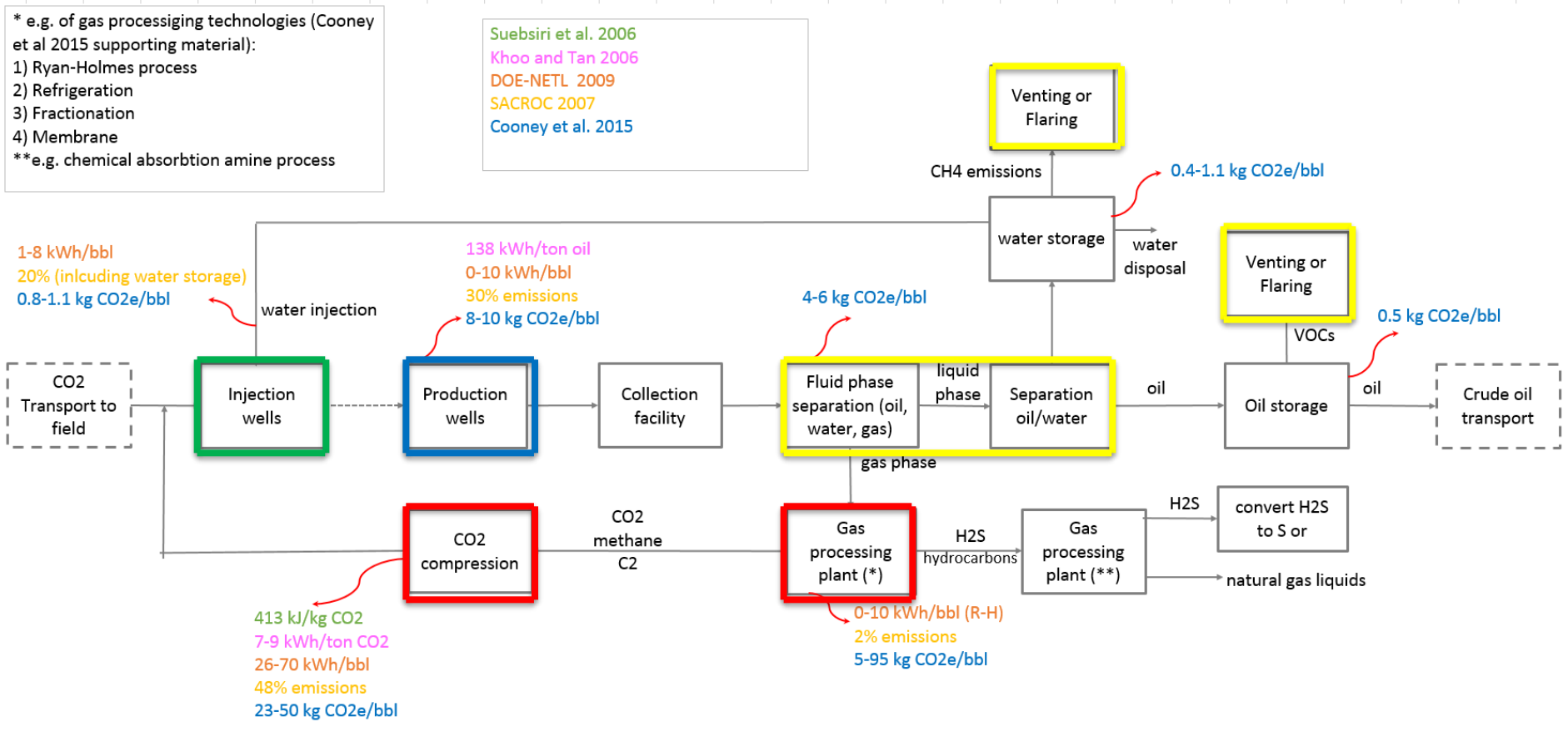
Accomplishments to Date

Selection of system boundaries for NCNO classification



Accomplishments to Date

Identification of critical CO_2 emission components within the EOR site



Fluid injection | Fluid production | Liquid processing | Gas processing plant

Expected Outcomes

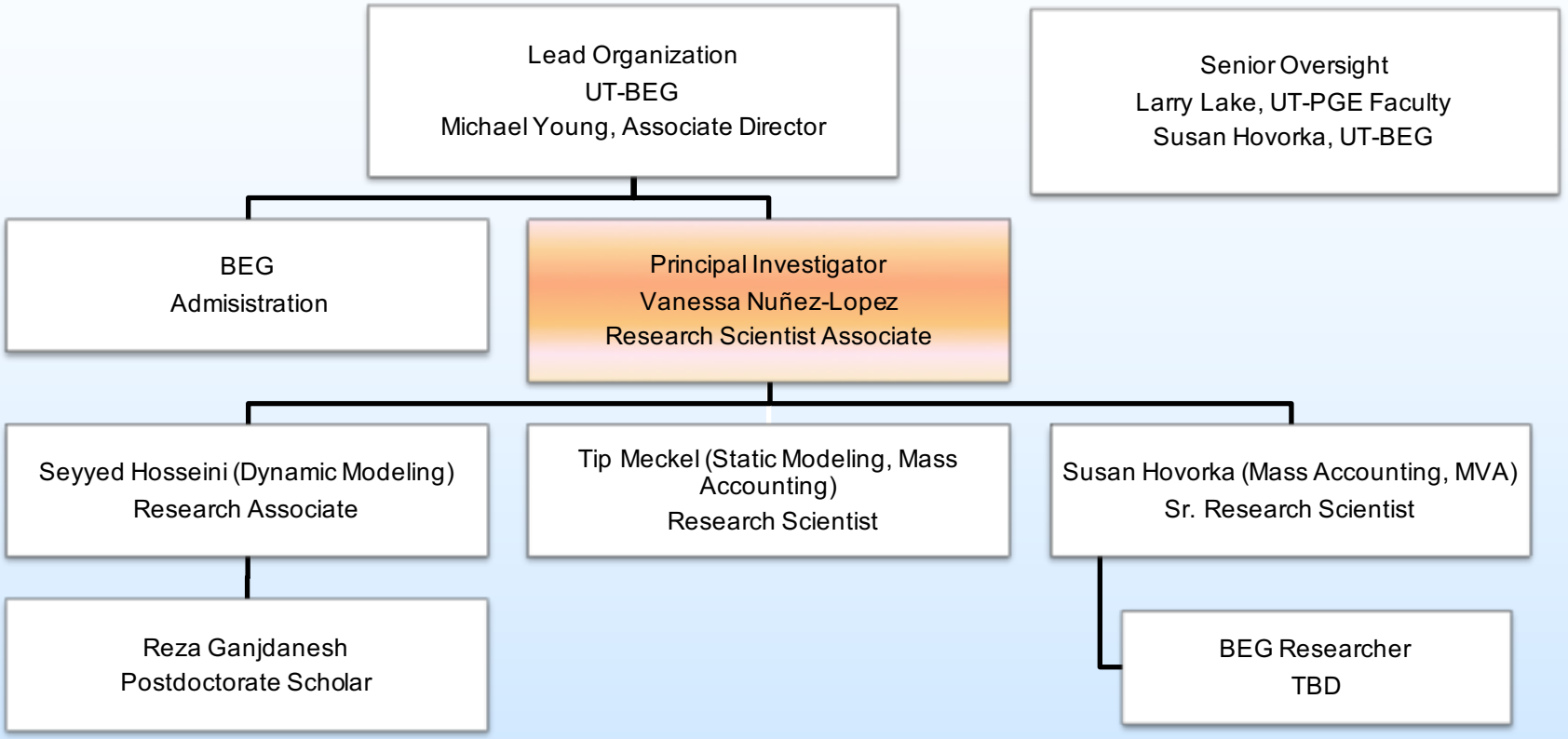
- A comprehensive carbon balance analysis of a CO_2-EOR operation with an accurate mass accounting methodology for determining whether the operation can be classified as NCNO.
- A recommendation of CO_2 surface operation and injection strategies that are conducive to achieving a NCNO classification.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

Summary

- Accomplishments:
  - ✓ Selection of system boundaries for NCNO classification
  - ✓ Identification of critical CO_2 emission components within the EOR site
- Lessons Learned: To come
- Future Plans:
  - Build a model for energy consumption of the CO_2-EOR operation
  - Start numerical reservoir simulations
  - Couple results from numerical simulations with energy consumption model

Appendix

Organization Chart



Gantt Chart

		BUDGET PERIOD 1				BUDGET PERIOD 2				BUDGET PERIOD 3			
		Year 1:FY 2015				Year 2: FY 2016				Year 3: FY 2017			
		qtr1	qtr2	qtr3	qtr4	qtr1	qtr2	qtr3	qtr4	qtr1	qtr2	qtr3	qtr4
Task	Tasks												
	Carbon Life Cycle Analysis of CO_2-EOR for Net Carbon Negative Oil (NCNO) Classification												
1	Project Management, Planning, and Reporting												
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												
3	Reservoir Mass Accounting Methodology												
			I, 2					D, 3.1					
4	Static and Dynamic Modeling												
4.1	Static Model												
4.2	EOR-storage performance model development										D, 4.2		
5	Monitoring, Verification, and Accounting (MVA) methodology												
													D, 5.0
Q = Quarterly Report; A = Annual Report; F = Final Report													
D = Deliverable													

Bibliography

None yet