Overview of LSU's Planned Contributions to SECARB Offshore GOM Project

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Beaumont, TX

LSU Team Participants

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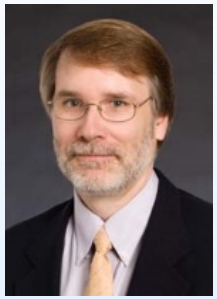

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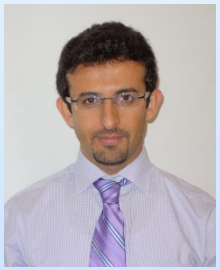

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Outline

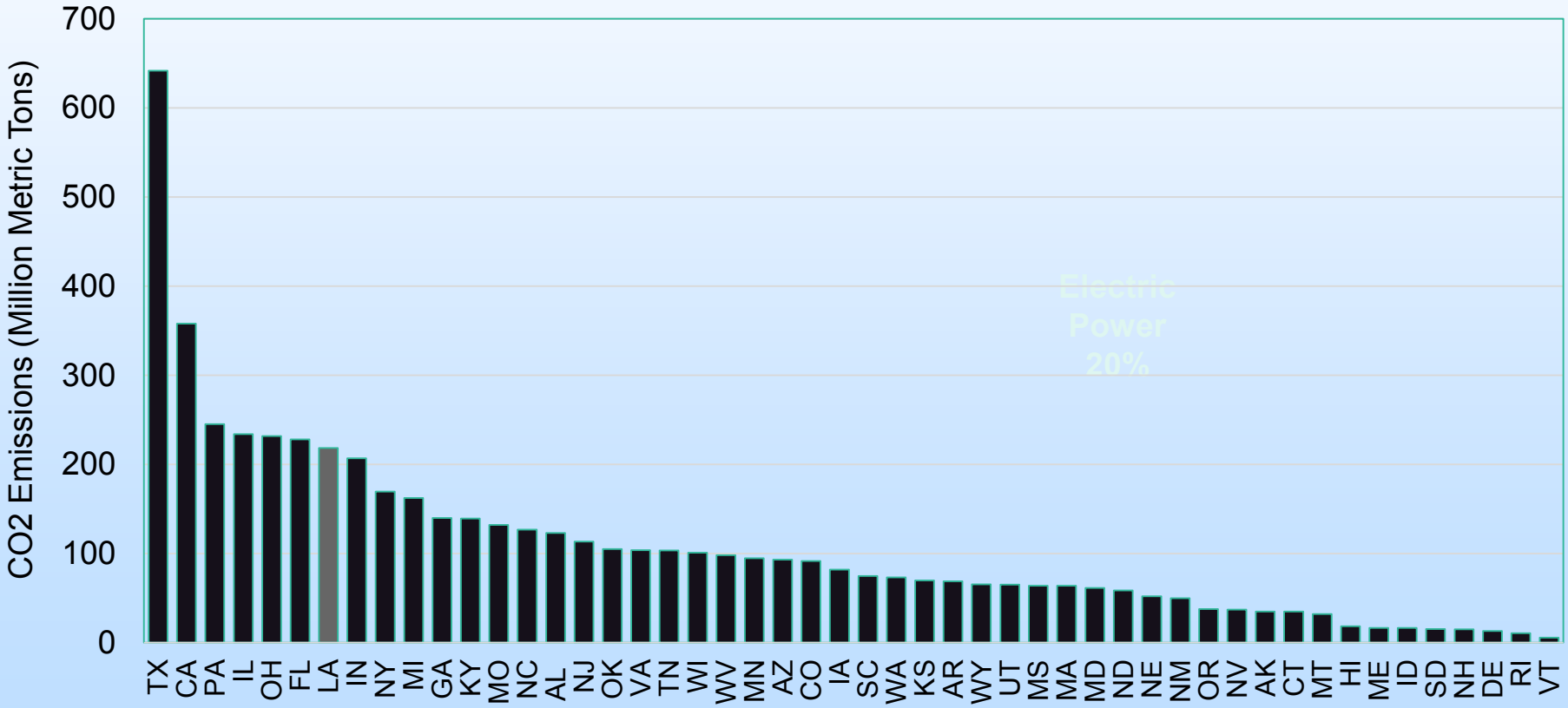
- Learnings from CarbonSafe
- LSU tasks
- LSU study subarea
  - State waters
  - Federal waters
- Previous studies
- Data gathering
  - Facilities
  - Characterization
- Detailed field study identification
- Conclusions

Relationship with CarbonSafe

- CO_2 emissions in Louisiana
- Source-sink matching
- Selected storage sites' characterization
- Storage capacity estimation
- Containment assessment
  - Wells
  - Faults

Energy-Related Emissions by State, 2014

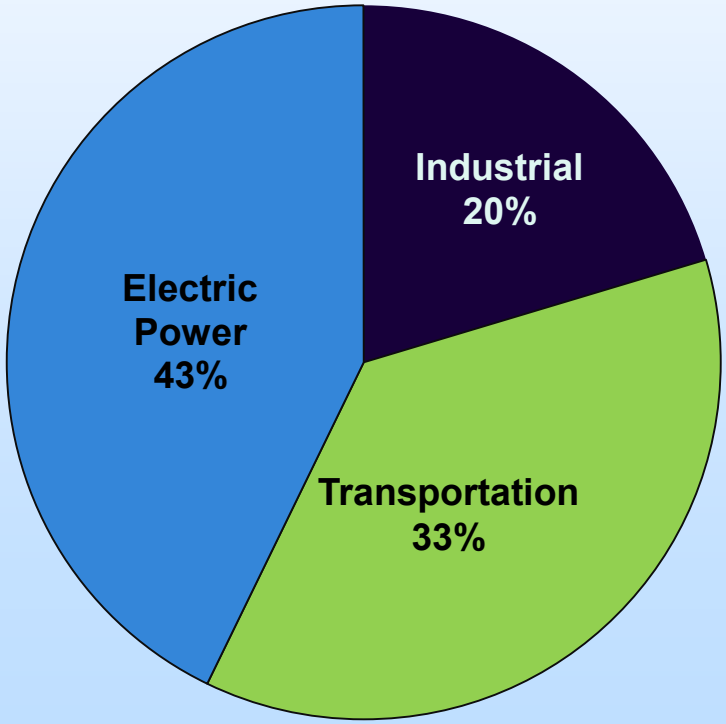
At ~220 million tons of CO_2 emissions, Louisiana ranks seventh in the U.S.



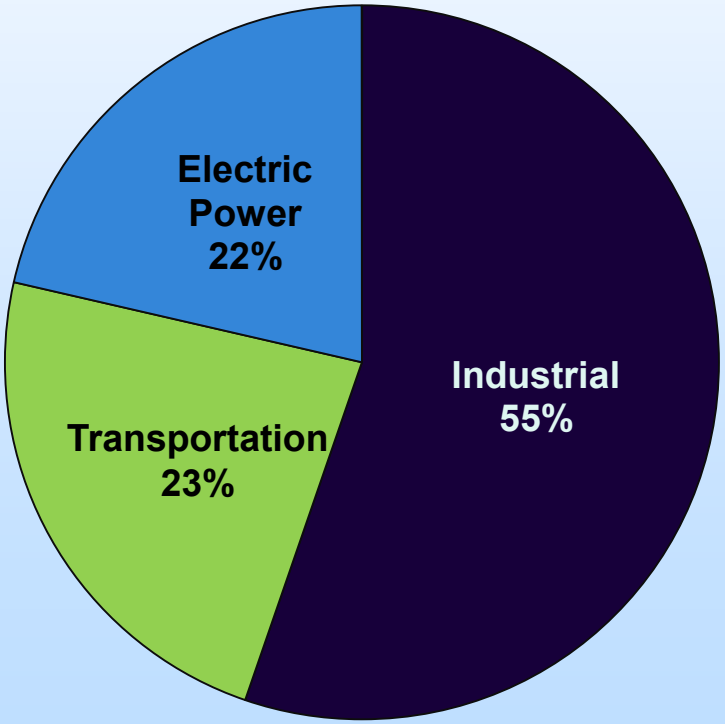
Source: Energy Information Administration, U.S. Department of Energy.

U.S. and Louisiana CO_2 Emissions per Sector

In the U.S., power generation comprises over 40 percent of overall national emissions.



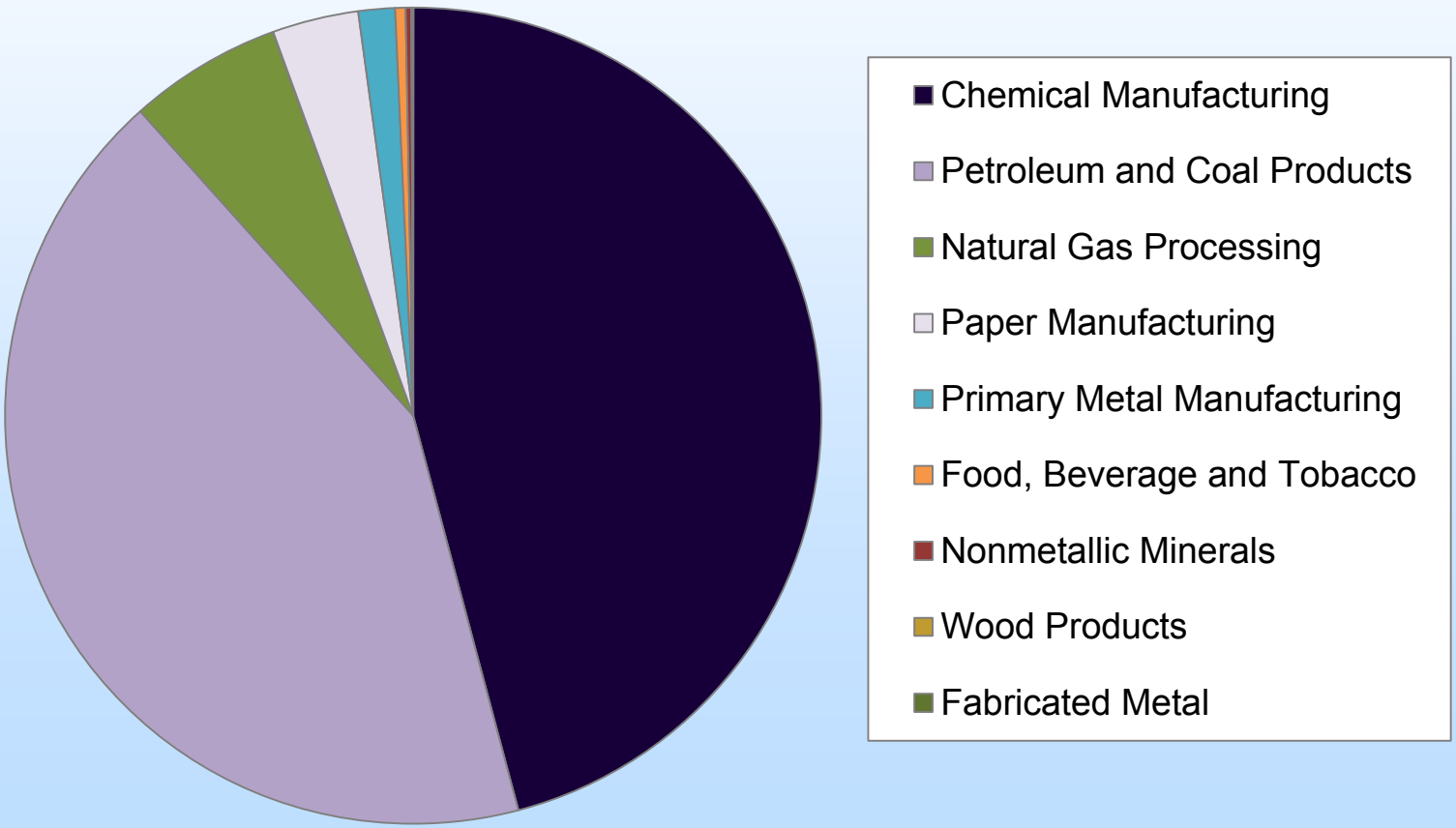
In Louisiana, power generation comprises about 22 percent of overall state emissions. Louisiana's primary source of CO_2 emissions comes from industry.



Source: Energy Information Administration, U.S. Department of Energy.

Industrial CO_2 emissions by category

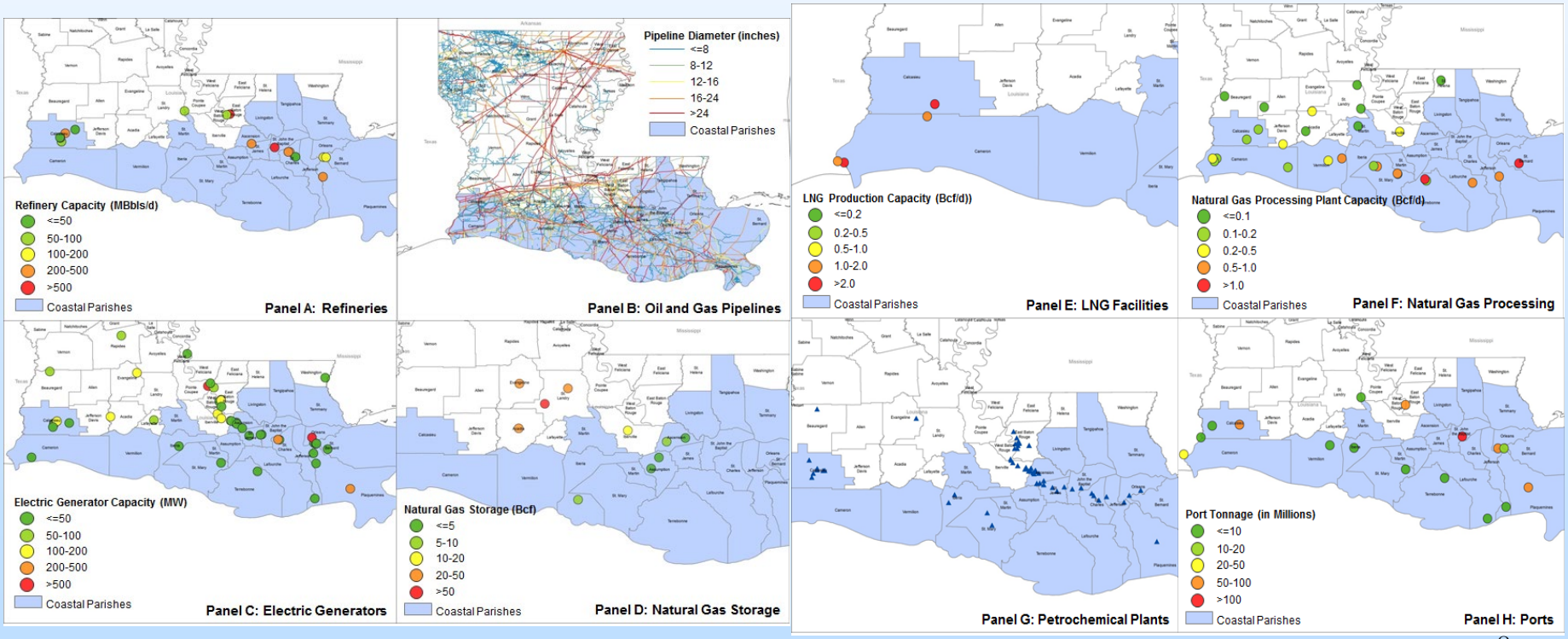
Most of the Louisiana industrial CO_2 emissions are concentrated in the chemical and refining sectors. Natural gas processing is a distant third.



Source: U.S. EPA Envirofacts.

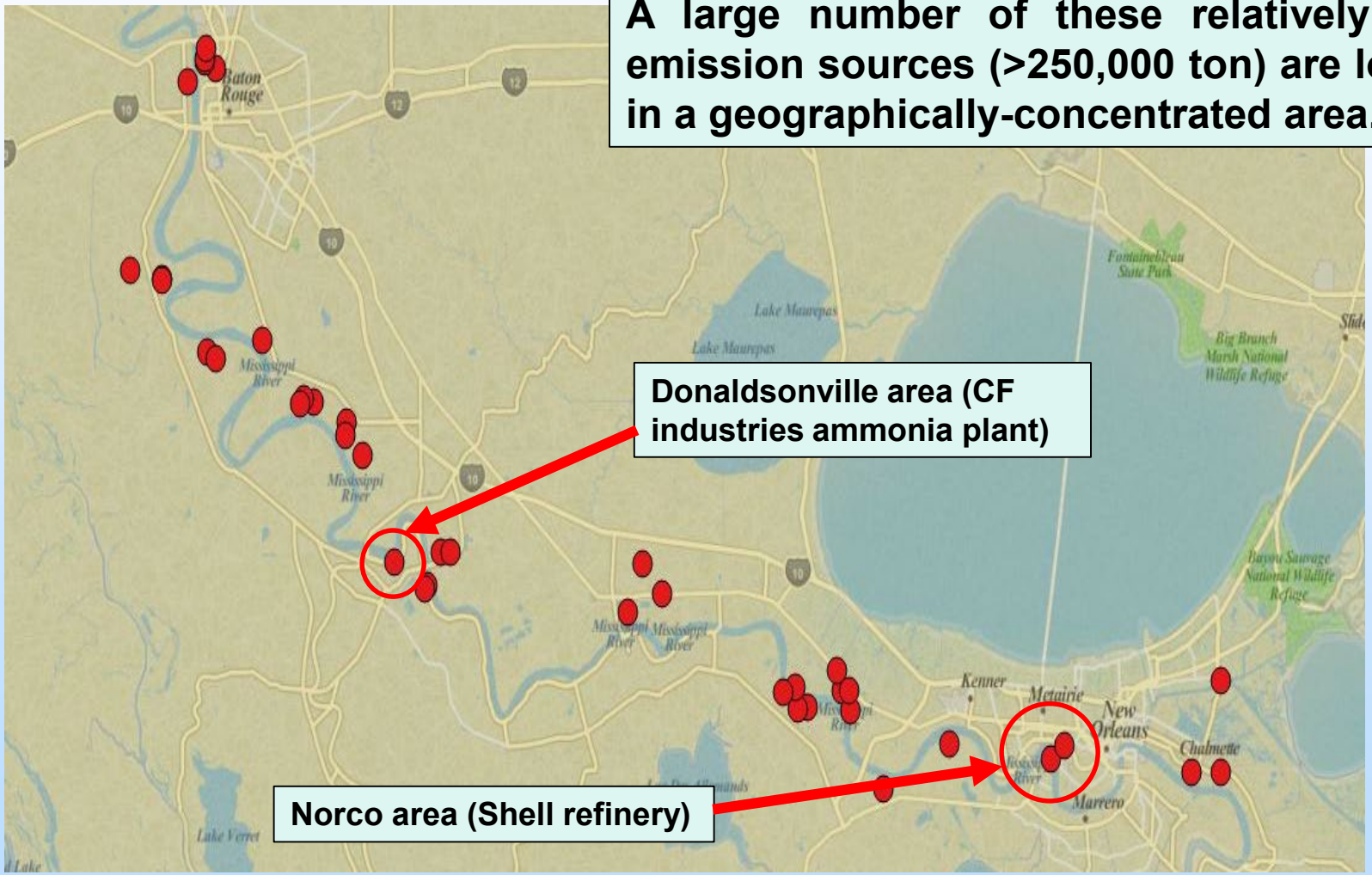
Louisiana's critical energy infrastructure

Refineries, certain petrochemical facilities, and gas processing facilities can serve as important carbon sources. The existing pipeline and storage infrastructure underscores opportunities for linking potential sources and sinks.



Industrial Sources (corridor)

A large number of these relatively high-emission sources (>250,000 ton) are located in a geographically-concentrated area.



Top Sources (totals)

Facility	City	2014 CO_2 Emissions (mt)	CO_2 Purity	Facility Type	NAICS
Big Cajun 2	New Roads	10,624,054	Low	Power Plant	221112
Brame Energy Center	Lens	6,725,251	Low	Power Plant	221112
ExxonMobil Baton Rouge	Baton Rouge	6,245,428	Mostly Low	Refinery	324110
CF Industries Nitrogen	Donaldsonville	5,388,579	High	Petrochemical	325311
CITGO Lake Charles	Sulphur	4,766,415	Mostly Low	Refinery	324110
Marathon Petroleum Company	Garyville	3,930,022	Mostly Low	Refinery	324110
Norco Manufacturing Complex	Norco	3,527,991	Mostly Low	Refinery	324110
R S Nelson	Westlake	3,513,465	Low	Power Plant	221112
Dolet Hills Power Station	Mansfield	2,943,833	Low	Power Plant	221112
Saint Charles Operations - Dow	Taft	2,881,974	Mostly Low	Petrochemical	325199

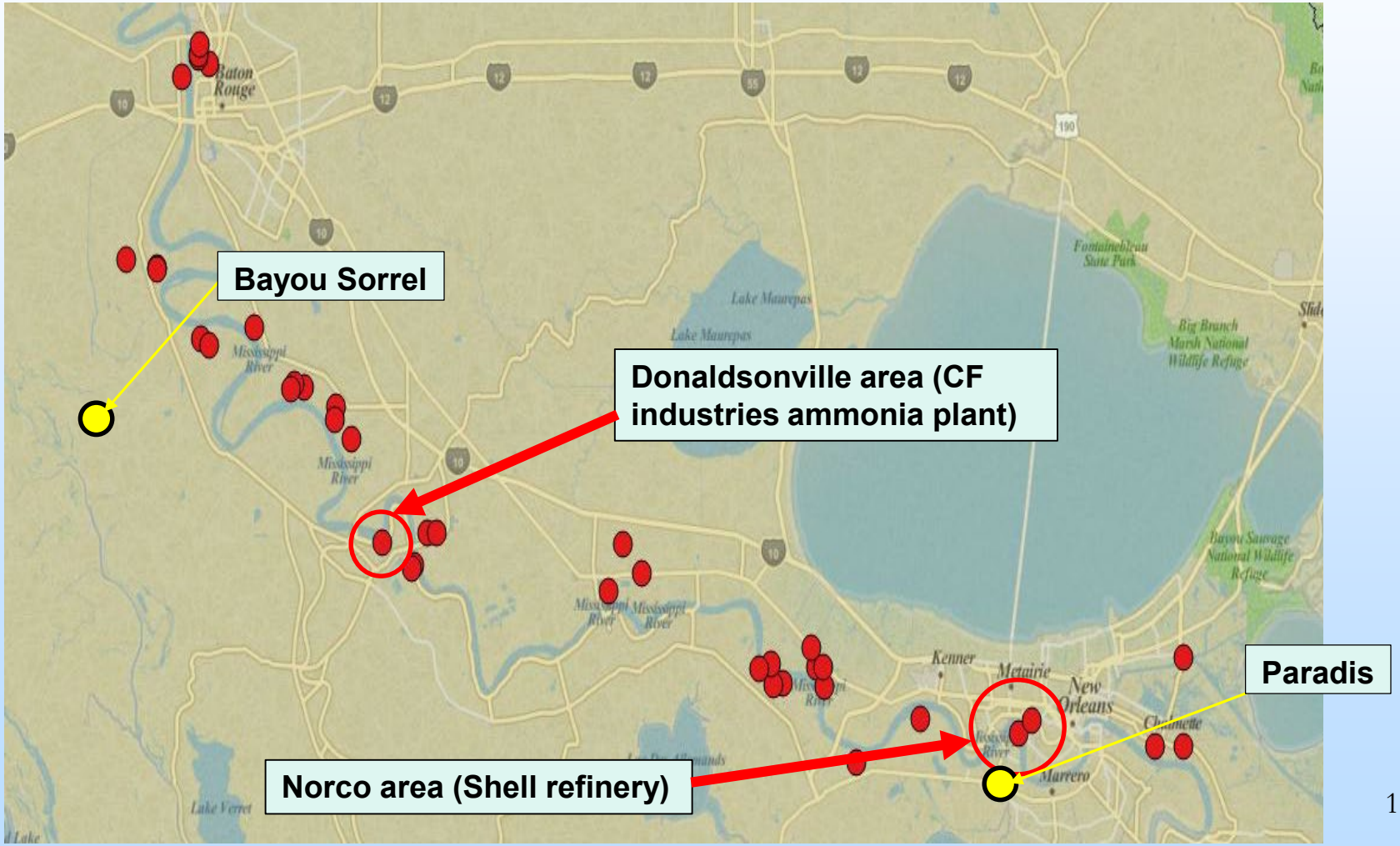
Storage Site Selection

- **Site selection criteria**:
  - Proximity to CO_2 sources
  - Large storage capacity
  - Potential for CO_2 containment

- **Site specific data collection from public sources**
  - Initial site screening by Louisiana Geological Survey*
  - Well logs (to estimate capacity)
  - Well data (active and abandoned)
  - Well history data (cement tops and plugging data)

Source: *Chacko John, Warren Schulingkamp, Bobby Jones, Brian Harder & Reed Bourgeois, (2011). "Potential for Carbon Dioxide Sequestration in Five Fields along the Mississippi River Industrial Corridor in Louisiana", LGS, LSU.

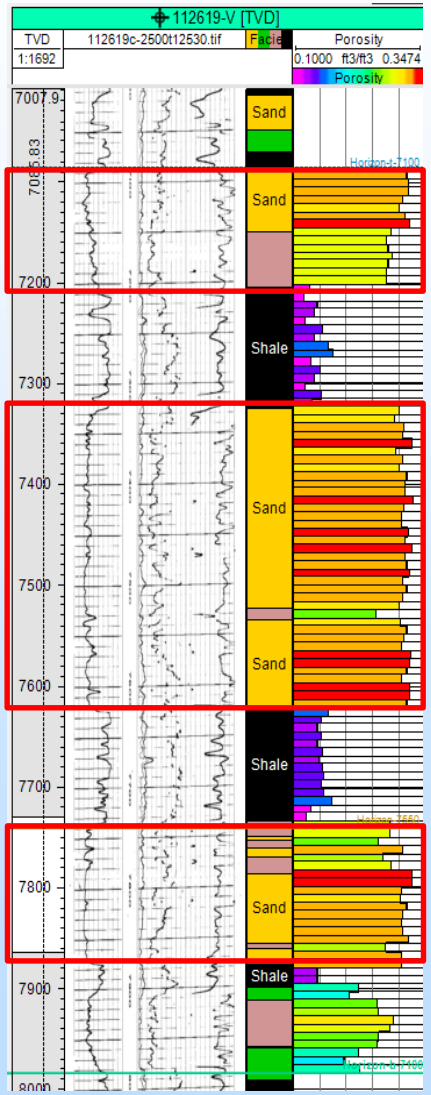
Selected Depleted Oil Fields



Common Sites Features

- **Multiple storage zones with stacked sand systems**
- **Thick zones (up to several hundred ft.)**
- **High porosity and high permeability**
- **Normal hydrostatic pressure ~0.465 psi/ft**

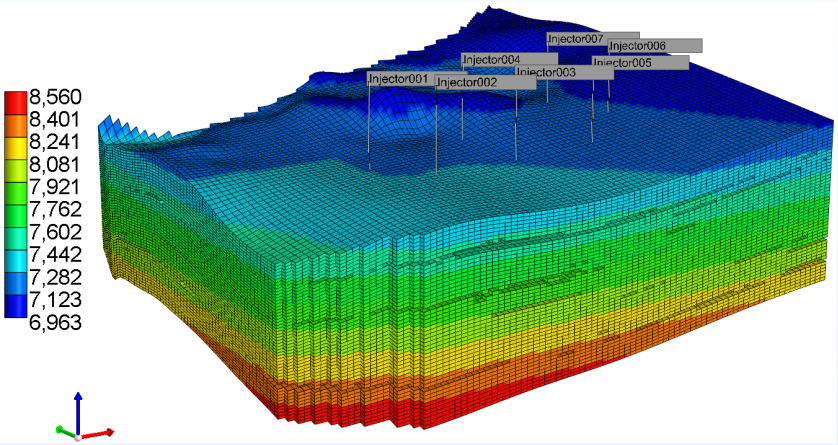
	Cum oil (MMSTB)	Cum gas (BSCF)	Total wells	Currently prod. wells*
Bayou Sorrel	44	190	176	3
Paradis	156	1350	411	16



* Current production intervals are deeper than 10,000 ft

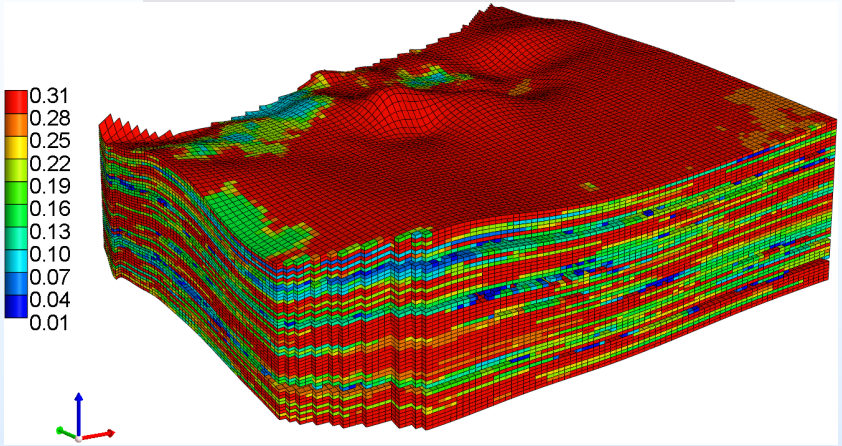
Bayou Sorrel Petrophysical Data

Zone Depth (ft)



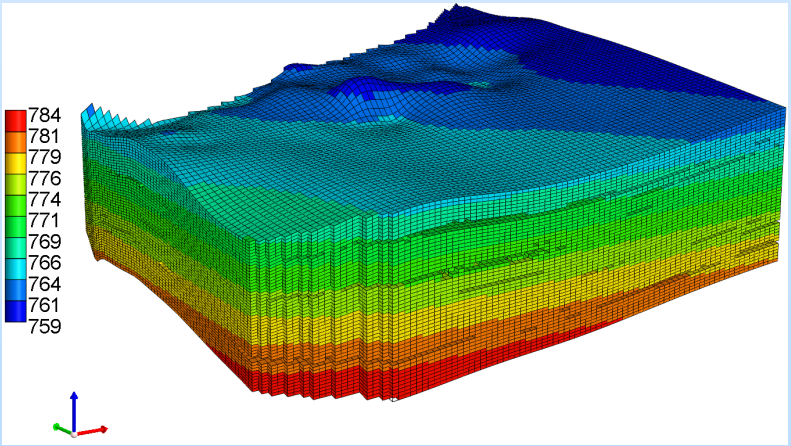
Average thickness = 998 ft

Porosity



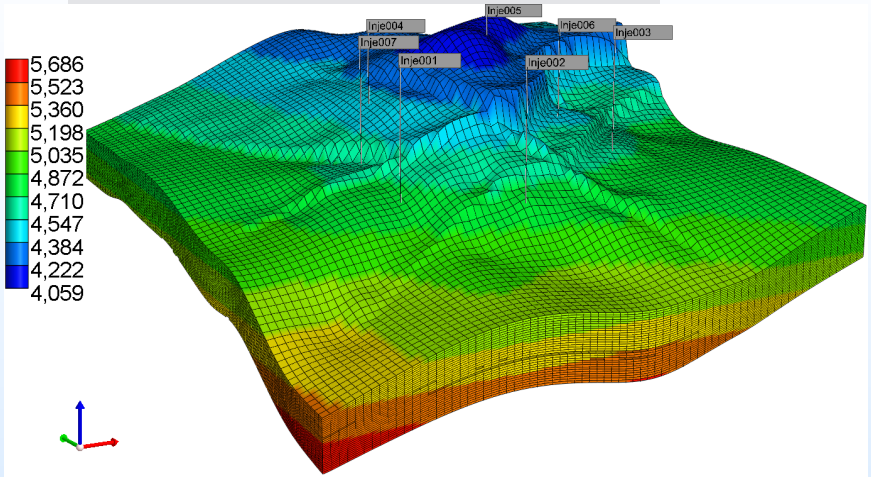
Average Porosity = 0.28

CO_2 Density (kg)



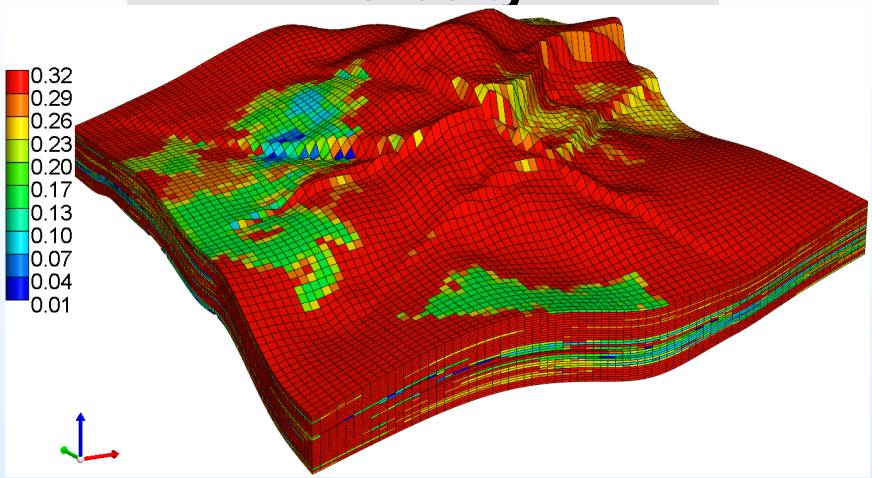
Paradis Petrophysical Data

Zone Depth (ft)



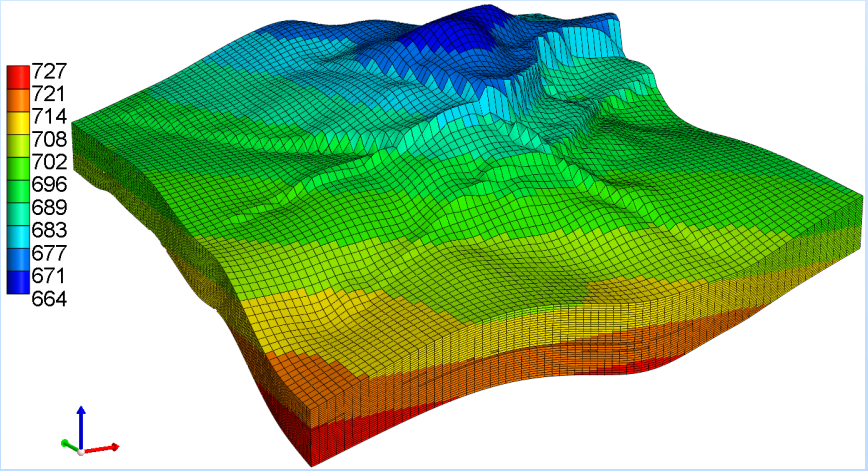
Average thickness = 350 ft

Porosity



Average Porosity = 0.3

CO_2 Density (kg)

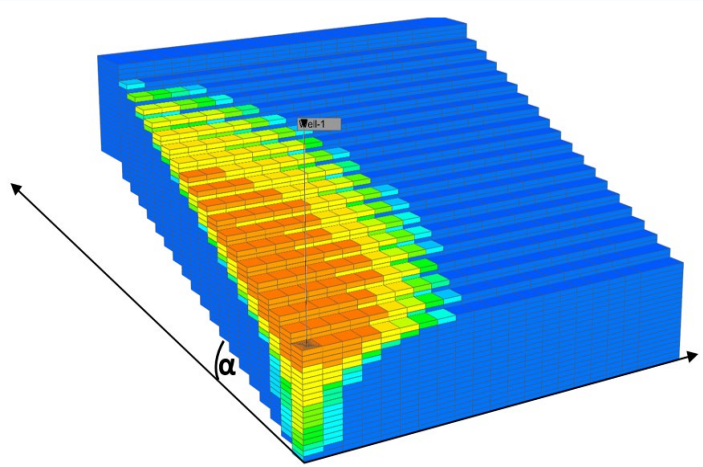


Storage Capacity

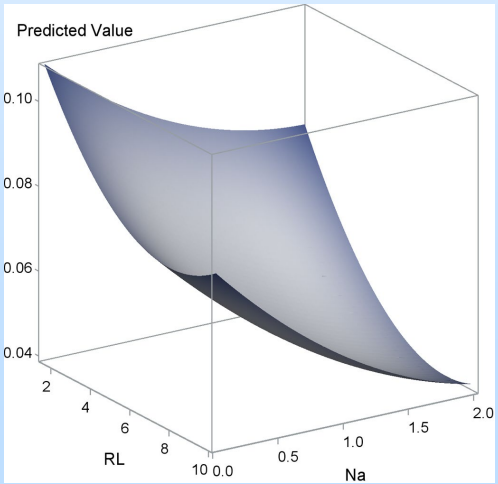
Static Model	Bayou Sorrel	Paradis
Average depth to top of potential storage zone (ft)	7300	4300
Average thickness of potential storage zone (ft)	990	350
Average porosity of potential storage zone (fraction)	0.280	0.300
Average CO2 density (kg/m3)	771.1	714
Static storage efficiency (fraction)	0.020	0.020
Static storage capacity (Mt)	133	84
Static capacity per unit volume (Kg/m3)	4.318	4.284

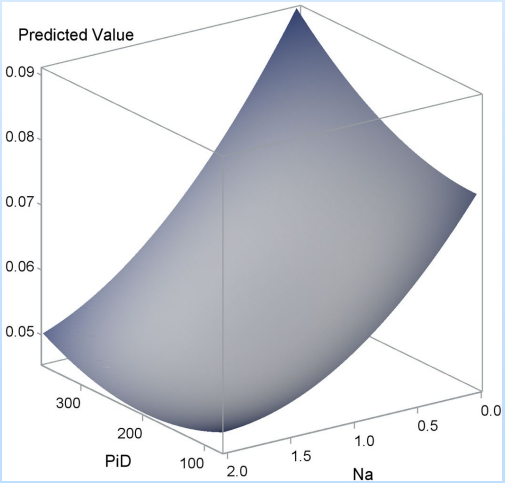
Dynamic Model Parameters	Bayou Sorrel	Paradis	
		Transmissive Faults	Non-transmissive Faults
No. of wells	7	7	7
Dynamic Capacity (Mt)	129	124	71
Storage efficiency (fraction)	0.019	0.043	0.025
Dynamic capacity (Kg/m3)	4.20	9.29	5.33

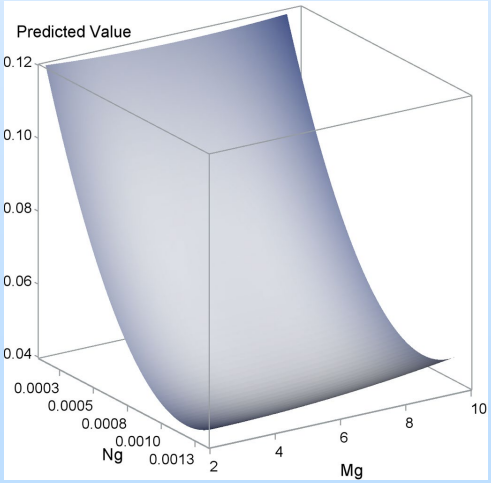
Dynamic Storage Efficiency



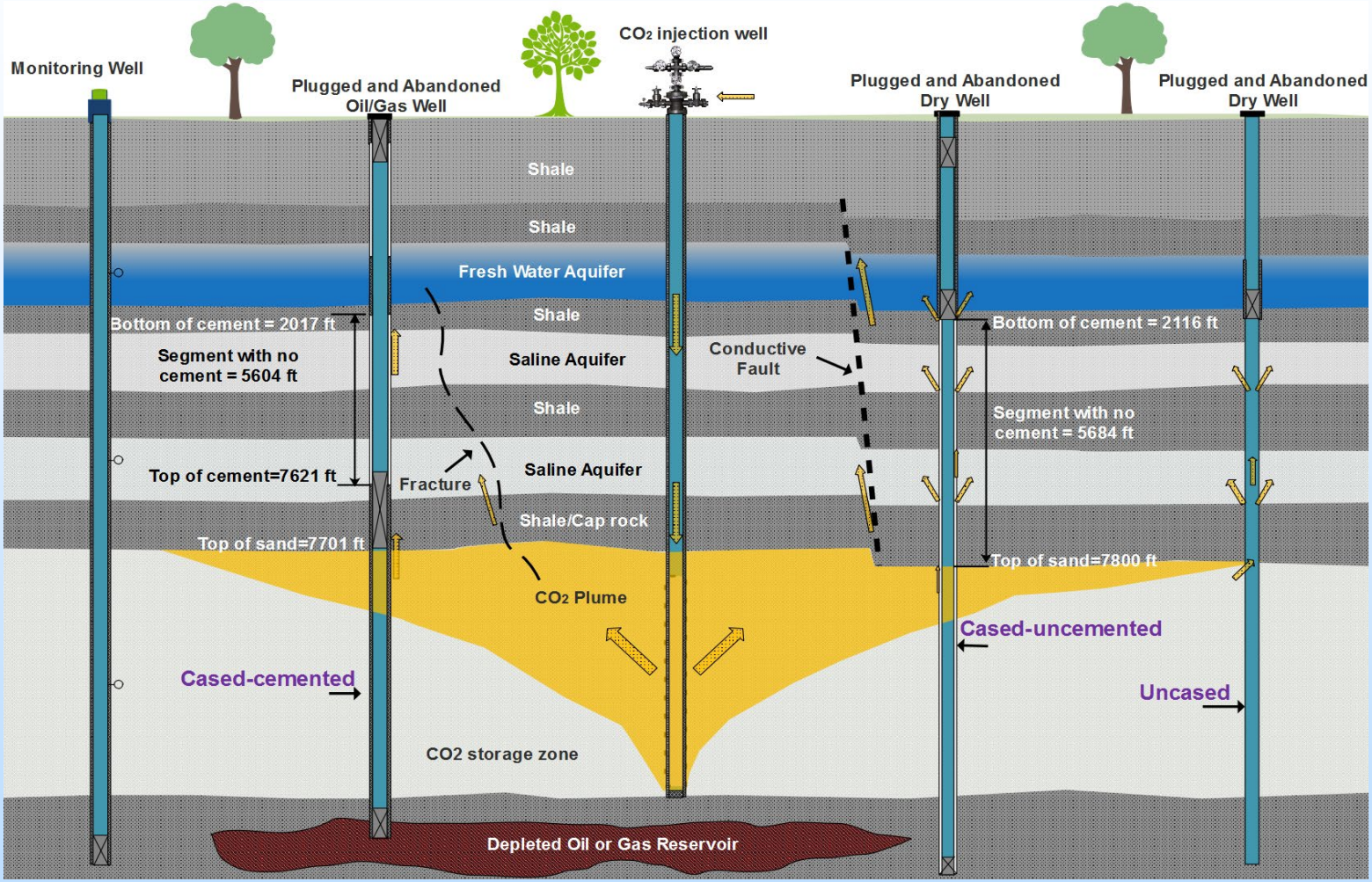
Dimensionless Group	Min	Max
N_α	0.1957	1.8608
R_L	2.1447	9.4056
M_g	2.7871	8.9555
$N_g \times 10^{-3}$	0.2017	1.2446
S_{wr}	0.1002	0.3975
P_{iD}	96	339







Wellbore/fault CO_2 Leakage



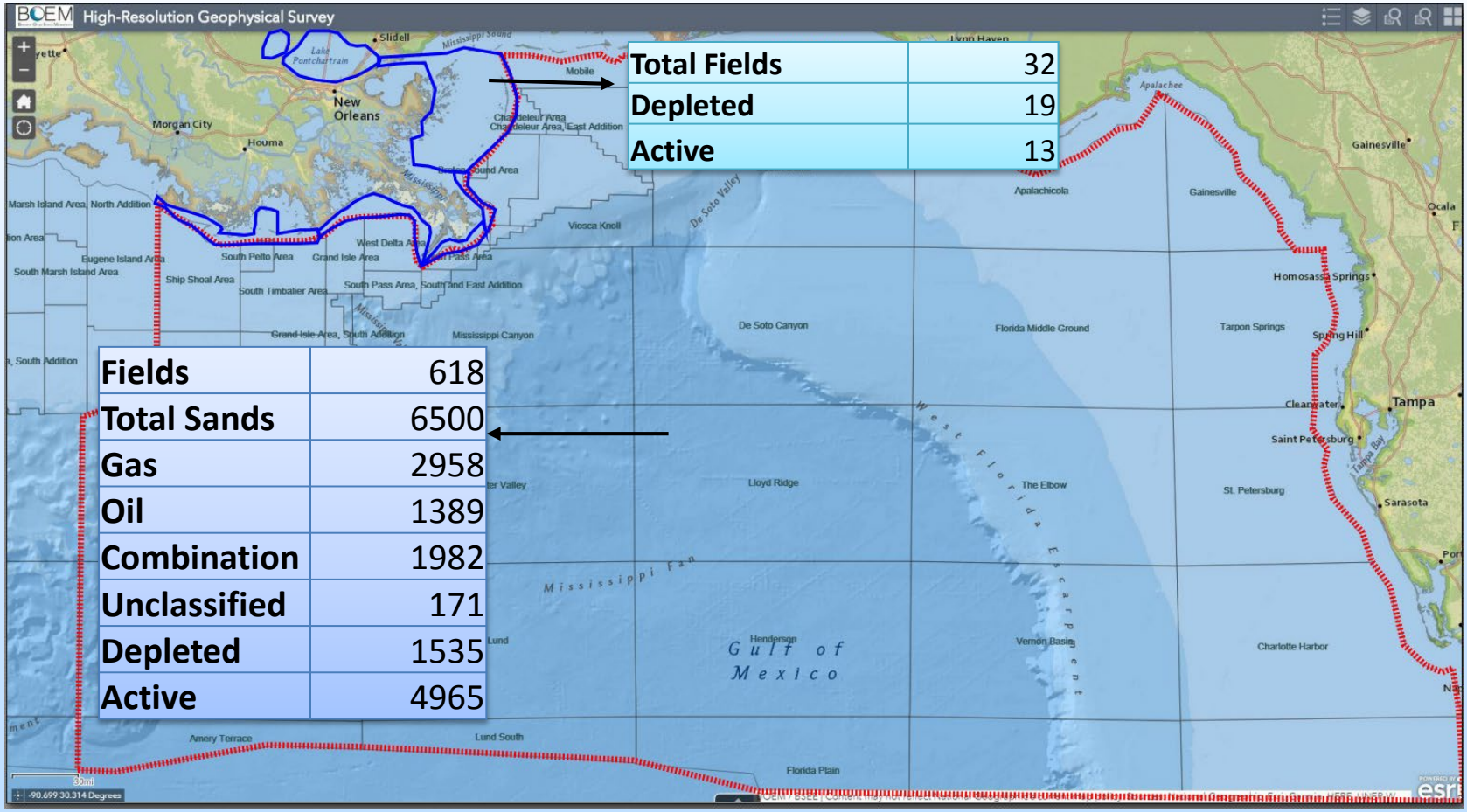
LSU tasks for SECARB Offshore GOM project

Task 3: Offshore Storage Resources Characterization

Task 4: Risk Assessment, Simulation, and Modeling

Task 5: Monitoring, Verification, and Accounting

LSU Contributions (Cont'd): depleted and active hydrocarbon reservoirs

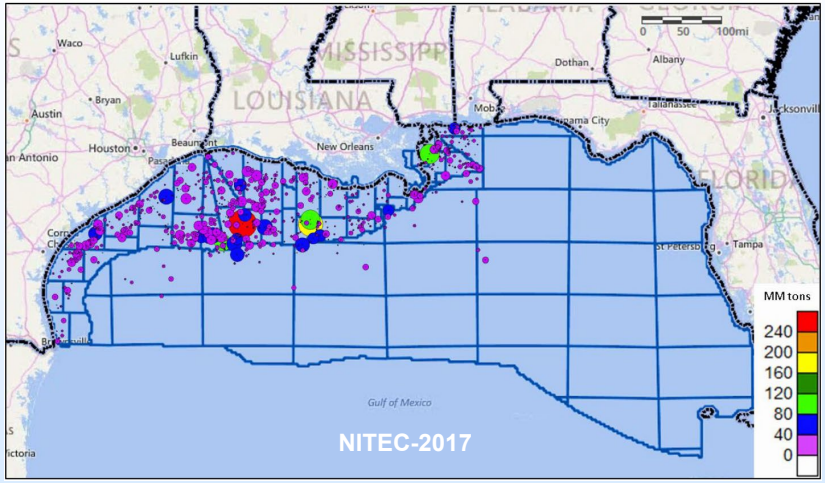


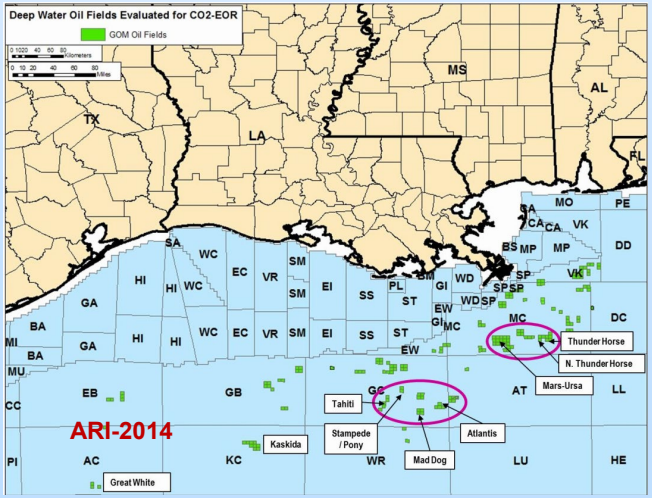
Total Fields	32
Depleted	19
Active	13

Fields	618
Total Sands	6500
Gas	2958
Oil	1389
Combination	1982
Unclassified	171
Depleted	1535
Active	4965

Previous studies

- CO_2 Storage Capacity Estimate
  - NITEC-2017 (Depleted sands in Federal waters GoM)
  - BEG (SECARB, Phase3, 2011)
- CO_2 EOR
  - ARI-2014 (CO_2 -EOR Offshore Resource Assessment)
- Cost and benefits
  - ICF International (2012), NETL reports and spreadsheets
- Monitoring, Verification, and Accounting
  - Carbon Sequestration Leadership Forum (2017)





Data gathering: characterization

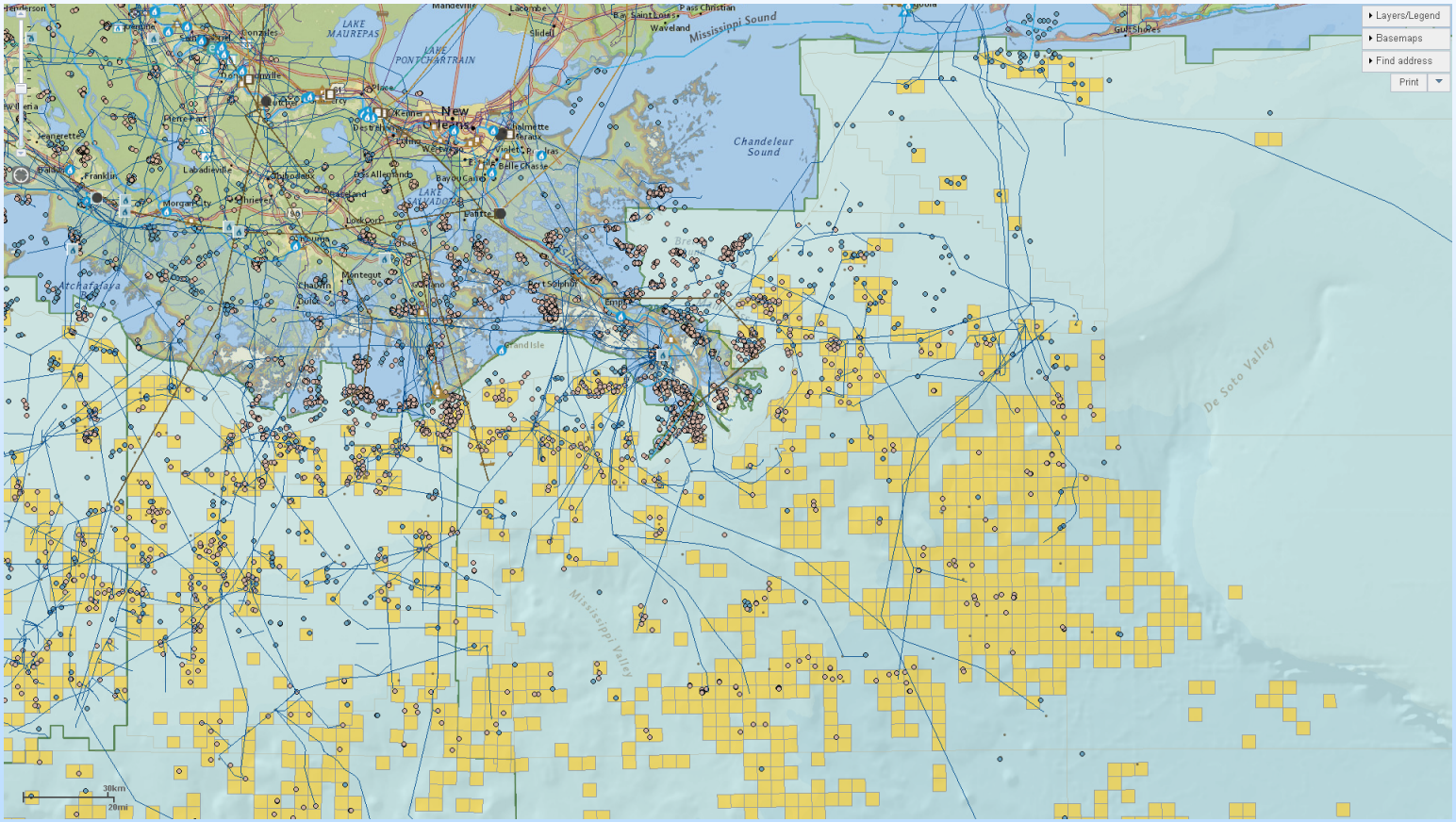
Work is in progress to

- Collect & analyze sand data: Pore Volumes, Cumulative production, Pressure, Temperature, Drive mechanisms, Recovery factors for depleted sands

- Define a strategy to estimate/verify recovery factors for actively producing sands and extend to include recovery with EOR

Data gathering: Facilities

Work is in progress to collect data of exiting or planned facilities to be incorporated into considering the potential fields

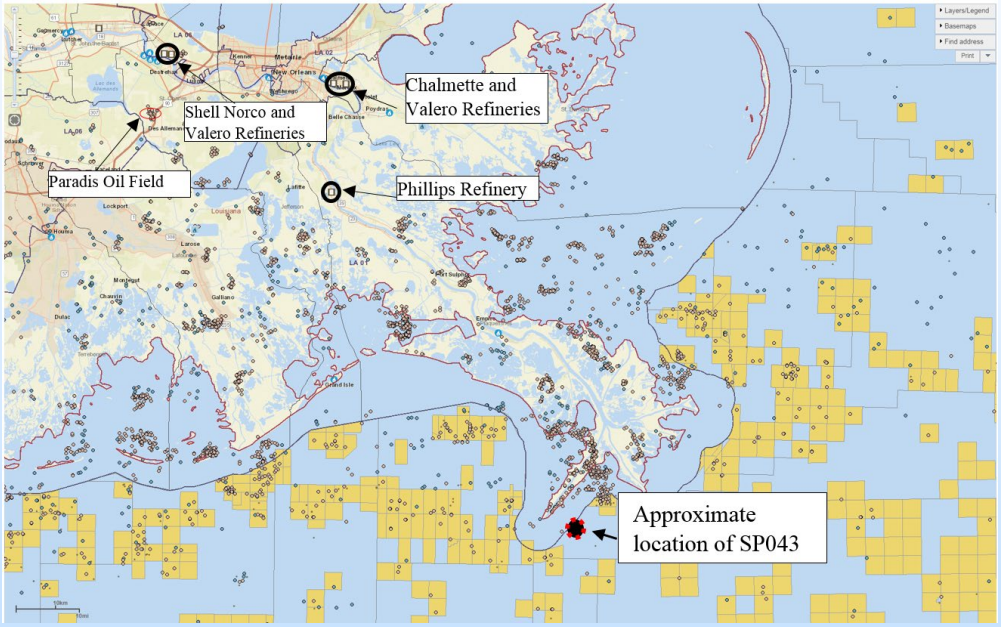


Source: EIA

Detailed field study identification

- Field South Pass Block 43 (SP043) was selected

- Field selection criteria:
  - Short source-sink distance
  - Least number of wells
  - Shallow water depth (108 ft)
  - Storage zone not very deep (6,348 ft)
  - Recently depleted
  - Existing near infrastructure
  - Reservoir confined to a single block



Conclusions

- Initial phase of literature review for most relevant past studies is performed to collect required data while avoiding repetition. Detailed literature review is in progress;
- Collection of sand and production data necessary for storage analysis is in progress from BOEM online data base and relevant past studies;
- Data Collection (from SONRIS) and analysis for state waters is in progress;
- Facilities data collection and analysis is in progress to apply a source-sink matching criteria;
- Based on the initial data and following a risk based criteria, a depleted field has been selected for detailed study.

Questions?

Thank you