Oil and Gas 101: An Overview of Oil and Gas Upstream Activities and Using EPA’s Nonpoint Oil and Gas Emission Estimation Tool for the 2017 NEI

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Training Overview

• Oil and gas production in the United States
• Upstream oil and gas emission sources
• Data resources
• Oil and gas emission estimates in the NEI
• Future plans
• Use and application of the Nonpoint Oil and Gas Emission Estimation Tool
Oil and Gas Production in the US

- Over 3 billion barrels of crude oil produced in 2016
  - ~50% increase since 2011
  - Down slightly from 2015
  - ~18% of production offshore (was 30% in 2010)
  - Texas, North Dakota, California
- Over 28 trillion cubic feet of gas produced in 2016
  - ~30% increase since 2009
  - ~5% of production offshore
  - Texas, Pennsylvania, Oklahoma

Source: U.S. Energy Information Administration
US Onshore Crude Oil Production

Source: U.S. Energy Information Administration
US Onshore Natural Gas Production

Source: U.S. Energy Information Administration
Natural Gas, NGLs, Condensate, Oil

• Natural Gas (C1 – primarily Methane)
• Natural Gas Liquids (C2 – C4)
  • Ethane, Propane, Butane
  • Extracted at gas processing plants
  • “Wet gas”
• Condensate (~C5+)
  • Condenses out of gas stream at surface
• Crude Oil (mixture of heavier hydrocarbons)
  • Distilled into gasoline, kerosene, diesel, jet fuel
Eagle Ford Shale Oil and Gas Well Map

Source: U.S. Energy Information Administration
Lower 48 states shale plays

- Bakken
- Niobrara
- Eagle Ford
- Marcellus
- Utica

Upstream Oil and Gas Emission Sources

**Production & Processing**
1. Drilling and Well Completion
2. Producing Wells
3. Gathering Lines
4. Gathering and Boosting Stations
5. Gas Processing Plant

**Natural Gas**
**Transmission & Storage**
6. Transmission Compressor Stations
7. Transmission Pipeline
8. Underground Storage

**Distribution**
9. Distribution Mains
10. Regulators and Meters for:
   a. City Gate
   b. Large Volume Customers
   c. Residential Customers
   d. Commercial Customer

*Source: Adapted from American Gas Association and EPA Natural Gas STAR Program*
Upstream Oil and Gas Emission Sources

**Exploration Sources**
- Drilling Rigs
- Hydraulic Fracturing Pumps
- Mud Degassing
- Well Completion Venting

**Production Sources**
- Artificial Lift Engines
- Associated Gas Venting
- Condensate Tanks
- Crude Oil Tanks
- Dehydrators

**Production Sources (continued)**
- Fugitive Leaks
- Gas-Actuated Pneumatic Pumps
- Heaters
- Lateral Compressor Engines
- Liquids Unloading
- Hydrocarbon Liquids Loading
- Pneumatic Devices
- Produced Water Tanks
- Wellhead Compressor Engines
Tool Estimation Methodologies

- Area (nonpoint) source methodologies
- Based on point source methodologies averaged over the population
- Scaled to the county level using activity factors (well counts, oil production, gas production)
- Refer to “2014 Nonpoint Oil and Gas Emission Estimation Tool Version 2.2” (June, 2017) for details
Exploration - Drilling Rigs

- Used to drill wellbore to target formation
- 2 primary rig types
  - Mechanical
  - Diesel-electric
- Powered by large, diesel engines (~1,000 – 1,500 HP)
- ~2 – 4 weeks

EPA photo.
Drilling Rigs

- Emissions based on cumulative feet drilled
- Process characteristics needed to estimate emissions
  - Engine size and type (HP)
  - Operating hours (hr/spud)
- Emission factors from EPA's NONROAD model
- Methodology accounts for different types of rig configurations (mechanical and diesel-electric)
Mud Degassing

- Mud degassing refers to the process of “off-gassing” of entrained gas in the drilling mud once it is outside of the wellbore.
- Drilling mud used to keep the drill bit cool, carry out drill cuttings, and maintain wellbore pressure to prevent formation fluids from entering wellbore.
- Emissions based on total drilling days.
- Emission factor derived from 1977 EPA report “Atmospheric Emissions from Offshore Oil and Gas Development and Production.”
Hydraulic Fracturing Pumps

- Emissions based on number of fracture events
- Process characteristics needed to estimate emissions
  - Engine size (HP)
  - Number of engines
  - Operating hours (hr/event)
- Emission factors from EPA's NONROAD model
Well Completion Venting

- Emissions generated as gas is vented prior to well being brought into production
- For fractured wells, emissions are generated as gas entrained in the flowback fluid is emitted through open vents at the top of flowback tanks
- Fractured wells regulated under NSPS OOOO and OOOOa

Example of Green Completion Equipment (Source: Weatherford)
Well Completion Venting

- Emissions based on number of completion events
- Process characteristics needed to estimate emissions
  - Volume of gas released per completion (MCF/event)
    - Oil and gas
    - Conventional and unconventional
  - Gas composition
  - Controls
Production Sources

Source: Texas Commission on Environmental Quality Air Permit Reference Guide APDG 5942
Artificial Lift Engines

- “Pumpjack” engines
- Engines used to lift oil out of the well if there is not enough bottom hole pressure for the oil to flow to the surface
- Generally use casinghead gas
Artificial Lift Engines

- Emissions based on number of oil wells
- Process characteristics needed to estimate emissions
  - Engine size (HP)
  - Engine operating schedule (hr/yr)
  - Fraction of oil wells with engines
- Emission factors from AP-42
- Electric engines are common, accounted for in methodology
Associated Gas Venting

- Refers to the practice of venting gas produced at oil wells where the well is not connected to a gas sales pipeline
- May be flared (e.g. Bakken Shale)
- Process characteristics needed to estimate emissions
  - Quantity of gas vented per barrel of oil production (MCF/bbl)
  - Fraction of gas flared
  - Composition of the vented gas
Condensate Tanks

EPA photo.
Condensate Tanks

- Emissions based on condensate production
- Emissions occur from flashing, working, and breathing losses
- Flashing losses are generally the largest component and occur when gases entrained in a liquid “flash off” as the pressure drops
- Emissions per barrel of condensate needed to estimate total county-level emissions (lb/bbl)
- Regulated under NSPS OOOO and OOOOa
Crude Oil Tanks

- Used to store crude oil at a well pad or central tank battery prior to transfer to a refinery
- Some oil fields pipe oil directly downstream and do not have tanks in the field
  - Accounted for in Tool
- Largest VOC source as calculated by the Tool

Permian Basin Tank Battery
Source: Google Earth
Crude Oil Tanks

- Emissions based on oil production
- Emissions occur from flashing, working, and breathing losses
- Emissions per barrel of crude oil needed to estimate total county-level emissions (lb/bbl)
- Regulated under NSPS OOOO and OOOOa
Dehydrators

• Use glycol to remove water from gas stream to prevent corrosion or freezing issues downstream
• Small reboiler used to regenerate the glycol
• May be located at well pad, or at centrally located gathering station

EPA photo.
Dehydrators

- Emissions generated from the still vent and the reboiler
- Emissions from the still vent based on gas production
  - Emissions per throughput (lb/MMSCF)
- Emissions from the reboiler based on gas well count
  - Number of dehydrators per well
  - Reboiler size (MMBtu/hr) and operating schedule (hr/yr)
- NESHAP HH and HHH may require controls
Fugitive Leaks

- Emissions of gas that escape through well site components such as connectors, flanges, and valves
- Source category only covers components located at the well pad
- Regulated under NSPS OOOOa

Source: Texas Commission on Environmental Quality Air Permit Reference Guide APDG 5942
Fugitive Leaks

- Emissions based on well count
- Process characteristics needed to estimate emissions
  - Counts of fugitive components by type per well
  - Operating schedule (hr/yr)
  - Composition of leaked gas
Gas-Actuated Pneumatic Pumps

- Small gas-driven plunger pumps used to provide a constant supply of chemicals or lubricants
- Commonly used in sites where electric power is unavailable
- Gas-actuated pumps vent by design
Gas-Actuated Pneumatic Pumps

- Emissions based on well counts
- Kimray pumps
- Chemical injection pumps (CIP)
- Certain pumps regulated under NSPS OOOOa
- Process characteristics needed to estimate emissions
  - Count of pumps per well (oil, gas, CBM)
  - Pump vent rate (SCF per throughput or day)
  - Composition of vented gas
Heaters

- Line heaters - used to maintain temperatures as pressure decreases to prevent formation of hydrates (Marcellus Shale)
- Heater treaters – used to heat oil/water emulsions to aid in separation (Bakken Shale, Permian Basin)

Source: Texas Commission on Environmental Quality Air Permit Reference Guide APDG 5942
Heaters

- Emissions based on the number of wells
- Heaters used as control devices regulated under NSPS OOOO and OOOOa
- Process characteristics needed to estimate emissions
  - Number of heaters per well
  - Heater size (MMBtu/hr)
  - Operating schedule (hr/yr)
  - H₂S content (to estimate SO₂)
Lateral Compressor Engines

- Large “line” engines
- May serve ~10 to 100 wells
- Used at gathering or booster stations (mid-stream)
- Natural gas-fired
- Rich-burn or lean-burn
Lateral Compressor Engines

- Emissions based on the number of gas wells
- Compressors regulated under NSPS OOOO and OOOOa
- Process characteristics needed to estimate emissions
  - Number of gas wells served by a lateral engine
  - Engine size (HP)
  - Operating schedule (hr/yr)
  - Control information
Liquids Unloading

- Used to remove accumulation of fluids in the wellbore
- Also known as “well blowdowns”
- May be controlled (flaring or plunger lifts)
Liquids Unloading

- Emissions based on the number of gas wells
- Process characteristics needed to estimate emissions
  - Number of unloading events per well
  - Volume of vented gas per liquids unloading event (MCF/event)
  - Composition of vented gas
  - Control information
Hydrocarbon Liquids Loading

- Emissions generated during transfer of liquids from tanks to trucks
- As with storage tank emissions, where liquids are piped directly downstream, no emissions from this category
  - Accounted for in Tool

Source: Texas Commission on Environmental Quality Air Permit Reference Guide APDG 5942
Hydrocarbon Liquids Loading

- Emissions based on oil and condensate production
- AP-42 loading loss equation used to estimate emissions
- Tank vapor composition needed to estimate VOC and HAP emissions

\[ L = 12.46 \times \left( \frac{S \times V \times MW_{\text{gas}}}{T} \right) \]
Pneumatic Devices

- Use high-pressure gas to produce mechanical motion (levers, switches)
- Largest CH$_4$ source under Subpart W and in the GHG EI (production sector)
- 2$^{nd}$ largest VOC source as calculated by the Tool
Pneumatic Devices

- Emissions based on the number of wells
- Process characteristics needed to estimate emissions
  - Number of devices per well
  - Type of devices (high, low, and intermittent-bleed)
  - Volume of vented gas per device (SCF/hr/device)
  - Operating schedule (hr/yr)
  - Composition of vented gas
- Regulated under NSPS OOOO and OOOOOa
Produced Water Tanks

- Store water separated at the wellhead
- Emissions generated from working and breathing losses
- Water may be injected underground to maintain pressure (waterflooding) or for disposal

Source: Texas Commission on Environmental Quality Air Permit Reference Guide APDG 5942
Produced Water Tanks

- Emissions based on produced water production
- Emissions occur from working and breathing losses
- Process characteristics needed to estimate emissions
  - Emissions per barrel of production (lb/bbl)
  - Fraction of produced water directed to tanks
  - Composition of the tank vapors
Wellhead Compressor Engines

- Provide energy to move produced gas downstream to gathering or boosting station
- Brought onsite as well pressure drops
- Utilize produced gas as fuel
- Largest NO\textsubscript{x} source as calculated by the Tool

Source: Texas Commission on Environmental Quality Air Permit Reference Guide APDG 5942
Wellhead Compressor Engines

- Compressors regulated under NSPS OOOO and OOOOa
- Emissions based on the number of gas wells
- Process characteristics needed to estimate emissions
  - Fraction of gas wells requiring compression
  - Engine size (HP)
  - Operating schedule (hr/yr)
  - Control information
Data Resources

- National Oil & Gas Committee Information Repository
- Existing Studies
- EPA Natural Gas STAR Program
  - https://www.epa.gov/natural-gas-star-program/natural-gas-star-program
- Industry Surveys
- State Permitting/Inventory Data
Existing Studies

- National Oil & Gas Committee Information Repository
  - http://vibe.cira.colostate.edu/ogec/home.htm
- Texas Commission on Environmental Quality (TCEQ)
- Western Regional Air Partnership (WRAP)
  - https://www.wrapair2.org/emissions.aspx
Industry Surveys

• Send directly to industry, focused or broad
• Recent Industry Surveys/Examples
  – CenSARA
  – TCEQ
  – WRAP
State Permitting/Inventory Data

- Permit Applications
- Annual Emissions Inventory Submittals
- Dehydrator Simulation Software
  - Gas Research Institute (GRI) GLYCalc Model
  - ProMax®, Aspen HYSYS®, etc.
- Storage Tank Simulation Software
  - American Petroleum Institute (API) E&P TANKS
  - ProMax®, Aspen HYSYS®, etc.
State Permitting/Inventory Data

• EPA (Cindy Beeler) Presentation
  – GRI-GLYCalc and E&P TANK Example Applications
  – [Link](http://vibe.cira.colostate.edu/ogec/docs/meetings/2015-03-12/NationalOGEmissionWorkGroup_031215_GLYCalc_EPTank4.pdf)

• Data may be used to develop “nonpoint” factors
  – GRI-GLYCalc - fugitive gas composition and dehydrator emission factors
  – E&P TANK – VOC and HAP emission factors
## GRI-GLYCalc Gas Composition

### WET GAS STREAM

<table>
<thead>
<tr>
<th>Component</th>
<th>Conc. (vol%)</th>
<th>Loading (lb/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>1.08e-001</td>
<td>1.27e+001</td>
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<tr>
<td>Carbon Dioxide</td>
<td>1.90e-001</td>
<td>5.46e+001</td>
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<tr>
<td>Hydrogen Sulfide</td>
<td>9.99e-005</td>
<td>2.22e-002</td>
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<tr>
<td>Nitrogen</td>
<td>1.02e-001</td>
<td>1.96e+001</td>
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<tr>
<td>Methane</td>
<td>8.96e+001</td>
<td>9.39e+003</td>
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<tr>
<td>Ethane</td>
<td>5.67e+000</td>
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<td>Isobutane</td>
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<td>C8+ Heavies</td>
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### DRY GAS STREAM

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GRI-GLYCalc Gas Composition
# GRI-GLYCalc Dehydrator Emissions

## CONTROLLED REGENERATOR EMISSIONS

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<th>Component</th>
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## FLASH TANK OFF GAS

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<td><strong>Total Emissions</strong></td>
<td><strong>7.7396</strong></td>
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</table>

Total Hydrocarbon Emissions: 0.0668
Total VOC Emissions: 0.0484
Total HAP Emissions: 0.0106
Total BTEX Emissions: 0.0097

Total Hydrocarbon Emissions: 7.7395
Total VOC Emissions: 1.9579
Total HAP Emissions: 0.0635
Total BTEX Emissions: 0.0246
E&P TANKS

---

**Project Setup Information**

- **Project File**: C:\Program Files\API\E&P TANK Version
- **Flowsheet Selection**: Oil Tank with Separator
- **Calculation Method**: API
- **Control Efficiency**: 95.0%
- **Known Separator Stream**: Low Pressure Oil
- **Entering Air Composition**: No

---

**Production Rate**

- 301.2 [bbl/day]

---

**Days of Annual Operation**: 505 [days/yr]

---

**Emission Summary**

<table>
<thead>
<tr>
<th>Item</th>
<th>Uncontrolled [ton/yr]</th>
<th>Uncontrolled [lb/hr]</th>
<th>Controlled [ton/yr]</th>
<th>Controlled [lb/hr]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total HAPs</td>
<td>14.210</td>
<td>3.244</td>
<td>0.711</td>
<td>0.162</td>
</tr>
<tr>
<td>Total HC</td>
<td>566.994</td>
<td>129.451</td>
<td>28.350</td>
<td>6.473</td>
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<tr>
<td>VOCs, C2+</td>
<td>500.099</td>
<td>114.178</td>
<td>25.005</td>
<td>5.709</td>
</tr>
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</table>

---

**Emission Composition**

<table>
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<tr>
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<th>Component</th>
<th>Uncontrolled [ton/yr]</th>
<th>Uncontrolled [lb/hr]</th>
<th>Controlled [ton/yr]</th>
<th>Controlled [lb/hr]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>H2S</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>2</td>
<td>O2</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>3</td>
<td>CO2</td>
<td>3.783</td>
<td>0.864</td>
<td>3.783</td>
<td>0.864</td>
</tr>
<tr>
<td>4</td>
<td>N2</td>
<td>1.607</td>
<td>0.367</td>
<td>1.607</td>
<td>0.367</td>
</tr>
<tr>
<td>5</td>
<td>C1</td>
<td>66.085</td>
<td>15.273</td>
<td>3.345</td>
<td>0.764</td>
</tr>
<tr>
<td>6</td>
<td>C2</td>
<td>113.476</td>
<td>25.908</td>
<td>5.674</td>
<td>1.295</td>
</tr>
<tr>
<td>7</td>
<td>C3</td>
<td>141.081</td>
<td>32.210</td>
<td>7.054</td>
<td>1.611</td>
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<tr>
<td>14</td>
<td>C8</td>
<td>8.178</td>
<td>1.867</td>
<td>0.409</td>
<td>0.093</td>
</tr>
<tr>
<td>15</td>
<td>C10+</td>
<td>1.717</td>
<td>0.392</td>
<td>0.086</td>
<td>0.020</td>
</tr>
<tr>
<td>16</td>
<td>Benzene</td>
<td>0.023</td>
<td>0.005</td>
<td>0.001</td>
<td>0.000</td>
</tr>
<tr>
<td>17</td>
<td>Toluene</td>
<td>0.489</td>
<td>0.112</td>
<td>0.024</td>
<td>0.006</td>
</tr>
<tr>
<td>18</td>
<td>Xylenes</td>
<td>1.242</td>
<td>0.284</td>
<td>0.062</td>
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<tr>
<td>19</td>
<td>m-C6</td>
<td>0.147</td>
<td>0.034</td>
<td>0.007</td>
<td>0.002</td>
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<tr>
<td>20</td>
<td>p-C6</td>
<td>1.239</td>
<td>0.287</td>
<td>0.063</td>
<td>0.014</td>
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<tr>
<td>21</td>
<td>Ethyl methylp</td>
<td>11.006</td>
<td>2.313</td>
<td>0.350</td>
<td>0.126</td>
</tr>
<tr>
<td>22</td>
<td>Ethyl methyle</td>
<td>0.064</td>
<td>0.015</td>
<td>0.003</td>
<td>0.001</td>
</tr>
</tbody>
</table>
The full NEI is on a 3-yr cycle (e.g. 2011, 2014, 2017)
- Point sources (87,000 facilities)
- Nonpoint and mobile sources (county-process)
- Fires (daily/point)
- Biogenic soil and vegetation (county)

States, locals, and tribes are required to submit CO, SOx, NOx, VOC, PM10, PM2.5, NH3, and Lead.
- Basis is National Ambient Air Quality Standards (NAAQS) parts of the Clean Air Act
- Use CAA-based emissions thresholds for “point”. States can go lower.

Hazardous Air Pollutants (HAPs) and GHGs can also be voluntarily submitted
- EPA augments the data to make HAPs more complete
ROLE OF STATES VS. EPA

States are responsible for the emissions estimates

SLTs can choose to accept EPA estimates; however, states choose method to apply

- EPA methods are assumptions about activity and emissions rates that can be improved with local understanding

In the absence of SLT data, EPA still has to create a complete inventory.

2008 NEI NP oil and gas

2011 NEI NP oil and gas
COLLABORATIVE EFFORTS

• National Oil and Gas Emissions Committee (meets monthly)
• Internal agencywide EPA Oil and Gas Team that includes regional experts, regulation writers, EF developers, modelers
• Working closely with WRAP/WESTAR to help adjacent states share data; hope to do the same with MARAMA
• Working with OAP to incorporate GHG EI and RP data and methods (whole gas/venting)
ALIGNING THE INVENTORIES

NEI covers criteria pollutants and their precursors and HAPs

Office of Atmospheric Program’s EI covers GHGs

Two offices are working to align the inventories

- Methodologies
- Equipment counts
- Activity data
- Emission factors
NEW PROCESS FOR NONPOINT IN 2017

Lean Event November 2016

Outcome from this lean event included:

• Agreement to do early coordination and buy-in on methods and implementation

• Goal of release of one version of the NEI, rather than 2 or 3 (but a later release date))

• Division of the nonpoint data category into 3 bins, in order to create focus
  • Bin 1: no expected changes in methodology, no point source subtraction
  • Bin 2: changes in methodology, no point source subtraction
  • Bin 3: more complex source categories, with point source subtraction (Oil and Gas fits in here)
## IMPORTANT DATES FOR BIN 3

<table>
<thead>
<tr>
<th>Action</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPA posts draft tool and estimates</td>
<td>8/31/2018</td>
</tr>
<tr>
<td>SLT comments due</td>
<td>11/30/2018</td>
</tr>
<tr>
<td>SLTs submit inputs or emissions for Category 3 tools</td>
<td>12/1/18 - 5/31/2019</td>
</tr>
<tr>
<td>EPA posts revised tools and estimates</td>
<td>2/28/2019</td>
</tr>
<tr>
<td>EPA posts final tools and estimates using SLT submitted inputs</td>
<td>8/31/2019</td>
</tr>
<tr>
<td>2017 v1 NEI Release in EIS for nonpoint</td>
<td>12/31/2019</td>
</tr>
<tr>
<td>2017 v1 Public Release</td>
<td>1/31/2020</td>
</tr>
</tbody>
</table>
OIL AND GAS 2017 NEI TIMELINE

2017
- Pre-release for Training
- New Categories and Methodologies, GHGRP Data for some sources

2018
- Release Draft Tool
- QA, Feedback, & Comment
- EPA Review of new data (e.g. GHGRP) for updates to methods and emission factors for additional sources in conjunction with OAP

2019
- Submit Oil and Gas Inputs to NEI
- Release Final Tool
- Submit Oil and Gas Emissions to NEI
- State Updates to Tool
- Final Tool

August
August
November
May
August

2017 NEI

EPA Updates to Tool
THE OUTPUT IS ONLY AS GOOD AS THE INPUT!

Review the inputs for accuracy for your state.

- Gather process characterization data
- Contact oil and gas commission in your state
- Review permit data to see if equipment counts are accurate
- Do your own survey
- Talk to your RPO or neighboring states

START NOW!
No planned updates to the database structure for the 2017 Tool (re-engineered for the 2014 NEI).

- New categories and methodologies
  - Add CBM Dewatering Pumps category
- Abandoned wells
  - EPA/OAR/OAP currently developing draft estimates for abandoned wells for methane
  - For GHG EI, this may add up to millions of metric tons of methane
  - EIAG is working to adapt this methodology for the NEI to estimate VOC and speciated HAPs
- Disaggregate selected emissions algorithms that combine multiple processes into a single SCC (e.g., dehydrators) to individual components (dehydrator, flare, and reboiler)
2017 NEI PLANS (BUDGET RELIANT)

- Recode the tool for conventional/unconventional emissions calculations (need based)
- Include additional pollutants
  - SPECIATE profiles include pollutants not in the Tool
  - Gas analysis includes pollutants not in the Tool
- Update basin factors
  - Default conventional oil well completion value
  - Nonroad engine factors
  - 2017 Subpart W data mining/uploads
  - Other recent studies?
2017 NEI PLANS (BUDGET RELIANT)

- Add tribal reservation layer to activity data (consider also basin factor data)
- Add new control technologies:
  - Vapor recovery units (VRU)
  - Electrified engines
- Pull HPDI data (Fall 2018)
  - Consider updated methodology for oil/condensate distinction (EIA-based?)
- Final 2017 Tool (August 2019)
TO IMPROVE EMISSIONS, WE CAN...

Keep coordinated through better targeted and ongoing communication

Use the opportunity periods during the NEI cycle to focus efforts

Define new processes to update building blocks of emissions:
- Methods and their assumptions
- Test data and its use
- Emissions factors

Select source categories of common interest and collectively review:
- Find ways to update for improvements that meet different uses
- Resolve inconsistencies or clearly define and accept them
BREAK
Acknowledgements

• National Oil and Gas Committee
• ERG Staff
  o Bebhinn Do
  o Stacie Enoch
  o Karla Faught
  o Steve Mendenhall
  o Stephen Treimel
  o Jody Tisano
Overview of the Presentation

- Introduction/Timeline of the Tool Development
- 2014 NEI Oil and Gas Tool Coverage
- Walking through the Tool
- Case Studies using the 2014 Tool
- Development Plans for the 2017 NEI Oil and Gas Tool
Where We Were

• 2011 Oil and Gas Tool
  o Converted from Excel Workbook to Access
  o Spreadsheet-type formatted tables
Where We Are

- 2014 Oil and Gas Tool
  - Re-engineered to enhance user experience
  - Dashboard, buttons, import/export procedures
2014 Tool Coverage – Source Categories

• Exploration Sources:
  o Drilling
  o Mud Degassing
  o Hydraulic Fracturing
  o Well Completions
2014 Tool Coverage – Source Categories

• Production Sources:
  o Artificial Lifts
  o Associated Gas
  o Condensate Tanks
  o Crude Oil Tanks
  o Dehydrators
  o Fugitives
  o Gas-Actuated Pumps
  o Heaters
  o Lateral/Gathering Compressors
  o Liquids Unloading
  o Loading Operations
  o Pneumatic Devices
  o Produced Water
  o Wellhead Compressors
2014 Tool Coverage – Pollutants

• Criteria Pollutants:
  o CO, NH$_3$, NO$_x$, PM10-PRI, PM2.5-PRI, SO$_2$, VOC

• HAPs:
  o BTEX, formaldehyde, and Other HAPs

• Other Pollutants:
  o Hydrogen sulfide
2014 Tool Data Sources

- **Methodologies**: EPA, CenSARA, and Texas calculation tools

- **Activity Data**: HPDI, state-provided activity data, state OGC databases, EIA, GHGRP, RigData

- **Emission Factors**: mostly EPA AP-42; API, Climate Registry, GHGRP

- **Basin Factors**: EPA; CenSARA; state feedback; SPECIATE
2014 Tool Results

• Source category coverage: 54 SCCs from 18 source categories

• Pollutant coverage: 50 pollutants

• Geographic coverage: 34 states, 1157 counties, 65 basins

• Emission records generated:
  o From Tool = 939,493
  o To EIS = 749,096
Let’s Walk Through the Tool…

- **Tool Modules:**
  - OIL_GAS_TOOL_2014_NEI_PRODUCTION_V2_2.zip
  - OIL_GAS_TOOL_2014_NEI_EXPLORATION_V2_2.zip
- **Each Module contains:**
  - Tool in MS-Access format
  - Blank Nonpoint Bridge Tool database
  - Instructions
- **Production Module used as example**
Production Sources – Getting Started

- If using the Tool for the first time from unzipping, then you will need to “Enable Content”
Production Sources – Linking to EIS Staging Tables

- Click on the “LINK TO EIS STAGING TABLES” button, and a pop-up box will appear. Follow the instructions to link in the EIS Staging tables in the “nonpoint_bridge_tool.accdb” database (see figure below). If successfully linked, 11 tables will be linked.
Production Sources – Linking to EIS Staging Tables

• Once you have identified the location of the “nonpoint_bridge_tool.accdb” database to link, click on the “Link Tables” button. If successful, 11 tables will be linked. When finished click on the “When finished, Click here.” button.
Production Sources – Step 1

• Select the geographic-level of the emissions inventory based on interest. Most Users will select the “STATE” view. When finished, click the “When finished, click here to complete this step.” button. A message box will appear instructing the User to proceed to Step 2.
Production Sources – Step 2

- Select the specific geographic location of interest. The User may select more than one specific location. When finished, click the “When finished, click here to complete this step.” button. A message box will appear instructing the User to proceed to Step 3.
Production Sources – Step 3

- The User may generate emission estimates for all oil and gas production source categories or individually select source categories. When finished, click the “When finished, click here to complete this step.” button. A message box will appear instructing the User to proceed to Step 4.
Production Sources – Step 4

- Select the specific Source Categories to generate emission estimates. A message box will appear instructing the User to proceed to Steps 5, 6, and 7 to review/edit the activity data, basin factors, and emission factors; or to proceed directly to Step 8 for Point Source Activity Adjustments.

![Image of Production Sources - Step 4](image.png)

**Step 4 – All Source Categories are selected.**

After making the selection(s), click this button.
Production Sources – Step 5

• The User can view and edit the activity data that EPA has compiled for the geographic area and source categories selected

![Diagram of the Oil and Gas Tool: Production Activities - Dashboard View](image-url)

- Click here to review the Oil Production Data.
- Click here to review the Natural Gas Production Data.
- Click here to review the Coalbed Methane Production Data.
- Click here to review the Produced Water Data.

Pick a type of production dataset

When finished, please continue to Step 6 to View/Edit Basin Factors.
Production Sources – Step 5 (cont.)

- Once the county-level data set is selected, an Activity Data form will appear that the User can view or edit.

The User can filter for specific basins.

Values from the 2011 Tool. Values here cannot be edited.

When finished, click here

If new values are entered, please enter a reference.

When finished, click here
Production Sources – Step 5 (cont.)

• The User may also edit activity data in MS-Excel by using the “Import/Export Data…” button.
Production Sources – Step 5 (cont.)

- If the user elects to edit activity data in MS-Excel, after clicking the button, the data is then exported into MS-Excel as shown below.
Production Sources – Step 5 (cont.)

- A MS-Excel workbook will open when finished exporting. It is required that the User save this file to the hard drive for later upload. In the Excel file, the User can only edit the yellow shaded cells. When completed, simply save the file.
Production Sources – Step 5 (cont.)

• The User will need to go back to the Tool and click on the “Import/Export Data…” button to initiate importing the edited data file. After clicking, the Import/Export form will appear.
Production Sources – Step 6

• In Step 6, the User can view and edit the basin factor data that EPA has compiled for the geographic area and source categories selected.
Production Sources – Step 6 (cont.)

- In Step 6, the User can view/edit the basin factor data. If the User updates values for one county in a basin, then all other counties in the basin and state can be updated by clicking on the “Click to apply these values to all other counties in the same basin for the state.” button.
Production Sources – Step 7

- In Step 7, the User can view or edit the emission factors that are used to generate the emission estimates for the source categories selected.
Production Sources – Step 7 (cont.)

- Once a Source Category has been selected, the User can view or edit the emission factors. The User should update the reference field (EMISSION_FACTOR_SOURCE) for any updated emission factors.
Production Sources – Step 8

• In Step 8, the User may account for emissions that are to be reported to the point sources emissions inventory.

• Activity adjustments are preferred
  o Well counts
  o Liquids production
  o Etc.

• Emissions adjustments are also an option
  o NOx
  o VOC
  o Etc.
Production Sources – Step 8 (cont.)

- If the User does not have any point source activity adjustments, then they will need to click the “When finished, click here to complete this step.” button.
Production Sources – Step 8 (cont.)

- Point source activity adjustments are preferred over point source emission adjustments. Additionally, Users should pay careful attention to ensure that the point source activity data is entered in the same units as the nonpoint activity data (e.g., MMBBL vs. MBBL).
Production Sources – Step 9

In Step 9, the User can make point source emission adjustments directly in the emission tables. Select a Source Category to open. If a User has no point source emissions adjustments, they may click on the “When finished, click here to complete this step” button.
Production Sources – Step 9 (cont.)

- Point source emission estimates are to be entered in the “POINT_EMISSIONS_TPY” field.
Production Sources – Step 10

- In Step 10, the User can review the final emissions; update county-level activity data, emission factors, and/or basin factors they provided in Steps 5 through 7; or generate the Emission Inventory System (EIS) data tables.
Production Sources – Step 10 (cont.)

- Point source activity and/or emissions adjustments can also be saved within the Tool for future use.
Additional Notes

• In the EIS Staging Tables, the following tables are populated:
  o ControlApproach
  o ControlMeasure
  o ControlPollutant
  o Emissions
  o EmissionsProcess
  o Location
  o ReportingPeriod

• The Exploration Module runs the same way as the Production Module.
Additional Notes (cont.)

- If the User wishes to reset the tool, and regenerate the emissions, the following steps are recommended:
  - Click on the “Reset All Selections/Go to Step 1” button at the top of the Dashboard.
  - Compact and Repair the database.
Additional Notes (cont.)

- References cited for the original data in the Tool are found in the "Master References" tab.
Case Studies
Case Studies.

\(请确保生产和勘探模块均打开。\)
Case Study #1

- The Permian Basin consists of 4 counties in New Mexico and 62 counties in Texas. In 2014, the basin produced:
  - 582,987,082 barrels of oil from 125,421 wells
  - 552,747,870 MSCF of natural gas from 24,606 wells
  - 121,407 MSCF coalbed methane from 12 wells

Use the Tool to calculate the nonpoint VOC emissions for crude oil tanks for each state, and the % of total production sources.
Case Study #2

- Based on new permit applications, unconventional drilling activity is expected to begin in Wake County, NC (FIPS = 37183). Calculate NOx emissions from exploration sources.
  - 100 natural gas wells drilled horizontally; total estimated feet drilled is 425,000 ft.
  - 85 natural gas wells completed

NCDENR is also wanting to evaluate the impact of limiting hydraulic fracturing engines to 3.5 g/hp-hr for NOx from the current factor of 5.831 g/hp-hr for NOx. Calculate the NOx impact.
Case Study #3

• EPA is considering reducing the NOx emission factor for 4-cycle lean-burn wellhead compressor engines at gas wells (SCC = 2310021202) to 0.5 g/hp-hr in non attainment areas (current factor = 3.07359 g/hp-hr. Using the tool, assess:
  - Impact of total NOx emissions within non attainment counties.
  - Impact of total NOx emissions within non attainment counties for SCC 2310021202
Case Study #4

- The state of Oklahoma provides point source emissions in the NEI for several upstream oil and gas wells. Using the Tool, calculate benzene emissions from Dehydrators in Alfalfa County, OK (FIPS = 40003), after making point source activity adjustments.

  - Alfalfa County, OK Gas Production = 5,017,381 MSCF from 170 gas wells (No CBM production in Alfalfa County, OK)
  - Alfalfa County, OK Associated Gas Production = 107,564,300 MSCF from 783 oil wells
  - Point sources activity = 1,706,326 MSCF from 12 gas wells; 92,718,640 MSCF from 613 oil wells
Discussion/Q&A

- What else would you like to see?

- Q&A