CLIMATE IMPACT OF U.S. OFFSHORE OIL AND GAS PRODUCTION

Measurement-based carbon intensities of offshore oil and gas production vary widely, reflecting differences in field characteristics and operator practices. If offshore production expands, management and infrastructure choices can help lower future carbon intensities.

Artificial islands | North Slope, Alaska | Photo by Mackenzie Smith

While the burning of fossil fuels is often the focus when considering the climate impacts of oil and gas, emissions of methane and carbon dioxide during the harvesting of fossil fuels can be significant contributors to total climate impacts. With fossil fuels expected to remain part of the world's energy mix for the next 50 years, reducing methane and carbon dioxide emissions during production (the "carbon intensity") can substantively reduce climate impacts.

Carbon intensity (CI) measures greenhouse gas emissions per unit of energy produced. Extensive measurements of onshore U.S. oil and gas production regions have improved our understanding of their greenhouse gas emissions. However, offshore production has been less studied.

U.S. offshore production occurs primarily in the Gulf of Mexico (GOM), with additional areas in Alaska and California. Offshore production has generally declined except in the deep waters of the GOM but it is under consideration for expanded development, as evidenced by recent and planned lease sales and proposals for new infrastructure.

F3UEL RESEARCH

The F3UEL effort, which has produced multiple studies to improve knowledge of emissions from U.S. oil and gas production, collected new data from almost all infrastructure related to offshore production in Alaska and California through an airborne campaign. These new field measurements expand upon earlier work in the GOM, and combined provide the first complete field-based survey of U.S. offshore production emissions.

F3UEL researchers estimated emissions at the facility and regional levels and compared them with inventories, calculating measurement-based CIs of production activities for each field and the total U.S. offshore sector. This is currently the largest measurement set of its kind. The calculations, which shed light on how CIs may vary for oil and gas production in the real world, can be incorporated into future synthesis studies of the oil and gas supply chain at the national scale.

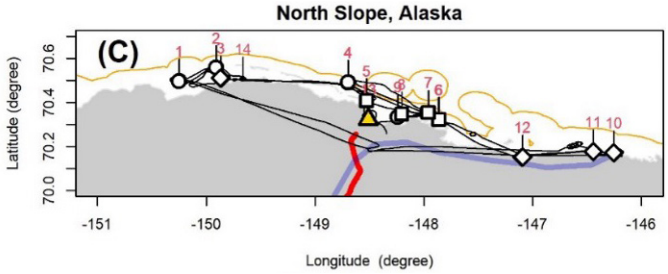
KEY FINDINGS

- The climate impact of offshore production in the U.S. is measured to be double that estimated in inventories (5.7 gCO2e/MJ compared to 2.4 gCO2e/MJ). This difference is primarily due to higher methane emission in Gulf of Mexico shallow waters.
- Offshore U.S. oil and gas production has lower carbon intensity than onshore production.
- Most production (80%) occurs in GOM deep waters, but most emissions (also 80%) occur outside of these areas.
- Offshore carbon intensity varies greatly across the U.S. Gulf of Mexico deep waters show low climate impacts, while the Cook Inlet and Gulf of Mexico shallow waters have the largest carbon intensities.
- The relative importance of CO_2 and CH_4 emissions differs between regions. For example, in GOM state shallow waters, CH_4 emissions contribute significantly more to the carbon intensity than CO_2 emissions, whereas CO_2 is the dominant source of emissions in Alaska.

ABOUT THE SITES

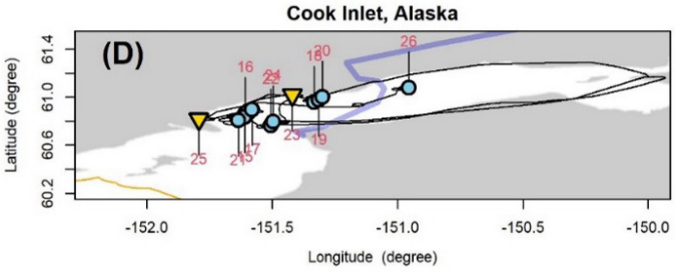
Offshore North Slope, AK

- Mean CI (100-year horizon): 11 (7.5, 15) gCO_2e/MJ
- Production trend: Declining production
- Regional information: Mainly in offshore and coastal state waters; infrastructure includes artificial islands, a causeway, coastal facilities servicing offshore wells; gas production exists but is not transported due to lack of infrastructure—only oil is transported via the Trans-Alaska pipeline
- Dominant greenhouse gas: CO_2
- Outlook: Plans include building the LNG Alaska pipeline for domestic use and export, potentially shifting production towards gas output



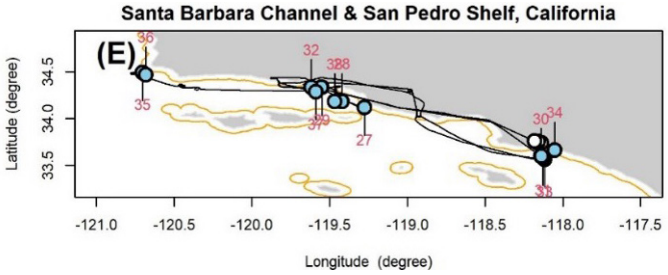
Cook Inlet, AK

- Mean CI (100-year horizon): 22 (13, 34) gCO_2e/MJ
- Production trend: Declining production currently but increasing production expected due to 2022 lease sale
- Regional information: State waters, moderate production rates, traditional infrastructure; nearby onshore facilities transport gas fuel to platforms, with three directly connected by pipeline
- Dominant greenhouse gas: CO_2
- Outlook: Some platforms have been replaced or ramped up production recently



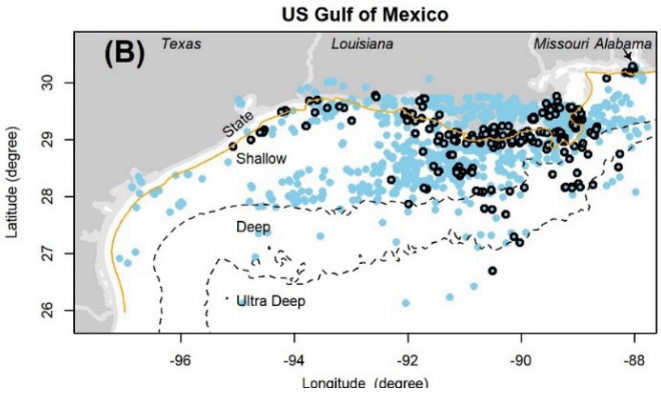
Santa Barbara Channel and San Pedro Shelf, CA

- Mean CI (100-year horizon): 7.2 (3.2, 13) gCO_2e/MJ
- Production trend: Declining production with many facilities decommissioned or pending decommissioning
- Regional information: Mainly in federal waters with some state facilities on the San Pedro Shelf
- Dominant greenhouse gas: CO_2
- Outlook: Subject to a stringent regulatory environment with long periods of moratoriums on new production and no new leases since 1982



U.S. Gulf of Mexico

- Mean CI (100-year horizon):
  - State Shallow GOM: 43 (25, 65) gCO_2e/MJ
  - Federal Shallow GOM: 16 (12, 22) gCO_2e/MJ
  - Federal Deep GOM: 1.1 (1.0, 1.1) gCO_2e/MJ
- Production trend: Divided into state shallow, federal shallow, and federal deep waters
- Regional information: Deep water platforms aggregate production from multiple subsea wells at high production rates; shallow waters have mixed facilities for production and processing
- Dominant greenhouse gas:
  - State Shallow GOM: CH_4
  - Federal Shallow GOM: CH_4
  - Federal Deep GOM: CO_2
- Outlook: Scheduled for expanded development with recent and proposed lease sales, anticipating substantial new production from both shallow and deep water locations.



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ABOUT THE PROJECT

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