Southeast Regional Carbon Storage Partnership Offshore Gulf of Mexico

DE-FOA-0001734

Presented by:

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U.S. Department of Energy

National Energy Technology Laboratory

Mastering the Subsurface Through Technology Innovation, Partnerships and Collaboration:
Carbon Storage and Oil and Natural Gas Technologies Review Meeting

August 13-16, 2018

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Offshore Gulf of Mexico

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Presentation Outline

- Goals and Objectives
- Project Area for Assessment
- Technical Status/Project Plan
  - Note: this effort has just begun
- Project-Specific Appendices

Program Goal

- Expands membership of the Southern States Energy Board's (SSEB) existing Gulf of Mexico (GOM) government-industry partnership to focus on assembling the knowledge base required for secure, long-term, large-scale CO_2 subsea storage, with or without enhanced hydrocarbon recovery.
- Supports DOE's long-term objective to ensure a comprehensive assessment of the potential to implement offshore CO_2 subsea storage in all of the U.S. Department of Interior's Bureau of Ocean Energy Management (BOEM) Outer Continental Shelf (OCS) Oil and Gas Leasing Program Planning areas in the GOM.

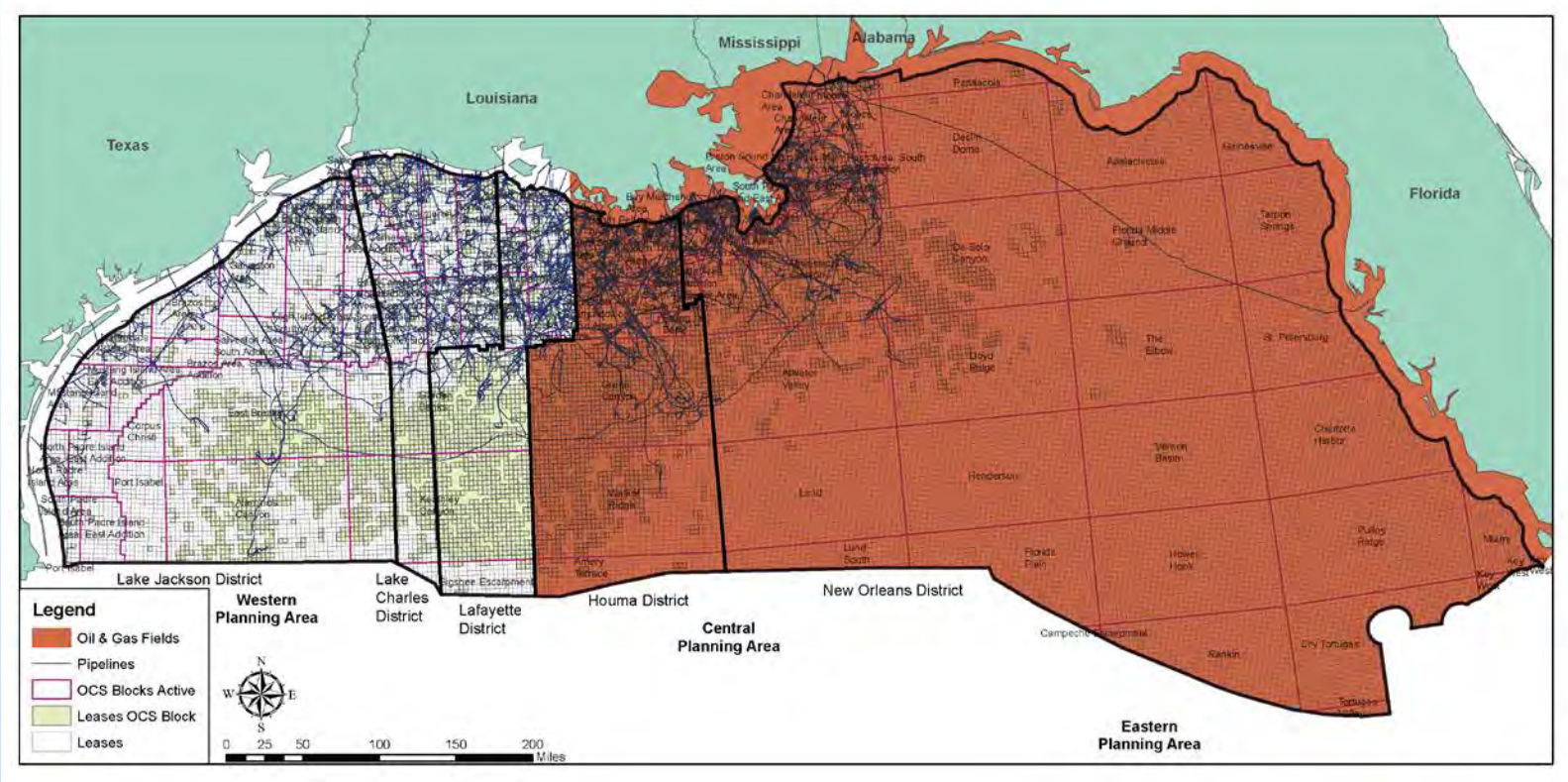
Project Objectives

- **Objective 1**: Combine the capabilities and experience of industry, academia, and government to develop and validate key technologies and best practices to ensure safe, long-term, economically-viable CO_2 storage in offshore environments, which includes collaborating and coordinating with international organizations.
- **Objective 2**: Facilitate the subsequent development of technology-focused permitting processes needed by industry and regulators (i.e., Department of Interior and BOEM).
- **Objective 3**: Collaborate with Federal and State agency programs to improve the confidence in containment of CO_2 in the subsea offshore environment in storage reservoirs over both short and long timeframes.
- **Objective 4**: Provide a comprehensive assessment of the potential to implement offshore CO_2 storage in the defined GOM Study Area.

SECARB Offshore Study Area & Project Boundaries

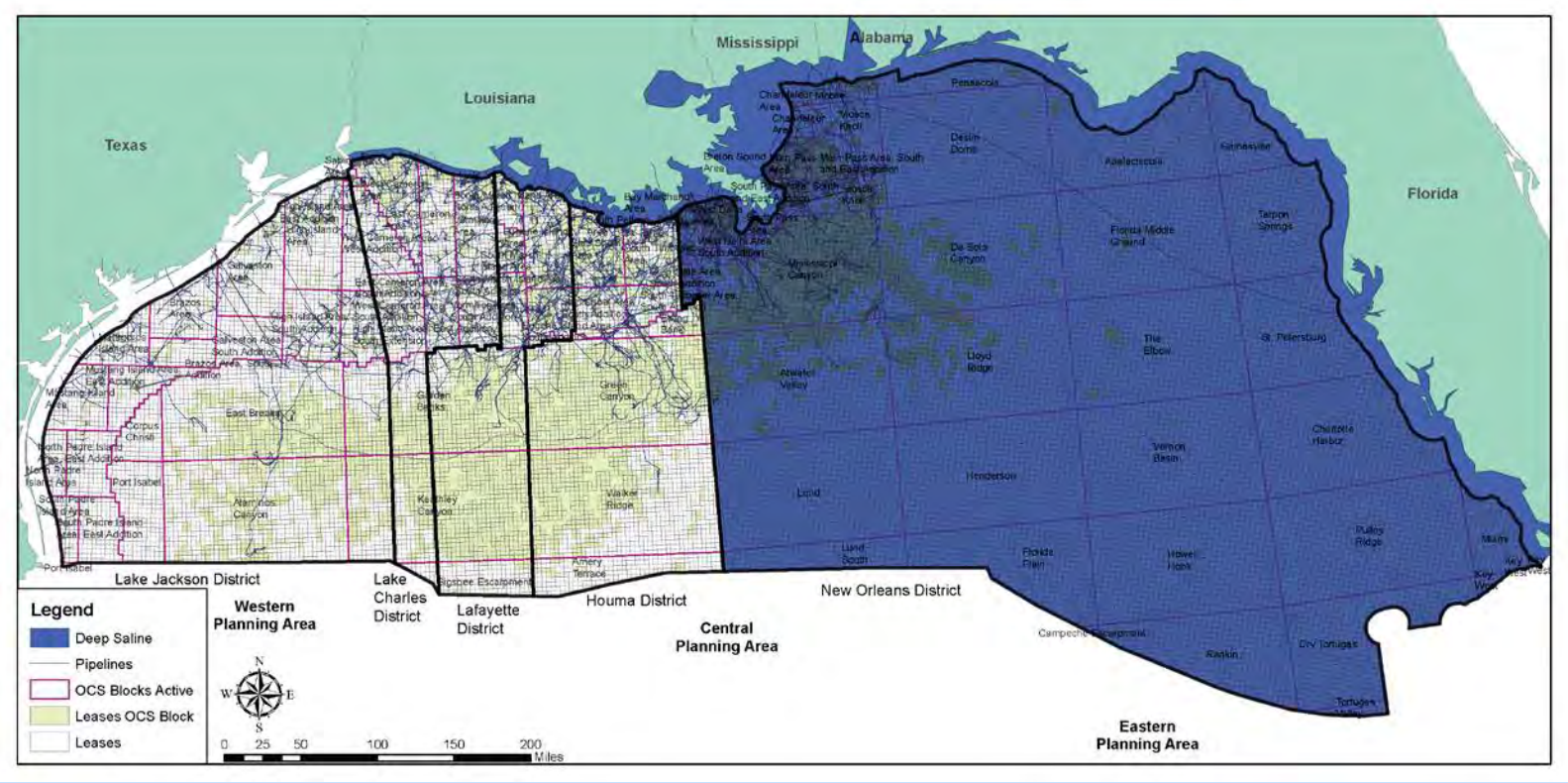
FEDERAL WATERS		
	Depleted Oil & Gas Fields, and Potentially Associated CO_2-EOR	**Deep Saline**
Western Planning Area	No	No
Central Planning Area	Study Area is East of Houma District's Western Boundary (includes Houma District)	Study Area is East of New Orleans District's Western Boundary (excludes Houma District)
Eastern Planning Area	All	All
STATE WATERS		
	Depleted Oil & Gas Fields, and Potentially Associated CO_2-EOR	**Deep Saline**
Texas	No	No
Louisiana	Partial, Includes State Waters East of Houma District Boundary Extension	Partial, Excludes Chandeleur Sound/Islands
Mississippi	Yes	Yes
Alabama	Yes	Yes
Florida (West Coast)	Yes	Yes

Study Area | Oil and Gas



The western boundary of the Study Area for active and depleted oil and gas fields directly correlates with the western boundary of the Houma District and its extension into the Louisiana state waters including all GOM Federal and State waters eastward of this boundary (Figure 1).

Study Area | Deep Saline



The western boundary of the Study Area for the deep saline storage resource assessment in Federal waters (Figure 2) is the western boundary of the New Orleans District. The deep saline evaluation in state waters includes all of Louisiana (excluding Chandeleur Sound/Islands), Mississippi, Alabama, and West Florida.

Primary Tasks

- T1: Project Management & Planning (standard for all contracts – not discussed here)
- T2: Knowledge Dissemination
- T3: Offshore Storage Resource Characterization
- T4: Risk Assessment, Simulation, and Modeling
- T5: Monitoring, Verification, and Accounting
- T6: Infrastructure, Operations, and Permitting

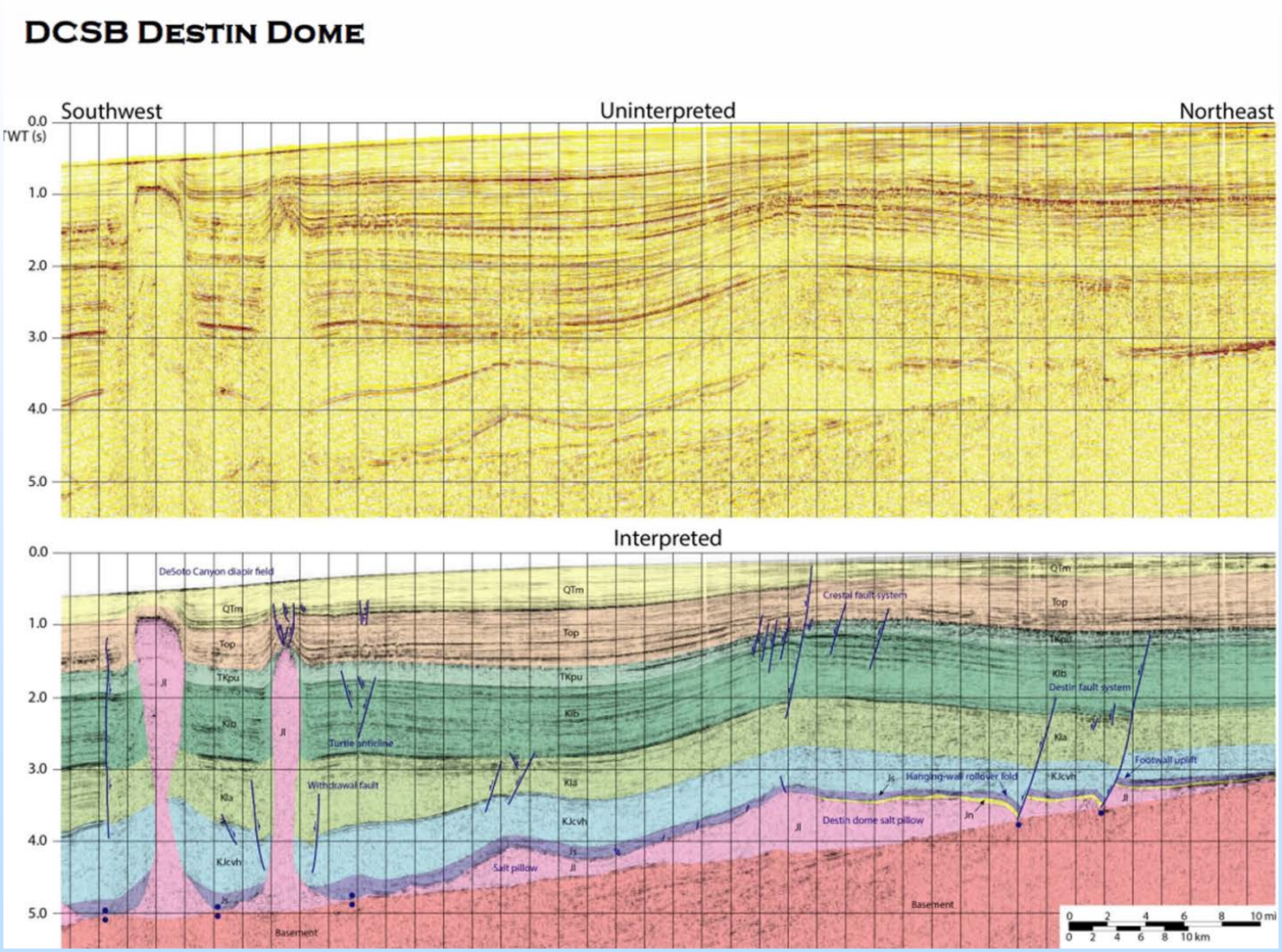
Task 2: Knowledge Dissemination

- **Objective: Raise awareness subsea geologic CO_2 storage in the GOM; provide stakeholders with information applicable to the region.**
- **Task 2.1: Outreach, Education, and Knowledge Sharing**
  - Educate, share, communicate research results through multiple venues to the SSEB board and members, industry, and other stakeholders.
- **Task 2.2: Capacity Building**
  - Advisory and Capacity Building Committee will be established, to participate in Team Meetings and assist in knowledge dissemination.
  - Involves providing information on: current knowledge on storage potential; characterization of potential "representative " opportunities for CO_2 storage; infrastructure requirements necessary to deliver CO_2 to these opportunities; and applicable MVA best practices.
- **Task 2.3: Government-Industry Partnership**
  - Expand membership of existing SSEB government-industry partnership/stakeholders group.

Task 3: Offshore Storage Resource Characterization

- **Objective: Assemble, review, analyze, integrate, assess existing available information on storage resource potential in the GOM.**
- **Task 3.1: Assemble Data and Review Existing Information**
  - Data on saline storage prospects, depleted oil and gas fields, including that associated with CO_2-EOR – in Federal and State waters.
- **Task 3.2: Integrate and Assess Available Information**
- **Task 3.3: Screen for "Representative" Storage Opportunities**
  - For variety of geologic and operational settings, including stacked storage and CO2-EOR. Criteria include approximate location, storage capacity, injectivity, sealing potential, available infrastructure, quality of data coverage and certainty, and likelihood of potential deployment.
- **Task 3.4: Identify and Address Risks and Data Gaps in Characterization**
  - Address risks and data gaps by identifying and partnering with private companies or organizations to obtain real-world data such as cores, geophysical logs, and seismic data to be used for better characterization.

DeSoto Canyon Salt Basin
Destin Dome Seismic Data



Differences Between CO_2 Injection Onshore and Offshore

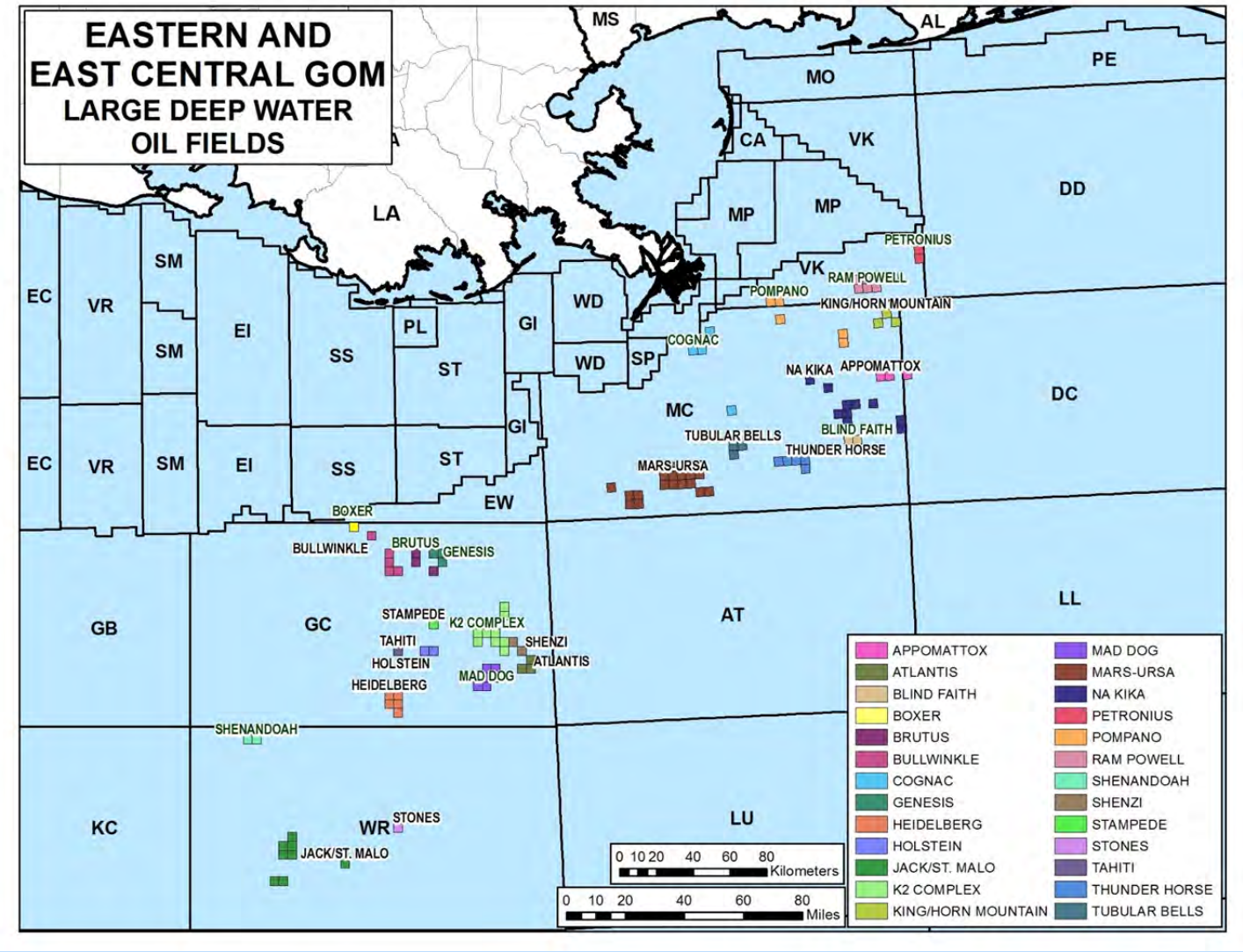
- **CO_2 injection and CO_2-EOR offshore will be different from the past experience of CO_2 flooding onshore.**
- **Offshore developments are characterized by fewer wells, larger well spacing and higher rates per well.**
- **Offshore, because of larger inter well spacing, a greater degree of heterogeneity can exist between well pairs.**
- **The requirement for compression is greater offshore.**
- **Microscopic sweep efficiency increases due to higher miscibility development**
- **The density difference between CO_2 and other reservoir fluids decreases and net CO_2 utilization efficiency can be higher.**
- **This could make offshore reservoirs better candidates for coupled CO_2-EOR and CO_2 storage.**

Offshore GOM CO_2-EOR Potential -- Preliminary

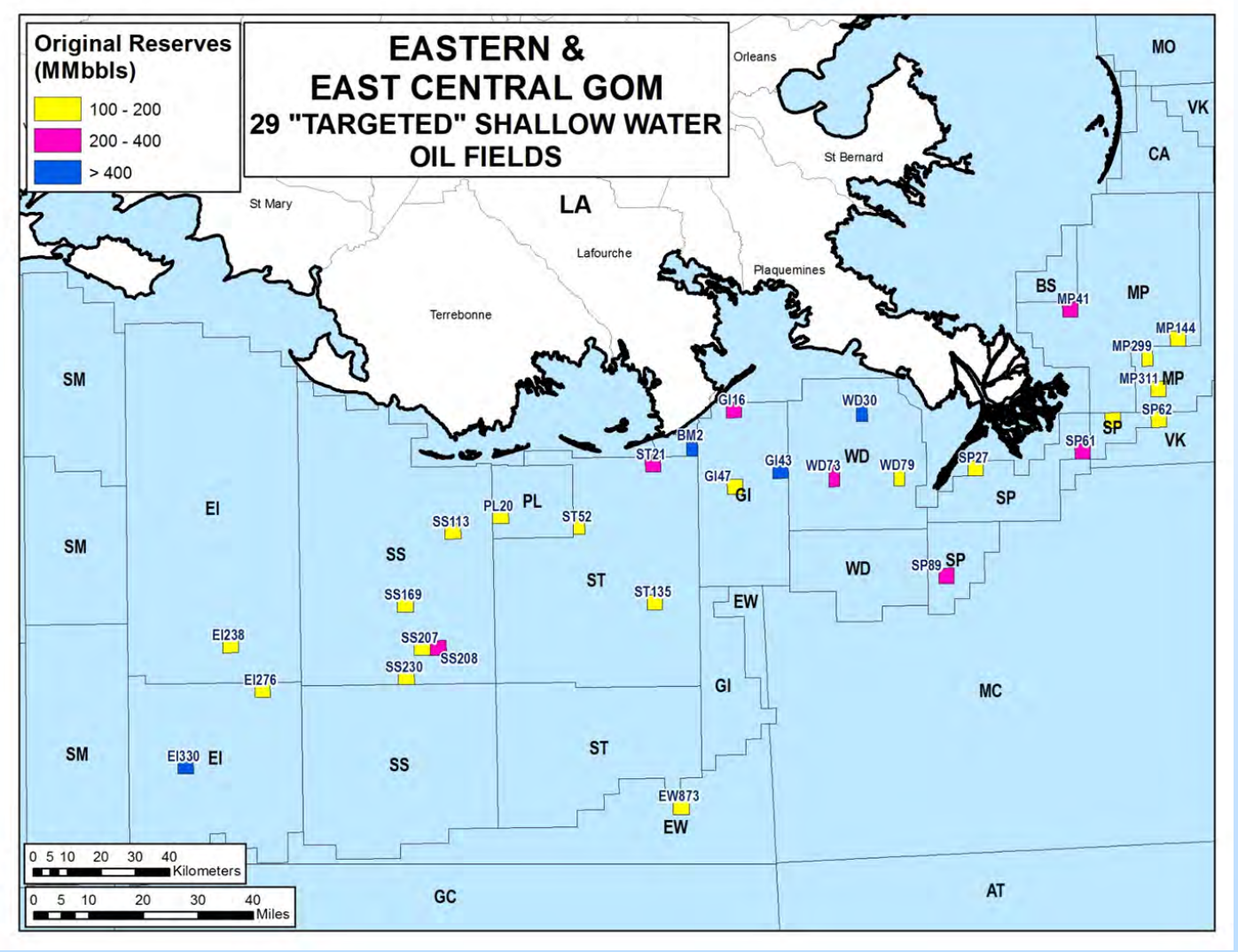
The large oil fields in the Eastern and East Central GOM offshore offer significant opportunities for productively utilizing and storing CO_2 while helping increase domestic oil production and Federal revenues.

- The Eastern and East Central portions of the GOM shallow water offshore hold 52 moderate- to large-size oil fields. These oil fields contain 8.2 billion barrels of original oil reserves, with 97% of these original reserves already produced.
- 63 large deep water Eastern and East Central GOM oil fields, concentrated in Green Canyon and Mississippi Canyon, contain 8.6 billion barrels of original oil reserves, with about half of these original reserves already produced

Deep Water Offshore GOM Oil Fields



Shallow Water Offshore GOM Oil Fields



Task 4: Risk Assessment, Simulation, Modeling

- **Objective: Refine/adapt existing tools, geologic models, and risk assessment/mitigation strategies for site-specific assessments.**
- **Task 4.1: Evaluate and Adapt Onshore Simulation, Modeling, and Risk Assessment Tools for Offshore Settings**
  - Including National Risk Assessment Partnership (NRAP) tools.
- **Task 4.2: Adapt Models for Offshore Storage Opportunities**
  - Geologic and dynamic flow models that evaluate physical/chemical processes, describe the effects of CO_2 movement within the storage reservoir and potentially through caprock, overburden, water column.
  - For "representative" opportunities for CO_2-EOR/storage, depleted oil and/or gas field storage, and deep saline aquifer storage, in shallow and deep water.
- **Task 4.3: Risk Assessment and Mitigation Planning and Strategies**
  - Develop risk registry fully integrated systems; addressing infrastructure issues/uncertainties to develop risk management/ mitigation plans.

Task 5: Monitoring, Verification, Accounting

- **Objective: Identify/evaluate MVA technologies/methodologies for CO_2 storage projects designed for prospective storage opportunities.**
- **Task 5.1: Assemble and Review Available Information on MVA Methods That May Be Employed in Offshore Environments**
  - Representative opportunities for shallow and deep water CO_2-EOR/storage, depleted fields, and deep saline aquifers.
  - Seismic technologies, EM/gravity survey, continuous downhole pressure/temperature monitoring, wireline logging, fluid sampling (formation/above zone), micro-seismic, and the use of tracers.
  - For storage in existing fields, the integrity of legacy wells will be assessed.
- **Task 5.2: MVA Lessons Learned for Offshore Environments**
  - Specify suite of MVA technologies and methodologies, based on lessons learned, including from international collaborations.
  - Plans will be developed to test MVA technologies to support analogs of offshore geologic storage opportunities, including storage with EOR.

T6: Infrastructure, Operations, and Permitting

- **Objective: Address infrastructure, operations, permitting topics pertaining to CO_2 transport, delivery, storage in the offshore.**
- **Task 6.1: Offshore CO_2 Transport and Delivery Options**
  - Assess range of feasible CO_2 options (onshore to offshore) to include: existing infrastructure and potential accessibility; logistical and regulatory obstacles; and the process and requirements of decommissioning.
- **Task 6.2: Assessment of Legal and Regulatory Frameworks**
  - Communicate with BOEM and other regulatory agencies to inform on project activities to facilitate a dialogue on permitting requirements.
  - Develop updated assessment on legal and regulatory frameworks applicable to U.S. offshore storage projects that are needed by industry and regulators.
  - Topical experts will be engaged in collaboration.

Appendix

Project Summary

This project will expand membership of the Southern States Energy Board's existing Gulf of Mexico (GOM) government-industry partnership to focus on assembling the knowledge base required for secure, long-term, large-scale carbon dioxide (CO_2) subsea storage. The partnership's evaluation will focus on active and depleted oil and gas fields and potentially associated CO_2-enhanced oil recovery, as well as deep saline storage resources in the eastern portion of the GOM's Federal and state waters. The partnership will integrate and assess characterization data and infrastructure delivery options and adapt and tailor monitoring, verification, and accounting (MVA) technology applications and geologic and dynamic flow models for offshore CO_2 storage projects. The project will facilitate the subsequent development of technology-focused permitting processes needed by industry and regulators for CO_2 storage in the GOM.

Accomplishments to Date

- Nothing yet to report.

Lessons Learned

- Nothing yet to report.

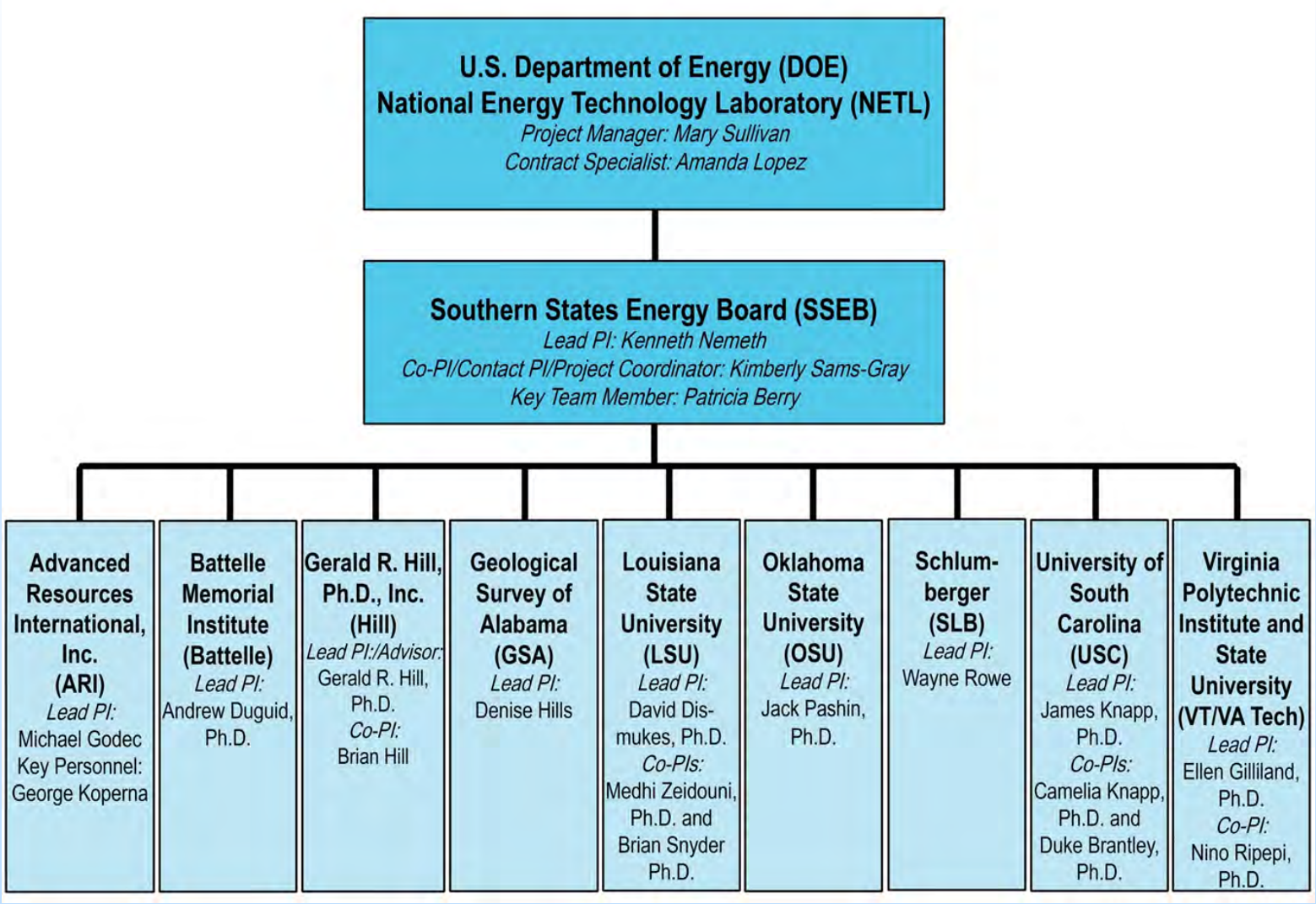
Synergy Opportunities

- This project will expand SSEB's existing GOM government-industry partnership on assembling the knowledge base required for secure, long-term, large-scale offshore CO_2 storage.
- This project will build on ongoing SSEB work on the Southeast Offshore Storage Resource Assessment (SOSRA) project assessing prospective CO_2 storage resources in State and Federal waters of the Mid-Atlantic, South Atlantic, and the eastern Gulf of Mexico
- Finally, this project was one of two projects awarded to assess offshore geologic storage of CO_2 and technology development in the Gulf of Mexico. The other is the Offshore Gulf of Mexico Partnership for Carbon Storage—Resources and Technology Development led by the University of Texas at Austin. Extensive collaboration and joint work is planned between these two projects, resulting in considerable anticipated synergies.

Benefit to the Program

- Comprehensive knowledge base of existing and newly acquired offshore CO_2 storage resources and transportation infrastructure
- Characterizaion of high-prospect geologic basins and specific reservoirs in the Gulf of Mexico for future offshore subsea CCS project development.
- MVA technology applications, geologic and dynamic flow models, and a preliminary risk registry that are tailored to the offshore environment, tied to specific, representative offshore CO_2 storage prospects.
- Summary of MVA best practices also will be developed
- Guidance document on the legal, regulatory, and technical feasibility of offshore CO_2 subsea storage projects will be prepared.
- Application of real-world CCS project development experiences to efficiently identify and address knowledge gaps, regulatory issues, infrastructure requirements, and technical challenges associated with offshore CO_2 storage.
- Increased awareness of CCS applications.
- Significant workforce creation.
- Knowledge dissemination.

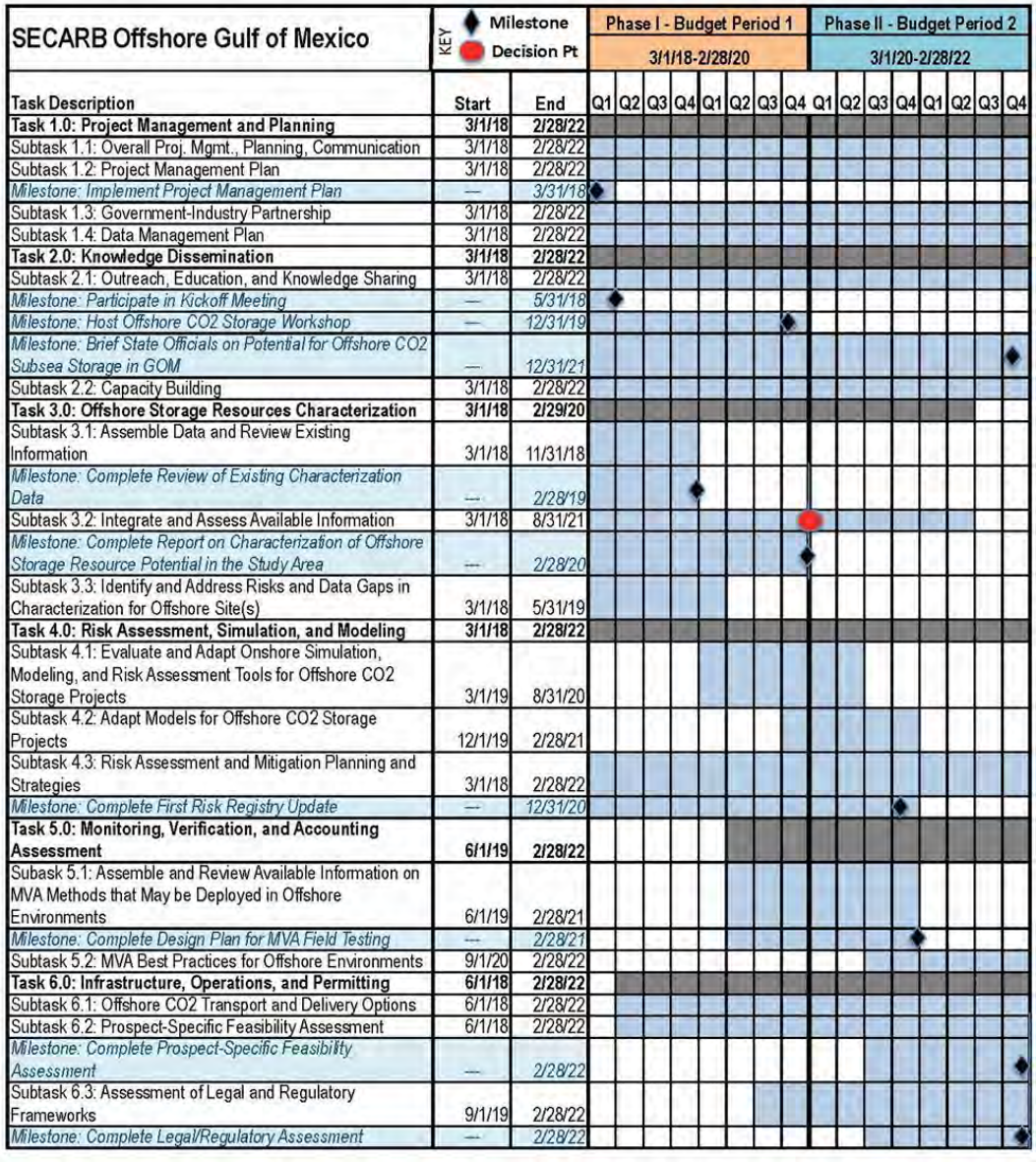
Organization Chart



Partners, Task Assignments, & Roles

Project Partners	Sr. & Key Personnel	Task(s)	Role
SSEB	Nemeth, Gray, Berry	1,2,4,6	PI/Lead organization/project mgmt., knowledge dissemination, risk assessment, infrastructure planning re: legal/regulatory/permitting
ARI	Godec, Koperna	1-6	Data management, knowledge dissemination, characterization lead, risk/simulation/modeling, MVA, infrastructure planning
Battelle	Duguid	2,4	Knowledge dissemination, risk assessment/simulation/modeling support
GSA	Hills	2,3,4,5,6	Knowledge dissemination, characterization AL/MS, risk/simulation/modeling support, MVA support, infrastructure planning AL/MS
HILL	G. Hill, B. Hill	1,2,4,6	Advisor for project management/gov-industry partnership building, knowledge dissemination, risk assessment lead, infrastructure planning
LSU	Dismukes, Zeidouni, Snyder	3,4,5,6	Characterization LA, risk/simulation/modeling support, MVA support, infrastructure planning LA
OSU	Pashin	3	Characterization AL/MS
SAS	Tomski	1	Data management support/expertise
SLB	Rowe	4	Software donation, simulation/modeling support, MVA support
USC	J. Knapp, C. Knapp, D. Brantley	4	Risk/simulation/modeling support
VT	Gilliland, Ripepi	4	Risk/simulation/modeling support

Gantt Chart



SECARB Offshore Gulf of Mexico	KEY: Milestone / Decision Pt		Phase I - Budget Period 1 3/1/18-2/28/20								Phase II - Budget Period 2 3/1/20-2/28/22							
Task Description	**Start**	**End**	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Task 1.0: Project Management and Planning	**3/1/18**	**2/28/22**																
Subtask 1.1: Overall Proj. Mgmt., Planning, Communication	3/1/18	2/28/22																
Subtask 1.2: Project Management Plan	3/1/18	2/28/22																
Milestone: Implement Project Management Plan	—	*3/31/18*	◆															
Subtask 1.3: Government-Industry Partnership	3/1/18	2/28/22																
Subtask 1.4: Data Management Plan	3/1/18	2/28/22																
Task 2.0: Knowledge Dissemination	**3/1/18**	**2/28/22**																
Subtask 2.1: Outreach, Education, and Knowledge Sharing	3/1/18	2/28/22																
Milestone: Participate in Kickoff Meeting	—	*5/31/18*		◆														
Milestone: Host Offshore CO2 Storage Workshop	—	*12/31/19*								◆								
Milestone: Brief State Officials on Potential for Offshore CO2 Subsea Storage in GOM	—	*12/31/21*																◆
Subtask 2.2: Capacity Building	3/1/18	2/28/22																
Task 3.0: Offshore Storage Resources Characterization	**3/1/18**	**2/29/20**																
Subtask 3.1: Assemble Data and Review Existing Information	3/1/18	11/31/18																
Milestone: Complete Review of Existing Characterization Data	—	*2/28/19*				◆												
Subtask 3.2: Integrate and Assess Available Information	3/1/18	8/31/21								●								
Milestone: Complete Report on Characterization of Offshore Storage Resource Potential in the Study Area	—	*2/28/20*								◆								
Subtask 3.3: Identify and Address Risks and Data Gaps in Characterization for Offshore Site(s)	3/1/18	5/31/19																
Task 4.0: Risk Assessment, Simulation, and Modeling	**3/1/18**	**2/28/22**																
Subtask 4.1: Evaluate and Adapt Onshore Simulation, Modeling, and Risk Assessment Tools for Offshore CO2 Storage Projects	3/1/19	8/31/20																
Subtask 4.2: Adapt Models for Offshore CO2 Storage Projects	12/1/19	2/28/21																
Subtask 4.3: Risk Assessment and Mitigation Planning and Strategies	3/1/18	2/28/22																
Milestone: Complete First Risk Registry Update	—	*12/31/20*												◆				
Task 5.0: Monitoring, Verification, and Accounting Assessment	**6/1/19**	**2/28/22**																
Subask 5.1: Assemble and Review Available Information on MVA Methods that May be Deployed in Offshore Environments	6/1/19	2/28/21																
Milestone: Complete Design Plan for MVA Field Testing	—	*2/28/21*												◆				
Subtask 5.2: MVA Best Practices for Offshore Environments	9/1/20	2/28/22																
Task 6.0: Infrastructure, Operations, and Permitting	**6/1/18**	**2/28/22**																
Subtask 6.1: Offshore CO2 Transport and Delivery Options	6/1/18	2/28/22																
Subtask 6.2: Prospect-Specific Feasibility Assessment	6/1/18	2/28/22																
Milestone: Complete Prospect-Specific Feasibility Assessment	—	*2/28/22*																◆
Subtask 6.3: Assessment of Legal and Regulatory Frameworks	9/1/19	2/28/22																
Milestone: Complete Legal/Regulatory Assessment	—	*2/28/22*																◆

Bibliography

- Nothing to date; project just started.