



Improving Area Source Oil and Gas Emissions Estimates

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Overview

- Background information
 - How area source emissions are estimated
 - Oil and gas emissions submitted for the National Emissions Inventory (NEI)
 - Texas oil and gas inventory milestones
- Development of tools/calculators used to estimate oil and gas emissions
 - TCEQ Excel spreadsheet calculator
 - Central States Air Resource Agencies (CenSARA) Excel spreadsheet calculator
 - Environmental Protection Agency (EPA) Access database tool



Overview (cont.)

- Developing basin-specific equipment profiles and emission factors
 - Using survey data
 - Using point source data
 - Using EPA Greenhouse Gas Reporting Program (GHGRP) data
- Example: Updated compressor engine equipment profiles developed using GHGRP data



How Area Source Emissions Are Estimated

- Emissions are estimated at the county-level

$$\text{Emissions} = \text{Activity} \times \text{EF}$$

- Activity
 - Surrogate county-level data that is representative of the source being estimated
 - Examples include: population, employment data, amount of fuel purchased, and number of oil and gas wells
- Emission Factor (EF)
 - Generally, factors that are applied nation-wide
 - Example: combustion factors from AP-42



How Area Source Oil and Gas Emissions Are Estimated

- For oil and gas sources, the equation is modified slightly:

$$\text{Emissions} = \text{Activity} \times \text{EF} \times \text{Equipment Profile}$$

- Activity
- Emission Factor (EF)
- Equipment profile
 - Number of pieces of equipment per well
 - Operating parameters of equipment
 - Amount of controls on equipment
 - Goal: develop basin-specific equipment profiles to improve emission estimates



Background Information

- Area source emissions are submitted for the NEI every three years
- Texas began estimating area source oil and gas emissions using well count and production activity data for the 2002 NEI
- The current Texas oil and gas calculator was developed in 2010, for the 2008 NEI
- Through the 2008 NEI, Texas was one of only a handful of states submitting area source oil and gas emissions for the NEI



Background Information (cont.)

- Tools developed to help estimate oil and gas emissions
 - TCEQ Excel spreadsheet calculator
 - CenSARA Excel spreadsheet calculator
 - EPA Access database tool
- For the 2014 NEI, Texas estimated oil and gas emissions for:
 - 189,706 active oil wells
 - 104,446 active gas wells



Protecting Texas by
Reducing and
Preventing Pollution

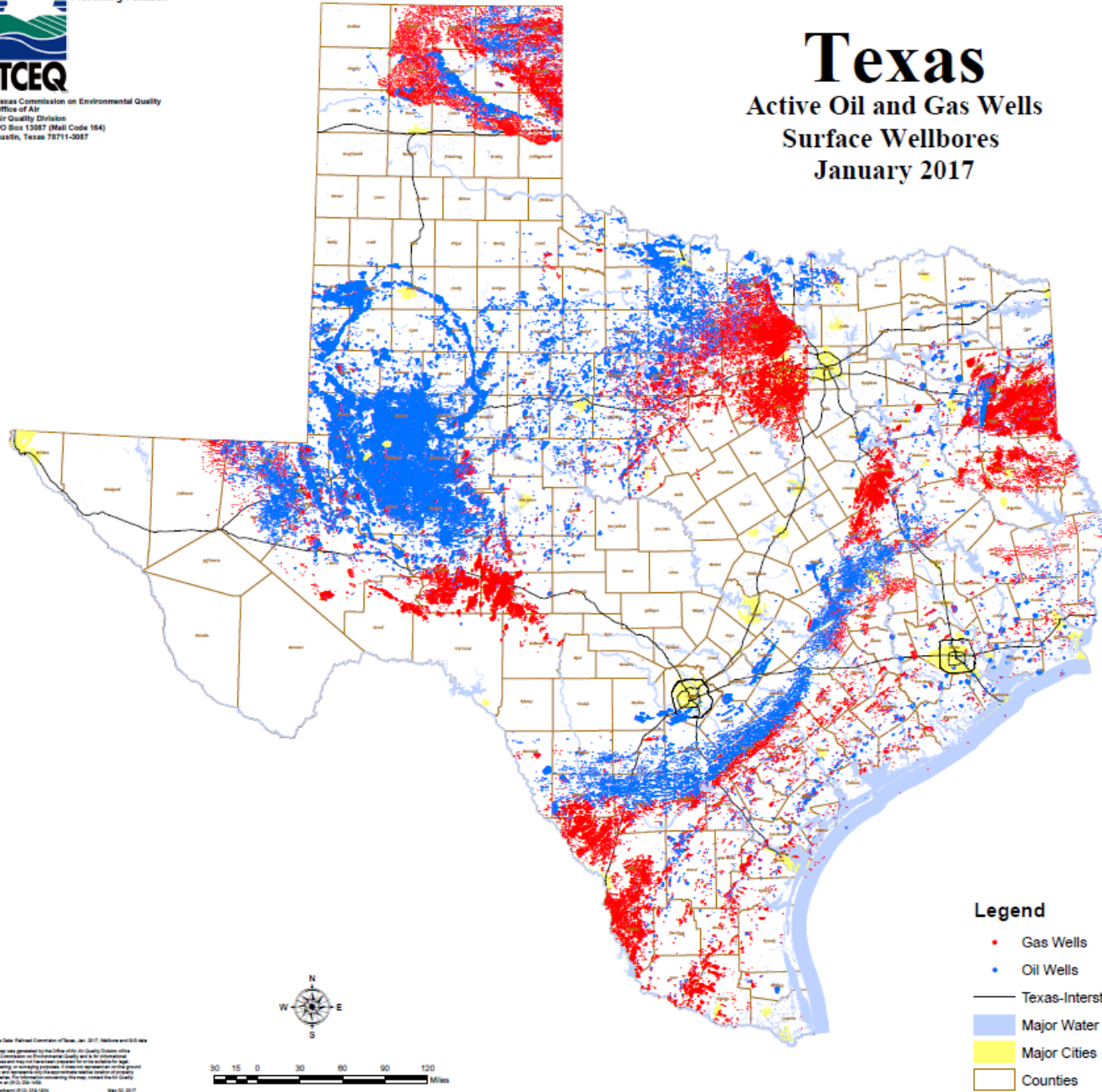
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Texas

Active Oil and Gas Wells Surface Wellbores

January 2017



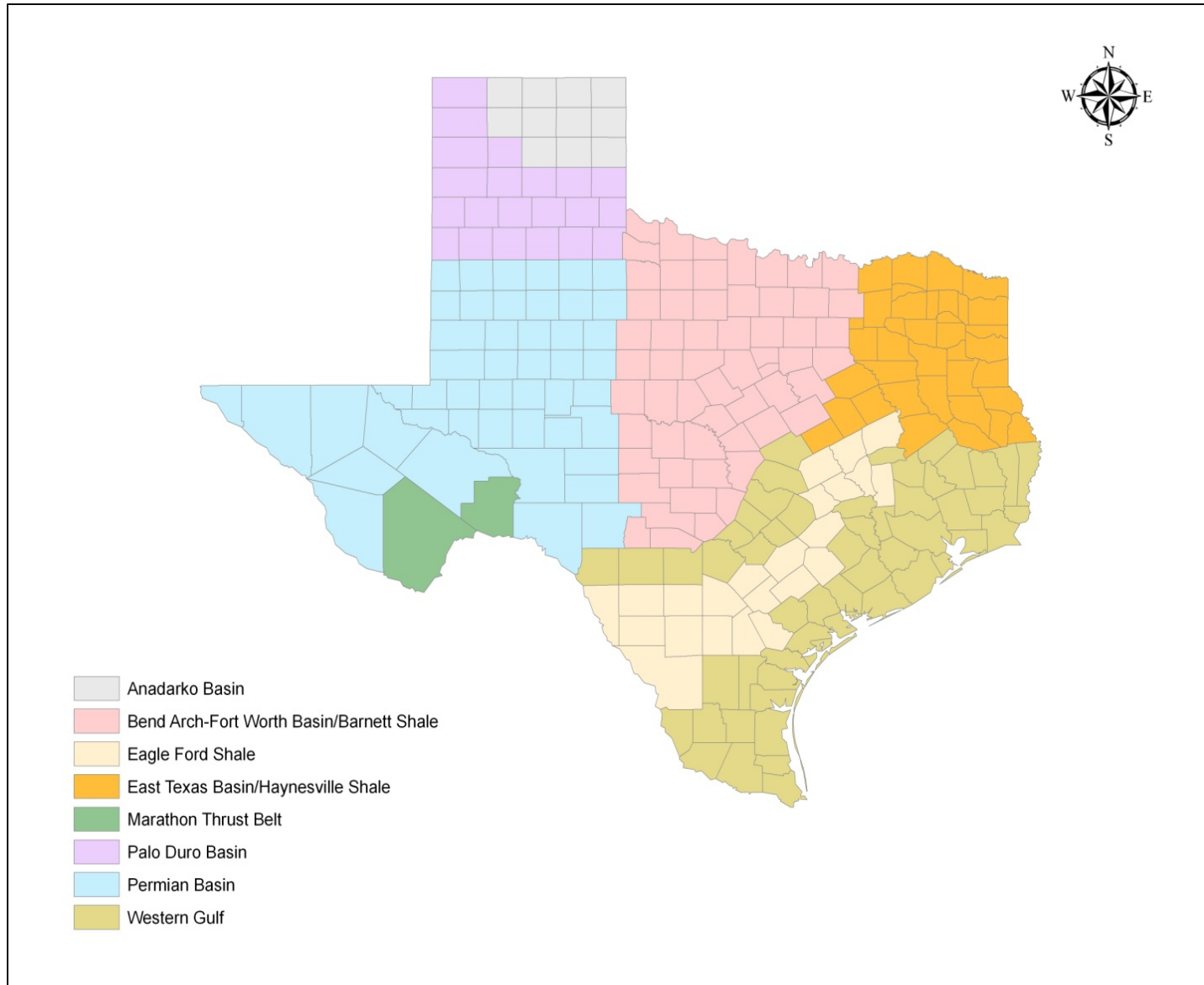


TCEQ Oil and Gas Calculator

- Developed by Eastern Research Group (ERG) in a 2010 TCEQ project, for the 2008 NEI
- Set of two Excel spreadsheet calculators
- By updating the activity data, Texas oil and gas inventories can be developed for different years by TCEQ staff
- Initially state-level equipment profiles
- A number of additional studies and projects have refined many equipment profiles and emission factors to the basin-level



Texas' Oil and Gas Basins and Shale Plays





CenSARA Oil and Gas Calculator

- Based on the TCEQ calculator
- Developed by Environ in a 2012 CenSARA project, for the 2011 NEI
- Refined the equipment profiles and emission factors to the basin-level using survey data
- Focused on CenSARA states other than Texas (however, includes some Texas coverage since a few basins cross from neighboring states into Texas)
- For basins with no survey data, CenSARA average factors were developed



EPA Oil and Gas Tool

- Based on the CenSARA calculator
- Developed by ERG in 2013 for the 2011 NEI
- An Access Database tool
- Used by EPA to estimate emissions for states that don't submit their own estimates
- Initially populated with basin-specific factors from CenSARA and TCEQ projects
- For other basins, populated with the CenSARA average factors as a default



EPA Oil and Gas Tool (cont.)

- EPA encourages states to review the default factors, and to update the tool with state-specific factors
- Several states and regional organizations have provided area-specific updates
- For the 2014 NEI, ERG updated the tool with some basin-specific equipment profiles based on GHGRP data:
 - Storage tank controls
 - Pneumatic device counts
 - Heater equipment profiles
 - Compressor engine factors
- Continue to look for ways to update factors



Developing Basin-Specific Equipment Profiles and Emission Factors

- To develop basin-specific factors, you need representative data
- Three common types of data used for oil and gas sources:
 - Survey data
 - Point source data
 - GHGRP data



Developing Basin-Specific Factors using Survey Data

- Obtain data directly from oil and gas operators through surveys
- Pros
 - State-specific (and often basin-specific, or even county-specific)
 - Represents actual real-world conditions
- Cons
 - Time and cost intensive
 - Difficult to get a high response rate
 - Data can become outdated
 - Question of whether there is enough data to be representative



Examples of Texas Studies: Factors Developed from Survey Data

- *2014 Statewide Drilling Rig Emissions Inventory with Updated Trends Inventories (July 2015)*
- *Specified Oil and Gas Well Activities Emissions Inventory Update (August 2014)*
 - Hydraulic fracturing pump engines
 - Mud degassing
- *Upstream Oil and Gas Heaters and Boilers (August 2013)*



Examples of Texas Studies: Factors Developed from Survey Data (cont.)

- *Condensate Tank Oil and Gas Activities* (October 2012)
- Pneumatic Device surveys (2011 and 2012)
- Barnett Shale Special Inventory (2011)
 - Compressor engines
 - Piping component fugitives
- *Characterization of Oil and Gas Production Equipment and Develop a Methodology to Estimate Statewide Emissions* (Nov. 2010)



Developing Basin-Specific Factors using Point Source Data

- Review data submitted by oil and gas operators
 - Point source EI supporting documentation
 - Permit supporting documentation
- Pros
 - Large amount of data available for some basins
 - Low (or no) cost
- Cons
 - Can be time intensive, especially if the data is not in electronic format
 - Reporting threshold: is data representative of area sources, or just the larger sources?



Examples of Texas Factors Developed from Point Source Data

- Natural gas speciation and Volatile Organic Compound (VOC) content
 - Derived from Glycol Dehydrator calculations
 - Used the “wet stream” gas analyses to develop basin-specific speciation profiles
 - These profiles are used for gas well piping fugitives, pneumatic devices, and mud degassing emissions estimates
- Condensate storage tank VOC emission factors and control factors
 - Data taken from sample calculations
 - Used to supplement survey data



Developing Basin-Specific Factors using GHGRP data

- Review data submitted by oil and gas operators to the EPA GHGRP under Subpart W
- Pros
 - Large amount of data available for many basins
 - Mandatory reporting results in good response rate
 - Data is current (2016 data will be available soon)
 - Data is available for free on EPA's Envirofacts website
- Cons
 - Reporting threshold: is data representative of all sources in a basin, or just the larger sources?
 - Shale areas are not broken out and may skew the data



Examples of Basin-Specific Factors developed from GHGRP data

- ERG-developed factors for the EPA tool
 - Storage tank controls
 - Pneumatic device counts
 - Heater equipment profiles
 - Number of compressor engines per gas well
- TCEQ-developed factors
 - Storage tank controls (survey data supplemented by GHGRP data)
 - Compressor engine horsepower (hp) sizes



Updated Compressor Engine Profiles developed using GHGRP data

- Two types of basin-specific factors were developed:
 - Number of compressors per gas well
 - Average compressor engine hp sizes
- GHGRP data is available from EPA's Envirofacts website at:
<https://www.epa.gov/enviro/greenhouse-gas-customized-search>
- Oil and gas data is available under Subpart W "Petroleum and Natural Gas Systems"



GHGRP Data: Number of Compressors per Gas Well

- Data taken from table EF_W_EQUIP_LEAKS_ONSHORE
 - Number of gas wellheads
 - Number of compressors
- Adjustment made by TCEQ: removed data points where no compressors were reported (but gas wellheads were reported)
 - GHGRP data is a subset of all oil and gas sources
 - However, there were more gas wellheads reported in the GHGRP data than were present in the EPA tool for 10 out of 36 basins
 - Appeared that some oil wellheads were mistakenly reported as gas wellheads



GHGRP Data: Number of Compressors per Gas Well

- For most basins in Texas, the adjustments were minor:

Basin	Compressors per gas wellhead original	Compressors per gas wellhead adjusted
220 - Gulf Coast Basin (LA TX)	0.111	0.112
260 - East Texas Basin	0.052	0.057
350 - South Oklahoma Folded Belt	0.381	0.381
360 - Anadarko Basin	0.156	0.156
400 - Ouachita Folded Belt	0.316	0.316
415 - Strawn Basin	0.247	0.248
420 - Fort Worth Syncline	0.182	0.182
425 - Bend Arch	1.047	1.047
430 - Permian Basin	0.050	0.051
National average	0.077	0.087



GHGRP Data: Average Compressor Engine hp Sizes

- Data taken from three tables and merged using the GHGRP facility ID number
- EF_W_COMBUST_LARGE_UNITS
 - Basin-wide fuel usage by compressor engines
 - Carbon dioxide (CO₂) emissions
- EF_W_RECIP_COMP_ONSHORE
 - Number of compressor engines in each basin
- EF_W_INTRODUCTION_SUMM
 - GHGRP facility ID number
 - Basin associated with facility ID



GHGRP Data: Average Compressor Engine hp Sizes (cont.)

- Important to do some quality assurance checks to ensure the data is reasonable
- Estimated CO₂ emissions (based on fuel usage and AP-42 emission factors) were compared to reported CO₂ emissions
 - Two data points were 1000x too high
 - One data point was 1000x too low
- Average hp size for each data point was estimated using default engine parameters
 - hp's > 2500 appeared to be too high
 - hp's < 25 appears to be too low



GHGRP Data: Average Compressor Engine hp Sizes (cont.)

- Basin-level compressor engine runtimes were taken from the EPA tool
- Since 95% of the load factors were 0.75 or 0.76, a load factor of 0.75 was used to develop these hp sizes
- The GHGRP data was not subdivided into lean-burn and rich-burn engines, so average hp sizes were developed
- Using the hp size data from the EPA tool, the average hp sizes were ratioed to get updated lean-burn and rich-burn hp's



GHGRP Data: Things to Consider

- The GHGRP data is reported at the basin-level for most source types
- Shale areas are not broken out from the basins, and can sometimes skew the data
- Some source types have data reported at the county-level, so it may be possible to develop separate factors for shale areas versus non-shale areas
- Example: TCEQ performed an in-depth review of storage tank controls, and was able to develop control factors for the Eagle Ford Shale area



Storage Tanks Controls

Comparison between EPA tool and TCEQ calculator storage tank control factors:

Oil storage tanks	EPA tool % controls	TCEQ calculator % controls
Western Gulf Basin	81.1	31.9
Eagle Ford Shale area	81.1*	83.6

Condensate storage tanks	EPA tool % controls	TCEQ calculator % controls
Western Gulf Basin	78.8	43.3
Eagle Ford Shale area	78.8*	70.5

* The EPA tool does not break the Eagle Ford Shale area out of the Western Gulf Basin



Project Reports posted on the TCEQ website

- Air Quality Research and Contract Reports can be found at:

http://www.tceq.texas.gov/airquality/airmod/project/pj_report_ei.html

- Reports include:
 - *Growth Factors for Area and Point Sources*
 - *2014 Statewide Drilling Rig Emissions Inventory with Updated Trends Inventories*
 - *Specified Oil and Gas Well Activities Emissions Inventory Update*
 - *Upstream Oil and Gas Heaters and Boilers*
 - *Condensate Tank Oil and Gas Activities*
 - *Emission Factor Determination for Produced Water Storage Tanks*



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