SECARB Horn Mountain Case Study: Reservoir Modeling and Viable CO_2 Transportation Infrastructure

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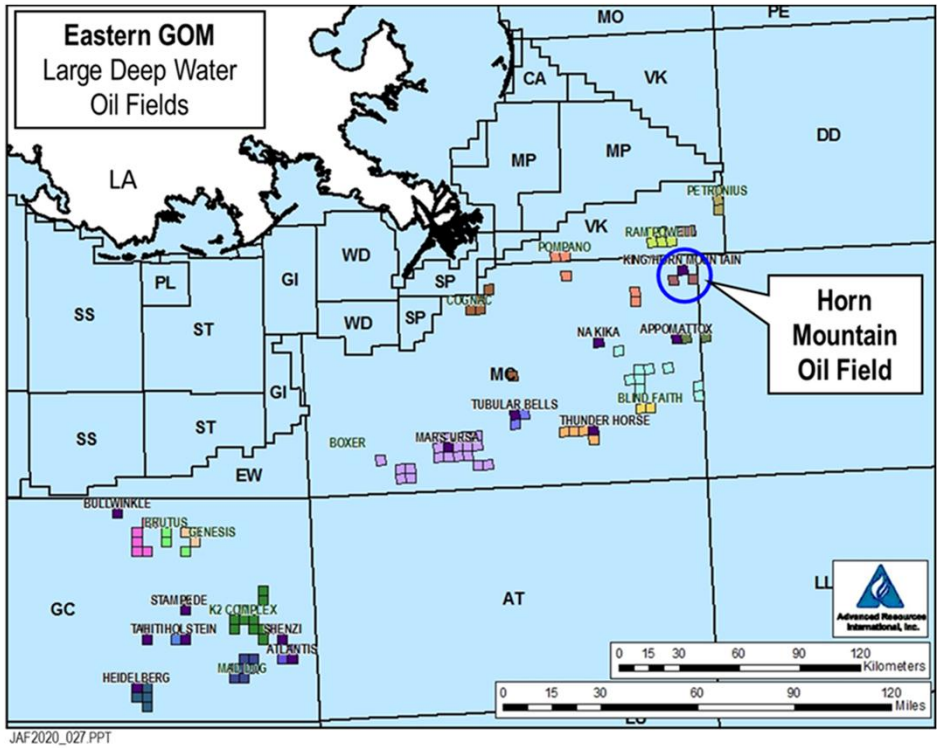
Sub-Task 4.2 Depleted Oil Field – Horn Mountain

SECARB Subtask 4.2: Develop and/or adapt a representative geologic and dynamic flow model to evaluate offshore CO_2 storage opportunities

- The selected geologic model for this study is a model developed for the Horn Mountain oil field (Mississippi Canyon 126) in Central Gulf of Mexico, approximately 80 miles from onshore Louisiana.
- As of the end of February 2022, over 40% of the Horn Mountain original oil in place has been produced.
- Good candidate for deep water, straight CO_2 storage.



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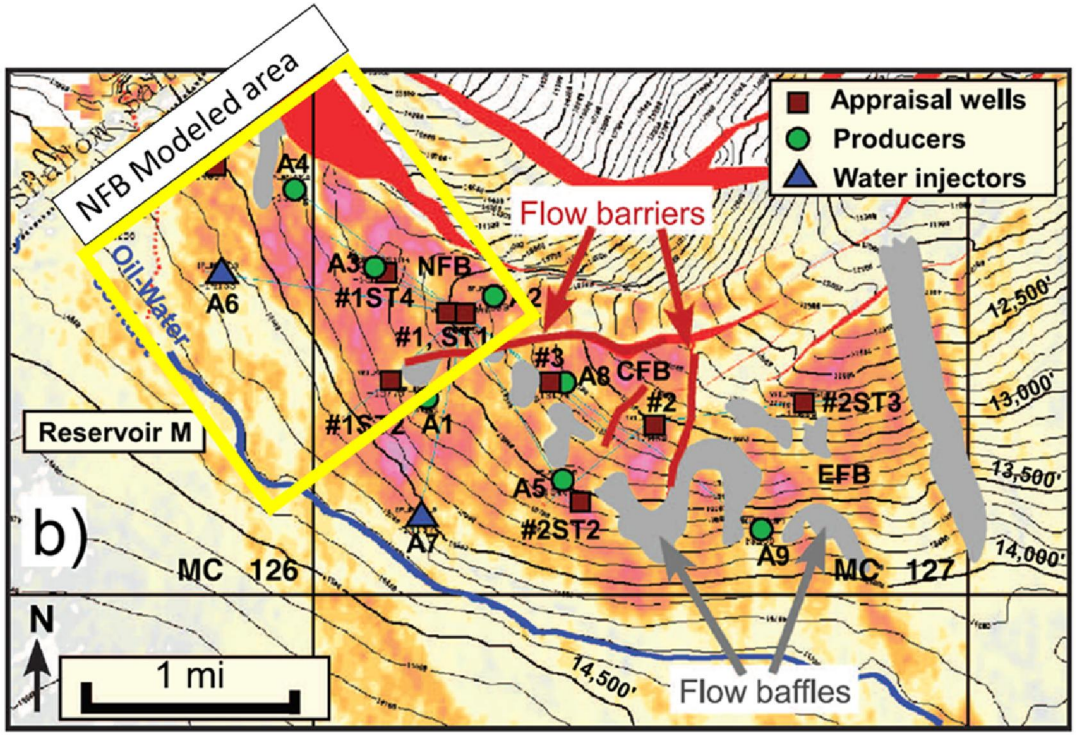
Depleted Oil Field – Horn Mountain

- The Horn Mountain oil field includes two stacked Middle Miocene sands, the J Sand and M Sand.
- The M Sand is a relatively uniform anticlinal structure with bounding faults on the north and east.
- The J sand is much smaller (but could eventually be considered after further evaluation).



NFB: North Fault Block

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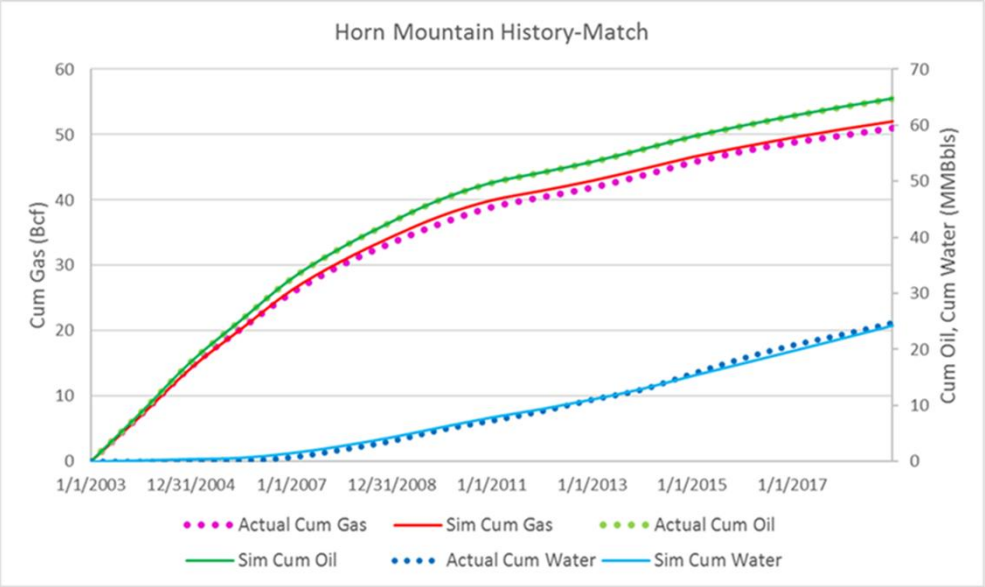
Methodology for Building the Horn Mountain Oil Field Model

- A representative geologic model was built for the M Sand of the Horn Mountain oil field (the NFB model).
- A reservoir model was built based on the geologic model and field development of the M Sand, including the existing oil/gas production wells and water injection well.
- Calibrated the model to historical data using a compositional numerical simulator (GEM).



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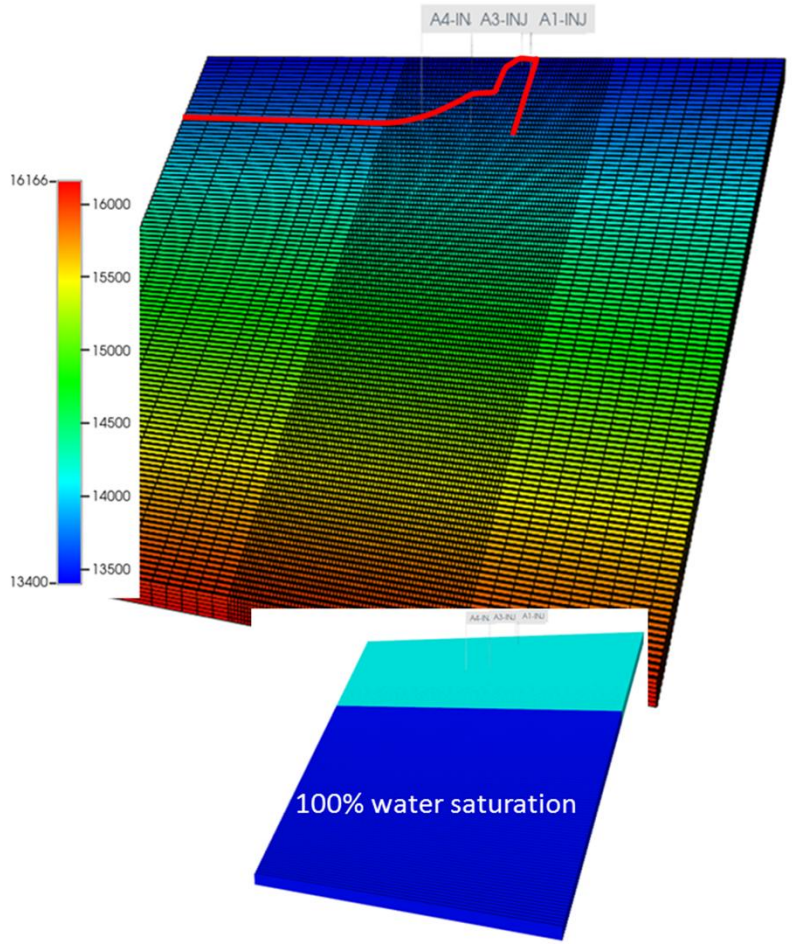
Approach for Modeling CO_2 Storage in a Depleted Oil Reservoir

- Average water saturation (47%) and pressure (7,500 psi) of the field from the end of the history in the previous model were employed to initialize the 'storage' model.
- Expanded the model area to avoid CO_2 plume reaching model boundaries and model full extent of the M sand.
- Four production wells were converted to CO_2 injection wells and the water injection well was shut in.
- Injected CO_2 at a maximum rate of 2,650 tons/day (50 MMscf/day) per well for 30 years with a maximum bottom-hole pressure constraint of 0.72 psi/ft.
- Monitored CO_2 plume movement for 50 years post injection.

Model Setup

- Faults modeled as zero transmissibility
- Water-Oil contact at 14,300 ft with analytical aquifer attached to the southern edge of the model
- Model covers a 31 square mile area
- Porosity: 27%
- Permeability: 250mD
- Net thickness: 132 feet



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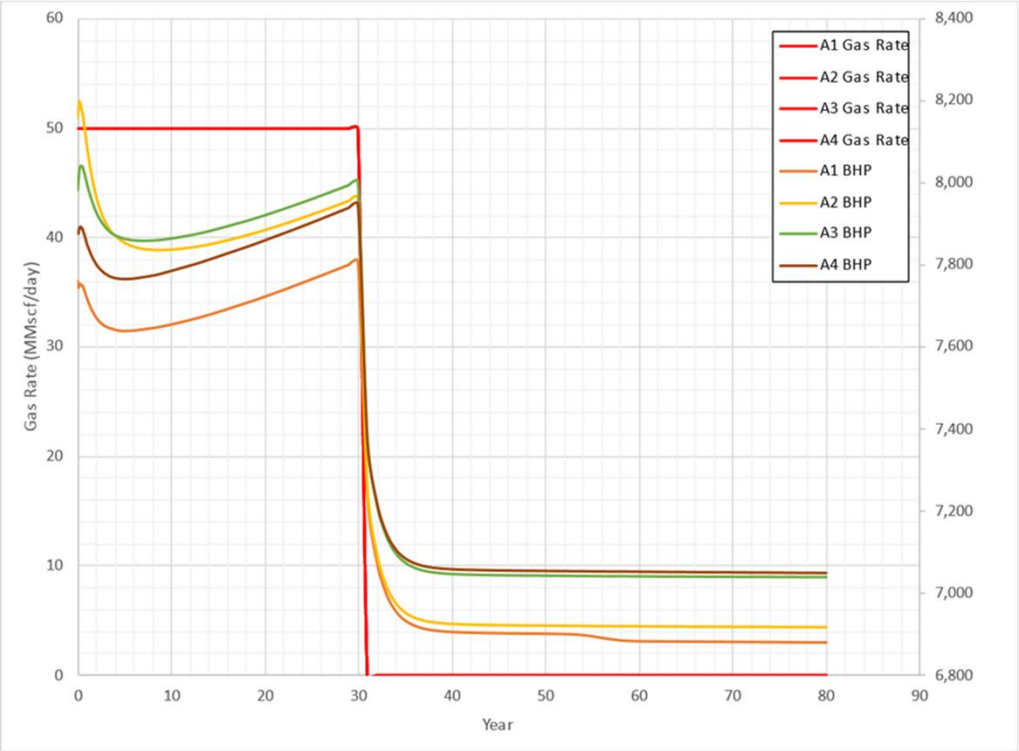
Injection Rate and Bottomhole Pressure Profiles



- All four wells can inject the design rate for 30 years because of a high porosity and permeability environment
- The maximum BHP is not reached
- A total of 114 million metric tons of CO_2 is injected.

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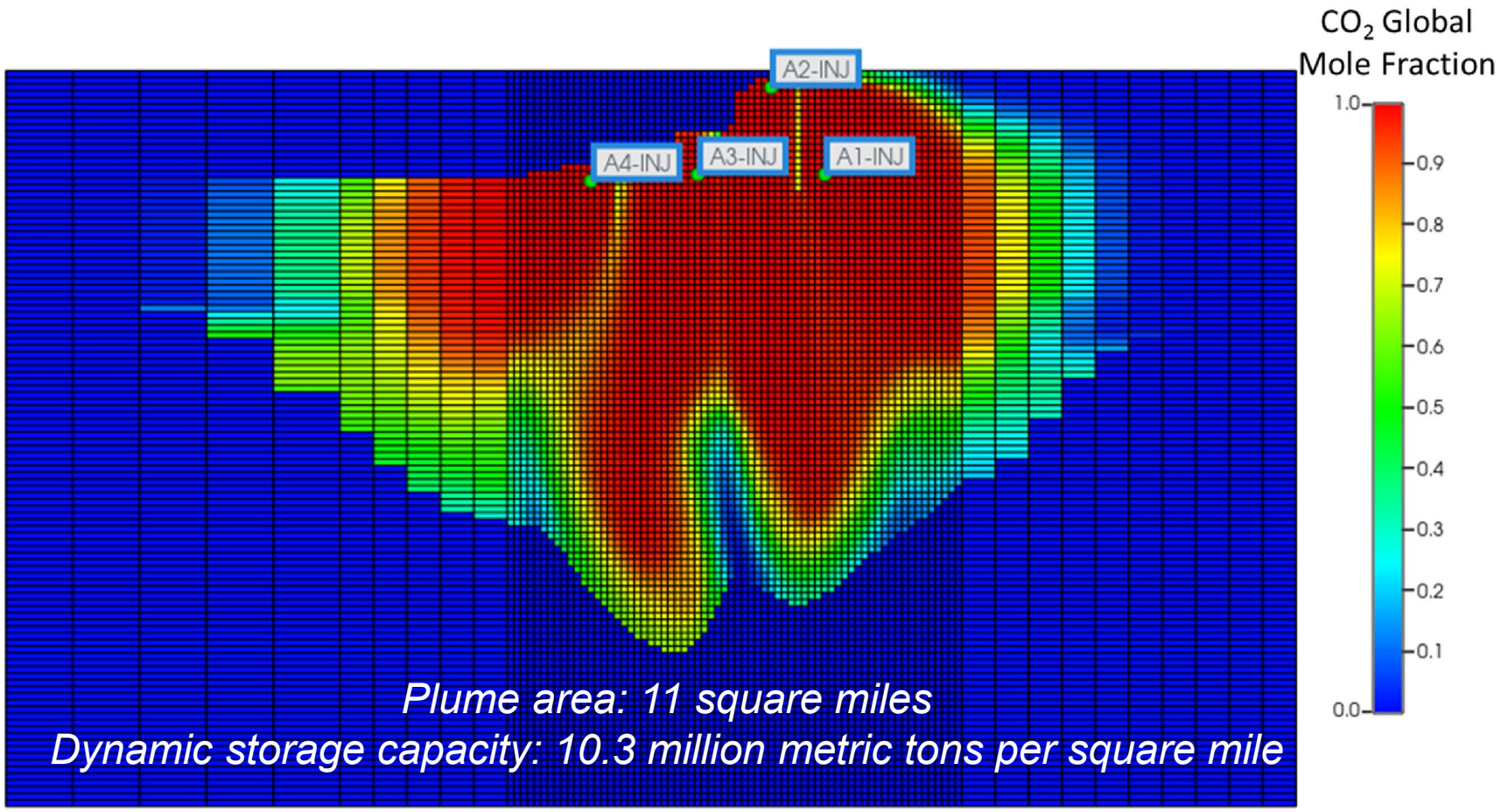
CO_2 Plume – End of 30 Years of Injection



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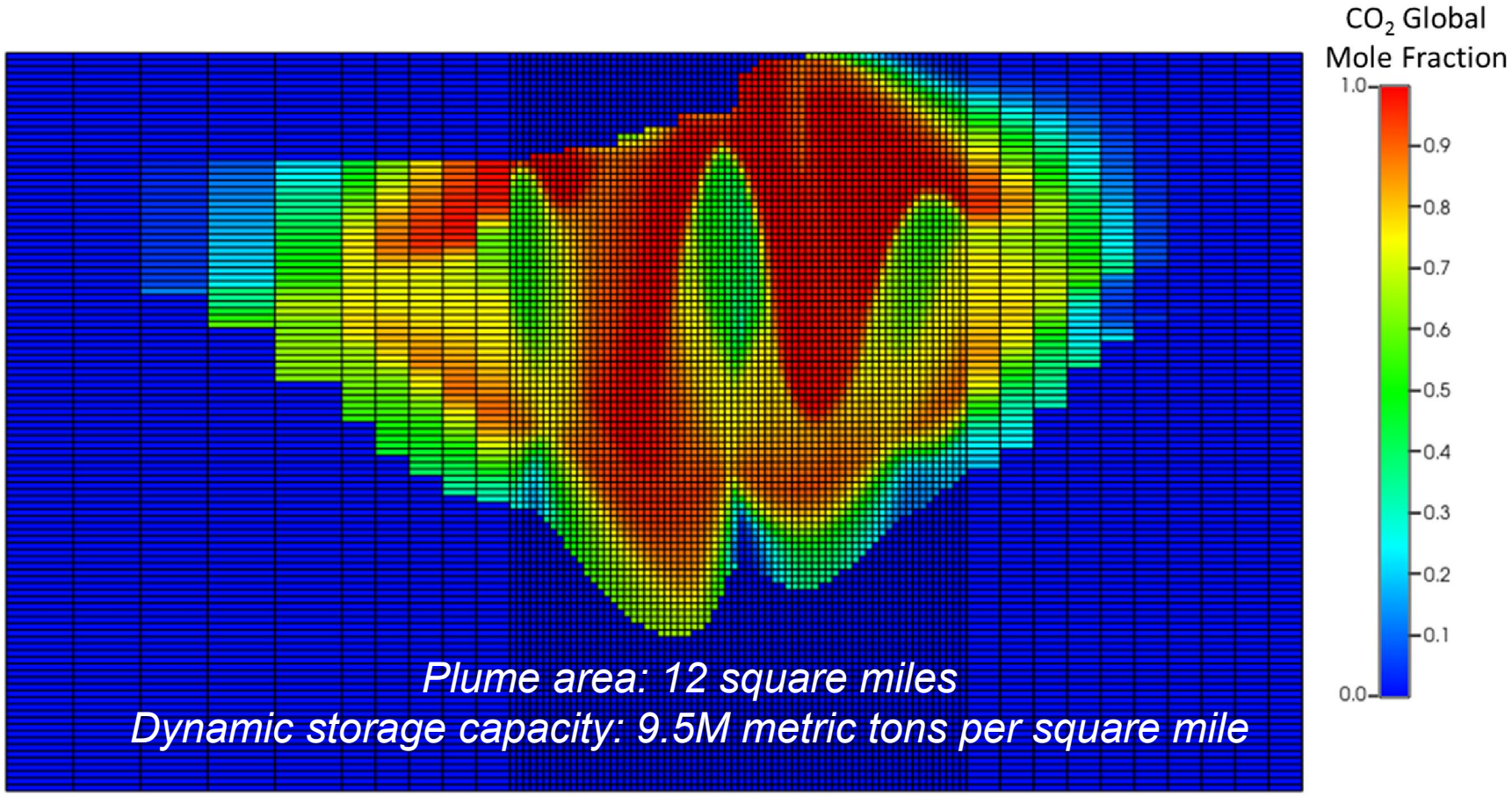
CO_2 Plume – 50 Years Post-injection



Because of the structure, the plume area doesn't really change.

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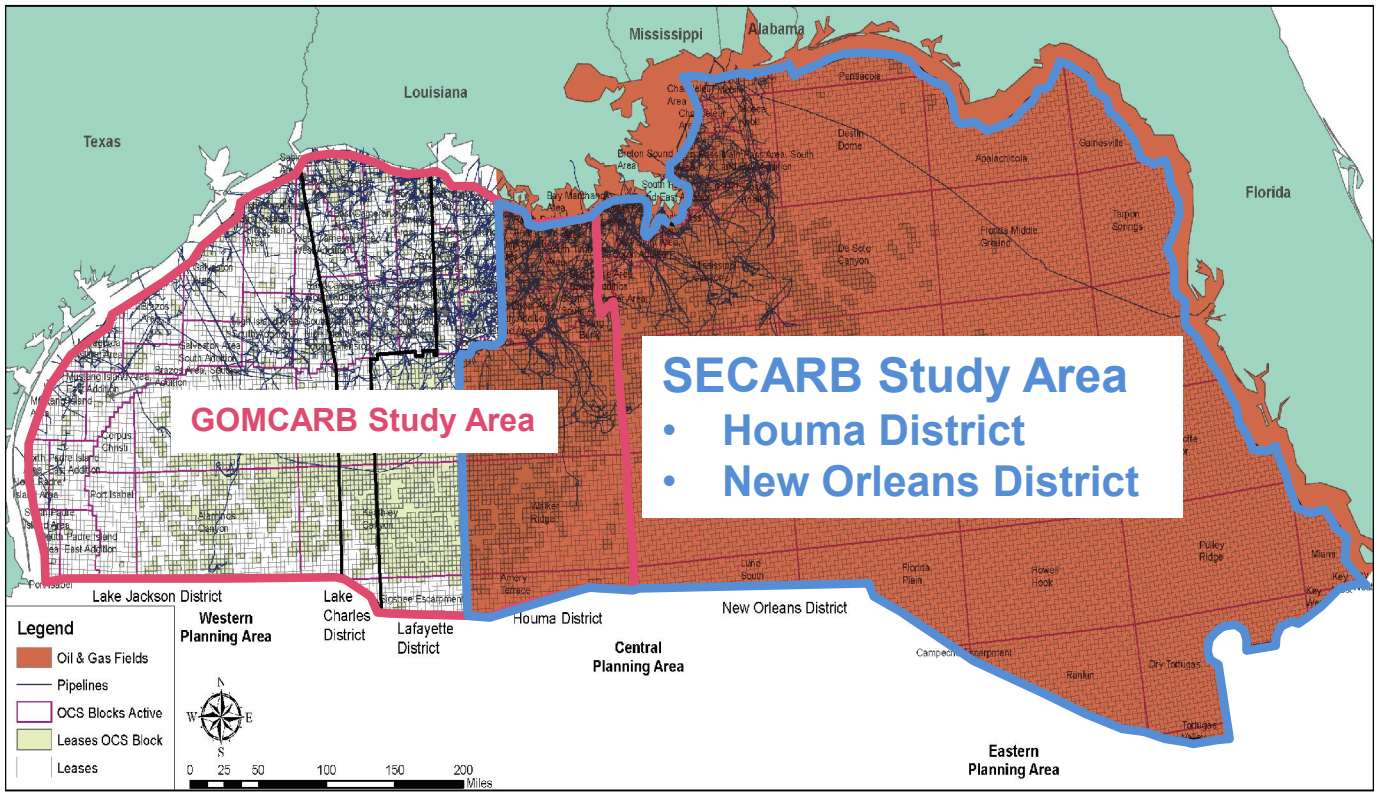
Sub-Task 6.1 CO_2 Transportation Infrastructure

- **SECARB Subtask 6.1: Offshore CO_2 Transport and Delivery Options**
- **OBJECTIVE: Identify viable CO_2 transportation pathways in the GOM SECARB Study Area using existing oil & gas infrastructure**



Database Development

BOEM
Bureau of Ocean Energy Management

- **Pipeline Data**
- **Platform Data**
- (Aug 2021 Vintage)

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Review of Existing Offshore Oil & Gas Infrastructure

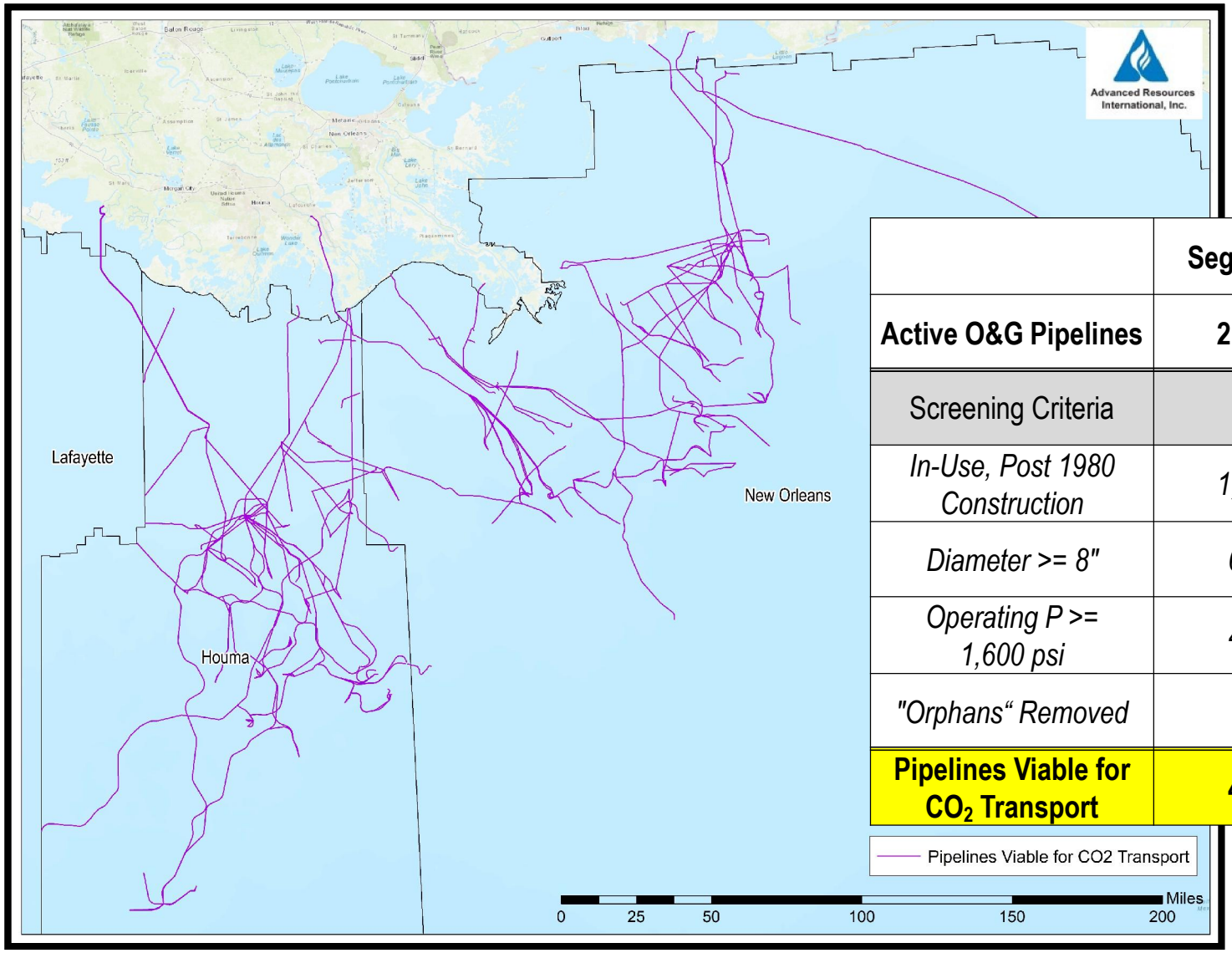
METHODOLOGY

Apply technical screening criteria to offshore GOM pipeline and platform infrastructure based on requirements for large-scale CO_2 transport and delivery.

Pipeline Screening Criteria

- **Status** – identify active pipelines vs decommissioned/shut-in/removed,
- **Type** – identify oil & gas pipelines vs water/service/other,
- **Age** – identify pipelines constructed after 1980,
- **Size** – minimum 8” diameter (roughly 1 MMmt/y capacity),
- **Operating Pressure** – minimum of 1,600 psi capability,
- **Network** – continuous link from onshore inlet location

Offshore Pipeline Network Viable for CO_2 Transport



	Segments	Distance (mi)
Active O&G Pipelines	**2,902**	**11,296**
Screening Criteria	*Screened Out*	
In-Use, Post 1980 Construction	*1,614*	*9,373*
Diameter >= 8"	*647*	*7,488*
Operating P >= 1,600 psi	*436*	*5,975*
"Orphans" Removed	*25*	*90*
Pipelines Viable for CO_2 Transport	**411**	**5,885**

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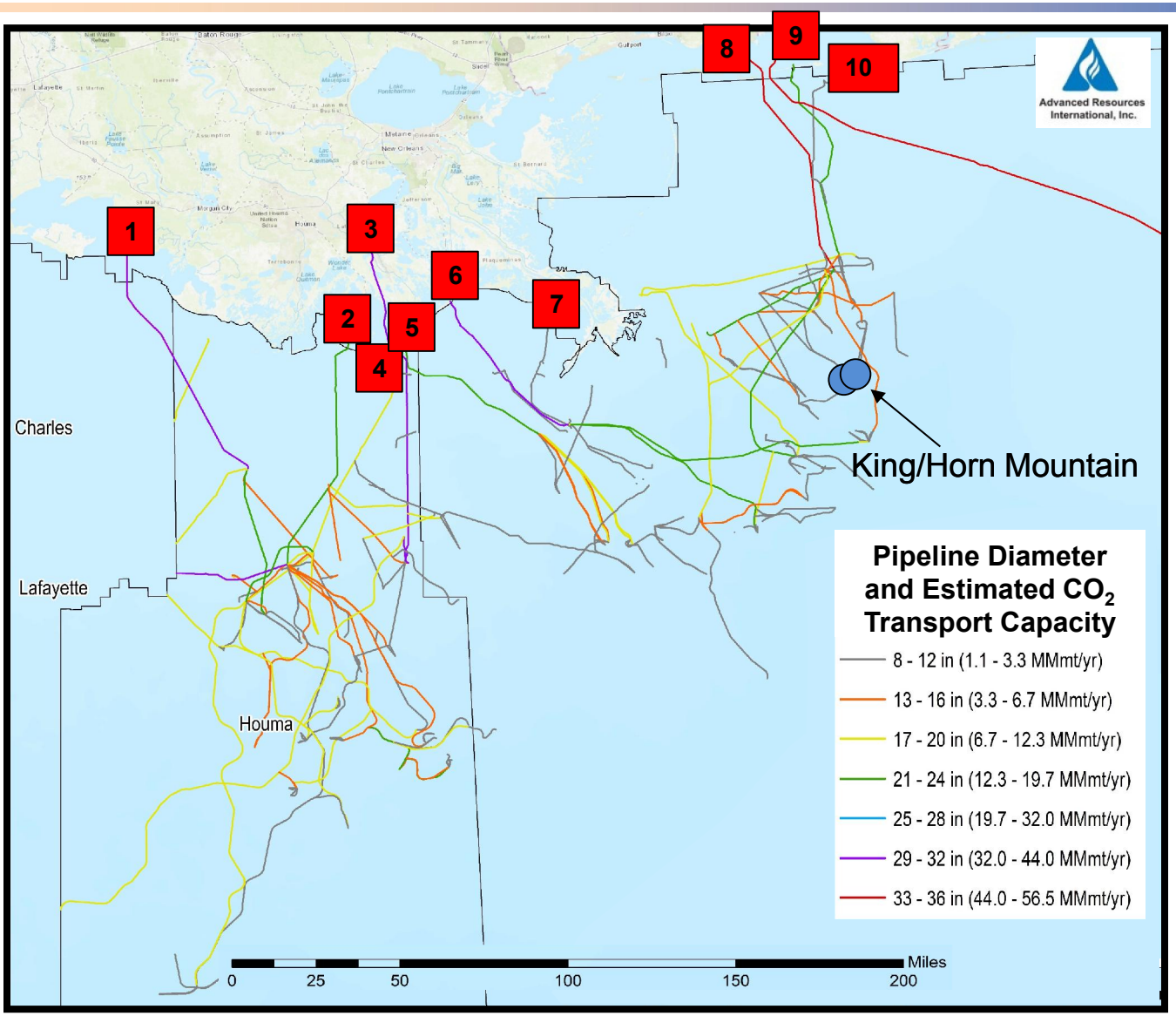
Offshore Pipeline Network Viable for CO_2 Transport



Inlet #	CO_2 Transport Capacity (MMmt/yr)
1	35
2	20
3	35
4	12
5	20
6	35
7	3
8	56
9	20
10	3
Total	**239 MMmt/yr**

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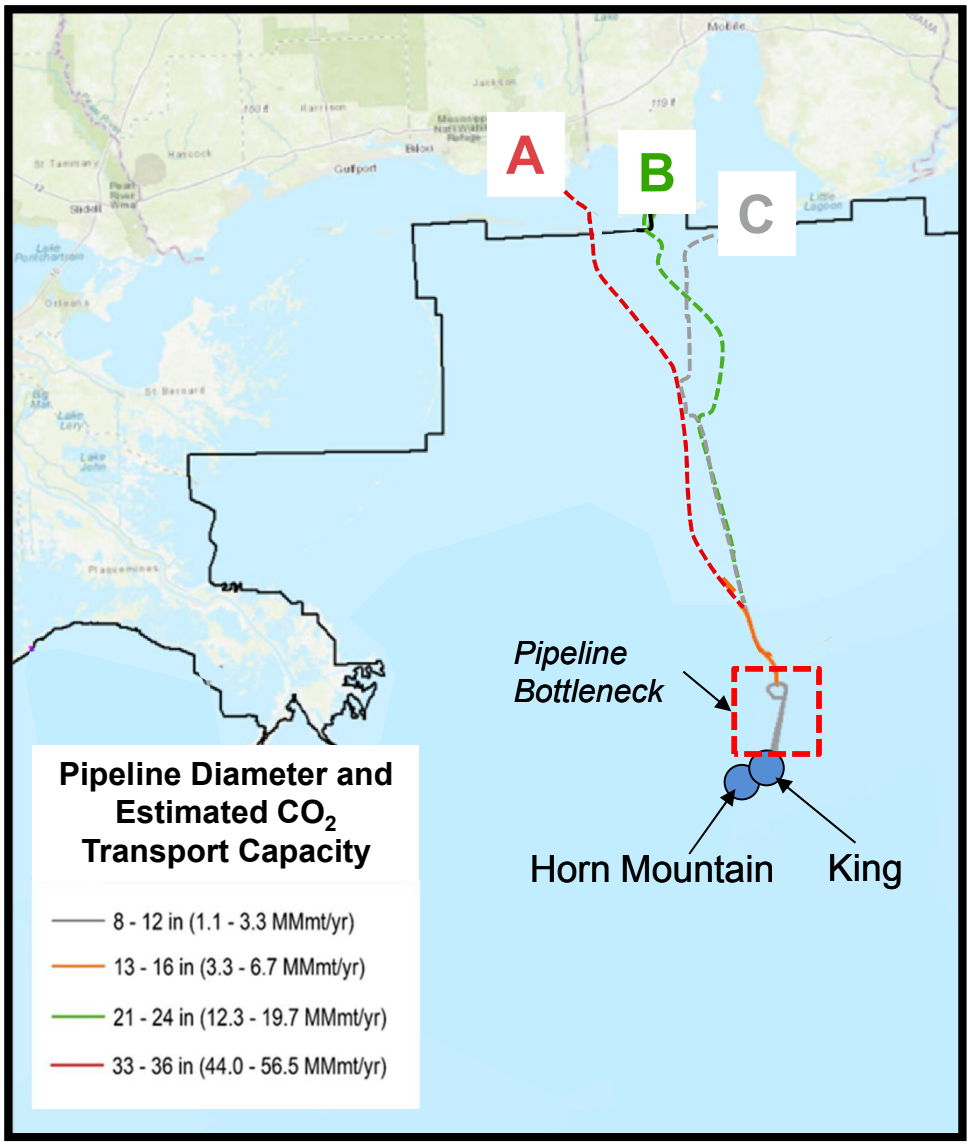
Horn Mountain Offshore CO_2 Transportation



- There are three direct pipeline routes from onshore to King/Horn Mountain that are technically viable for CO_2 transportation.
- Max CO_2 transport capacity for all routes is 1.1 – 3.3 MMmt/yr due to the pipeline bottleneck to King.
- Still, this capacity matches a rough estimate of annual CO_2 injection capacity at Horn Mountain.
- This is a viable option to utilize industrial sources of CO_2 along the central gulf coast.

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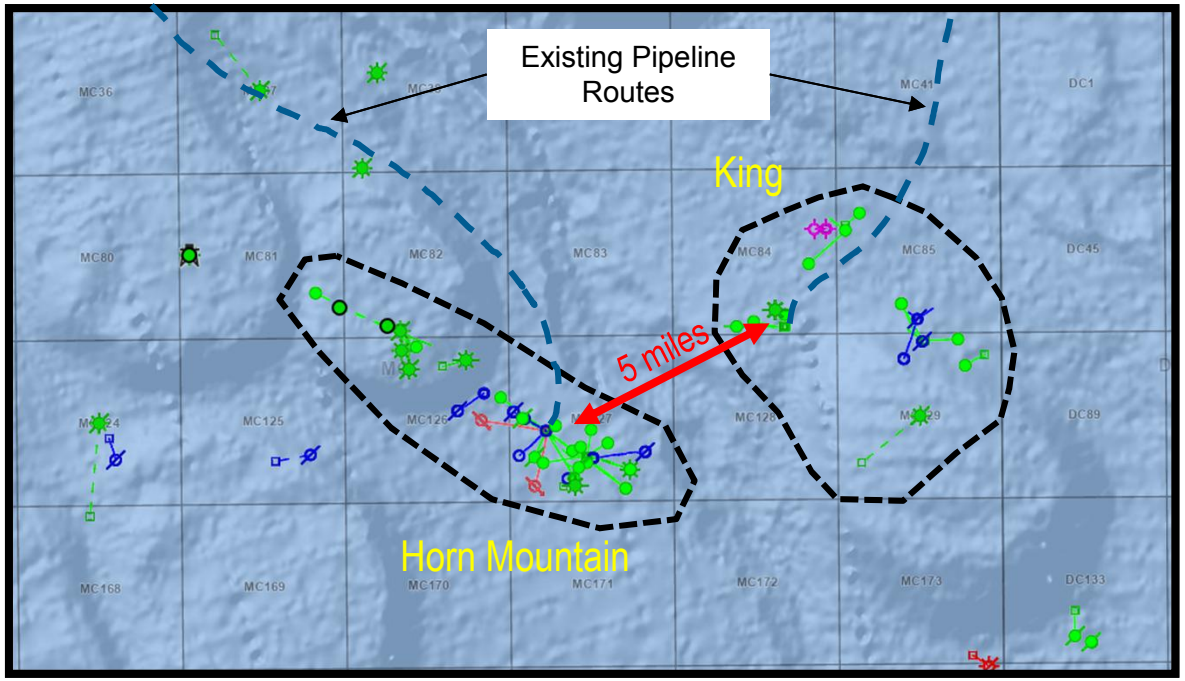
Horn Mountain Offshore CO_2 Transportation

- Horn Mountain and King have separate pipeline connections to onshore.
- Some of the pipelines connecting Horn Mountain to onshore do not meet CO_2 transportation criteria due to age and pressure rating.
- Option to utilize King for CO_2 delivery with additional pipeline infrastructure.



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