

NATURAL GAS & PETROLEUM SYSTEMS: UPDATES UNDER CONSIDERATION FOR OFFSHORE PRODUCTION EMISSIONS IN 2020 GHGI

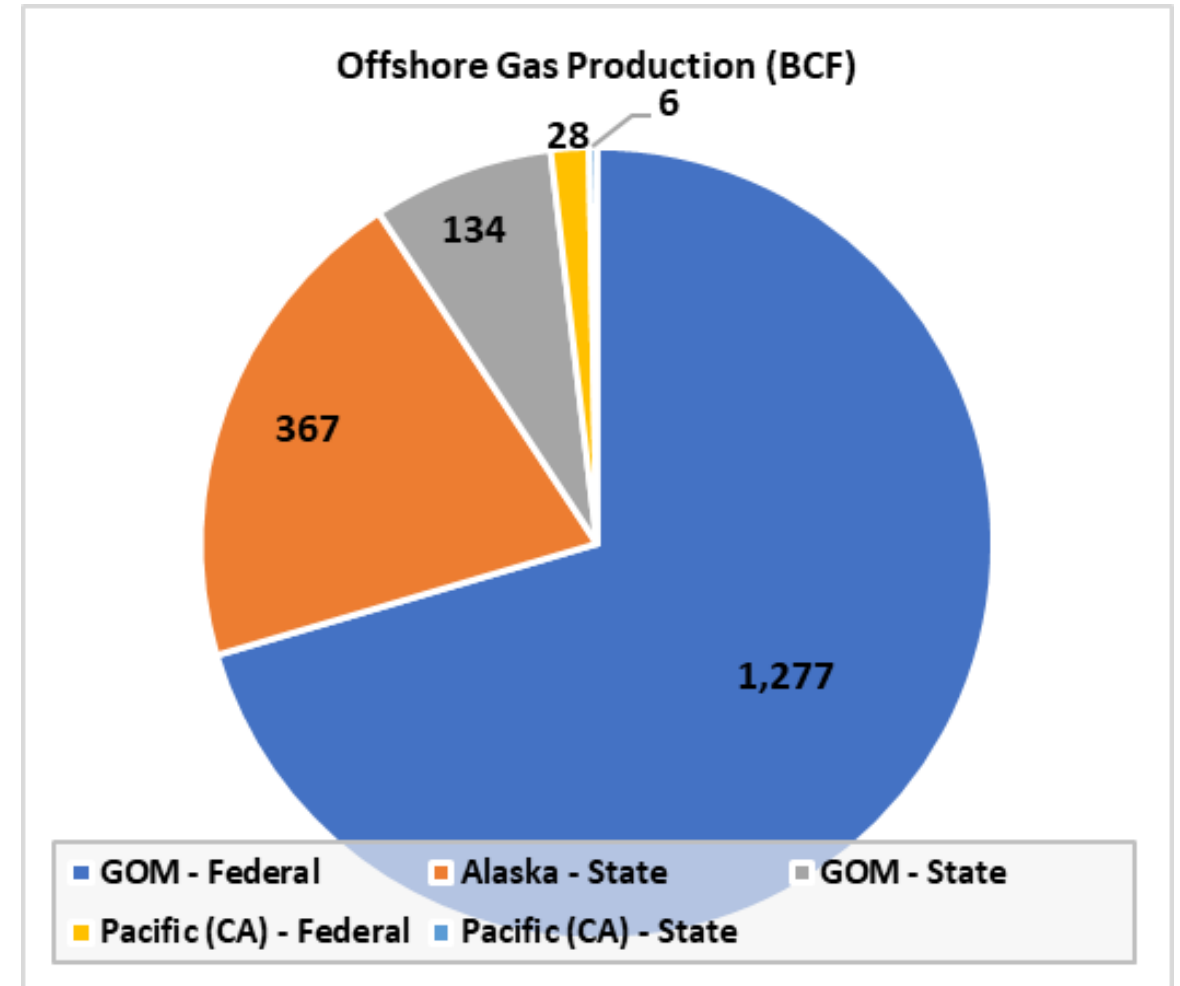
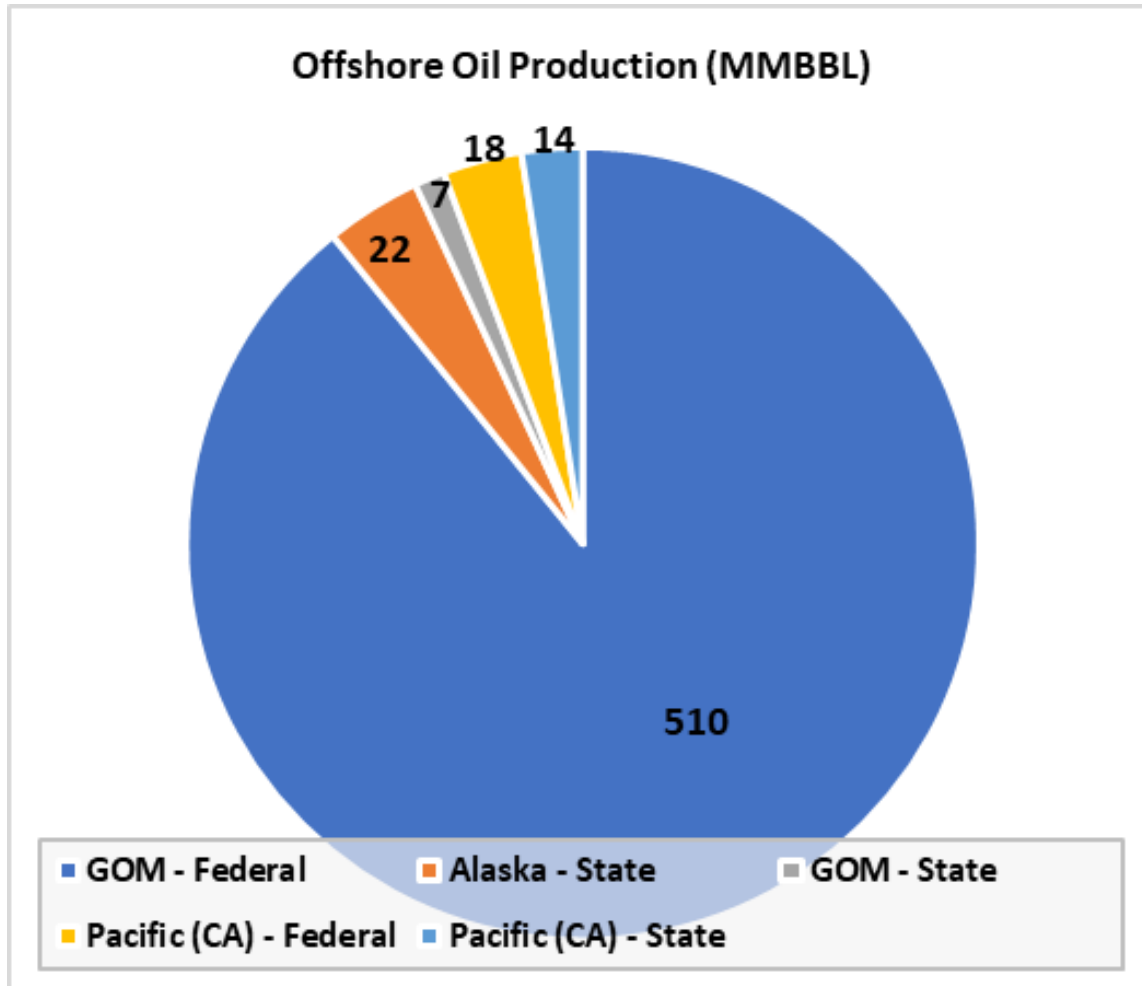
Stakeholder Workshop

November 7, 2019

OVERVIEW

- Offshore Production Background
- Current GHGI Methodology
- Updates Under Consideration
 1. Gulf of Mexico Federal Waters
 2. Gulf of Mexico State Waters
 3. Pacific and Alaska Regions (Federal/State Waters)
- National Emissions Summary
- Stakeholder Feedback

OVERVIEW OF OFFSHORE OIL & GAS PRODUCTION (YEAR 2014)



OFFSHORE PRODUCTION BACKGROUND

- Offshore production facilities
 - Can include production structures and supporting structures
 - Production complex = 1 or more structures
 - Variation in water depth (deep versus shallow water)
 - Variation in complexity (number and type of unit operations— “major” vs. “minor” complexes)
- Offshore facilities operate in waters that are under federal government (DOI/BOEM) jurisdiction (“federal waters”) or state government jurisdiction (“state waters”)
 - Federal waters = Outer Continental Shelf (OCS). Includes producing regions in Gulf of Mexico (GOM) and Pacific Ocean
 - State waters producing regions include GOM (multiple states), Pacific (California), and Alaska.

CURRENT GHGI METHODOLOGY

- Only accounts for offshore emissions in GOM federal waters

Vented and Leak Emissions

- EFs: Developed from BOEM's 2011 Gulfwide Emission Inventory
 - EFs are on a structure basis
 - 4 EF categories: Deepwater gas, Deepwater oil, Shallow water gas, and Shallow water oil
- Activity: Structure counts over time series are from a Minerals Management Service (MMS) census, which was last updated in 2010

Pollutant/Facility Category	Structure EF (mt/yr)
CH₄	
Deep Gas	–
Deep Oil	656
Shallow Gas	62
Shallow Oil	116
CO₂	
Deep Gas	–
Deep Oil	7.7
Shallow Gas	1.2
Shallow Oil	1.9

CURRENT GHGI METHODOLOGY (CONT.)

Flaring Emissions

- All offshore flaring CO₂ emissions are represented in natural gas systems
- EF: kg/mmBtu, with yr-specific heat content
- Activity: Flared gas volumes over the time series were provided by MMS staff, based on data collected in Oil and Gas Operations Reports (OGOR). Data were last available for 2008

1. UPDATES UNDER CONSIDERATION FOR OFFSHORE FACILITIES IN GOM FEDERAL WATERS

GOM FEDERAL WATERS: DATA SOURCES

- BOEM Gulfwide Emission Inventory (GEI)
 - Year-specific emission factors
- BOEM Platform Database
 - Counts of total “active” complexes for each time series year
 - Split between “major” and “minor” complexes for each time series year
- BOEM OGOR-A Production
 - Complex-specific production type (“oil” vs “gas”) assignment
- BOEM OGOR-B Flaring Volumes
 - Gas volume flared from each type of complex (“oil” vs “gas”) in each time series year

GOM FEDERAL WATERS: BOEM GEI

- Estimates criteria pollutant and GHG emissions
- All offshore facilities in GOM federal waters west of 87.5° longitude are required to report, however, there are non-reporters each year
- GEI studies are conducted triennially
 - Currently available for years 2000, 2005, 2008, 2011, and 2014
 - 2017 GEI publication expected soon, and will be taken into consideration for GHGI updates
- 2005 GEI: hurricanes led to fewer reporters with atypically low activity and emissions
- 2000 GEI was the first year of reporting and there were subsequent updates in GEI methods and operator understanding - Not used in our updates under consideration

GOM FEDERAL WATERS: BOEM GEI CALCULATION METHODOLOGY SUMMARY

Emission Source	BOEM GEI Methodology Summary
Cold Vent	Volume of gas vented, as provided by operators
Fugitives	EF (lb/component-day) from 1996 API report
Pneumatic Pump	EF (scf/hr) provided by operators or surrogate applied for make/model
Pneumatic Controller	EF (scf/hr) provided by operators or surrogate applied for make/model
Losses from Flashing	Equation (uses GOR and throughput)
Combustion	EFs (lb/MMBtu or lb/MMscf) from AP-42
Flares	EFs (lb/MMBtu) from AP-42
Glycol Dehydrator Unit	EF (lb/hr) developed from GRI-GLYCalc software runs
Storage Tank	Equation
Mud Degassing	EF (lb/day) from 1977 EPA Report
Amine Gas Sweetening Unit	AMINECalc Software

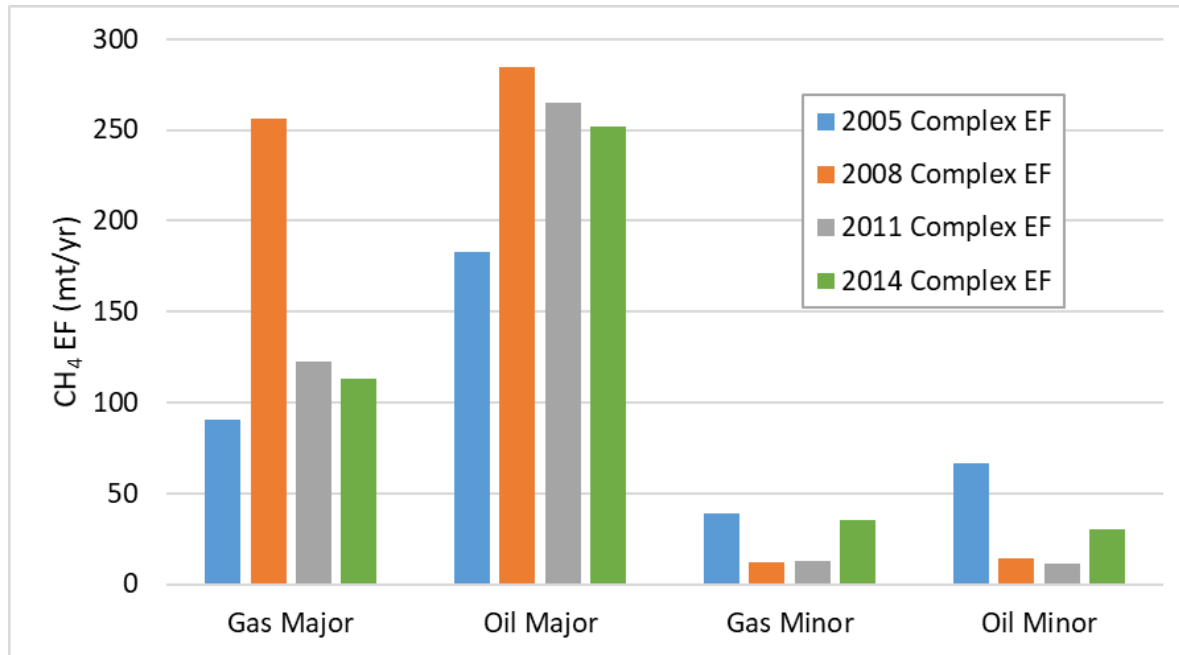
GOM FEDERAL WATERS: BOEM GEI DATA

Data Element	2005	2008	2011	2014
# Active Complexes	1,407	2,614	2,205	1,397
Flared Volume (Bcf)	5.1	7.0	10.1	5.1
Vent and Leak Emissions				
CH ₄ (KT)	194	383	245	204
CO ₂ (KT)	2	4	4	3
Flare Emissions				
CH ₄ (KT)	0.3	0.4	0.3	0.3
CO ₂ (KT)	10	380	548	279

GOM FEDERAL WATERS: APPROACH FOR BOEM GEI-BASED EFS

- EFS calculated on complex basis (instead of structure basis) – emphasizes the activity data unit most related to the presence of production operations
- Separate EFS calculated for major and minor complexes to represent differences in complexity expected to correlate with emissions
 - Major/minor categorization relies on BOEM Platform Database - A major structure is defined as containing at least six completions or containing more than two pieces of production equipment; otherwise the structure is defined as minor
 - Major complex has at least 1 major structure
 - This approach would replace the current subcategorization scheme based on water depth, which more indirectly correlates with emissions
- Separate EFS calculated for oil and gas complexes
 - Oil/gas complex assignments rely on BOEM OGOR-A production data
 - Updated method allows EPA to use all GEI data

GOM FEDERAL WATERS: BOEM GEI-BASED VENT AND LEAK EF CONSIDERATIONS



GHGI Time Series Year(s)	Applicable BOEM GEI EF Year	
	Major Complexes	Minor Complexes
1990-2004	2008 GEI	2014 GEI
2005	2005 GEI	
2006-2009	2008 GEI	
2010-2012	2011 GEI	
2013-2017	2014 GEI	

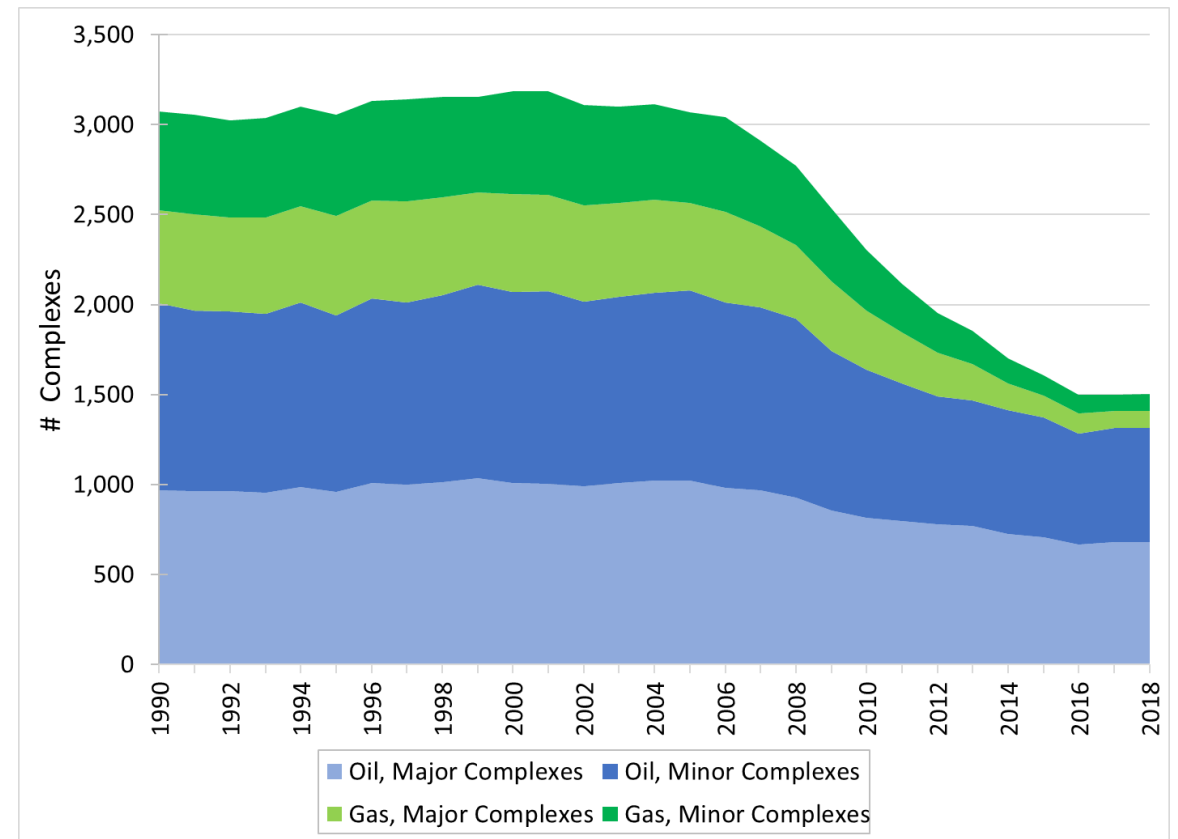
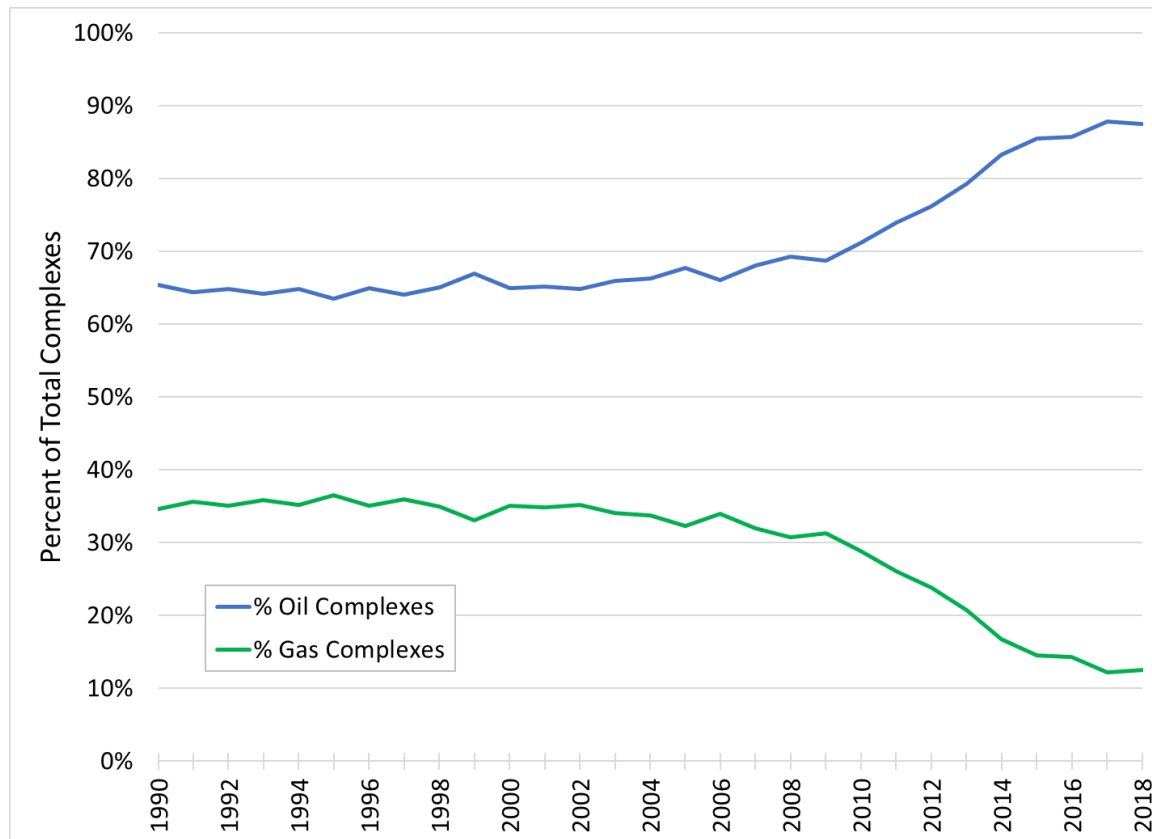
GOM FEDERAL WATERS: BOEM PLATFORM DATABASE

- Provides information on all offshore facilities in GOM federal waters, including: complex and structure IDs, lease IDs, Area/Block IDs, install dates, removal dates, the structure water depth, and a major/minor structure designation
- Used to develop “active” offshore complex counts, subcategorized by “major” versus “minor”, in each GHGI time series year
- Inactive complexes are excluded
 - There can be a period of inactivity (no emissions) while an offshore complex exists, but is awaiting or undergoing removal
 - EPA assumed 3-year decommissioning period

GOM FEDERAL WATERS: BOEM OGOR-A PRODUCTION

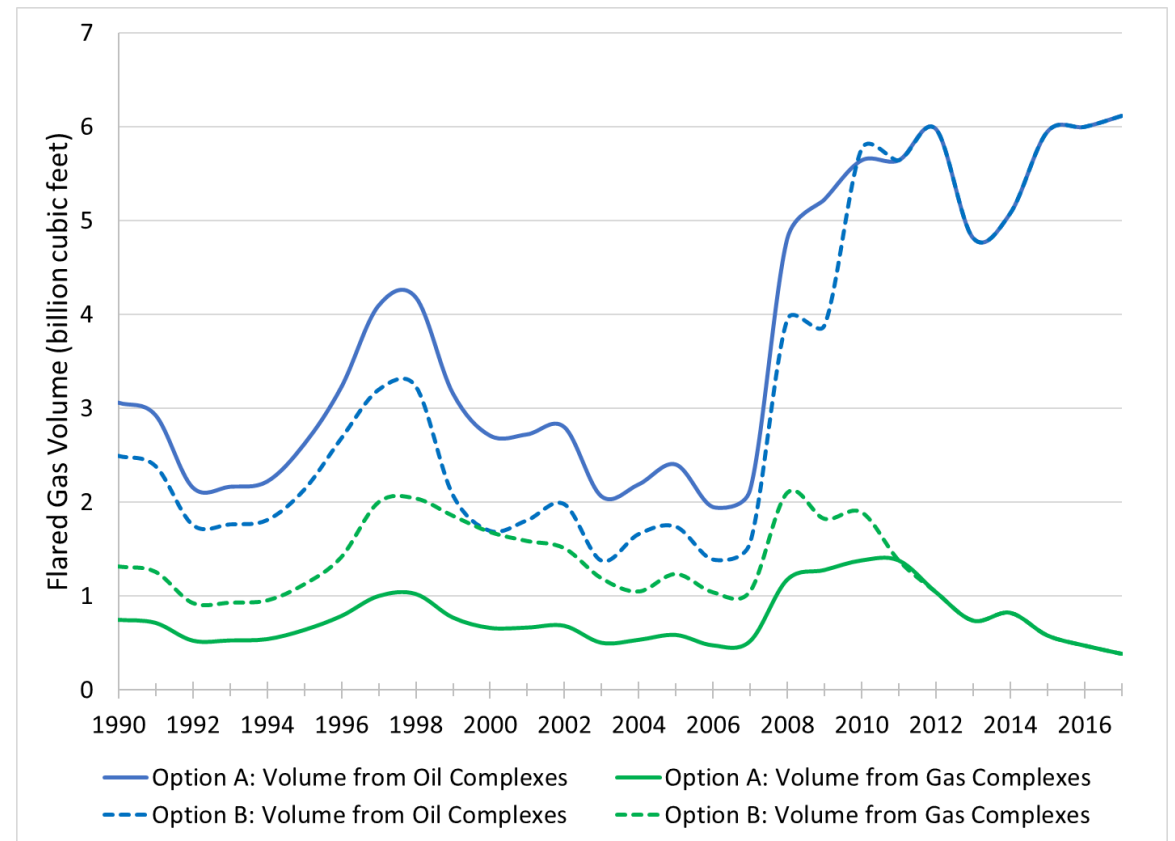
- Annual oil and gas production for each oil and gas lease
 - Area/Block IDs associated with each lease ID are available from 1996-present
- Used to:
 1. Classify each GEI complex as an oil or gas complex (previously discussed)
 2. Estimate the fraction of oil and gas complexes in each GHGI time series year
 3. Calculate production-based EFs for GOM federal waters, for use in estimating GOM state waters emissions (discussed later)

GOM FEDERAL WATERS: ACTIVE COMPLEX COUNTS FOR UPDATE UNDER CONSIDERATION

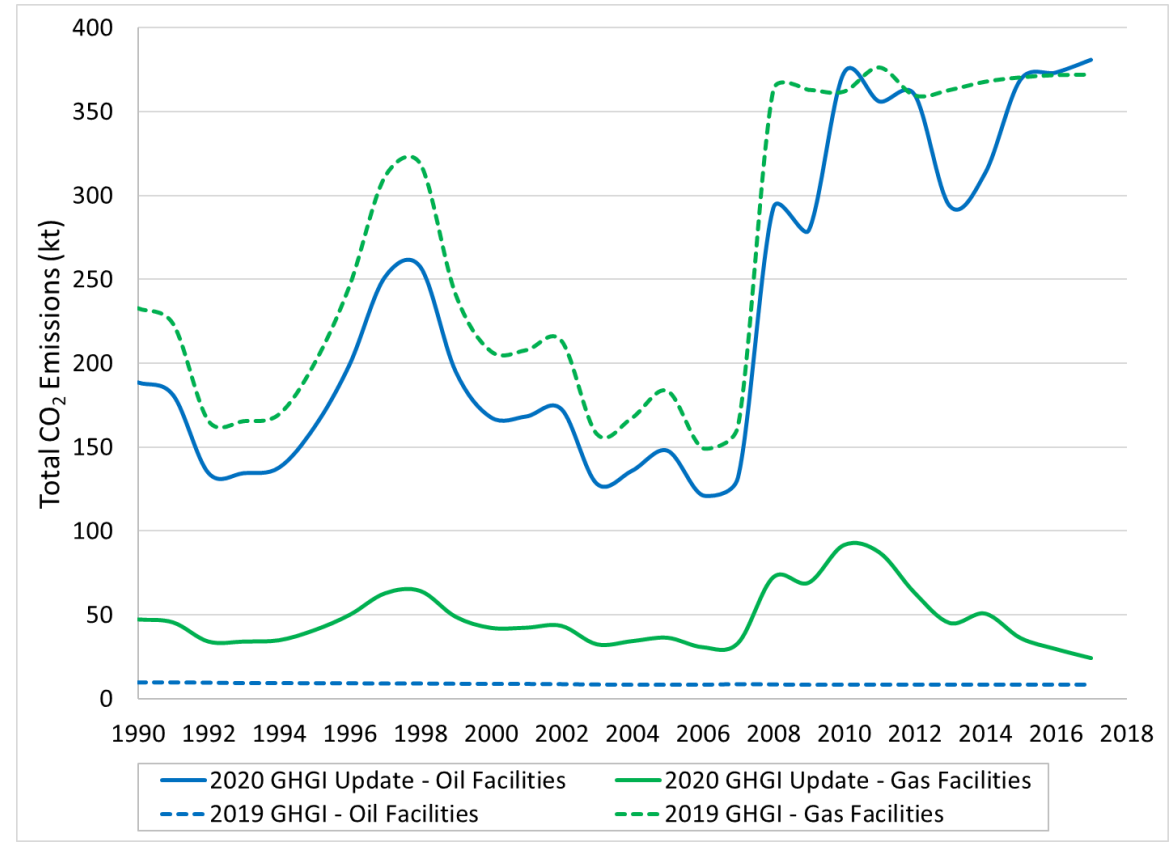
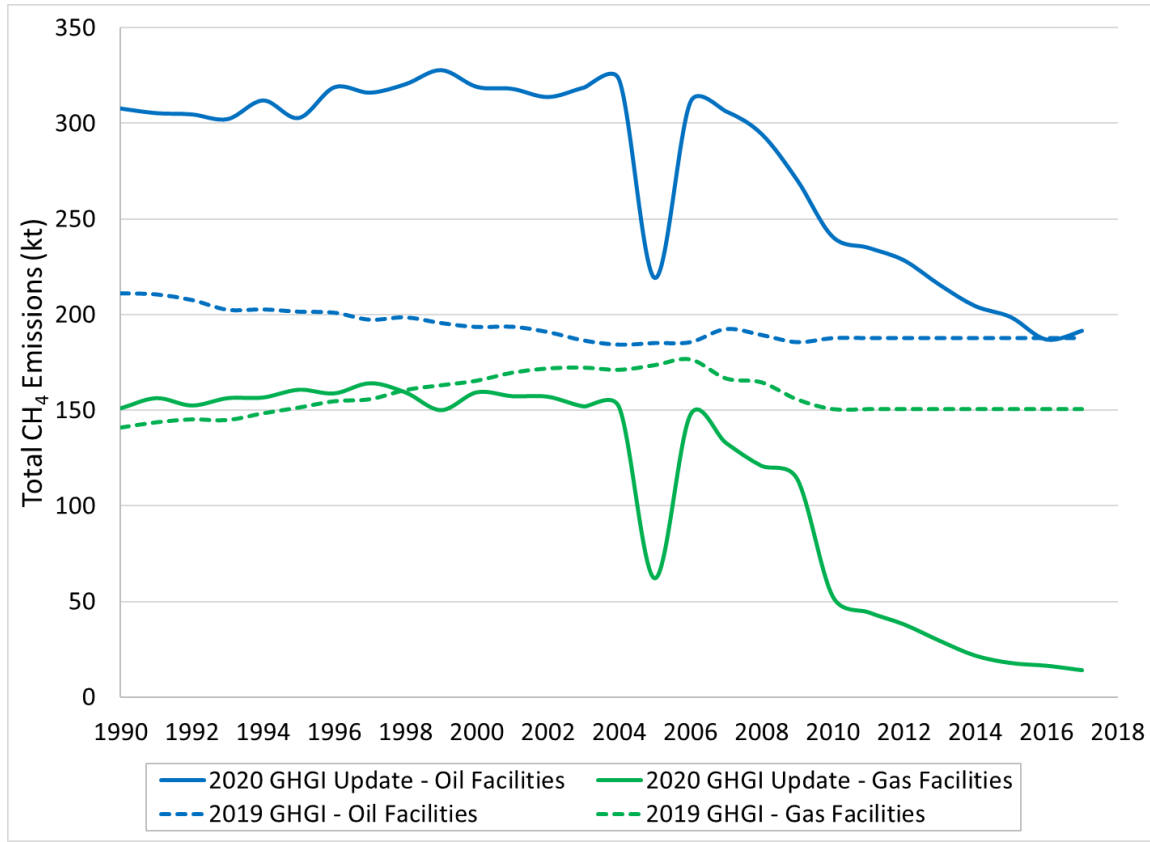


GOM FEDERAL WATERS: BOEM OGOR-B FLARED GAS VOLUMES

- OGOR-B data currently used does not apportion flared gas volumes to oil vs gas complexes (in current GHGI, all assigned to gas complexes)
- Publicly available OGOR-B provides separate oil vs gas flared gas volumes for 2011 forward
- EPA is considering two options for 1990-2010:
 - Option A (shown as solid lines) assigns more flaring to oil complexes
 - Option B (shown as dashed lines) assigns more flaring to gas complexes

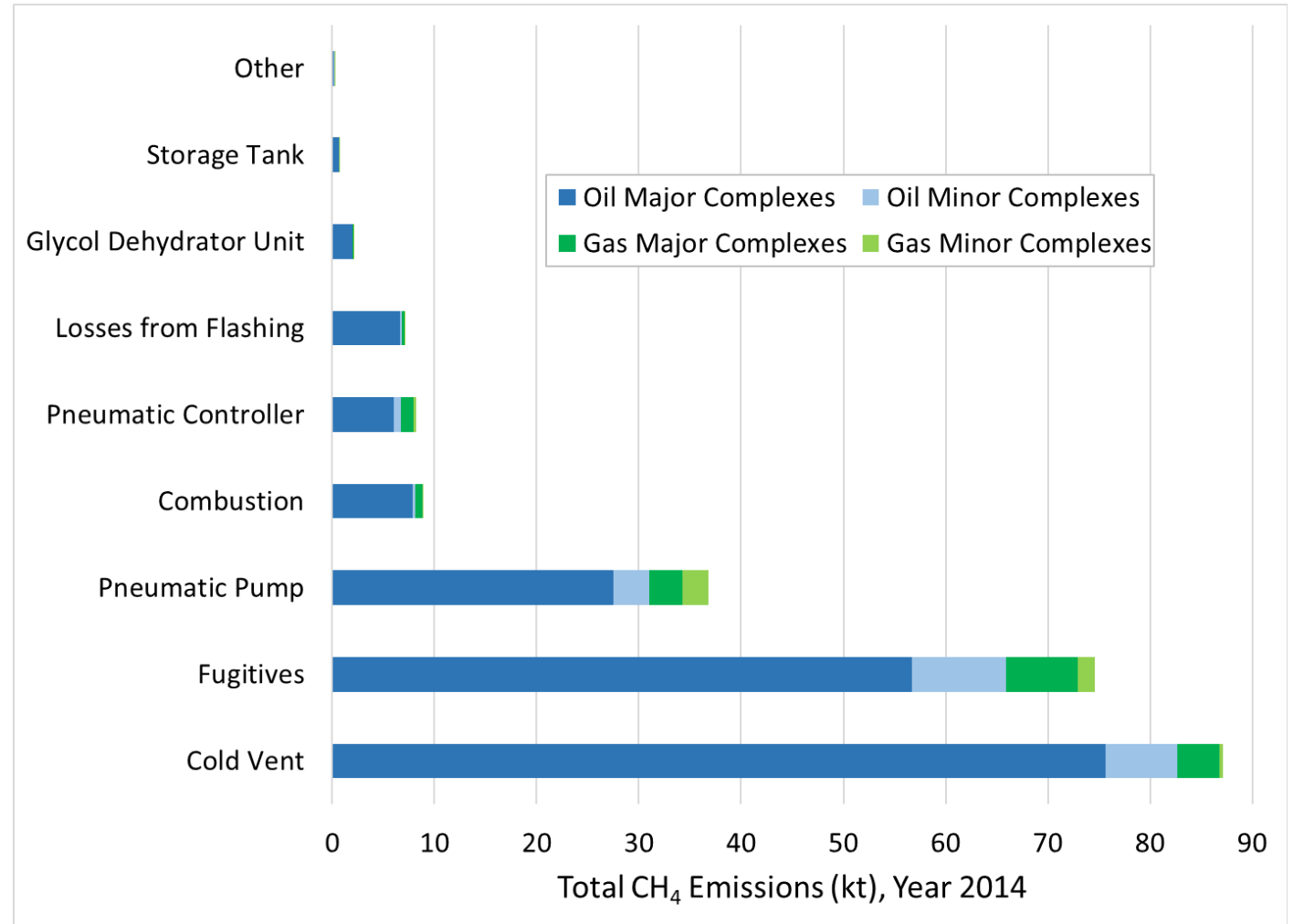


GOM FEDERAL WATERS: EMISSIONS



GOM FEDERAL WATERS: EMISSIONS BY SOURCE

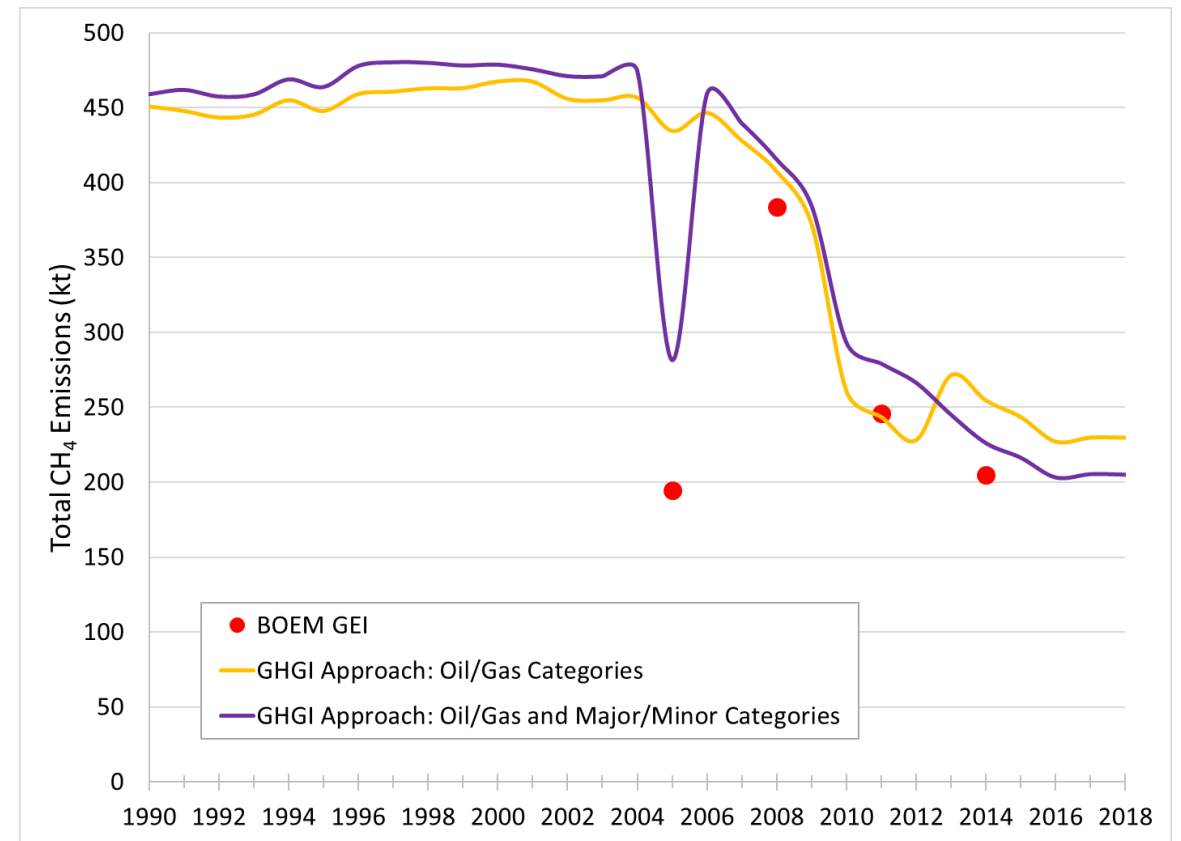
- Emissions can be broken out into the categories used in the BOEM GEI
- Breakdown for the year 2014 update under consideration shown in figure
- Dominant sources:
 - Cold vent
 - Fugitives
 - Pneumatic Pump



GOM FEDERAL WATERS: IMPACT OF MAJOR/MINOR CATEGORIES

- Total GOM federal water emissions differ depending on whether major/minor categories are used
- In certain years where major complex coverage is higher than overall coverage (e.g., 2005 and 2014), major/minor categories likely increase accuracy in total estimated emissions as it accounts for different average emissions between the two types of complexes

BOEM GEI Year	% of Complexes Reported to GEI		
	All Complexes	Major Complexes	Minor Complexes
2005	46	81	11
2008	94	100	88
2011	104	97	110
2014	82	96	67

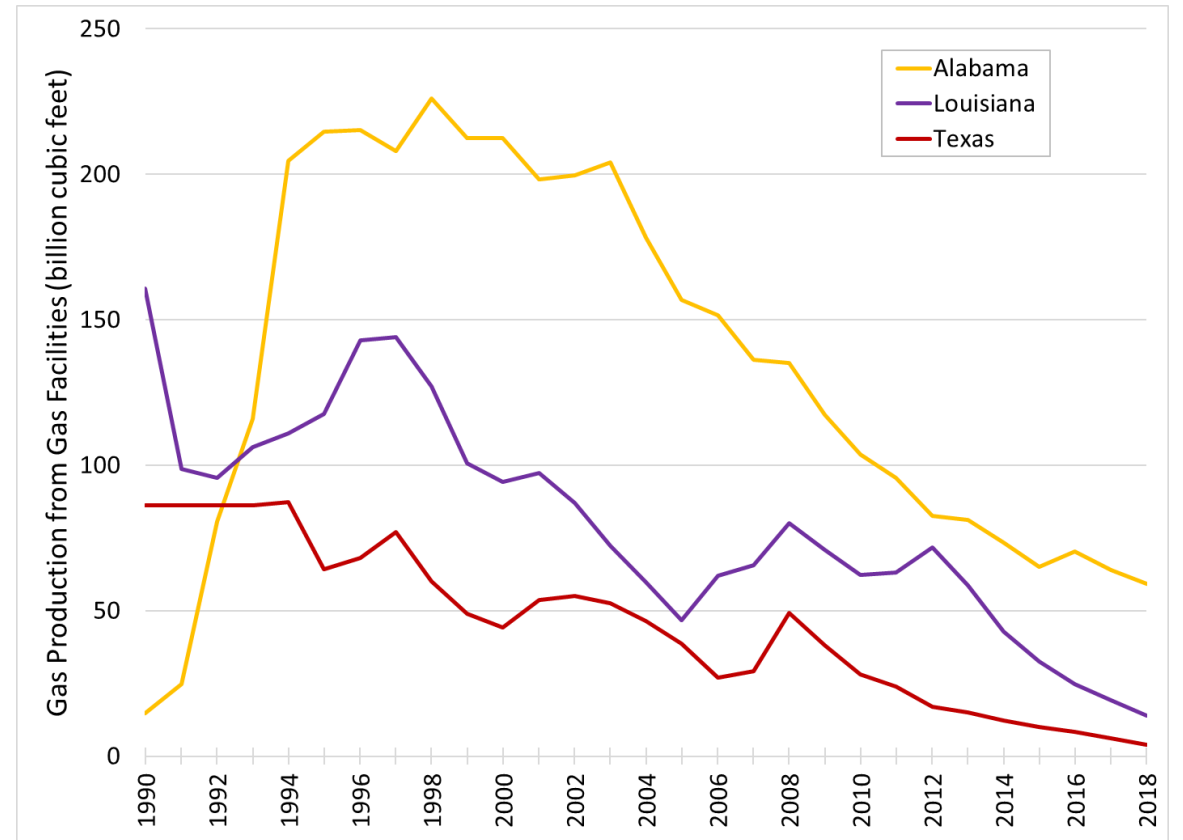
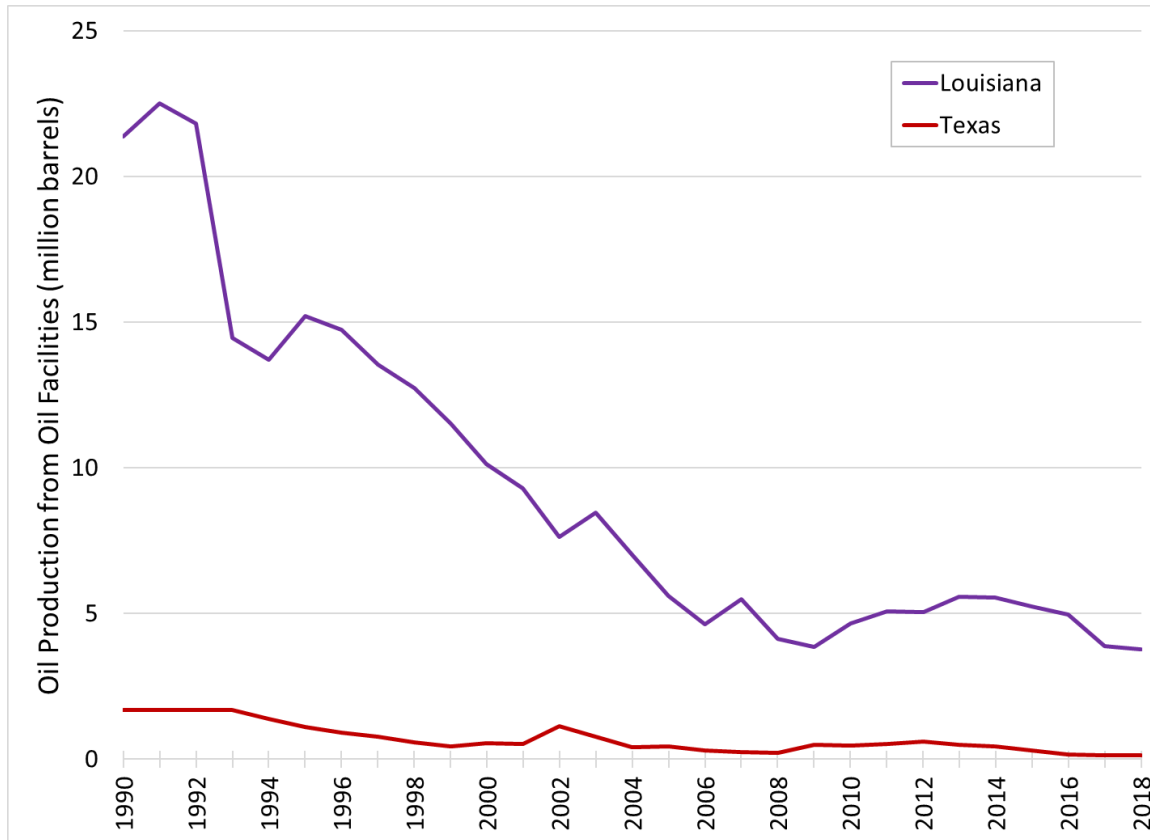


2. UPDATES UNDER CONSIDERATION FOR OFFSHORE FACILITIES IN GOM STATE WATERS

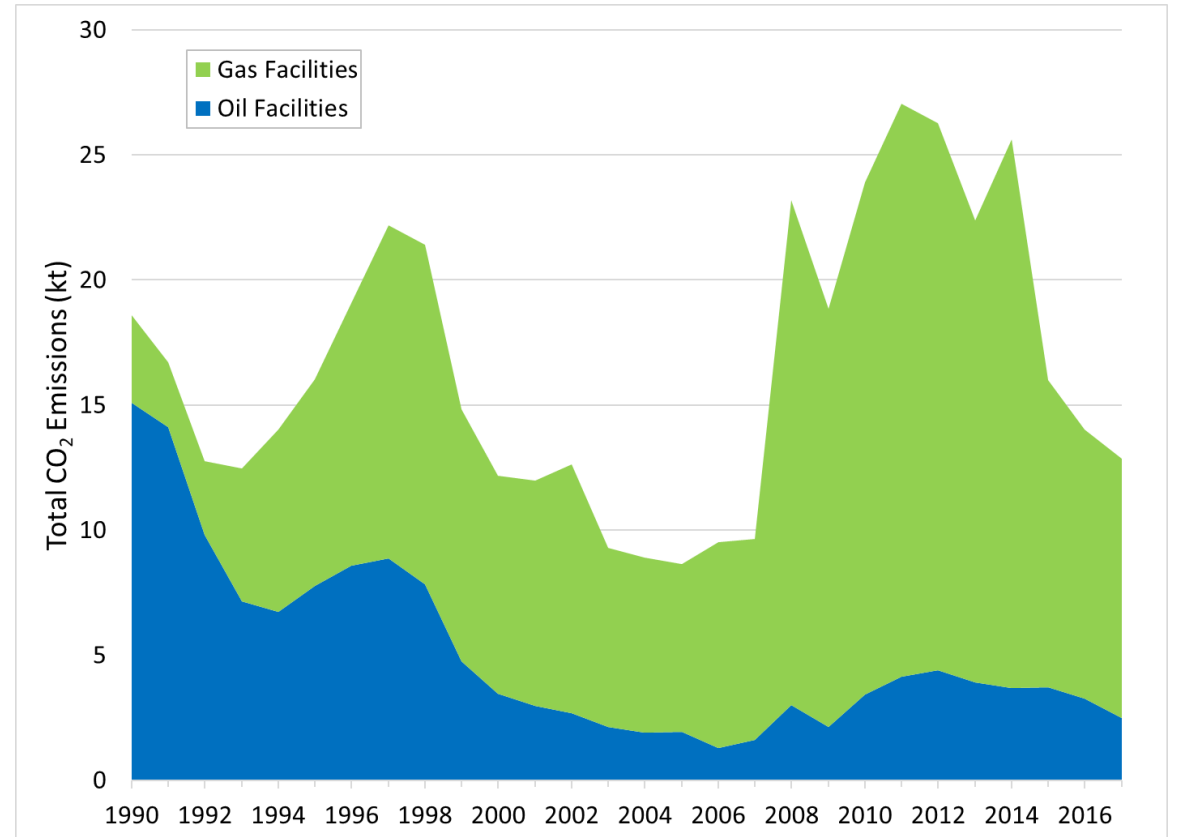
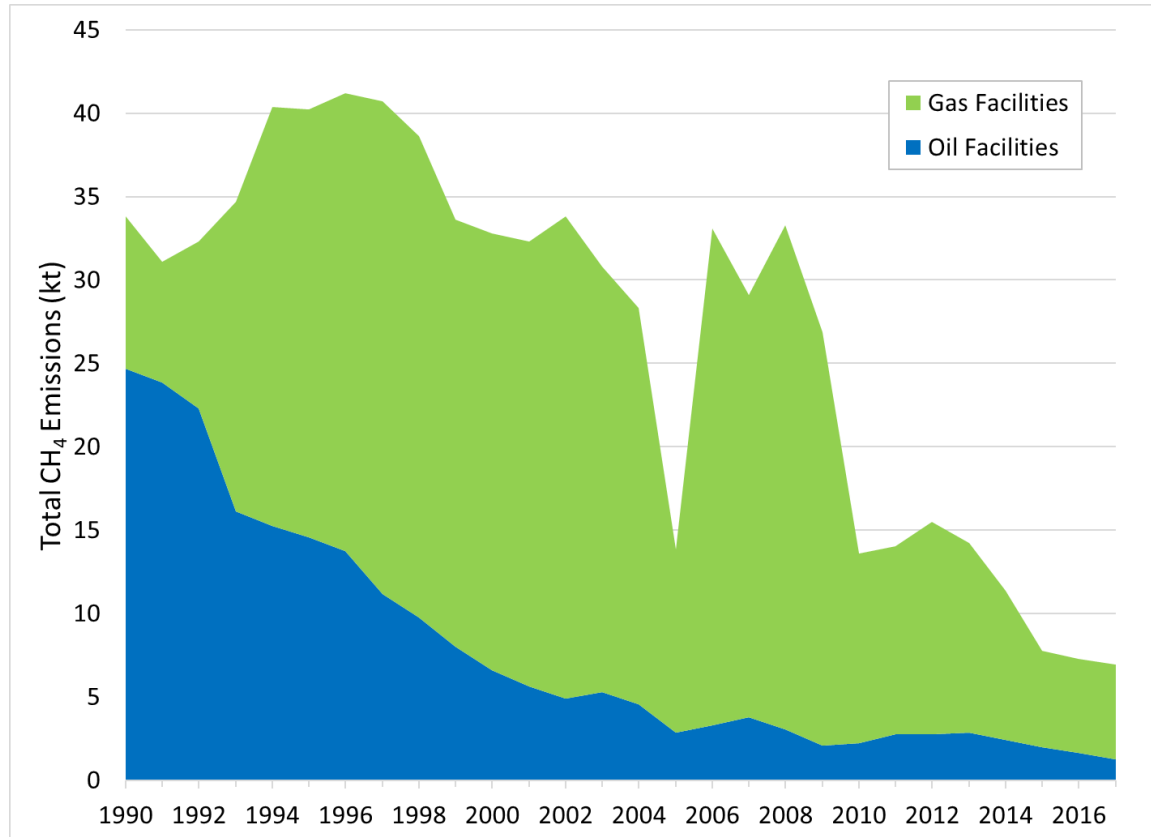
GOM STATE WATERS: BACKGROUND & APPROACH

- Offshore production in GOM state waters occurs in coastal areas off Alabama, Louisiana, and Texas
- EPA has not identified emissions data (e.g., regional inventories or GHGRP reporting) for these regions
- EFs: Calculate production-based EFs from GOM federal waters emissions and production
 - Emissions per unit oil production for oil complexes; emissions per unit gas production for gas complexes
- Activity: Production data in each GHGI time series year (available from states)

GOM STATE WATERS: PRODUCTION



GOM STATE WATERS: EMISSIONS



3. UPDATES UNDER CONSIDERATION FOR OFFSHORE FACILITIES IN THE PACIFIC AND ALASKA REGIONS

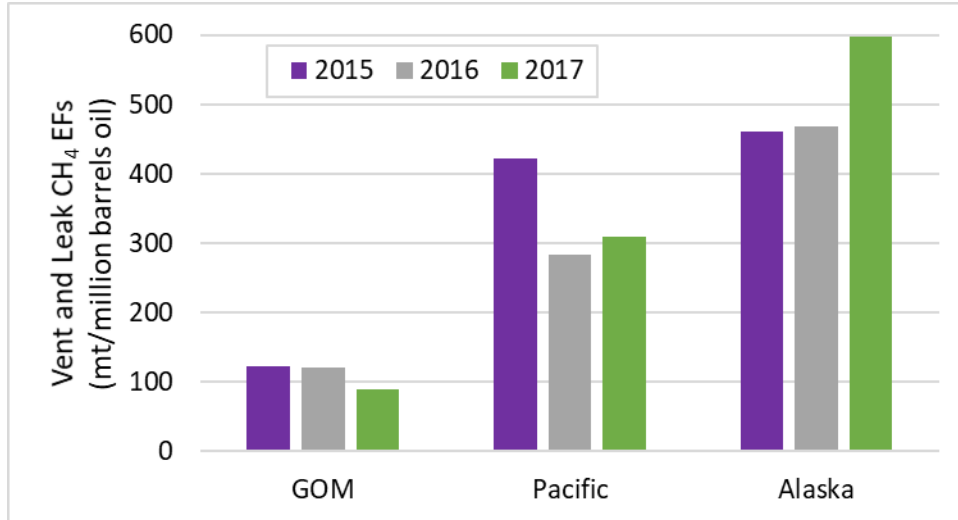
PACIFIC & ALASKA: BACKGROUND & APPROACH

- Offshore production in Pacific occurs in federal and state waters
 - EPA assumes all facilities are “oil” production type
- Offshore production occurs only in state waters off the coast of Alaska
- EFs: Calculate production-based EFs from GHGRP data
 - Emissions per unit oil production for oil complexes; emissions per unit gas production for gas complexes
- Activity: Production data
 - Pacific – available from EIA, BOEM, and California state
 - Alaska – available from state

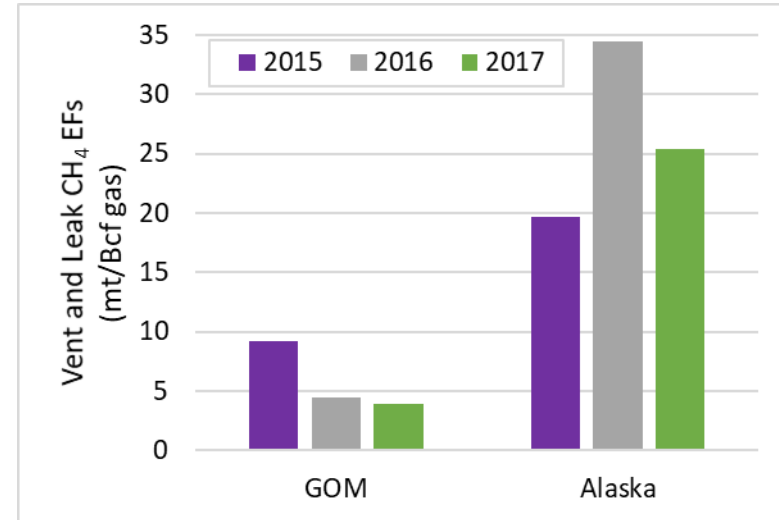
PACIFIC & ALASKA: CALCULATED GHGRP EFs

Vent and Leak CH₄ EFs

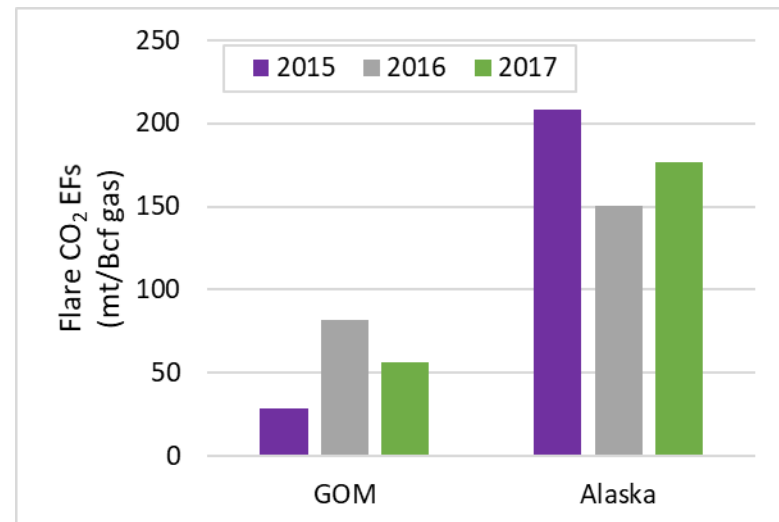
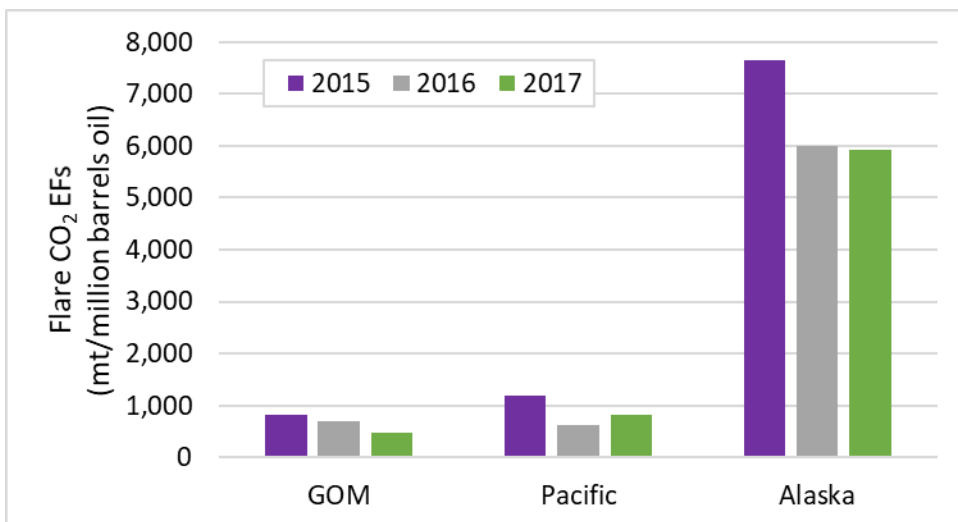
Oil Facilities



Gas Facilities

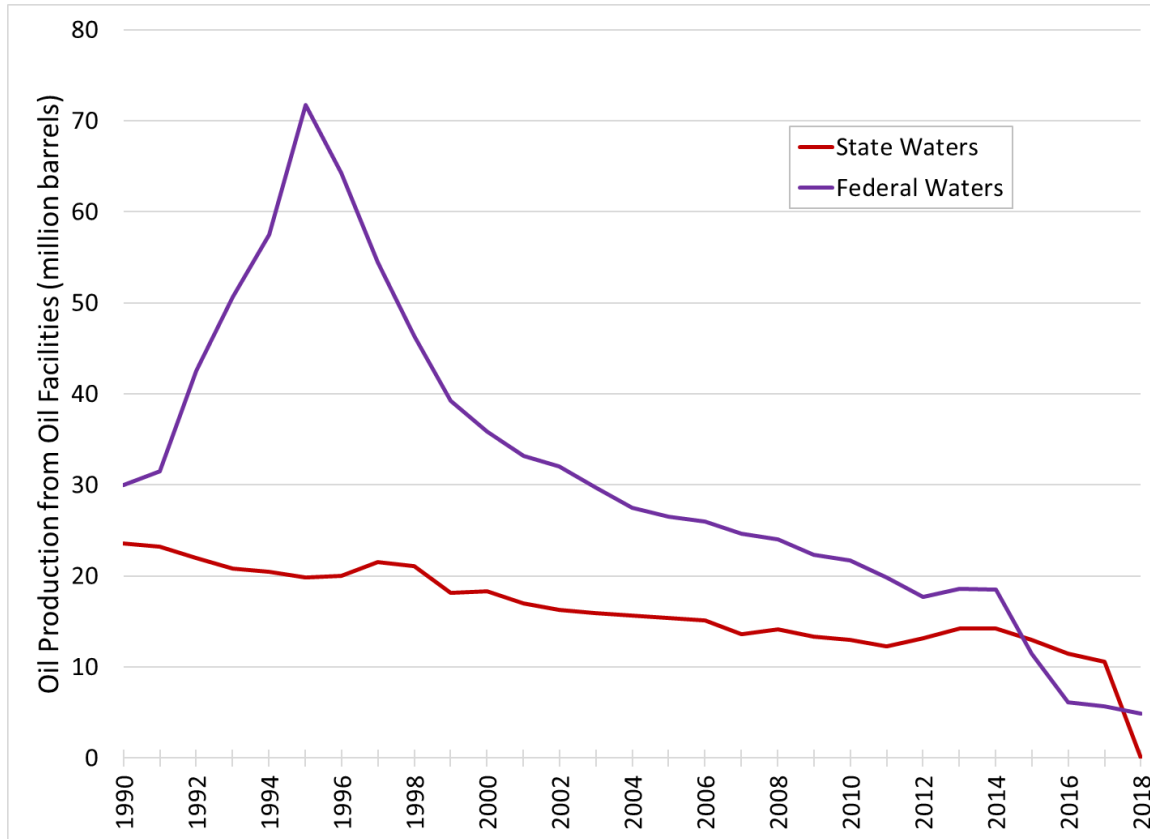


Flare CO₂ EFs

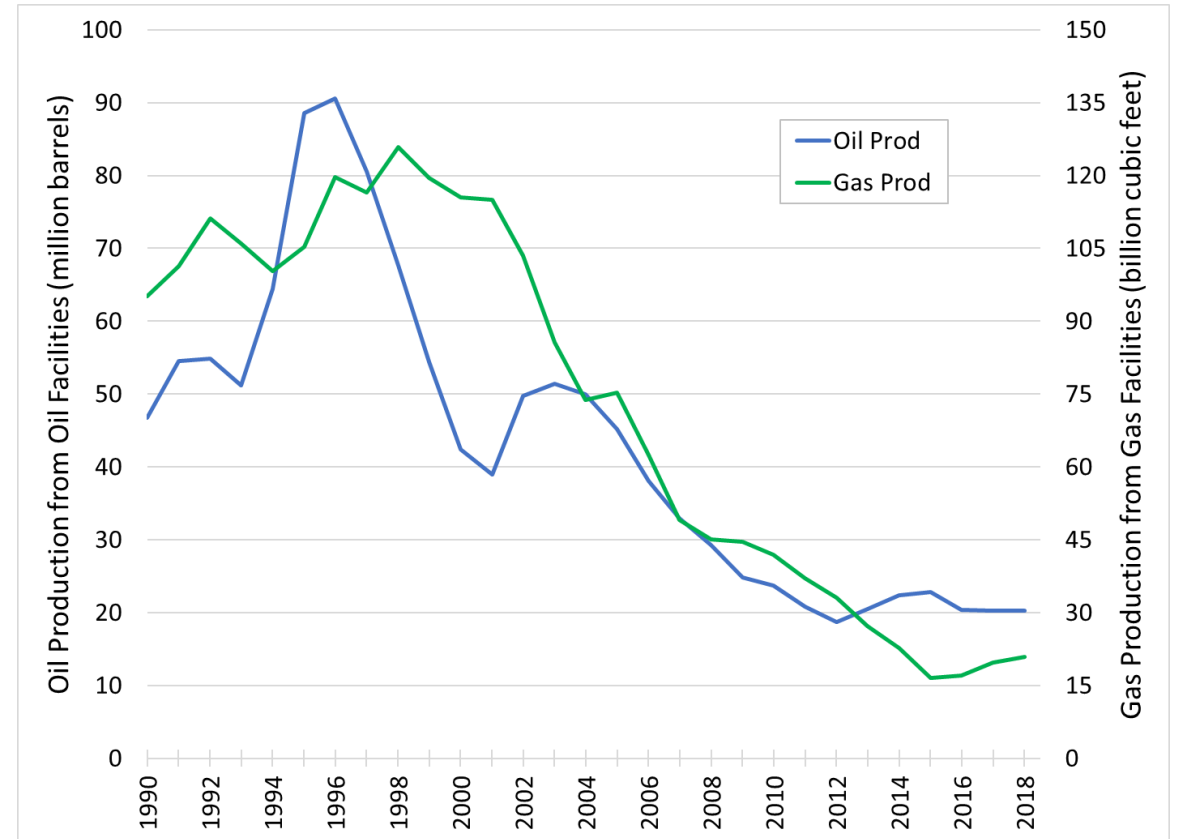


PACIFIC AND ALASKA: PRODUCTION

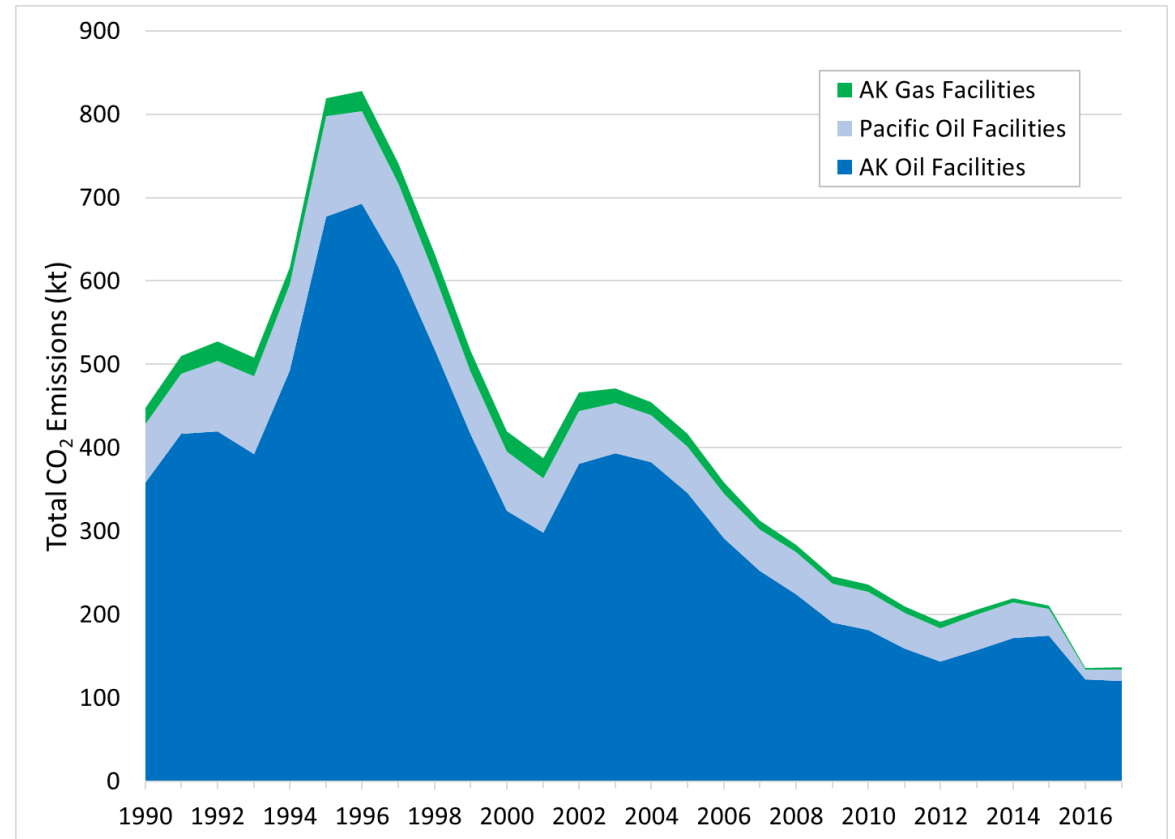
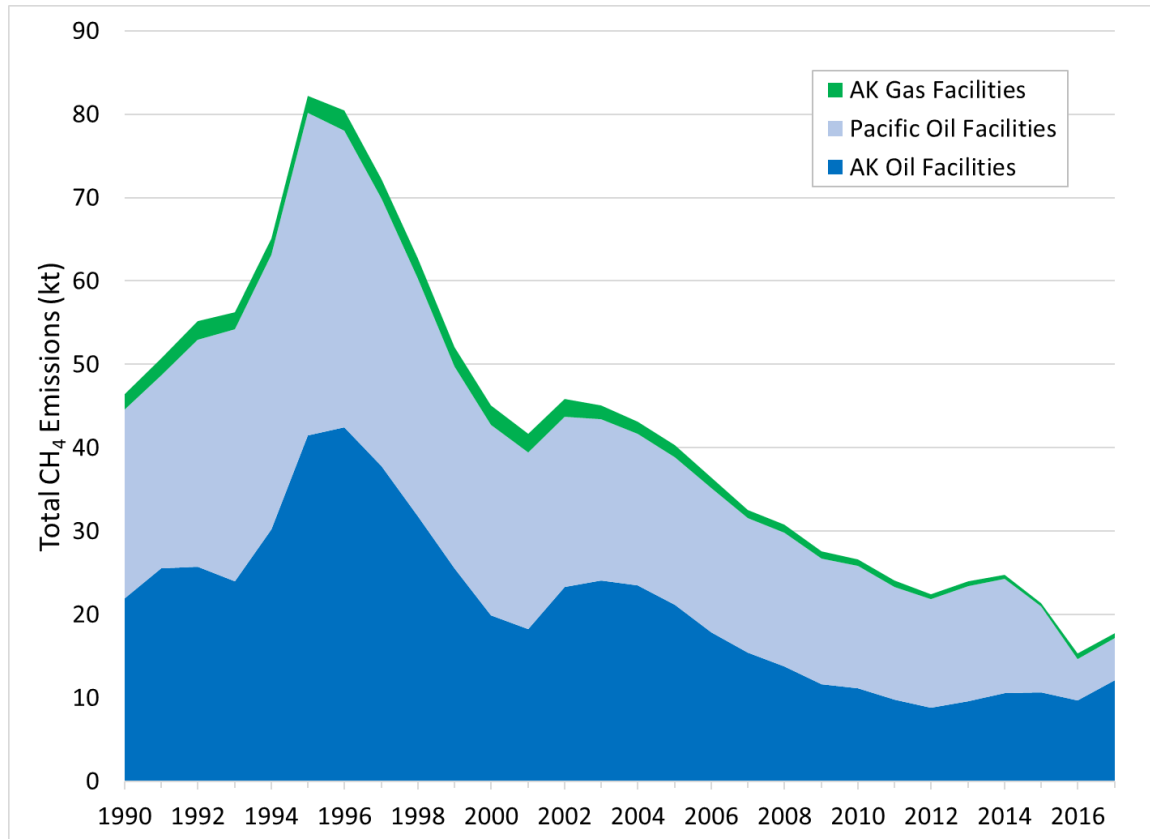
Pacific



Alaska



PACIFIC AND ALASKA: EMISSIONS



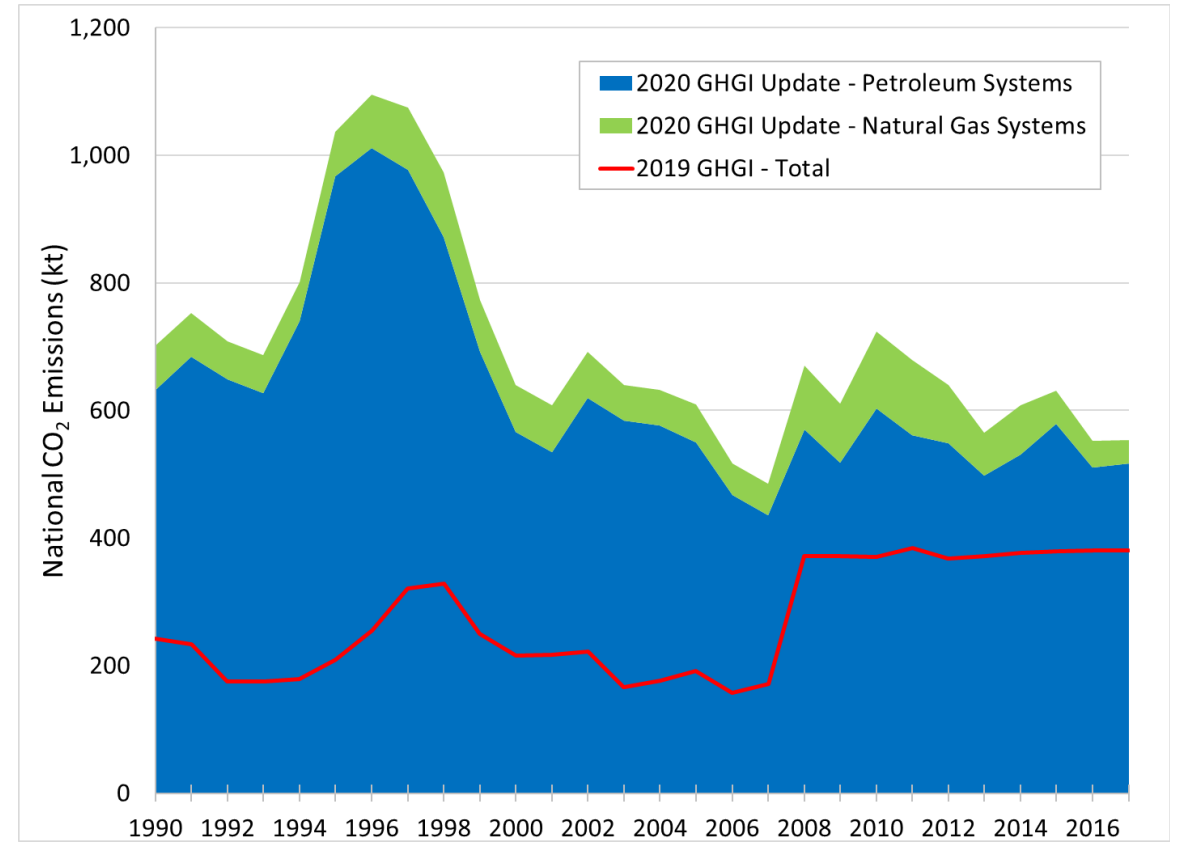
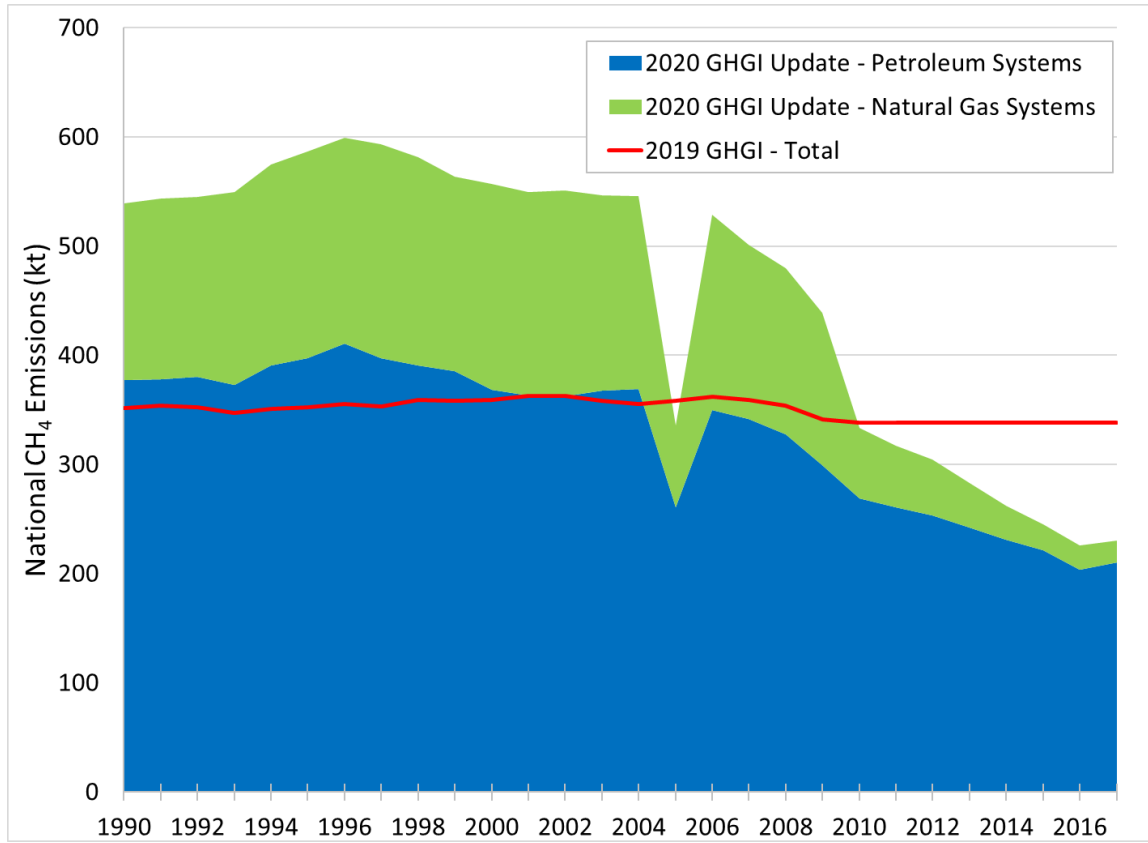
OFFSHORE PRODUCTION NATIONAL EMISSIONS SUMMARY

OFFSHORE PRODUCTION EMISSIONS – YEAR 2017

COMPARISON

Category	Region	National CH ₄ Emissions (kt)		National CO ₂ Emissions (kt)	
		2020 GHGI Update	2019 GHGI	2020 GHGI Update	2019 GHGI
Petroleum Systems	GOM Federal Waters	191	188	377	0
	GOM State Waters	1	NE	2	NE
	Alaska	12	NE	120	NE
	Pacific	5	NE	13	NE
Natural Gas Systems	GOM Federal Waters	14	151	24	369
	GOM State Waters	6	NE	10	NE
	Alaska	0.5	NE	3	NE
	Pacific	n/a	n/a	n/a	n/a

OFFSHORE PRODUCTION TIME SERIES EMISSIONS



REQUESTS FOR STAKEHOLDER FEEDBACK

1. GOM Federal Waters: Feedback on datasets and approach
 - a. Complex-level EFs: Oil/gas complexes, Major/minor complexes
 - b. Approach for applying BOEM GEI EFs over the time series
 - c. Approach to estimate complex counts over the time series
2. GOM Federal Waters Flaring: Feedback on two approaches; applying GEI-based EFs versus OGOR-B flaring volumes
 - a. Feedback on two options for use of OGOR-B flaring volumes
3. GOM State Waters: Feedback on relying on GOM federal waters production-based EFs

REQUESTS FOR STAKEHOLDER FEEDBACK (CONT.)

4. Pacific and Alaska Regions: Feedback on relying on GHGRP production-based EFs
5. Feedback on the 1990-2018 CH₄ emissions trend, including information on changes in offshore production practices over time that may have contributed to the trend
6. Feedback on how to track and estimate emissions from anomalous leak events
7. Information on other available or upcoming data related to offshore oil and gas emissions