Southeast Offshore Storage Resource Assessment (SOSRA)

Fast Tracking Infrastructure Development for Future Offshore CO^2 Storage

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SECARB Southeast Regional Carbon Sequestration Partnership

NETL National Energy Technology Laboratory

Bureau of Economic Geology

GCCC Gulf Coast Carbon Center

EPRI Electric Power Research Institute

Advanced Resources International, Inc.

Southern Company

Denbury

Task 6.0 - Best Practices

SOSRA TASK OBJECTIVE

Assist DOE in developing and advancing technologies that will significantly improve the effectiveness and reduce the cost of implementing offshore carbon storage, and be ready for widespread commercial deployment in the 2025–2035 timeframe.

SOSRA PROJECT APPROACH

Focus on best practices for CO_2 infrastructure development in support of offshore CO_2 storage (including storage with utilization) in the Gulf of Mexico.

CO_2 Infrastructure may be Poised for Rapid Development

- The recently passed Bipartisan Budget Act of 2018 (The Budget Act) may lead to more rapid development of CCUS projects in the United States.
- Proper planning of necessary onshore infrastructure could greatly improve the financial viability for future offshore projects.

FUTURE Act

- The Budget Act included language from the **F**urthering carbon capture, **U**tilization, **T**echnology, **U**nderground storage, and **R**educed **E**missions (FUTURE Act). The FUTURE Act provides for tax credits (45Q) for CO_2 capture, utilization, and/or storage.
- 45Q provides a tax credit of
  - $12.83 per metric ton captured rising to $35 per metric ton captured in the next 10 years for CO_2 utilization
  - $22.66 per metric ton captured rising to $50 per metric ton captured in the next 10 years for geologic storage without utilization
- Construction must begin prior to January 1, 2024
- Credit is received for 12-year period after equipment is originally placed in service

Offshore Projects Are Eligible for 45Q

- Within the 45Q legislative language only “carbon oxide captured and disposed of or used within the United States” is eligible. The credit shall apply only with respect to qualified carbon oxide the capture and disposal, use, or utilization of which is within:
  I. The United States (within the meaning of Section 638(1)); or
  II. A possession of the United States (within the is meaning of section 638 (2))

Definition of Section 638 1 & 2

I. The term “United States” when used in a geographical sense includes the seabed and subsoil of those submarine areas which are adjacent to the territorial waters of the United States and over which the United States has exclusive rights, in accordance with international law, with respect to the exploration and exploitation of natural resources; and

II. The terms “foreign country” and “possession of the United States” when used in a geographical sense include the seabed and subsoil of those submarine areas which are adjacent to the territorial waters of the foreign country or such possession and over which the foreign country (or the United States in case of such possession) has exclusive rights, in accordance with international law, with respect to the exploration and exploitation of natural resources, but this paragraph shall apply in the case of a foreign country only if it exercises, directly or indirectly, taxing jurisdiction with respect to such exploration or exploitation.

45Q Implementation and Final Regulations

- Final implementation and regulation of 45Q will require input and guidance from U.S. Treasury and the U.S. Environmental Protection Agency (EPA) for onshore CO_2 storage.
- The Department of Energy recently updated its Best Practices Manuals (2017) for onshore CO_2 geologic storage and utilization
- Offshore storage (including storage with utilization) will be managed by the Bureau of Ocean Energy Management (BOEM) and regulated by the Bureau of Safety and Environmental Enforcement (BSEE).
- BOEM is working on Best Practice Manuals for offshore CO_2 geologic storage and utilization.

2017 DOE-NETL update of Best Practice Manuals

The five 2017 Revised Edition BPMs are:

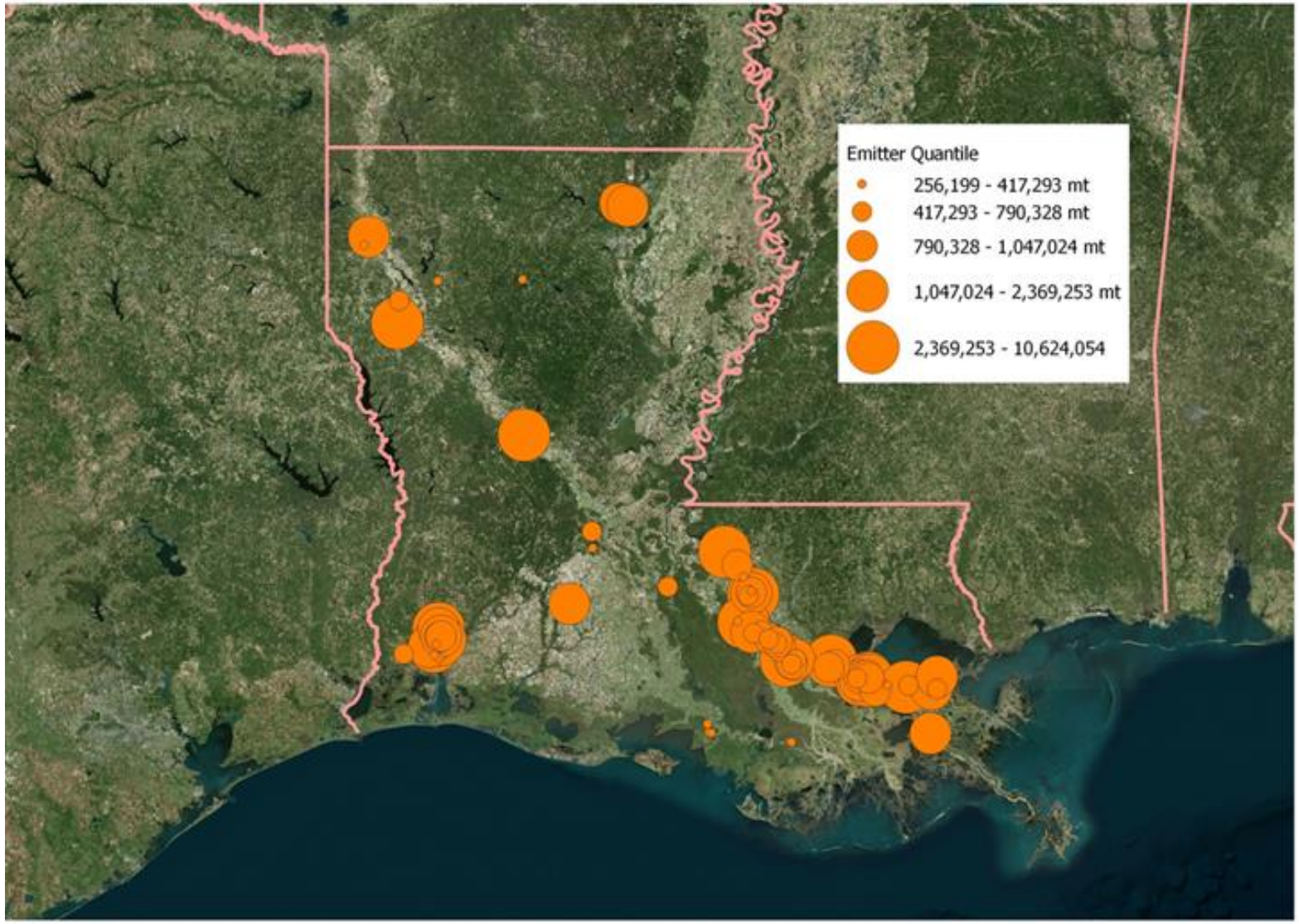
- **BEST PRACTICES:** Site Screening, Site Selection, and Site Characterization for Geologic Storage Projects
- **BEST PRACTICES:** Public Outreach and Education for Geologic Storage Projects
- **BEST PRACTICES:** Risk Management and Simulation for Geologic Storage Projects
- **BEST PRACTICES:** Operations for Geologic Storage Projects
- **BEST PRACTICES:** Monitoring, Verification, and Accounting (MVA) for Geologic Storage Projects

https://www.netl.doe.gov/research/coal/carbon-storage/strategic-program-support/best-practices

CO_2 Infrastructure Development Opportunity

- Within the Central Gulf Coast Region there are many areas that could benefit from CCUS, both on-shore and off-shore.
- In 2016 SSEB, with assistance from DOE, determined that Louisiana and its industrial corridor along the Mississippi River is uniquely situated to benefit from an integrated CCUS system.
- Additional pipeline infrastructure is needed to connect the Louisiana Industrial Corridor to onshore oilfields with potential for CO_2-EOR.
- Pipeline infrastructure can be sized to allow for expansion into state and federal offshore waters with a relatively small increases in overall spending.

Stationary CO_2 Emitters (2014) Showing a Concentration Along the Mississippi River Industrial Corridor

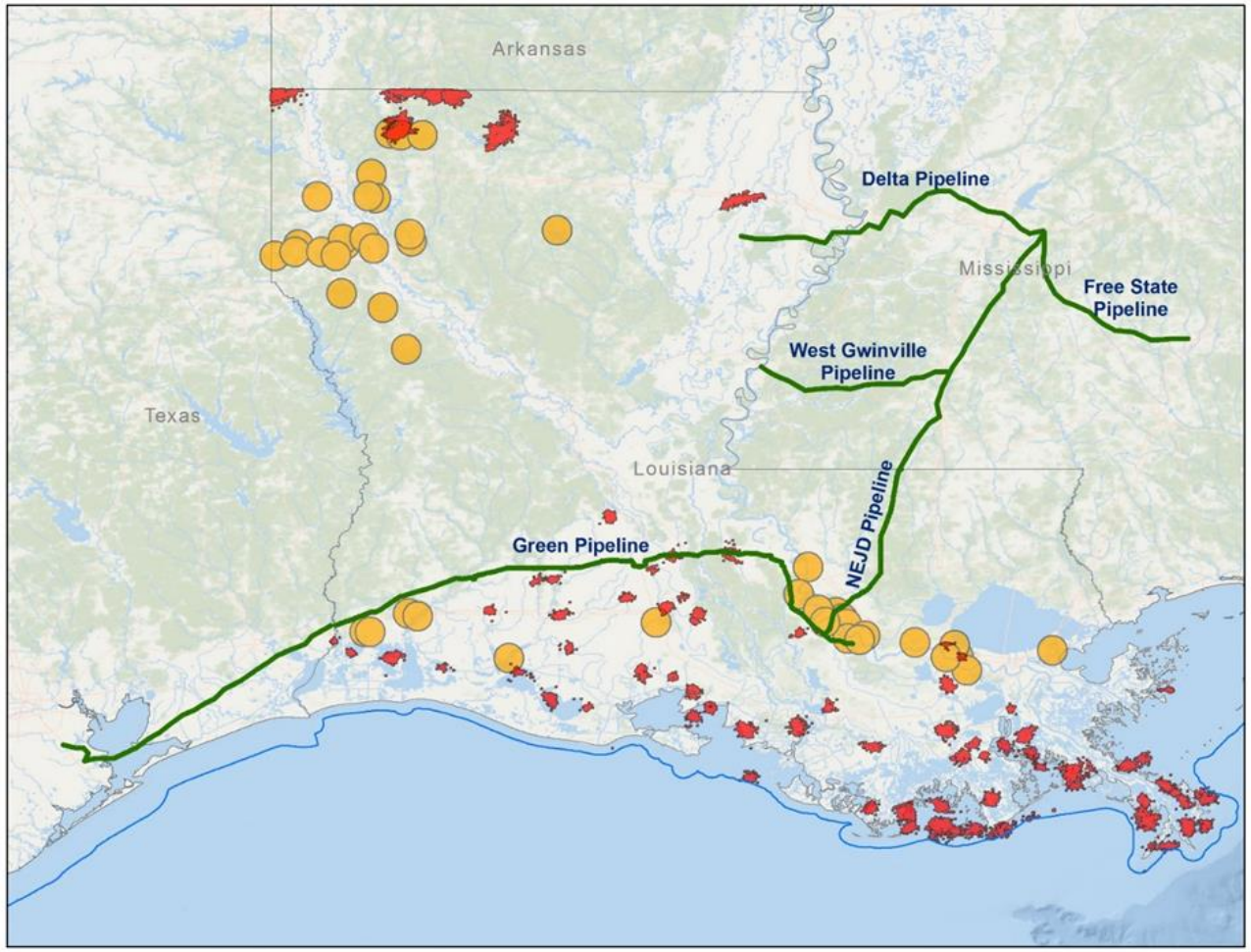


Sources: LSU | Center for Energy Studies (preliminary analysis)
Environmental Protection Agency

Louisiana CO_2-EOR Opportunities

- Potential high quality industrial sources in Louisiana (natural gas processing, ammonia, hydrogen production, and ethylene oxide production) along with existing CO_2 pipeline infrastructure and candidate EOR fields.
- Working from data in DOE publication 2013/1602 *Cost of Capturing CO_2 from Industrial Sources* the focus became high purity emitters & hydrogen units.

Low Purity(<90 vol %)	High Purity (>90 vol %)
Hydrogen(Refinery)	Natural Gas Processing
Iron/Steel	Ammonia
Cement	Ethylene Oxide
	Ethanol



Industrial CO_2 Vents

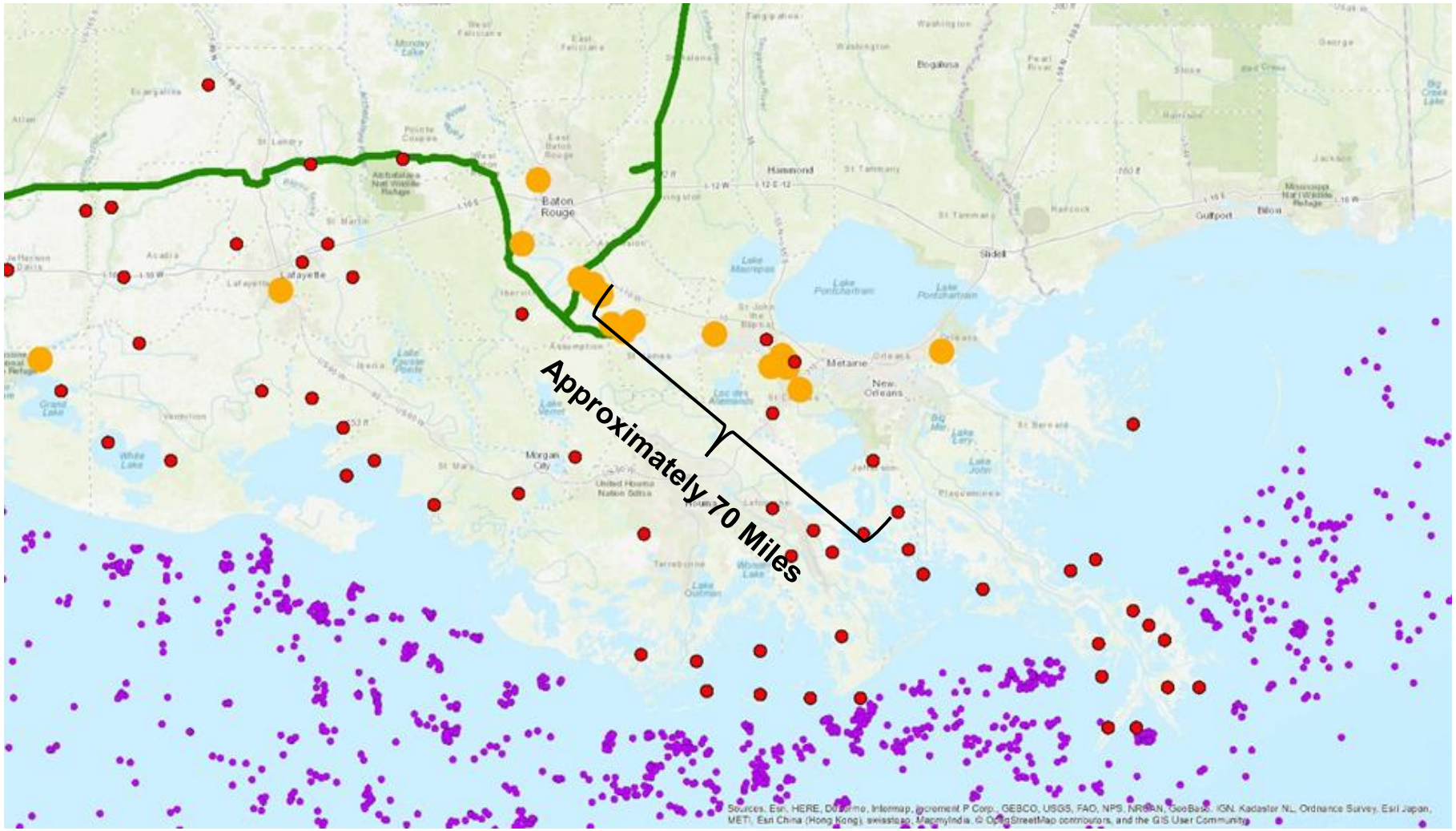
Existing CO_2 Pipeline

Candidate EOR Oil Fields

Source: LSU Center for Energy Studies

Source: DOE/NETL-2013/1602

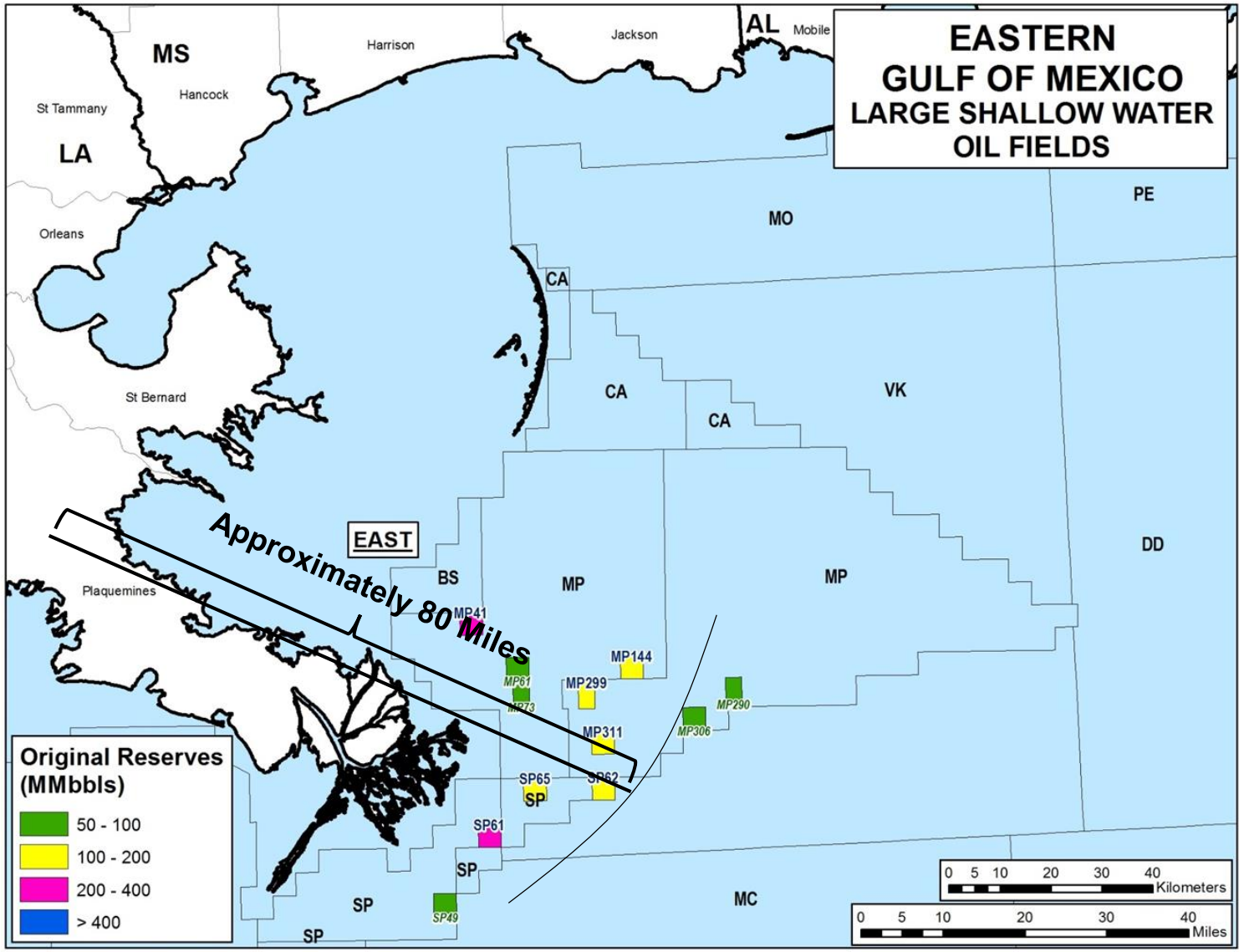
Potential Onshore & Near Shore Opportunities



- Industrial CO_2 Vents
- Candidate EOR Oil Fields
- Existing CO_2 Pipeline
- Offshore Oil Fields

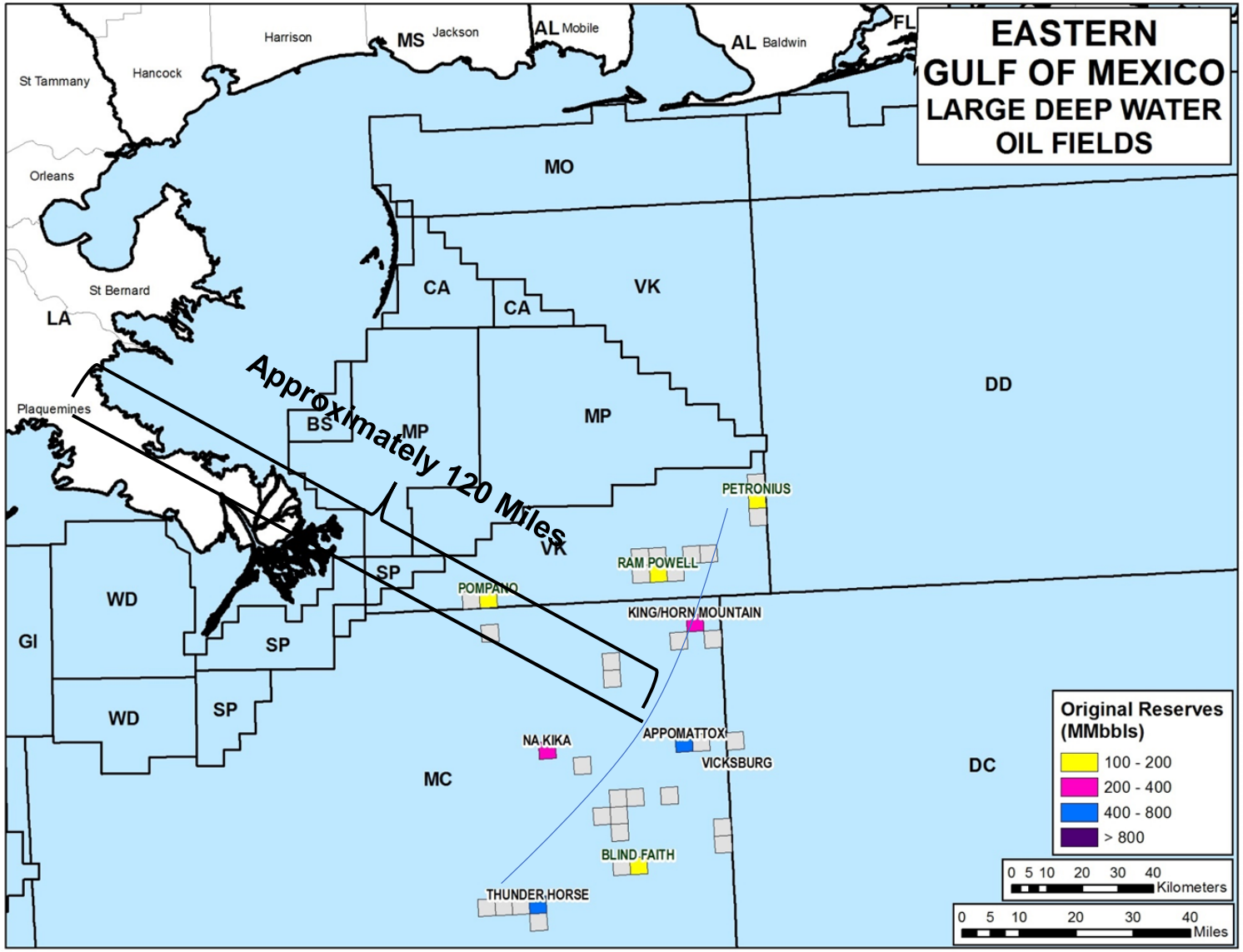
Source: LSU Center for Energy Studies

Eastern Gulf of Mexico Shallow Federal Water



Source: Advanced Resources International, Inc.

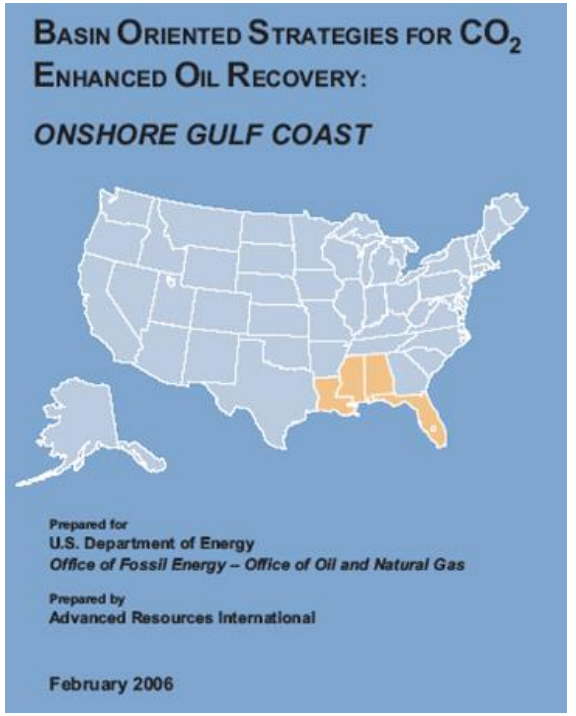
Eastern Gulf of Mexico Deep Federal Water



Source: Advanced Resources International, Inc.

Benefits of Establishing CO_2 Utilization, Storage, and Pipeline Systems for the Eastern Gulf of Mexico

- DOE study estimated that Louisiana contains 128 onshore reservoirs that are candidates for miscible CO_2-EOR
- Under “Traditional Practices” 3 million barrels could be recovered, with estimated royalties of $10.6 million.
- Under “State-of-the-Art” Technology 129 million barrels could be recovered, with estimated royalties of $454 million.
- Under “More Favorable Financial Conditions” and “Risk Mitigation Incentives” 1,117 million barrels could be recovered with estimated royalties of $5.2 billion.
- Under “More Favorable Financial Conditions” and “Low Cost CO_2 Supplies” 1,916 million barrels could be recovered with estimated royalties of $9.0 billion.



“With oil recovery of 1.89 billion barrels, an oil price of $72 per barrel (EIA AEO 2017 projected oil price for Year 2020), and a combined shallow and deepwater royalty rate of 18.1%, the Federal Government would receive about $25 billion dollars of royalty revenues from the oil produced using the GOM CO_2 pipeline systems.”

Source: Advanced Resources International

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