SECARB Offshore Gulf of Mexico
Project Overview and Status – February 2019

Presented by: Michael Godec, Advanced Resources International; Brian Hill, CrescentRI

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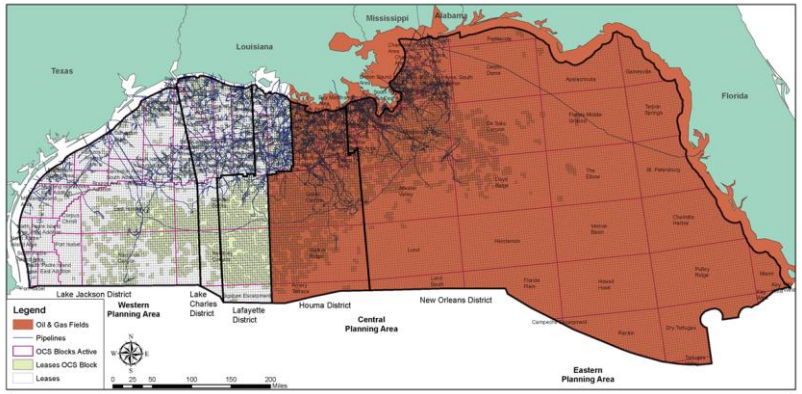
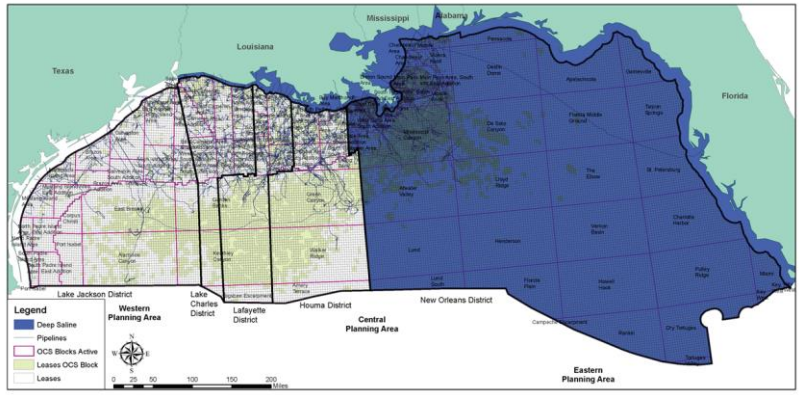
SECARB Offshore Study Area & Project Boundaries



Study Area | Oil and Gas

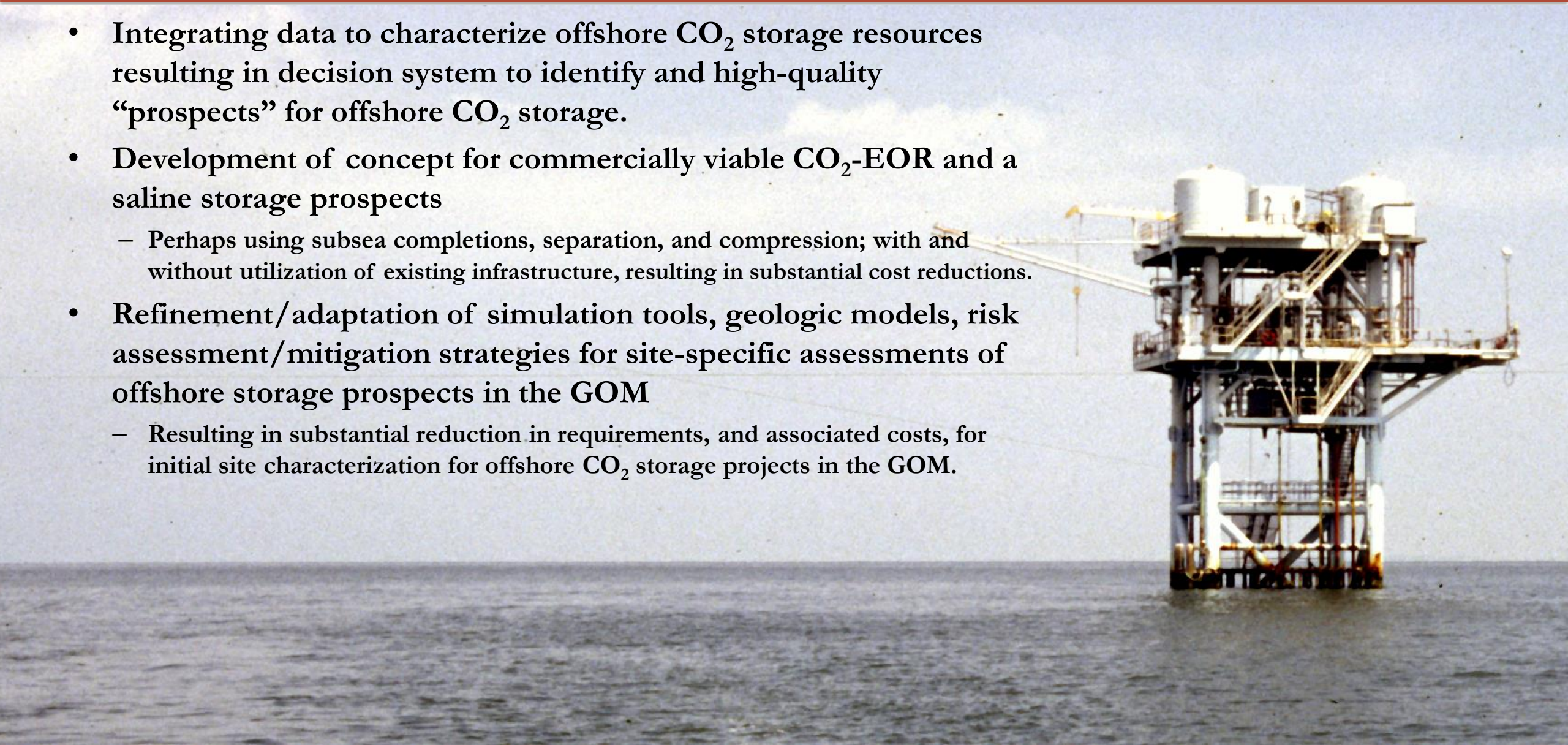


Study Area | Saline Aquifers

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

Anticipated Project Outcomes

- Integrating data to characterize offshore CO_2 storage resources resulting in decision system to identify and high-quality "prospects" for offshore CO_2 storage.
- Development of concept for commercially viable CO_2-EOR and a saline storage prospects
  - Perhaps using subsea completions, separation, and compression; with and without utilization of existing infrastructure, resulting in substantial cost reductions.
- Refinement/adaptation of simulation tools, geologic models, risk assessment/mitigation strategies for site-specific assessments of offshore storage prospects in the GOM
  - Resulting in substantial reduction in requirements, and associated costs, for initial site characterization for offshore CO_2 storage projects in the GOM.



Anticipated Project Outcomes (cont.)

- Development of "best practices" based on understanding of the offshore storage prospect(s) targeted, uncertainties associated with this understanding, the performance of site characterization, MVA and other technologies, and risk perceptions and potential tolerance of regulators.
- Reduce uncertainties/risks, better understand/validate performance of MVA technologies, and assist regulators to better understand risks and appropriate MVA approaches, leading to a reduction in MVA costs, and thus, the overall costs of storage.
- Address regulatory gaps in the oversight and regulation of CO_2 storage activities (with and without EOR) in the offshore GOM.

Where Are We Today? Are the Stars Aligning?

- Amended 45Q passed in February 2018; increasing potential commercial viability for CCS.
- Key question – Can CO_2-EOR/storage in the offshore Gulf of Mexico be ready to take advantage of this realignment of stars.
- Presents perhaps a slight refocus/change in timing of this project relative to that originally planned. Need to define:
  - What does a good prospect look like? Can we find one?
  - How should such a prospect be pursued? What strategy?
  - Can it be pursued in a commercially viable way? How?
  - If not, how might regulations/financial incentives adapt to help?
  - Are all risks/uncertainties addressed to ensure this can take place?
- <u>Our project is initially focusing on these considerations.</u>

FUTURE Act Enhancements to IRC Section 45Q -- Highlights

Previous 45Q	FUTURE Act
▪ 75 million metric ton cap	▪ Eliminates 75 million metric ton cap; applies to new facilities that "break ground" by EOY 2023.
▪ Credit based on "captured qualified CO_2"	▪ After enactment, credit based on captured "qualified carbon oxide" (CO_2 and other carbon oxides)
▪ \$20/metric ton for CO_2 stored and not used for EOR ▪ \$10/metric ton for CO_2 stored and used for EOR	▪ \$50/mt for geologic storage and \$35/mt for EOR (each rate phases up over 10-year period from 2017 to 2026). ▪ Existing qualified facilities would continue to receive the original inflation adjusted \$20 and \$10 credit rates.
▪ Available to <u>facility</u> with capture equipment capturing at least 500,000 metric tons CO_2/year.	▪ Capture > 500,000 metric tons CO_2/year for electric generating units; > 100,000 metric tons CO_2 /year for other. ▪ Credit goes to the <u>owner of the capture equipment</u>. ▪ Available to "direct air capture" and "beneficial use"
▪ Credit available until the 75-million-ton cap is reached.	▪ Credit available for 12 years from the date the carbon capture equipment is placed in service.

Advantages of CO_2 Injection Offshore vs. Onshore

- May allow surface discharge of produced water.
- Avoids populated areas (minimal NIMBY concerns).
- Minimal issues with surface, pore space, and mineral rights ownership in federal or state waters.
- Avoids issues pertaining to potentially impacting underground sources of drinking water.
- Could possibly be pursued at lower project life-cycle costs, especially where existing infrastructure is in place.
- Regulatory processes could be more straightforward and expeditious in federal waters (may not he quite the case in state waters); e.g., Class VI regulatory requirements are not applicable in federal waters, possibly resulting in shorter regulatory timelines.

Anticipated Benefits of this R&D

- Initial data acquisition, planning and anticipated permitting activities associated with this R&D can inform and be utilized for advantage in commercial offshore storage project(s), reducing characterization costs and regulatory uncertainties.
- Based on potential risks, some monitoring activities can be determined as more likely to yield minimal benefits; with others reduced or eliminated.
- The frequency and/or density of monitoring technologies/approaches can be reduced, based on R&D.
- The same could apply to site characterization, understanding of CO_2 injectivity, plume management, infrastructure considerations, addressing public perceptions and concerns, interactions with regulatory bodies, and addressing regulatory gaps.

INITIAL Focus of Activity

- Defining what a good CO_2 storage prospect might look like in the offshore Gulf of Mexico.
- Understanding the current regulatory environment in the offshore GOM, so that regulatory gaps are characterized and potentially addressed early to ensure expeditious project deployment.
- Reviewing how regulatory frameworks have evolved in other jurisdictions, and how they might apply in the offshore GOM.
- Understanding possible financial incentives and their potential applicability for CO_2 storage/CO_2-EOR in the offshore GOM.
- Reviewing characterizations of offshore project risks and uncertainties that may impact how regulatory frameworks and financial incentives may need to evolve to address.
- Reviewing offshore best practices for CO_2 storage & transport.

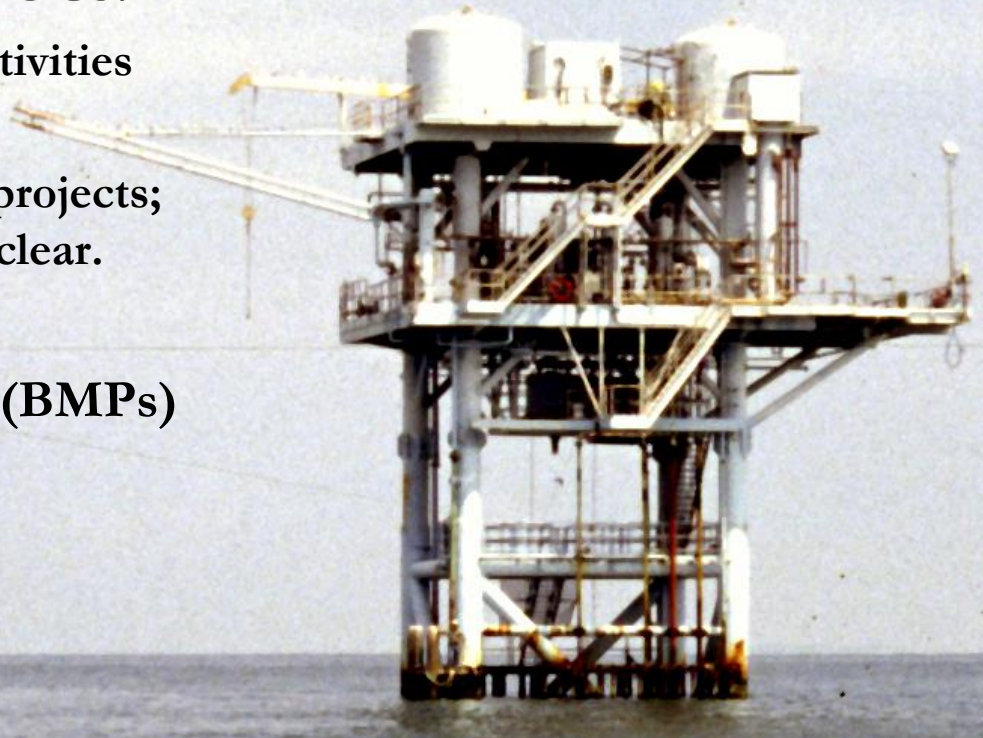
Key Features of Good Prospects for Offshore CO_2 Storage

Features identified in a proposed NETL multi-criteria screening process:

- Reservoir suitability – quality, injectivity, hydrocarbon potential (for EOR), relationship between oil/gas prospects and saline storage prospects (i.e., stacked storage), etc.
- Logistical feasibility
  - Infrastructure – density of available platforms, usability of existing infrastructure and pipelines ROWs, tradeoffs between reuse and new platforms, equipment, pipelines, wells, well slots; etc.
  - Source-to-sink -- distance to onshore CO_2 sources, volumes of CO_2 supply for EOR and/or storage, shipping route buffer areas, etc.
  - Developmental – water depth, subsea reservoir depth, above salt domes, potential interference between hydrocarbon production and storage, etc.
- Risk indicators – leakage risks, e.g., from faults, legacy wells, etc.

Regulatory Oversight of CO_2 Storage in the Federal Offshore -- DOI

- Outer Continental Shelf Lands Act (OCSLA), Dept. of Interior (DOI), Bureau of Ocean Energy Management (BOEM) and Bureau of Safety and Environmental Enforcement (BSEE) have authority to regulate development of mineral resources on OCS:
  - Authority to permit the use and storage of CO_2 for EOR activities on existing oil and gas leases on the OCS.
  - Authority to permit the storage of CO_2 for certain types of projects; though the authority to issue leases for storage remains unclear.
  - No facilities/operations permitted to date
- BOEM finalized research on Best Management Practices (BMPs) for CO_2 offshore transportation and storage on the OCS
- Specific categories of offshore issues (potential regulatory gaps)were identified.



Technical Gaps Identified in BOEM BPMs Study

- Lack of data for shallower sub-seabed intervals in active O&G areas (overburden above the injection and confining intervals) or throughout the sub-seabed stratigraphic column for areas in which O&G activity is absent.
- An approach (i.e., adaptive management) that should allow BOEM to determine the effectiveness of future regulatory frameworks, recognize regulatory gaps, and allow further development of BMPs as offshore technologies with and without CO_2-EOR begin to mature.
- BOEM concludes that first step will be to encourage offshore pilot-injection projects with collaboration between government, academia, and industry.

Technical Gaps Identified in BOEM BPMs Study (cont.)

Specific categories of offshore CO_2 transport and sub-seabed storage issues that should be addressed in future regulations include:

- Characterization and qualification of CO_2 storage sites
- Corrosion management for CO_2 pipelines and injection well or platform infrastructure
- CO_2 transport and injection operations planning
- Risk management and monitoring
- Quantification of CO_2 storage
- Site closure

A key aspect of this project is to work to address these gaps.

Regulatory Oversight of CO_2 Storage in the Federal Offshore - EPA

- Offshore facilities "certifying" CO_2 storage (including in association with EOR), must comply with GHGRP Subpart RR.
  - For CO_2 injected for CO_2-EOR (but not opting in for certifying storage), must report under Subpart UU.
- Emissions from petroleum & gas facilities (including offshore) that emit > 25,000 metric tons of CO_2e annually must report under GHGRP Subpart W, for process operations and stationary fuel combustion
- Subpart W reporting requirements are based on DOI regulations originally issued under 30 CFR 250.302 through 304 (subsequently moved to 30 CFR 550.302 – 304), currently managed by BOEM.
  - This industry segment does not include reporting of emissions from offshore drilling and exploration not conducted on platforms.
- This includes emissions reported to DOI as identified in the its latest Gulf-wide Offshore Activities Data System (GOADS) emissions study.
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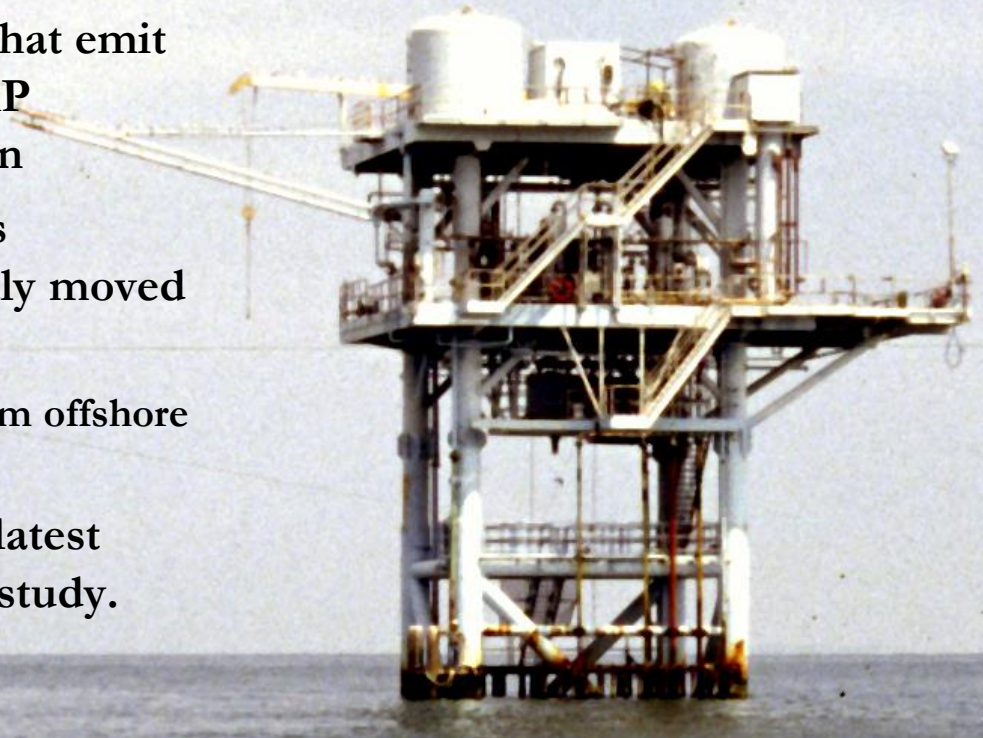
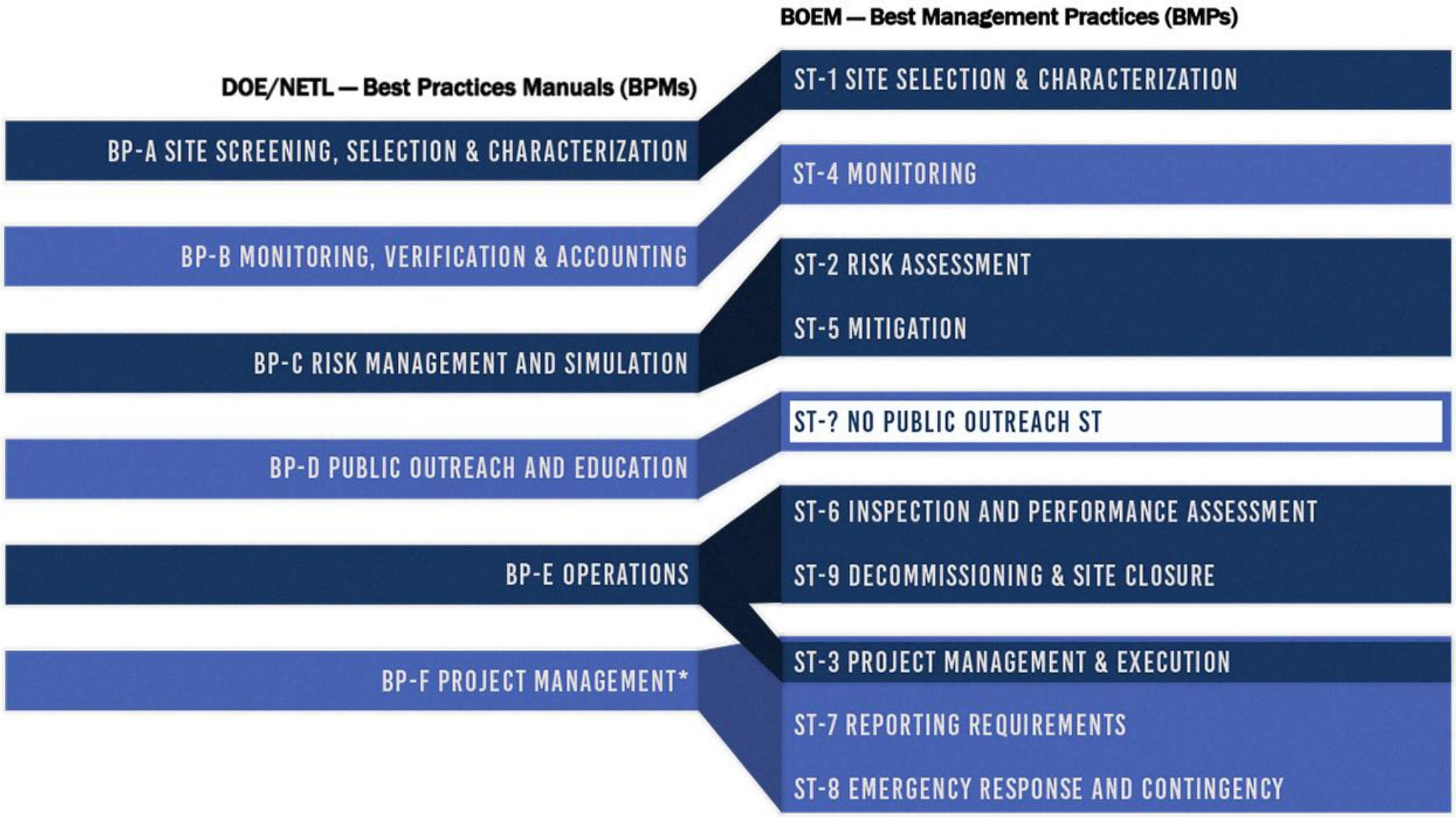


Best Practices: Recent Activities

- Offshore Best Practices for CO_2 Storage & Transportation
  - SSEB and the Interstate Oil and Gas Compact Commission (IOGCC) convened an Offshore Task Force that reviewed laws and regulations for CO_2 capture and storage (2012)
  - Texas BEG prepared a report for BOEM on best management practices for offshore transportation and sub-seabed geologic storage of CO_2 (2017)
  - SSEB prepared a SOSRA T6.1 report that compared DOE/NETL onshore best practices with the BOEM best management practices for offshore CO_2 transportation and storage (2019)

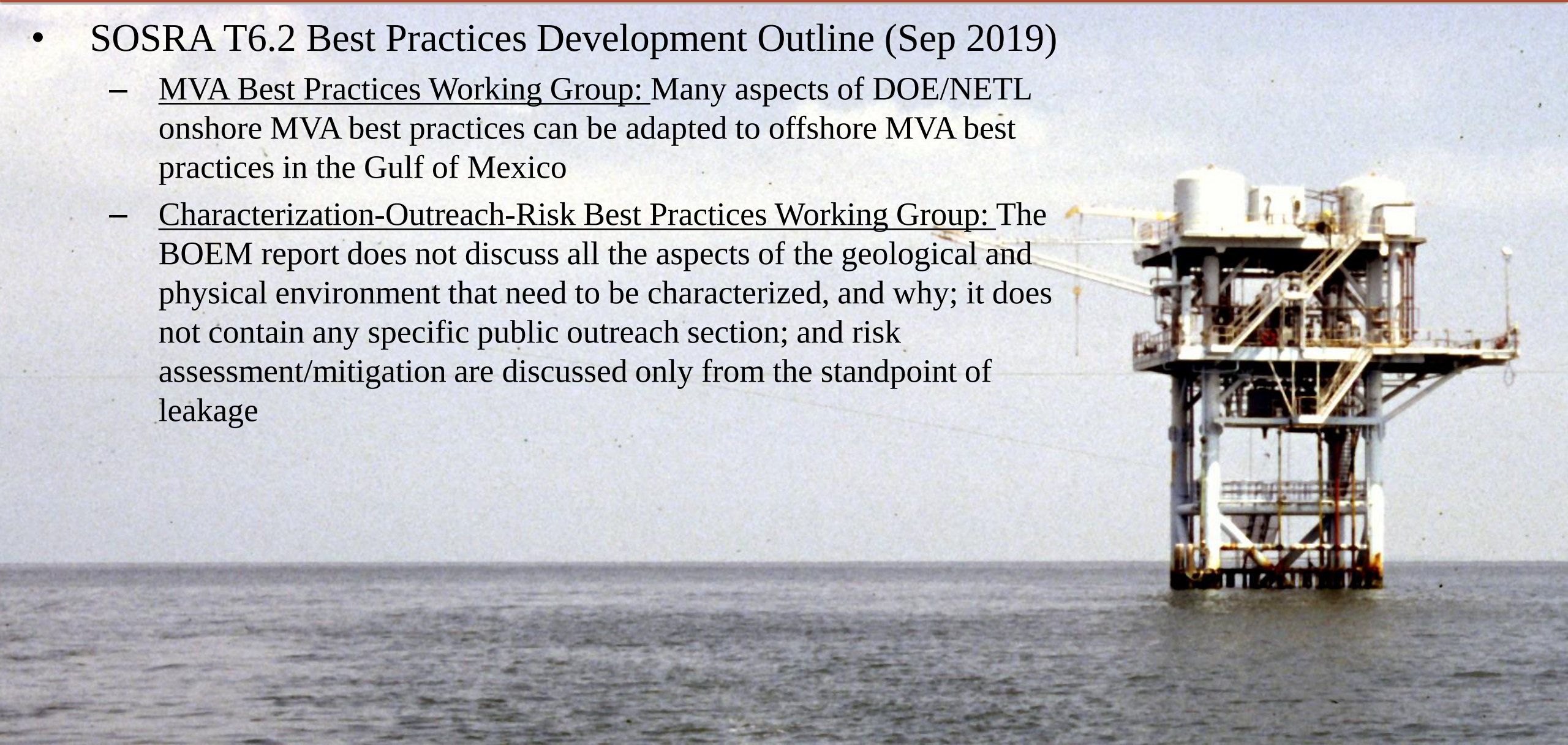
DOE/NETL and BOEM Best Practices Comparison

*Project Management BPM not part of DOE/NETL 2017 update; Under review at SSEB (2019)



Best Practices: SOSRA Planned Activities

- SOSRA T6.2 Best Practices Development Outline (Sep 2019)
  - MVA Best Practices Working Group: Many aspects of DOE/NETL onshore MVA best practices can be adapted to offshore MVA best practices in the Gulf of Mexico
  - Characterization-Outreach-Risk Best Practices Working Group: The BOEM report does not discuss all the aspects of the geological and physical environment that need to be characterized, and why; it does not contain any specific public outreach section; and risk assessment/mitigation are discussed only from the standpoint of leakage

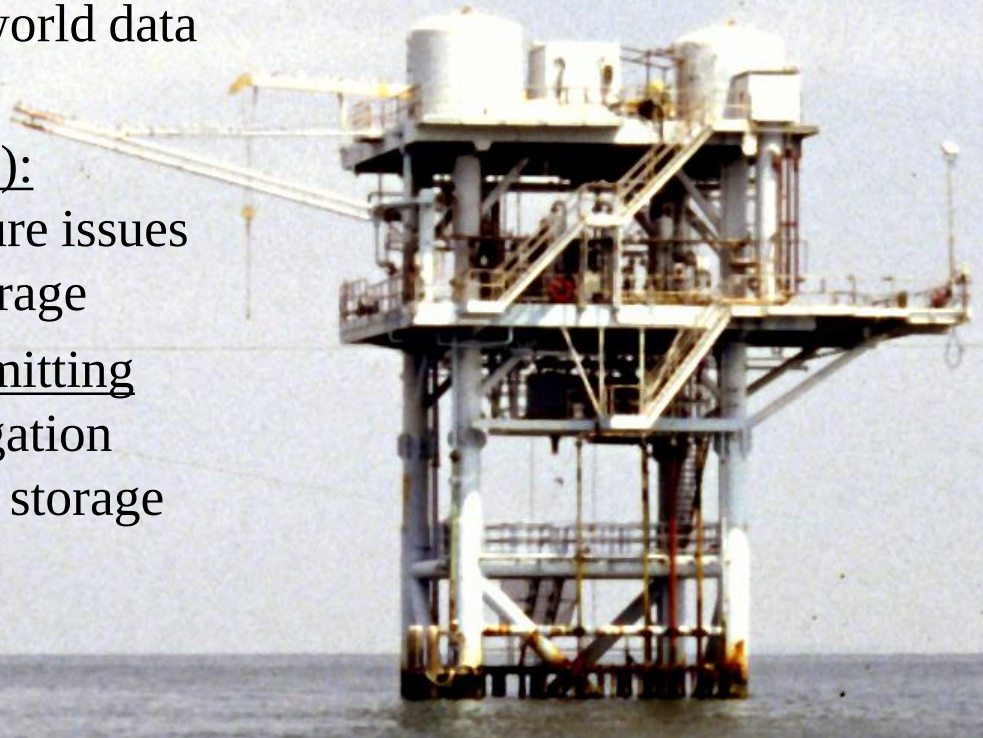


Best Practices: SECARB Offshore Planned Activities

- SECARB Offshore (BP1) Action Plan to Expand Best Practices Explicitly Applicable to the Gulf of Mexico (Mar 2020)
  - Create an action plan to advance offshore best practices, based upon SOSRA 6.2 and BOEM work completed
  - Include existing infrastructure, logistical & regulatory obstacles, and decommissioning requirements
- SECARB Offshore (BP2) Final Report (Mar 2023)
  - Incorporate best practices document into a final report on *"Assessment of Legal and Regulatory Frameworks"*

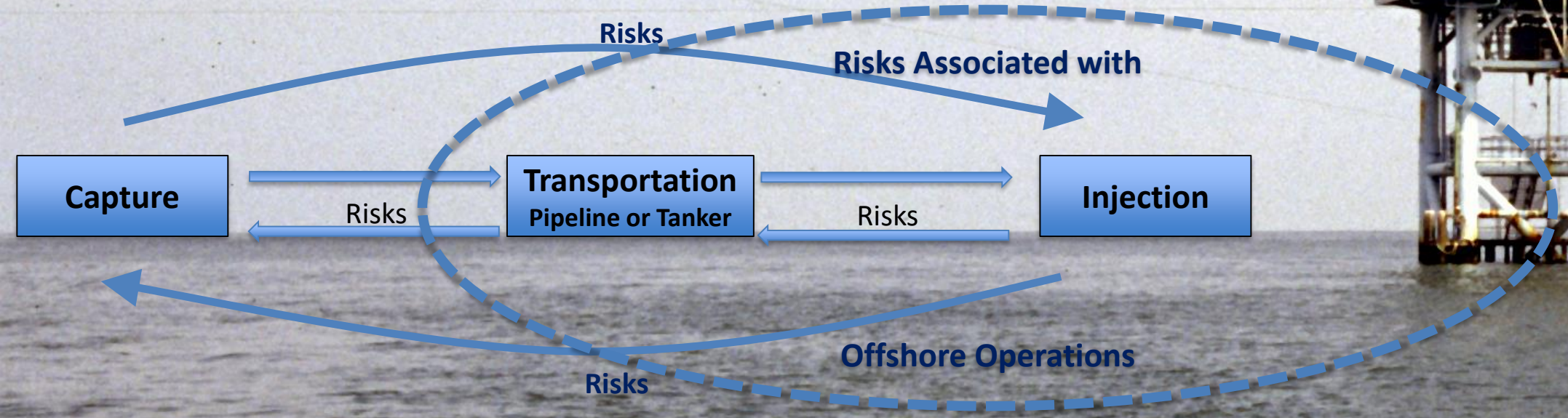
Risk Assessments: SECARB Offshore GOM

- Risk Assessments for CO_2 Transportation & Storage, Including Storage with Utilization
  - Risk & Data Gaps in Characterization (Subtask 3.4): partner with private companies & organizations to obtain real-world data for use in risk assessment and gap analysis
  - Risk Registry for Fully Integrated Systems (Subtask 4.3): develop preliminary risk registry addressing infrastructure issues and uncertainties in offshore CO_2 transportation and storage
  - Risks Associated with Infrastructure, Operations & Permitting (Subtasks 6.1 & 6.2): Address risk management & mitigation strategies as they pertain to CO_2 transport, delivery, and storage options in the offshore environment.



Project Risks

- An Integrated Offshore Project will need to overcome many of the same risks present in onshore projects but will also encounter risks specific to the offshore environment.
- While challenging, the subsea does provide some benefits relative to onshore projects



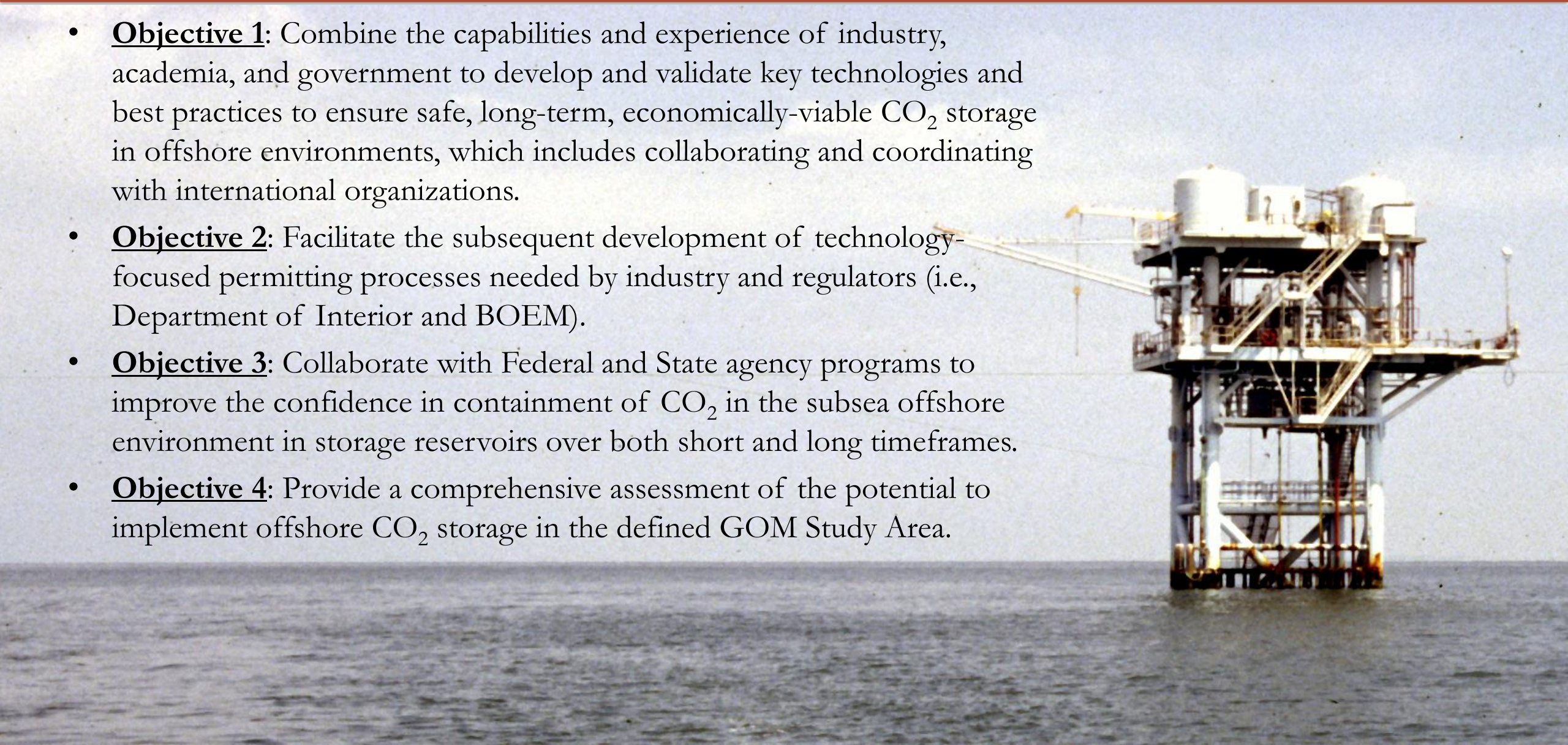
THANK YOU!

SOUTHERN STATES ENERGY BOARD | 6325 AMHERST COURT | PEACHTREE CORNERS, GEORGIA 30092
PRINCIPAL INVESTIGATOR (PI): KEN NEMETH, (770) 242-7712, NEMETH@SSEB.ORG
CO-PI: KIMBERLY GRAY, (770) 282-3576, GRAY@SSEB.ORG

EXTRA SLIDES

SEACARB Offshore 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.

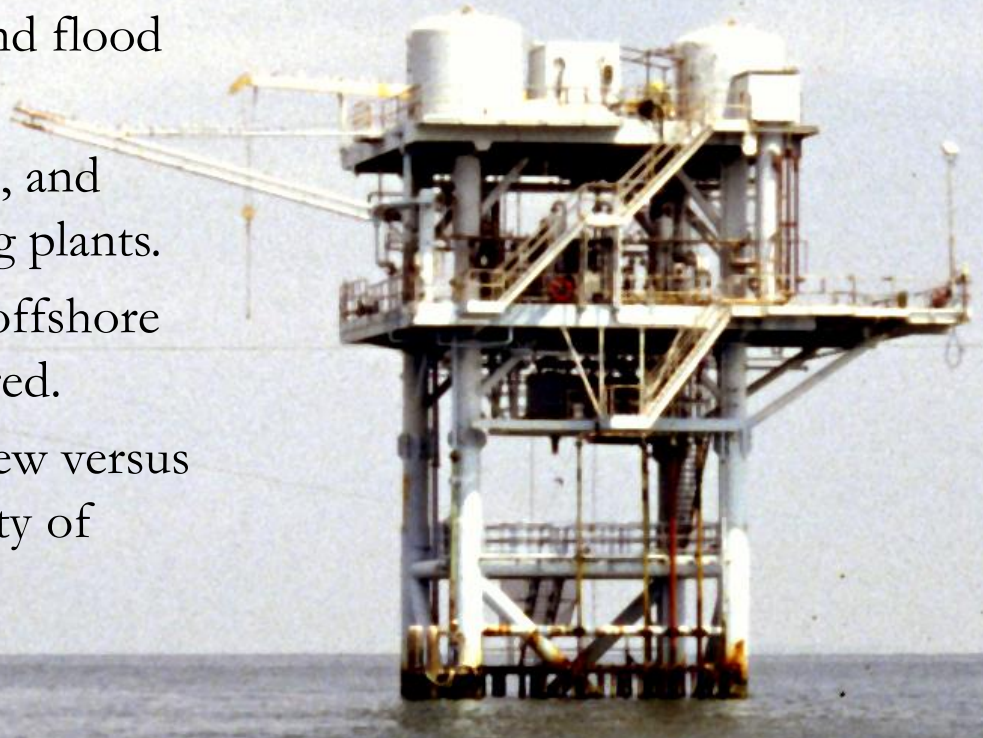


SEACARB Offshore Primary Tasks

- T1: Project Management & Planning
- T2: Knowledge Dissemination
- T3: Offshore Storage Resource Characterization
- T4: Risk Assessment, Simulation, and Modeling
- T5: Monitoring, Verification, and Accounting
- T6: Infrastructure, Operations, and Permitting

Key Considerations

- Detailed reservoir characterization essential for accurately characterizing the target reservoir and estimating oil production/CO_2, and for prediction and managing CO_2 plume and pressure fronts.
- Procedures that facilitate sharing of reservoir characterization and flood performance data could help address this issue.
- Offshore platforms designed to efficiently use all available space, and have limited room for new equipment, particularly CO_2 recycling plants.
  - Operators will need to consider innovative approaches for offshore CO_2 separation, compression and re-injection, where required.
  - This will include assessing the tradeoffs between utilizing new versus existing platforms, infrastructure, etc.; and in the applicability of utilizing subsea technologies.



Key Considerations

- Installing the required well patterns and spacing for optimal CO_2-EOR and/or storage performance offshore may be cost prohibitive due to the high costs of offshore well drilling.
  - Using horizontal wells with wider well spacing could be used to help overcome this challenge.
- Existing production facilities and well tubing may need to be retrofitted to prevent corrosion from CO_2.
  - These alterations may require a platform to be shut down, causing a loss of oil production in the case of an oil production platform converting to CO_2-EOR.
  - .

Understanding 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.

FUTURE Act Enhancements to IRC Section 45Q -- Highlights

Other provisions include:

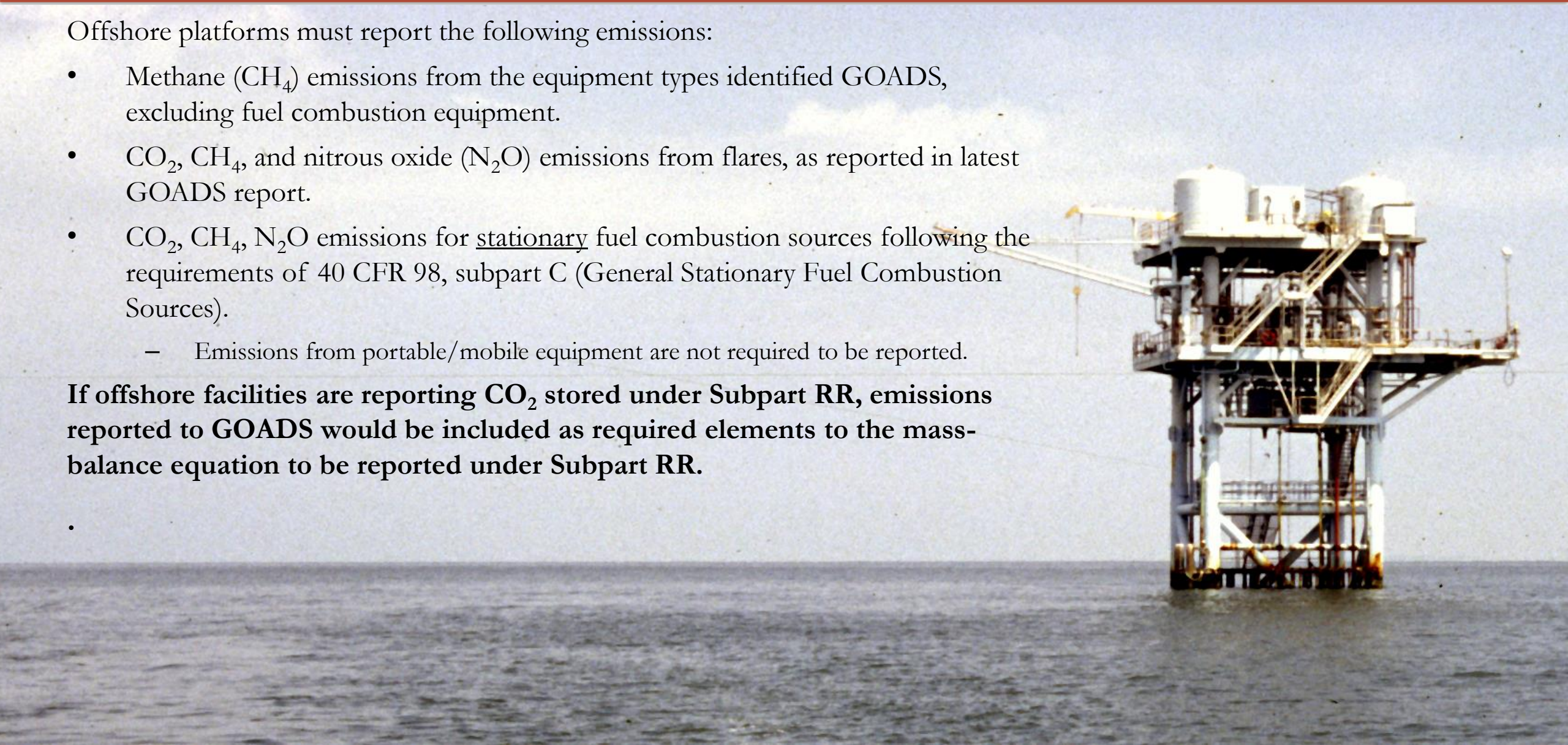
- Allows the taxpayer to transfer all or a portion of the credit to the entity that:
  - Disposes of the qualified CO_2
  - Utilizes the qualified CO_2
  - Uses the qualified CO_2 as a tertiary injectant (for EOR).
- EPA Greenhouse Gas Reporting Program (GHGRP) Rule (Subpart RR) basis for "certifying" storage
- The "devil will be in the details" as implementation guidance is developed by IRS

Emissions Reported to GOADS

Offshore platforms must report the following emissions:

- Methane (CH_4) emissions from the equipment types identified GOADS, excluding fuel combustion equipment.
- CO_2, CH_4, and nitrous oxide (N_2O) emissions from flares, as reported in latest GOADS report.
- CO_2, CH_4, N_2O emissions for stationary fuel combustion sources following the requirements of 40 CFR 98, subpart C (General Stationary Fuel Combustion Sources).
  - Emissions from portable/mobile equipment are not required to be reported.

If offshore facilities are reporting CO_2 stored under Subpart RR, emissions reported to GOADS would be included as required elements to the mass-balance equation to be reported under Subpart RR.



Greenhouse Gas Reporting under Subpart RR

- **Storage certification under 45Q may be established by EPA Subpart RR reporting**
  - Operators are required to submit a monitoring, reporting, and verification (MRV) plan
  - 5 MRV plans approved to date; three for CO_2-EOR, one for saline storage, one for acid gas disposal – none offshore.
- **Most significant concerns related to offshore application of Subpart RR include:**
  - Process for and timeliness of EPA approval of MRV plans
  - What constitutes "new" activity -- and thus a new MRV plan
  - Extent to which MRV plans are subject to litigation
  - What happens if the "rules of the game" change?