



Contract Report: Offshore Oil and Gas Platform Emissions

Dick Karp and Martha Maldonado
Air Quality Division

Presented to SETPMTTC Meeting
April 13, 2011



Project Objectives

- The TCEQ Emissions Assessment Section contracted with Eastern Research Group (ERG) to update emissions from oil and gas platforms in Texas waters, i.e., less than 10.3 miles from shore.
- Project tasks were to:
 - improve identification and characterization of process units (emission sources) on oil and gas platforms operating in Texas waters of the Gulf of Mexico;
 - develop accurate emissions for the various sources on the oil and gas platforms operating in Texas waters of the Gulf of Mexico; and
 - provide electronic data files in NIF3.0 and TexAER formats.



Data Sources

- The Texas Railroad Commission (TRC), responsible for permitting well heads
- The Texas General Land Office (GLO), responsible for permitting offshore platforms
- The EPA Toxic Release Inventory (TRI) database and National Emissions Inventory (NEI) database
- The DOE Energy Information Administration (EIA) database
- The TCEQ STARS database and Central Registry database
- The Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE, predecessor to the Minerals Management Service), responsible for permitting well heads and platforms in the Gulf of Mexico



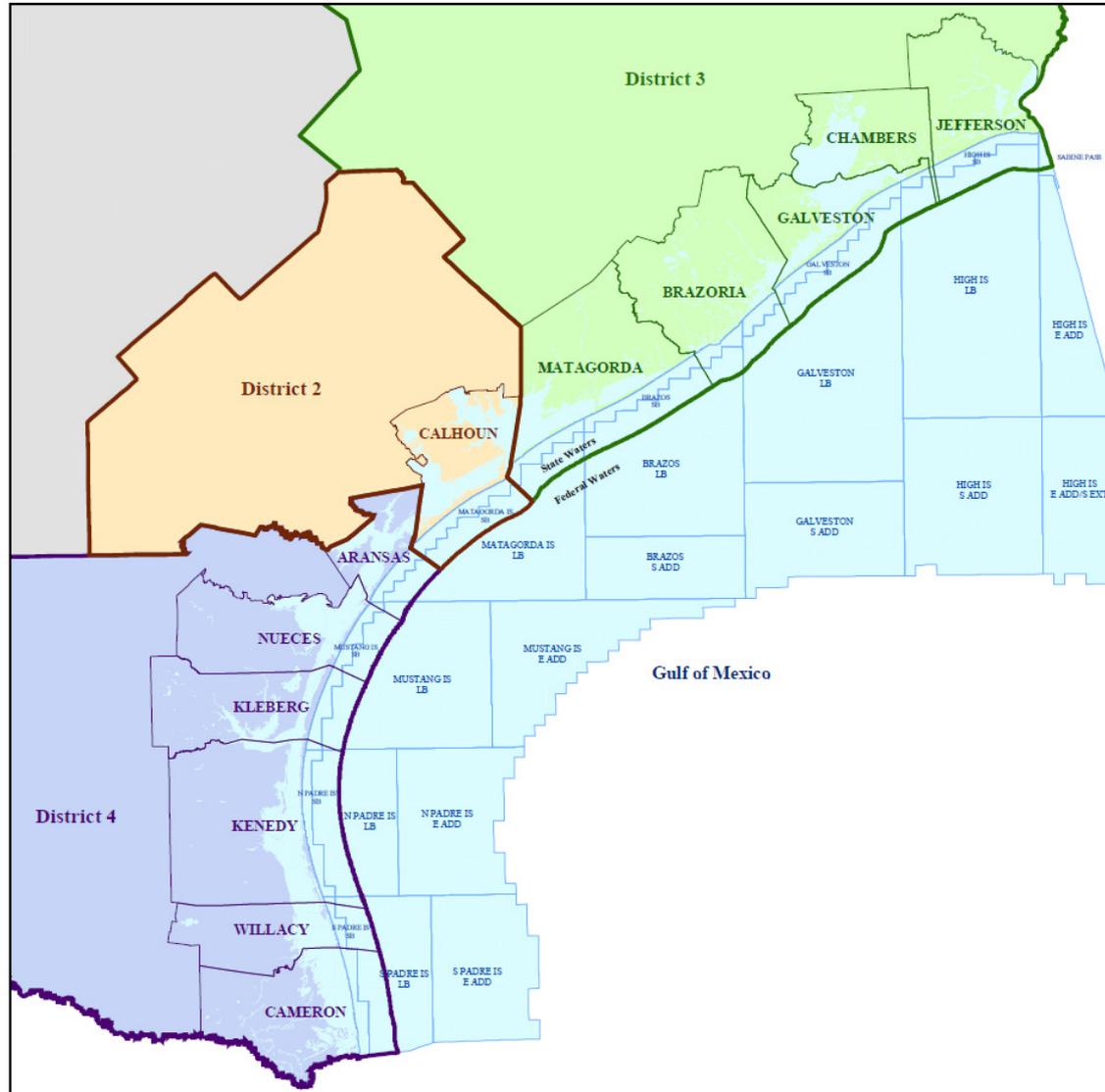
TRC Data

- Offshore Production Summary Data
 - Annual
 - By district
 - By county
- Production Database
 - Monthly by district
 - By lease
- Well Bore Database
 - API Code
 - Location
 - Completion
 - Formation

(Note: The production and well bore databases purchased from TRC were in unreadable EDCDIC format.)



TRC Districts and Counties





GLO Data

- 73 Individual Platforms
 - Latitude and longitude for 63 platforms
 - Lease area delineations for 10 platforms
- Platform Activity
 - Both oil and gas production at 43 platforms
 - Gas production at 4 platforms
 - No production type data specified for 26 platforms
- County Distribution
 - Aransas 10 platforms
 - Brazoria 4 platforms
 - Calhoun 9 platforms
 - Chambers 9 platforms
 - Galveston 9 platforms
 - Jefferson 6 platforms
 - Matagorda 5 platforms
 - Nueces 20 platforms
 - Orange 1 platform



Texas GLO Offshore Platforms



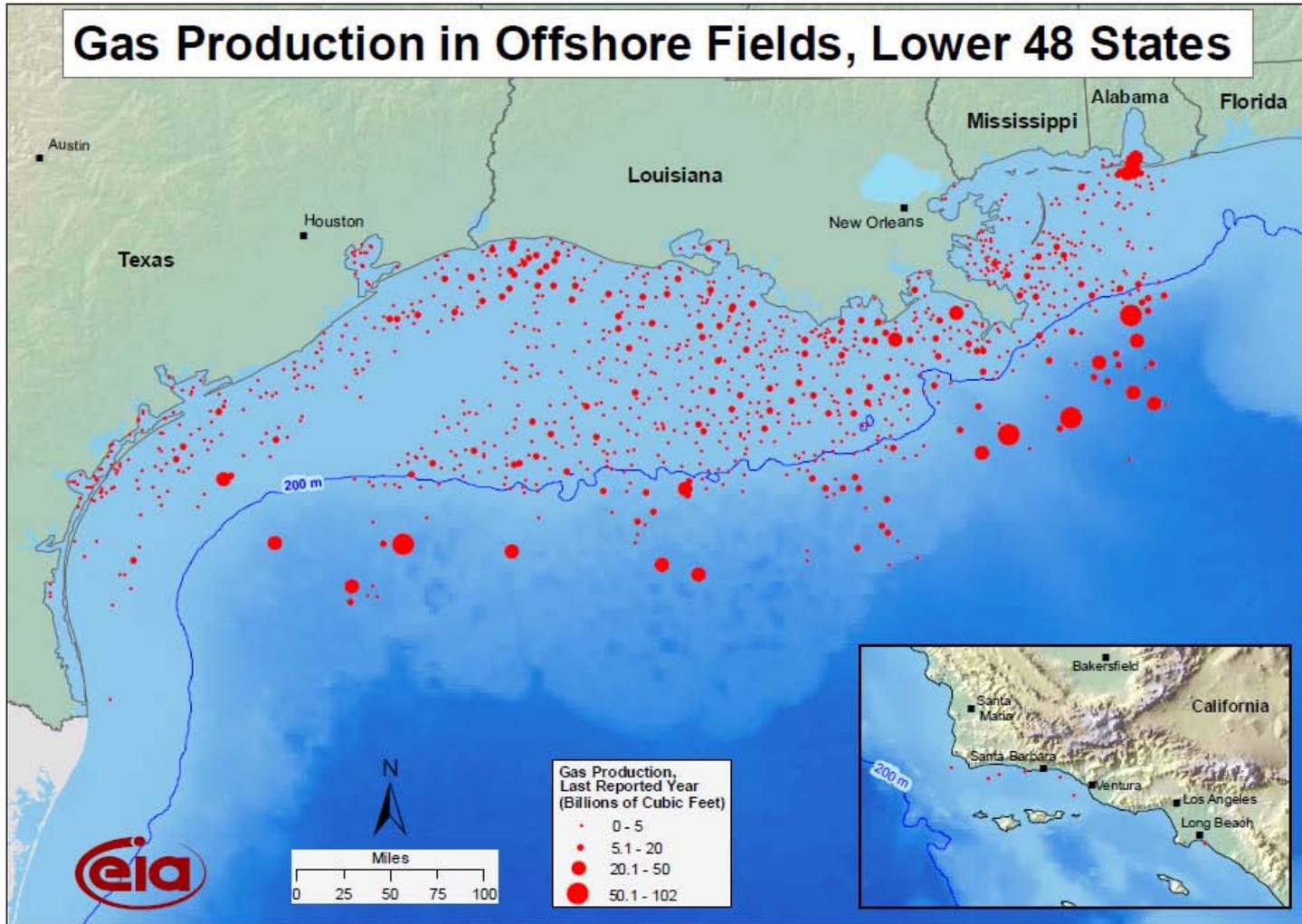


EPA and DOE Data

- EPA
 - TRI Database
 - Offshore oil and gas facilities are not required to report.
 - No oil and gas facility in Texas waters has reported.
 - NEI Database
 - The NEI includes five oil and gas facilities in Texas waters.
 - These facilities are classified as major sources.
- DOE
 - EIA Database
 - The EIA provides latitude and longitude location.
 - The EIA provides annual gas production.



DOE-EIA Offshore Platforms



Source: Energy Information Administration based on data from MMS, HPDI, CA Dept of Oil, Gas & Geothermal
Updated: April 8, 2009



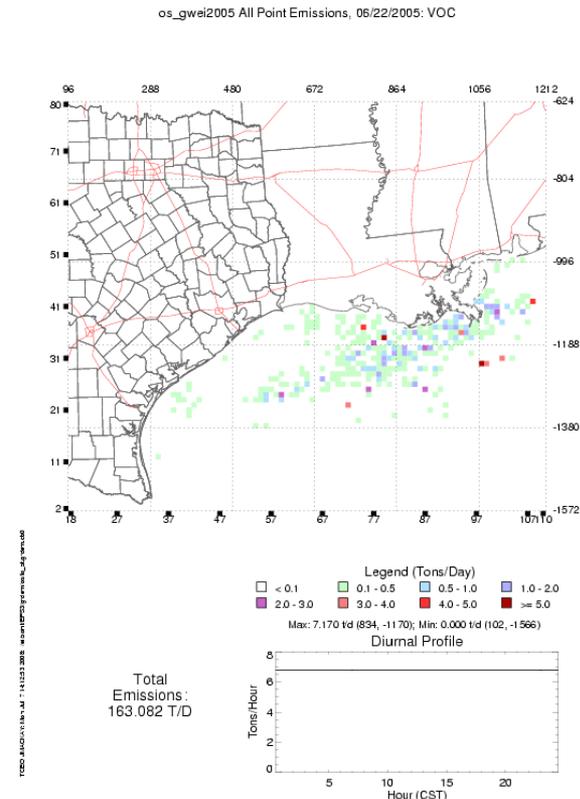
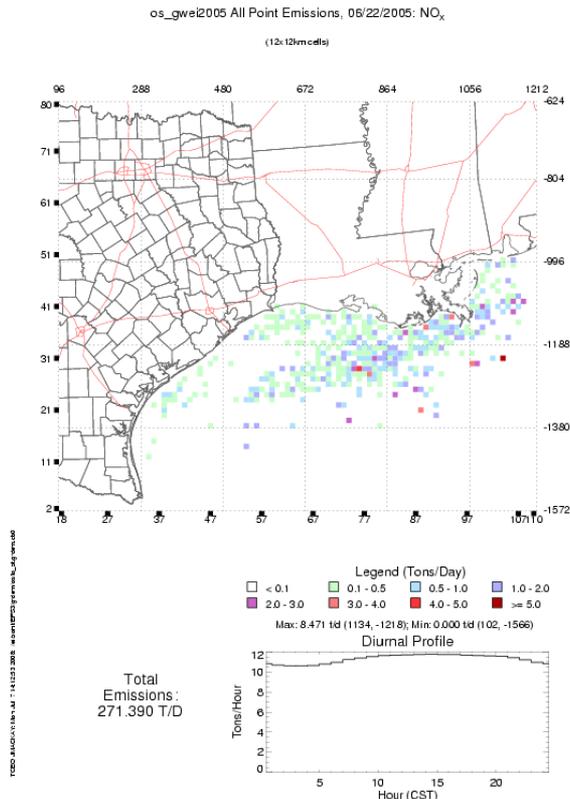
TCEQ Data

- STARS Database
 - 47 platforms with site identification number and county location, 45 with latitude and longitude
 - Aransas 2
 - Brazoria 2
 - Calhoun 1
 - Chambers 13
 - Galveston 7
 - Jefferson 16
 - Matagorda 2
 - Nueces 3
 - Orange 1
 - Annual emission estimates
- Central Registry of Regulated Entities
 - Company name and address
 - Permitted facility identification numbers (e.g., SIC, RN, CN)



BOEMRE Data

- No information for platforms in Texas waters
- Platforms in federal waters
 - Latitude and longitude location
 - Process unit (source-specific) activity and emissions factor data
 - 2005 vintage emissions 271.4 tpd NO_x and 163.1 tpd VOC





Issues and Limitations

- Very limited information was found for process units activity from the composite of data sources.
- Inconsistencies were found for platform designations and locations between sources of data.
- Only the TRC summary offshore oil and gas production data were usable.
- Both oil and gas are produced on most platforms, but due to available data, consideration was limited to oil producing and gas producing platforms separately.

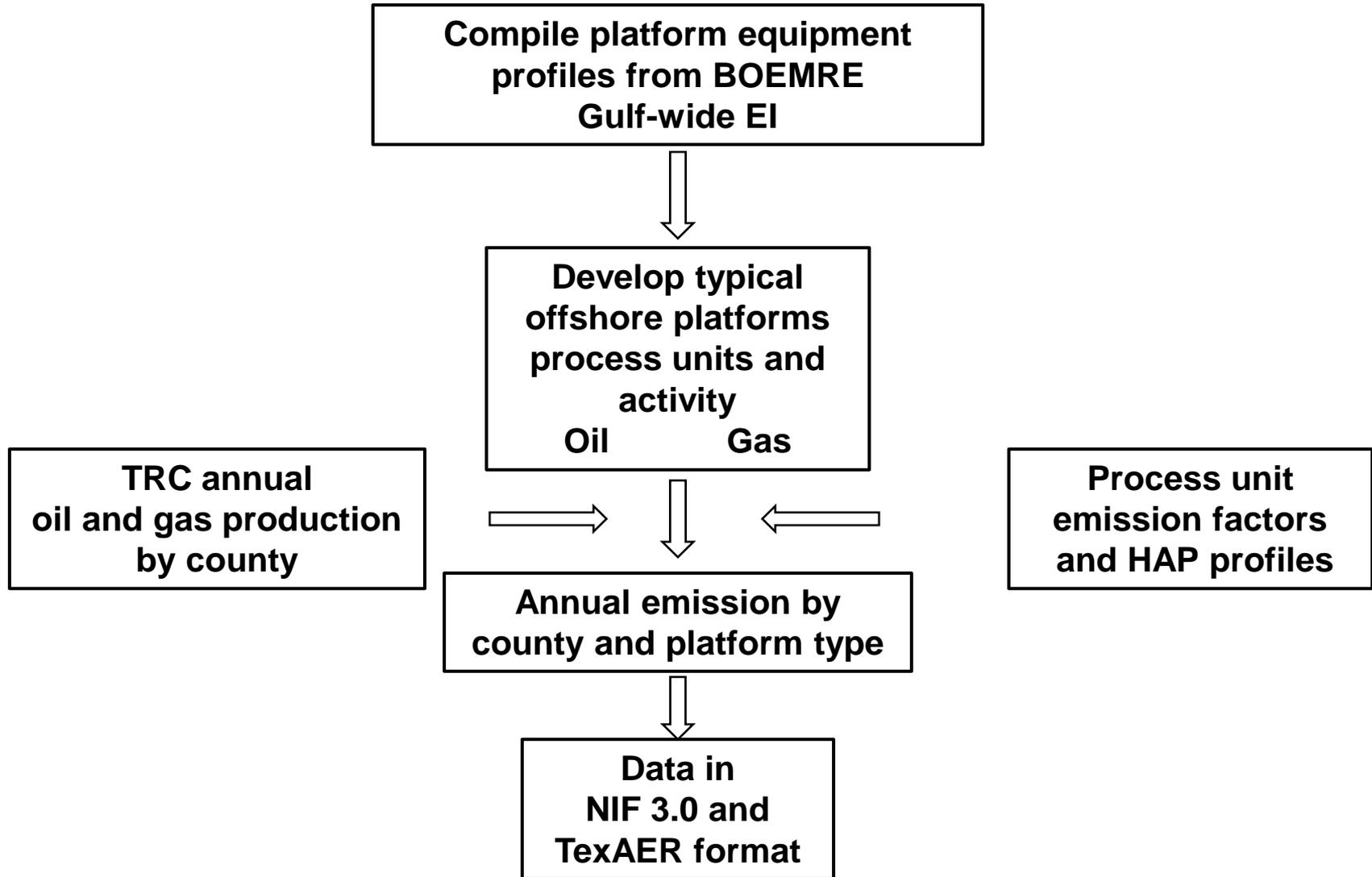


Project Approach

- Used the detailed BOEMRE Gulf-wide emissions to define a typical oil producing platform and separate typical gas producing platform
- Identified the typical process units associated with oil producing platforms and separately, the typical process units associated with gas producing platforms
- Determined the activity for the pertinent process units ratioed to the production, associated with typical oil producing and gas producing platforms
- Compiled available emission factors, e.g., AP-42, BOEMRE, and the HAPs speciation profiles using SPECIATE4 for the pertinent process units
- Used the TRC summary offshore production data for oil and gas, i.e., annual production by county
- Combined activity/production ratio, emission factor, speciation and production data to estimate county level emissions



Project Flow Chart





General Calculation Routine

$$AP_{e,i}^a = A_{e,i}^a / P_i^a$$

Where:

$AP_{e,i}^a$ = annual activity/production ratio for process unit 'e' on platform type 'i'

$A_{e,i}^a$ = annual activity for process unit 'e' on platform type 'i'

P_i^a = annual production on platform type 'i'

e = process unit, e.g., boiler, engine

i = platform type, i.e., oil or gas

$$EP_{p,e,i} = EF_{p,e,i} * AP_{e,i}^a$$

Where:

$EP_{p,e,i}$ = emission/production for pollutant 'p' from process unit 'e' on platform type 'i'

$EF_{p,e,i}$ = emission factor for pollutant 'p' from process unit 'e' on platform type 'i'

$AP_{e,i}^a$ = annual activity/production ratio for process unit 'e' on platform type 'i'

$$E_{c,p,e,i}^a = EP_{p,e,i} * PR_{c,i}^a$$

Where:

$E_{c,p,e,i}^a$ = annual emissions for county 'c' for pollutant 'p' from process unit 'e' on platform type 'i'

$EP_{p,e,i}$ = emission/production for pollutant 'p' from process unit 'e' on platform type 'i'

$PR_{c,i}^a$ = annual production for county 'c' on platform type 'i'



Example Calculation

$$AP_{e,i}^a = A_{e,i}^a / P_i^a$$

Given:

$A_{e,i}^a = 3.40$ MMscf/yr gas combustion for boilers on oil producing platforms

$P_i^a = 2.37$ Million barrels of oil produced annually from oil producing platforms

e = natural gas boiler

i = oil producing platform

$$AP_{e,i}^a = (3.40 \text{ MMscf/yr}) / (2.37 \text{ Million barrels/yr}) = 1.43 \text{ scf/bbl}$$

$$EP_{p,e,i} = EF_{p,e,i} * AP_{e,i}^a$$

Given:

$EF_{p,e,i} = 280$ lbs/MMscf for NO_x emissions from boilers on oil producing platforms

$$EP_{p,e,i} = (280 \text{ lbs/MMscf}) * (1.43 \text{ scf/bbl}) = 4.0 * 10^{-4} \text{ lbs/bbl}$$

$$E_{c,p,e,i}^a = EP_{p,e,i} * PR_{c,i}$$

Given:

$PR_{c,i} = 20,000$ bbl/yr from oil producing platforms in Aransas County

$$E_{c,p,e,i}^a = (4.0 * 10^{-4} \text{ lbs/bbl}) * (20,000 \text{ bbl/yr}) = 8.0 \text{ lbs/yr}$$

Therefore, the estimated annual NO_x emissions from boilers on oil producing platforms in Aransas County is 8.0 pounds per year.



Process Units and Gas and Oil Activity Levels

Process Unit	Gas Platforms Activity Level	Oil Platforms Activity Level
Amine Unit	3,592.44 MMBTU	
Boiler/Heater/Burner , 10-100 MMBTU/hr	289.01 MMSCF	
Boiler/Heater/Burner < 10 MMBTU/hr	498.35 MMSCF	3.40 MMSCF
Boiler/Heater/Burner > 100 MMBTU/hr	2.06 MMSCF	
Diesel Engine MaxHP < 600	71,611.48 MMBTU	1,857.44 MMBTU
Diesel Engine MaxHP > 600	14,044.26 MMBTU	420.00 MMBTU
Gasoline Engine MaxHP > 600	8,141.71 MMBTU	
Drilling Rigs, Diesel	30,618.94 MMBTU	
Combustion Flares No Smoke, No Pilot Fuel, flaring	777.00 MMBTU	
Combustion Flares No smoke, Pilot fuel, flaring	28,955.45 MMBTU	
Combustion Flares No Smoke, Pilot fuel, Pilot	8.33 MMBTU	
Glycol Dehydrator Triethylene glycol	19,790.36 MMSCF	
Natural Gas Engine 2-stroke, lean		228,840.00 MMBTU
Natural Gas Engine 2-stroke, rich	27,946.28 MMBTU	
Natural Gas Engine 4-stroke, clean	209,143.63 MMBTU	133,582.62 MMBTU
Natural Gas Engine 4-stroke, lean	459,962.29 MMBTU	
Natural Gas Engine 4-stroke, rich	3,256,851.22 MMBTU	445,139.74 MMBTU
Natural Gas Turbine	1,784,679.03 MMBTU	
Pneumatic Pumps	93.81 MMSCF	20.49 MMSCF
Pressure/Level Controller	22.26 MMSCF	1.06 MMSCF
Storage Tank Operations Condensate	493.23 BBL	24.70 BBL
Storage Tank Operations Crude Oil	502.34 BBL	7,826.03 BBL
Cold Vent		6,129.45 MMSCF



Results

Annual Emissions (tons)

FIPS	County Name	CO	NO _x	PM ₁₀ -PRI	PM ₂₅ -PRI	SO ₂	VOC
48245	Jefferson	137.41	102.83	0.75	0.75	0.48	6.93
48167	Galveston	77.82	56.32	0.39	0.39	0.31	3.51
48057	Calhoun	44.05	34.32	0.27	0.27	0.12	2.52
48321	Matagorda	39.34	29.61	0.22	0.22	0.13	2.02
48007	Aransas	19.96	15.43	0.12	0.12	0.06	1.11
48355	Nueces	19.93	14.88	0.11	0.11	0.07	1.00
48273	Kleberg	19.78	14.77	0.11	0.11	0.07	0.99
48039	Brazoria	19.17	13.61	0.09	0.09	0.08	0.81
48071	Chambers	5.10	3.75	0.03	0.03	0.02	0.24
48261	Kenedy	5.32	3.86	0.03	0.03	0.02	0.24
Total		387.87	289.37	2.12	2.11	1.38	19.36

Ozone Season Daily Emissions (lbs)

FIPS	County Name	CO	NO _x	PM ₁₀ -PRI	PM ₂₅ -PRI	SO ₂	VOC
48245	Jefferson	752.925	563.438	4.137	4.134	2.637	37.960
48167	Galveston	426.392	308.624	2.158	2.156	1.723	19.230
48057	Calhoun	241.344	188.049	1.457	1.457	0.682	13.781
48321	Matagorda	215.571	162.229	1.200	1.200	0.735	11.066
48007	Aransas	109.345	84.537	0.649	0.648	0.323	6.100
48355	Nueces	109.229	81.534	0.597	0.596	0.387	5.462
48273	Kleberg	108.393	80.910	0.592	0.592	0.384	5.421
48039	Brazoria	105.027	74.565	0.506	0.505	0.456	4.421
48071	Chambers	27.952	20.542	0.147	0.147	0.106	1.328
48261	Kenedy	29.128	21.174	0.149	0.149	0.116	1.333
Total		2,125	1,586	12	12	8	106



Results

- Approximately 290 tons per year of NO_x emissions are estimated to be emitted from platforms in Texas waters.
- Approximately 95% of the NO_x emissions are from natural gas engines deployed on both gas producing and oil producing platforms.
- Approximately 75% of the total NO_x emissions are estimated to be emitted from gas producing platforms and 25% from oil producing platforms.
- Approximately 20 tons per year of VOC emissions are estimated to be emitted from platforms in Texas waters.
- Approximately 66% of the total VOC emissions are estimated to be emitted from gas producing platforms and 34% from oil producing platforms.



Results

Agency	Oil Production (barrels)	NO _x Emissions (tpy)	Emissions/Production ratio (tpy/thousand barrels)
TRC	230,000	74	0.32
BOEMRE	420,000,000	18,750	0.045

Agency	Gas Production (MMscf)	NO _x Emissions (tpy)	Emissions/Production ratio (tpy/MMscf)
TRC	48,000	215	0.0045
BOEMRE	2,330,000	56,250	0.024

A comparison of the Emission/Production ratios between agencies appears to indicate an inconsistency since the BOEMRE ratio for oil production in the Gulf is a factor of seven times lower than the ERG-calculated estimate for TRC oil-producing platforms in state waters. The BOEMRE ratio for gas production is a factor of five times higher than the ERG-calculated estimate for TRC sources.



Conclusions

- The original project objectives could not be attained due to limitations of the data from the various sources.
- The methodology used resulted in a county-level resolution of annual pollutant emissions.
- These emission estimates are less than some previous estimates, which may be due to the approach of using platforms that produce either oil or gas, not both.



Conclusions

- These annual emission estimates are considered conservative, since the number of process units associated with each platform type, i.e., oil or gas, was based on rounding up the average number from the BOEMRE review. In addition, the methodology used uncontrolled emission factors, and some of the platforms in state waters are likely using some control devices.
- Developing platform-specific emissions will require decoding TRC databases, acquiring the updated GLO platform data, resolving data inconsistencies, as well as possibly surveying platform operations to identify process units and activity levels.



Questions

Contact Information:

Dick Karp

512-239-1462

Dick.Karp@tceq.texas.gov

Martha Maldonado

512-239-1999

Martha.Maldonado@tceq.texas.gov