

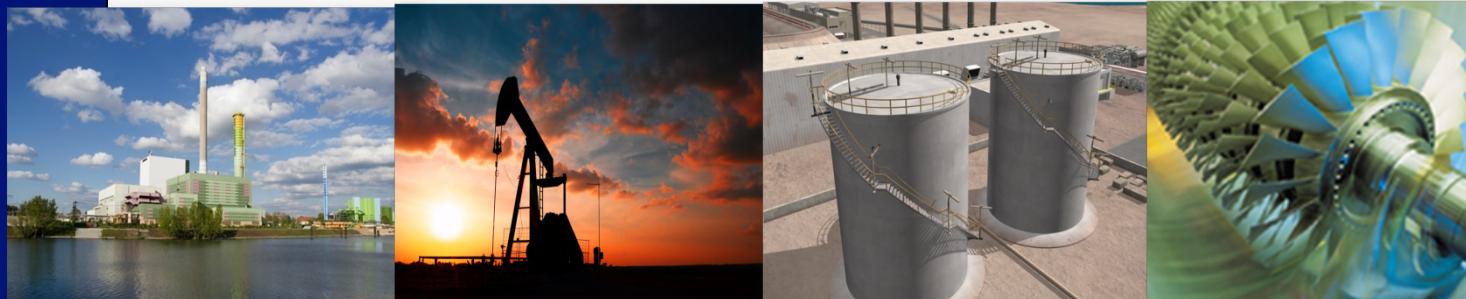


U.S. DEPARTMENT OF
ENERGY

Fossil
Energy

National Energy
Technology Laboratory

Fossil
Energy



USA Offshore Storage

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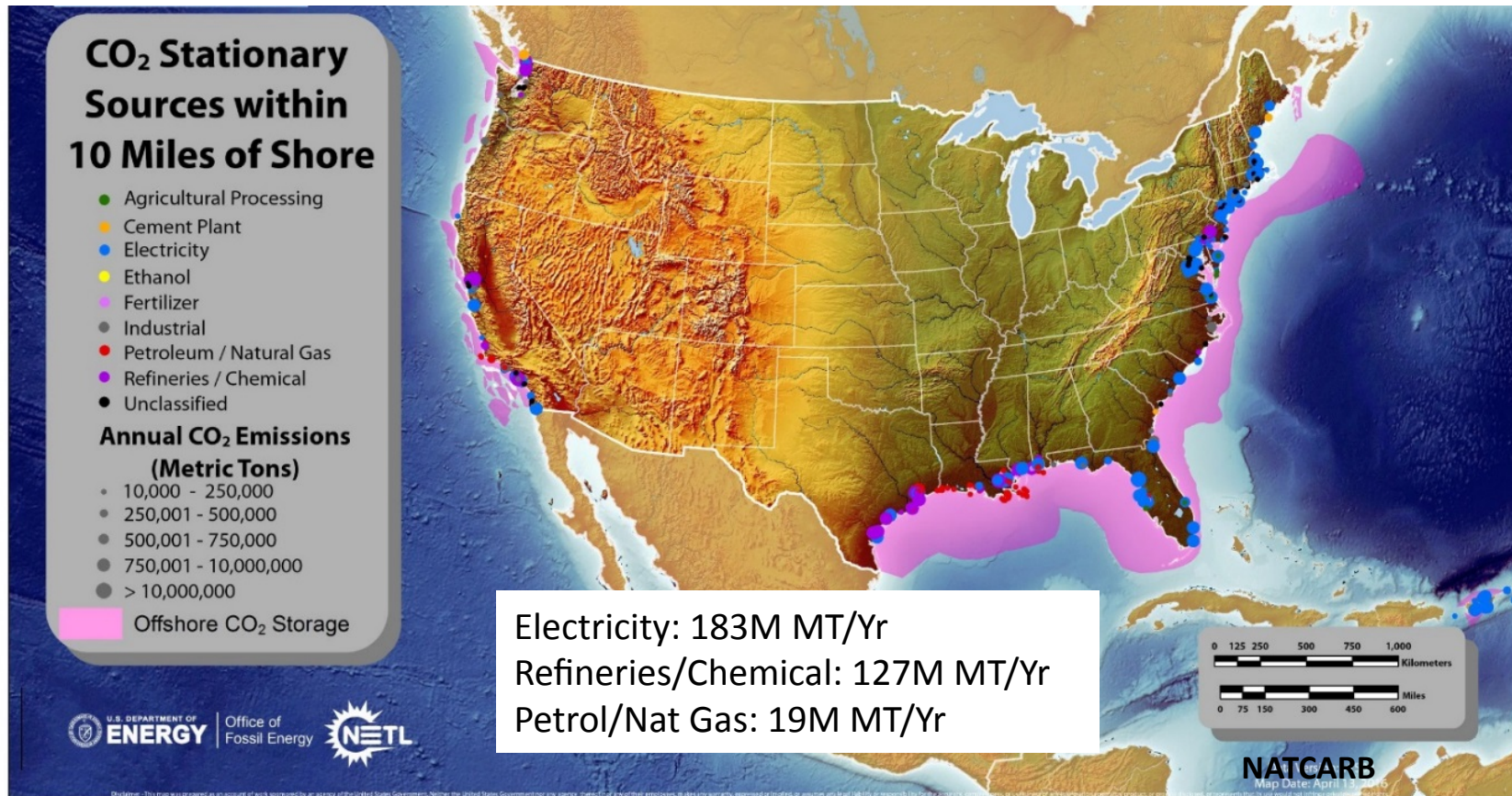
April 20, 2016



Driving Innovation ♦
Delivering Results



CO₂ Sources Within 10 Miles of Shore

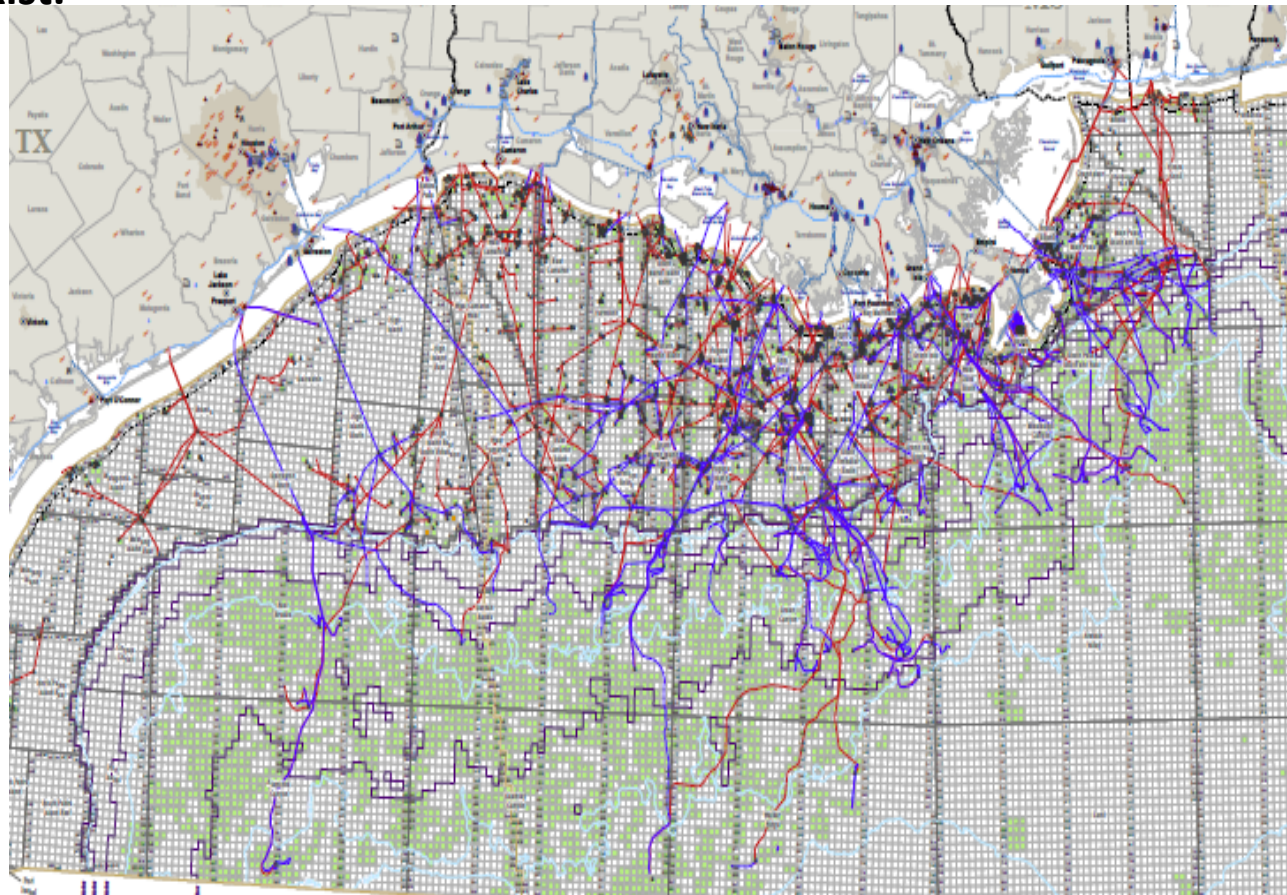


Capture Program Cost of Electricity (CoE) Goals*:

- ❖ 20% reduction with 2nd generation technology (2025 demo)
- ❖ 30% reduction with transformational technology (2030 demo)

Infrastructure and Regulatory Authority

The Department of Interior (DOI), Bureau of Ocean and Energy Management (BOEM) has authority under the Energy Policy Act of 2005 and is in the process of developing regulations to govern outer continental shelf (OCS) CCS projects, but at this time no regulations exist.



Oil Pipelines in Blue
Gas Pipelines in Red

Source: Bureau of Ocean
Energy Management
(BOEM) library

❖ Initial ad hoc Assessments

- SECARB Offshore Storage Assessment (Southeast Regional Carbon Sequestration Partnership)
- American Recovery and Reinvestment Act – 2 projects
 - Texas Gulf Coast; Los Angeles Basin

❖ Systems Engineering & Analysis

- Saline Storage Cost Model (under development) for Offshore Saline Storage
- Associated Storage- CO₂ EOR Performance and cost modeling

❖ Assessment of U.S. offshore areas with highest potential for economical, large-scale CO₂ storage

- Mid-Atlantic (Battelle Memorial Institute)
- South Atlantic; East Gulf of Mexico (Southern States Energy Board)
- Northern and Western Gulf of Mexico – State and Federal waters (NITEC, LLC; Univ. of Texas – Austin; GeoMechanics Technologies)

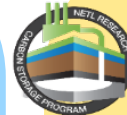
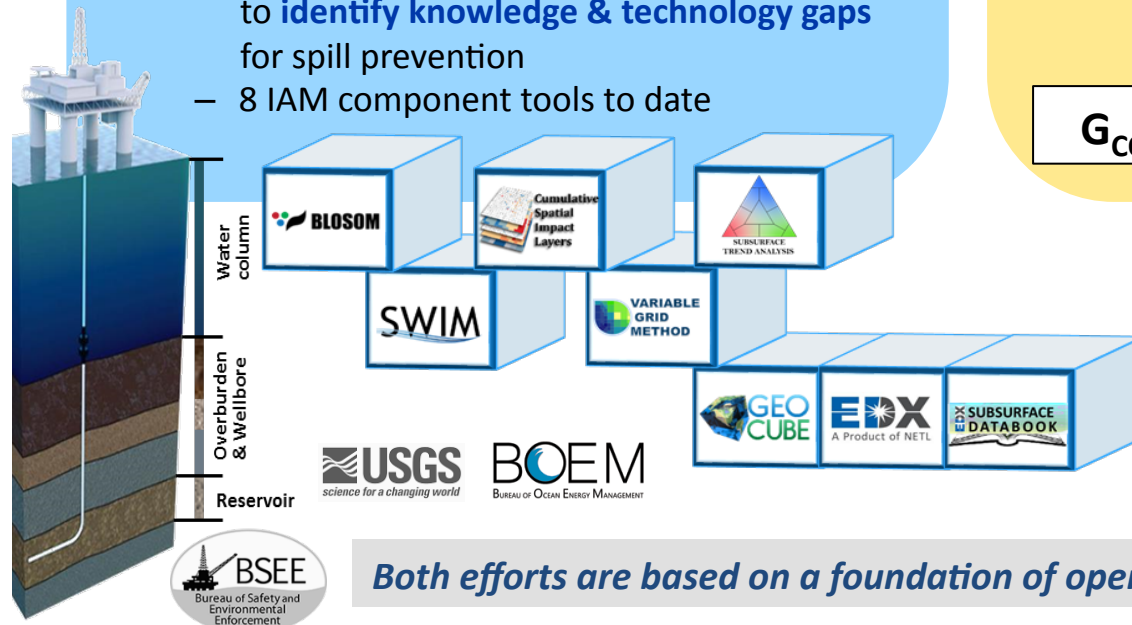
❖ MoU with various countries on Offshore Storage

Building on NETL Research for Offshore



Offshore Hydrocarbon Spill Prevention

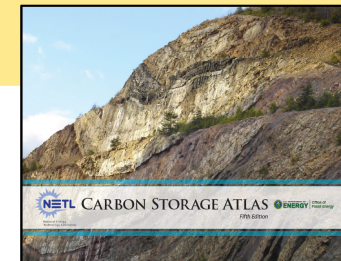
- **7 projects (2011-2015) focused on:**
 - Wellbore integrity
 - Rapid detection and in situ characterization
 - Risk reduction
- **Feeding NETL's Offshore Integrated risk Assessment Model (IAM)**
 - Integrated **modeling and data system**, from subsurface to the shore, developed to **identify knowledge & technology gaps** for spill prevention
 - 8 IAM component tools to date



Offshore Carbon Storage

- **Developing an offshore CO₂ storage methodology**
- **Leveraging off of NETL/DOE's onshore methodology**
- **Addressing key differences with offshore systems including:**
 - Young, immature basin conditions
 - Unconsolidated/unlithified sediments
 - Over-pressured conditions
 - Presence/behavior of natural seeps

$$G_{CO_2} = Ahfr E$$



Both efforts are based on a foundation of open data resources

CO₂ EOR Offshore Challenges

❖ Installation of CO₂ recycling facilities

- Modular subsea facilities
- Large volume facility on central platform
- Onshore recycling

❖ Retrofitting of wells and facilities for corrosion

❖ Optimal well placement

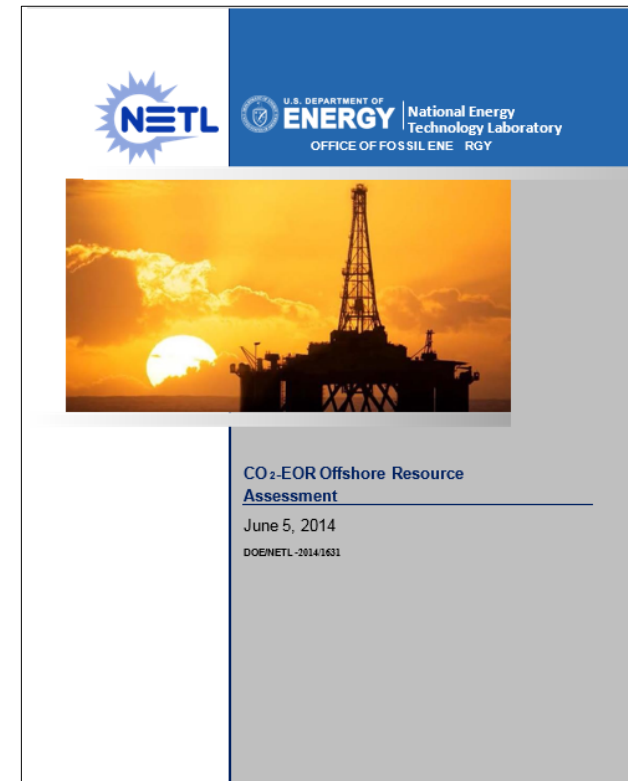
❖ Reservoir characterization to reduce uncertainty

❖ Adequate and affordable CO₂ supply

- Tax credits for capture and storage
- Royalty relief for EOR

❖ Subsea Technology

CO₂ EOR Offshore Assessment (6/5/2014)



CO₂ EOR potential (CO₂ Required):

- 810 MMB (310 MMT CO₂)
- 14,920 MMB (3,910 MMT)

Oil = \$90/bbl

CO₂ price = \$50 / mt

❖ Risk Assessment, Management and Mitigation

- Understanding of Risk associated with offshore Carbon Storage, Enhanced Oil Recovery (EOR) and Oil and Natural Gas Exploration/Exploitation

❖ CO₂-EOR Potential in the Gulf of Mexico (GOM)

- Near-term opportunity to utilize existing and to-be-decommissioned infrastructure for CO₂ storage “Associated” with currently bypassed oil production

❖ Carbon Storage in subsurface saline and depleted oil and natural gas reservoirs

- Offshore saline storage cost model (OPEX, CAPEX) and future regulations
- Storage and MVA technology development and validation in the offshore environment
- Large-scale and Commercial-scale field project(s)

❖ Collaborative “Big Data” Analyses in GOM

- ❖ **Carbon Storage Resource Assessments**
- ❖ **Monitoring, Verification and Accounting Field Site**
 - Develop and validate technologies for offshore environment
- ❖ **Large-scale and/or Commercial-scale Injection Project**
 - Understand and manage risks, existing infrastructure and validated technologies future deployment of commercial projects in offshore environment (subsea)
- ❖ **Offshore Analyses**
 - Resource assessment of potential carbon storage associated with enhanced oil recovery, modification to CO₂ Prophet Model for offshore, and Saline and EOR Cost and Performance models