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

Jennifer Snyder, U.S. EPA

Regi Oommen and Mike Pring, Eastern Research Group

August 15, 2017

2017 Emission Inventory Conference

Baltimore, MD

Presenters

- Mike Pring, Eastern Research Group
  - mike.pring@erg.com
- Jennifer Snyder, U.S. EPA
  - Snyder.Jennifer@epa.gov
- Regi Oommen, Eastern Research Group
  - regi.oommen@erg.com

Training Overview

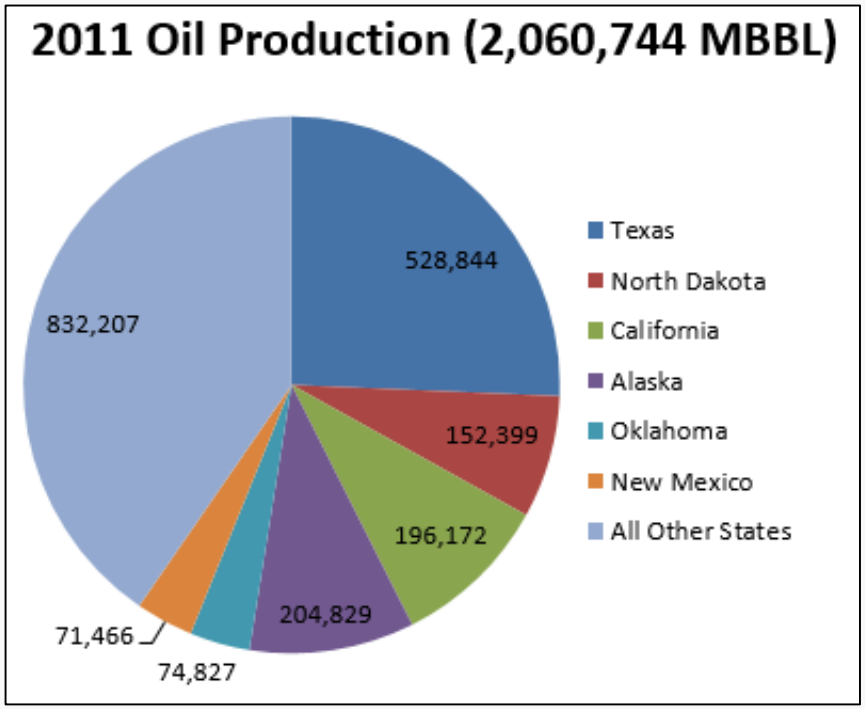
- Oil and gas production in the United States
- Upstream oil and gas emission sources
- Data resources
- Oil and gas emission estimates in the NEI
- Future plans
- Use and application of the Nonpoint Oil and Gas Emission Estimation Tool

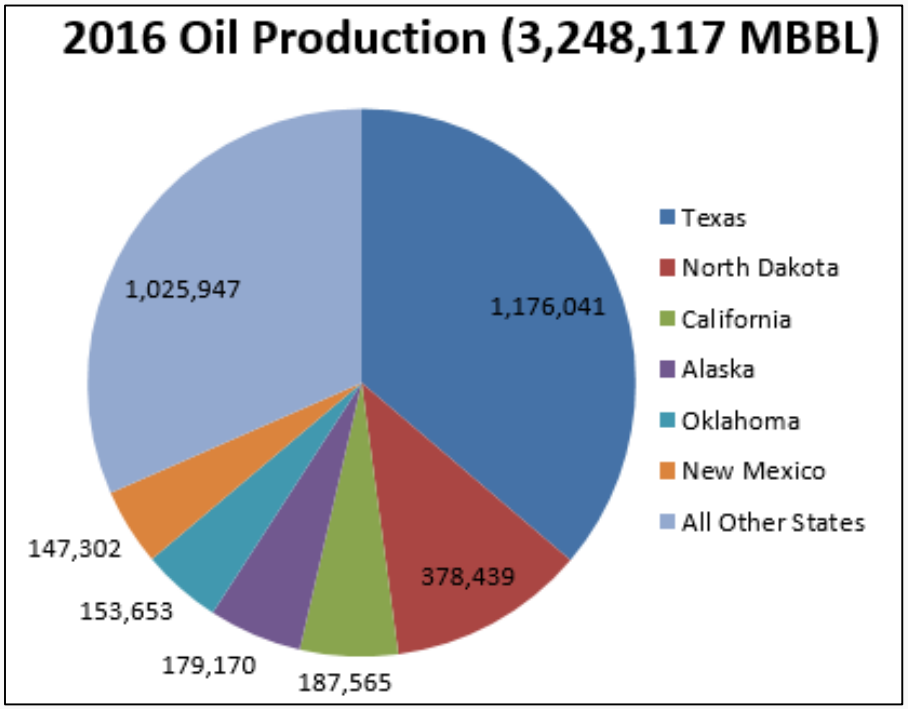
Oil and Gas Production in the US

- 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

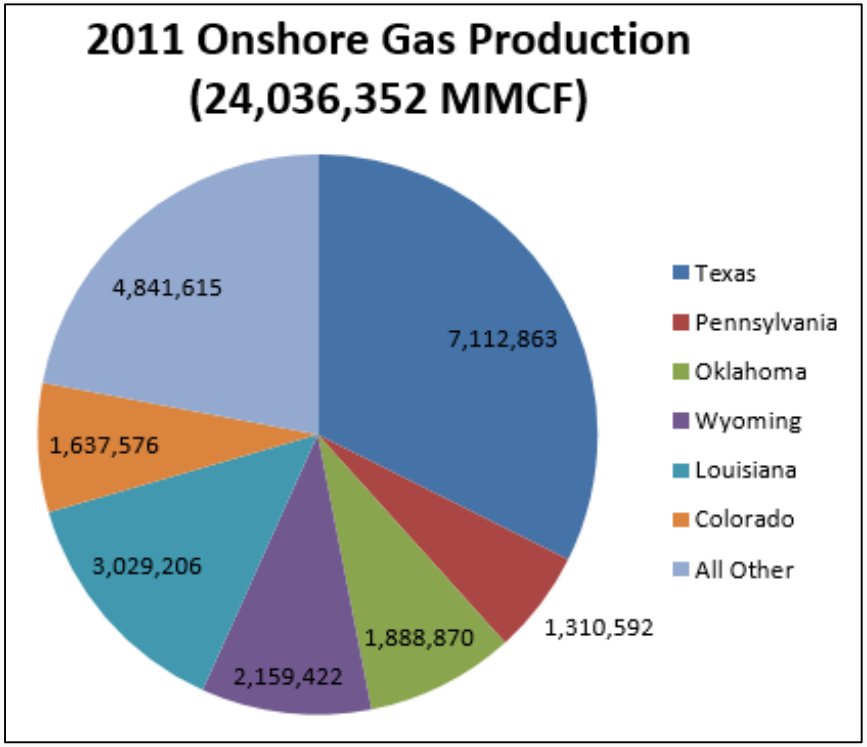
US Onshore Crude Oil Production

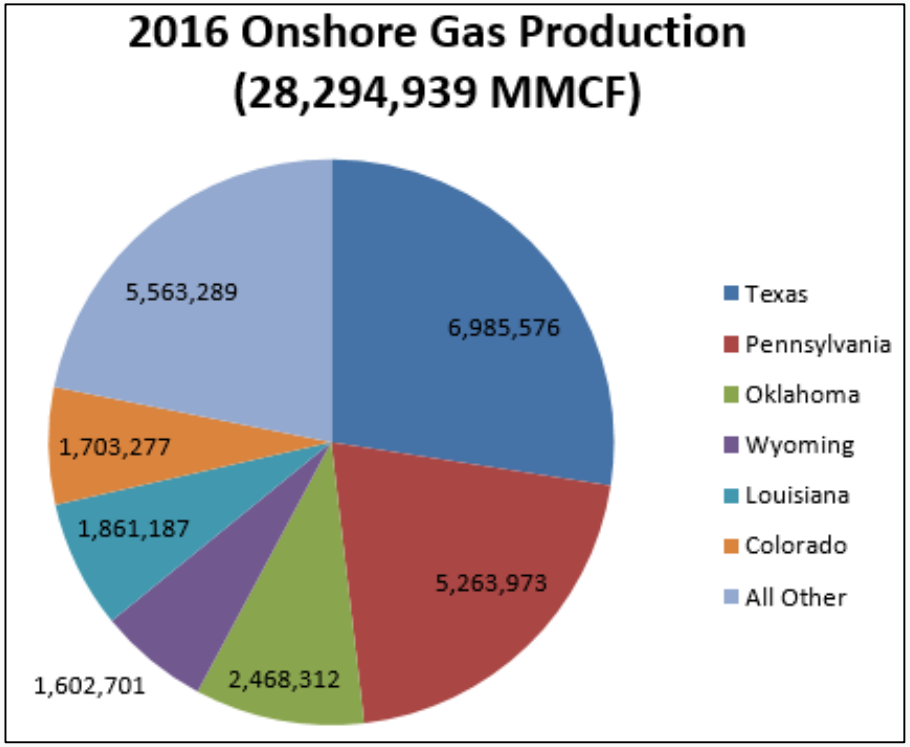




Source: U.S. Energy Information Administration

US Onshore Natural Gas Production



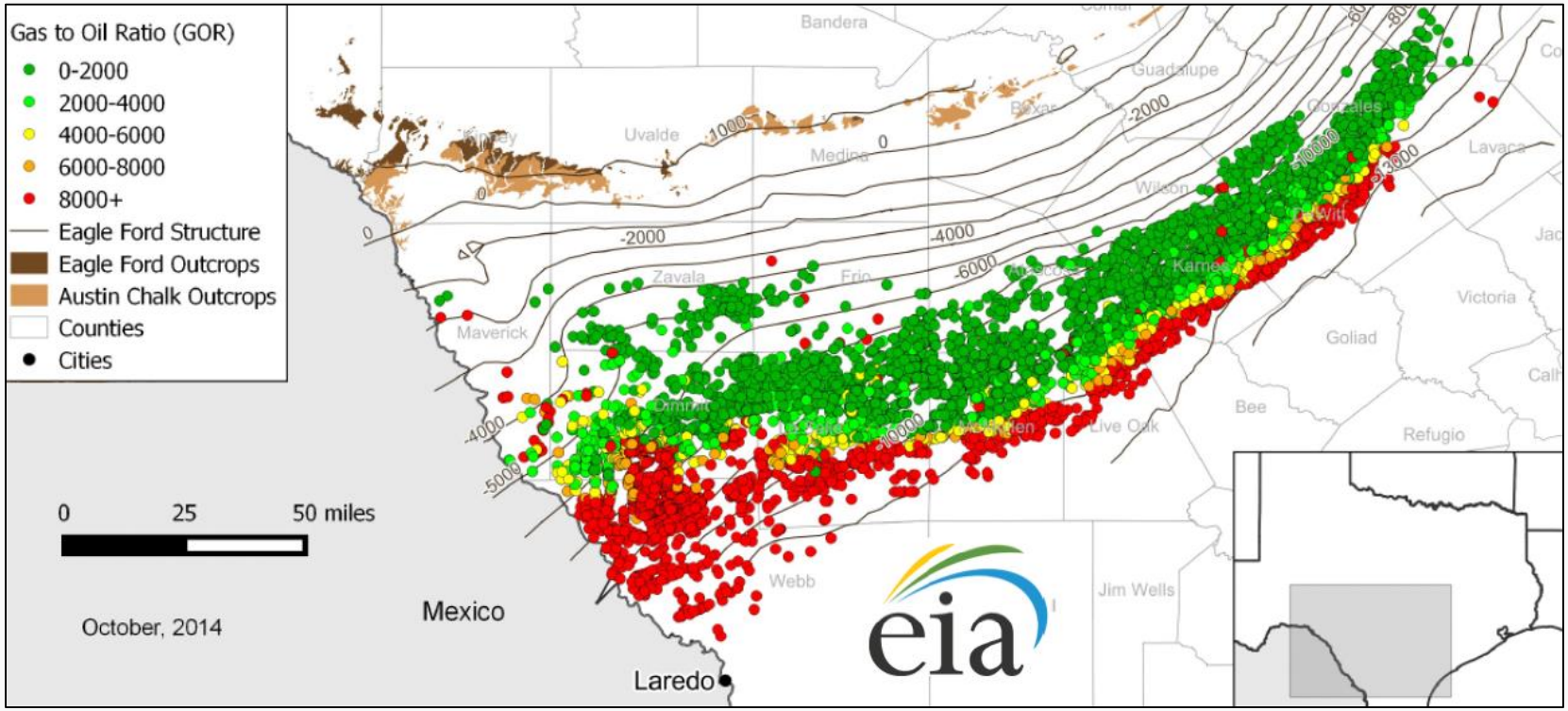


Source: U.S. Energy Information Administration

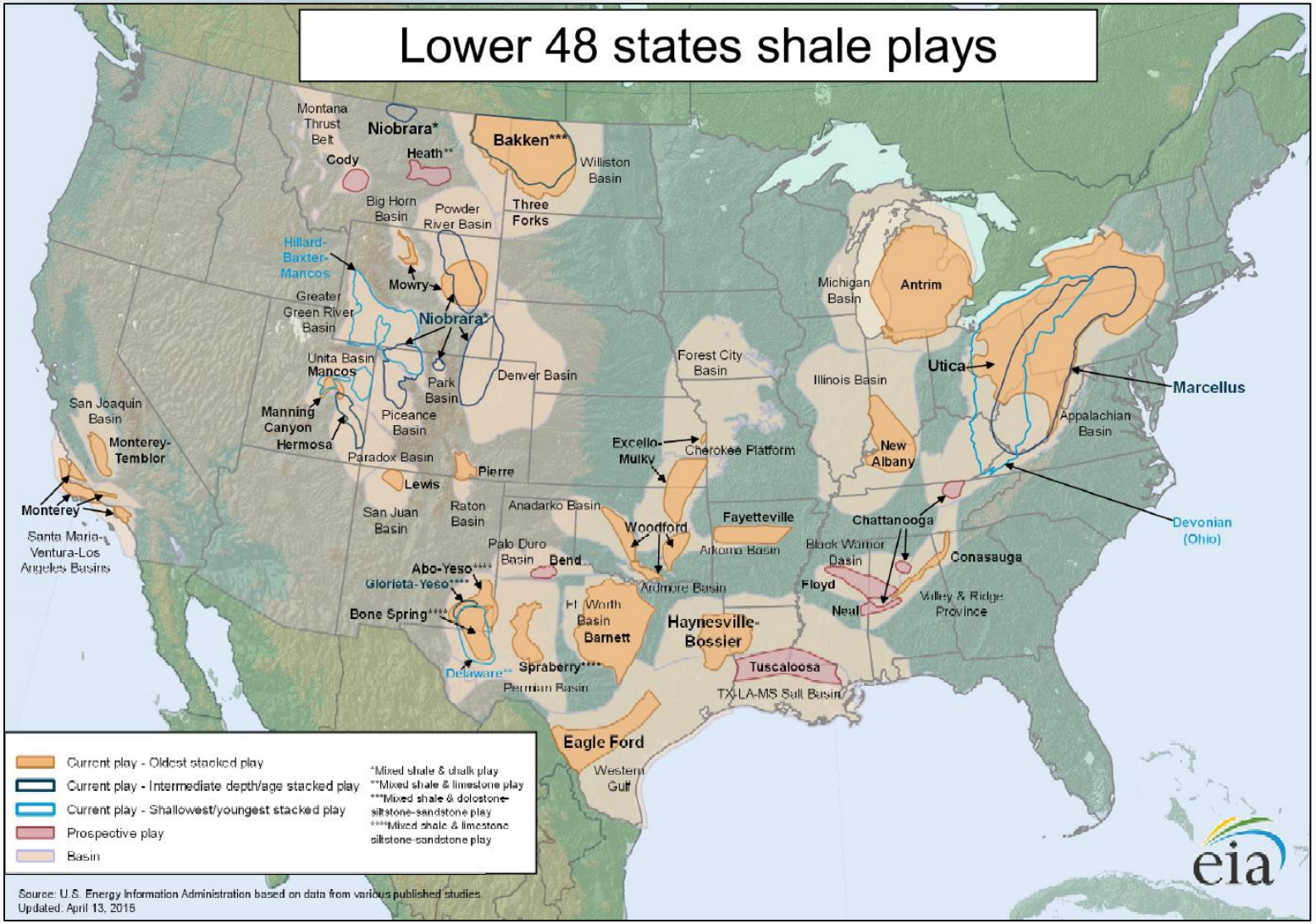
Natural Gas, NGLs, Condensate, Oil

- 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

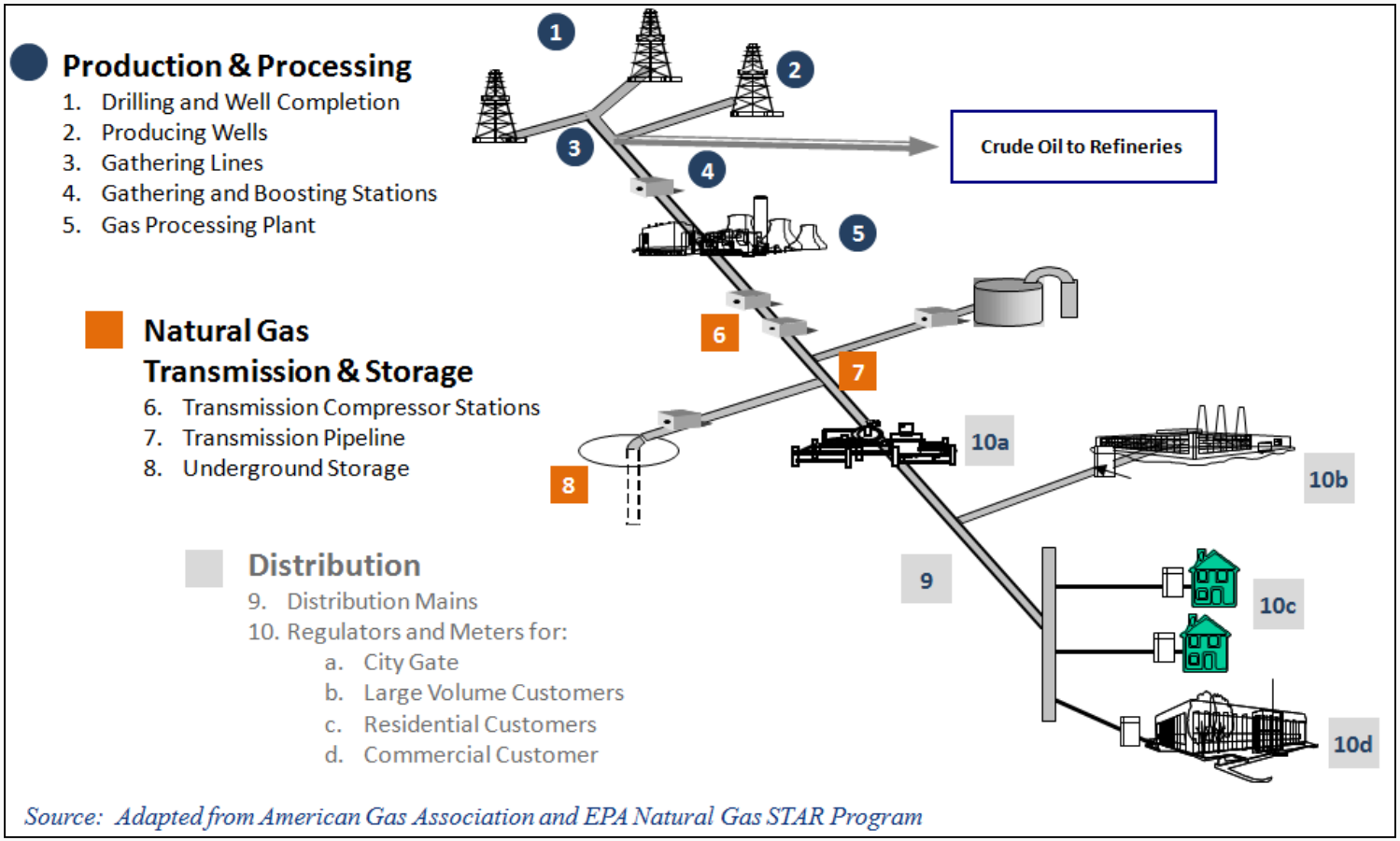
Eagle Ford Shale Oil and Gas Well Map



Source: U.S. Energy Information Administration


Lower 48 states shale plays
Montana Thrust Belt
Niobrara*
Cody
Heath**
Bakken***
Williston Basin
Big Horn Basin
Powder River Basin
Three Forks
Hillard-Baxter-Mancos
Mowry
Greater Green River Basin
Niobrara*
Unita Basin
Mancos
Park Basin
Denver Basin
Piceance Basin
Manning Canyon
Hermosa
Paradox Basin
San Joaquin Basin
Monterey-Temblor
Monterey
Santa Maria-Ventura-Los Angeles Basins
Pierre
Lewis
San Juan Basin
Raton Basin
Anadarko Basin
Palo Duro Basin
Bend
Abo-Yeso****
Glorieta-Yeso****
Bone Spring****
Delaware**
Spraberry****
Permian Basin
Ft Worth Basin
Barnett
Forest City Basin
Excello-Mulky
Cherokee Platform
Woodford
Fayetteville
Arkoma Basin
Ardmore Basin
Haynesville-Bossier
Tuscaloosa
TX-LA-MS Salt Basin
Eagle Ford
Western Gulf
Michigan Basin
Antrim
Illinois Basin
Utica
Marcellus
Appalachian Basin
New Albany
Chattanooga
Black Warrior Basin
Conasauga
Floyd
Neal
Valley & Ridge Province
Devonian (Ohio)
Current play - Oldest stacked play
Current play - Intermediate depth/age stacked play
Current play - Shallowest/youngest stacked play
Prospective play
Basin
*Mixed shale & chalk play
**Mixed shale & limestone play
***Mixed shale & dolostone-siltstone-sandstone play
****Mixed shale & limestone siltstone-sandstone play
Source: U.S. Energy Information Administration based on data from various published studies
Updated: April 13, 2015
eia

Upstream Oil and Gas Emission Sources



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

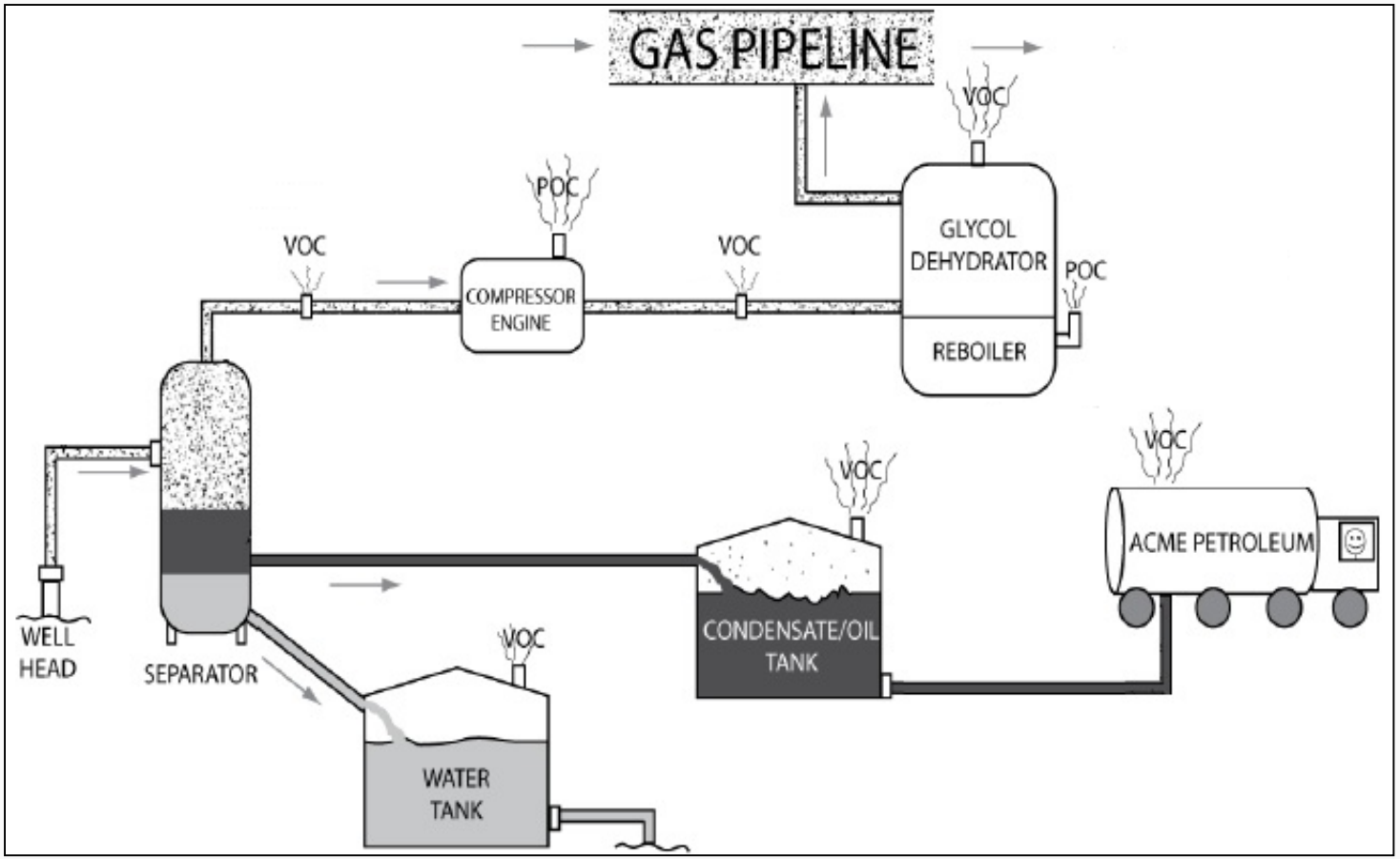
- Emissions generated as gas is vented prior to well being brought into production
- For fractured wells, emissions are generated as gas entrained in the flowback fluid is emitted through open vents at the top of flowback tanks
- Fractured wells regulated under NSPS OOOO and OOOOa

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

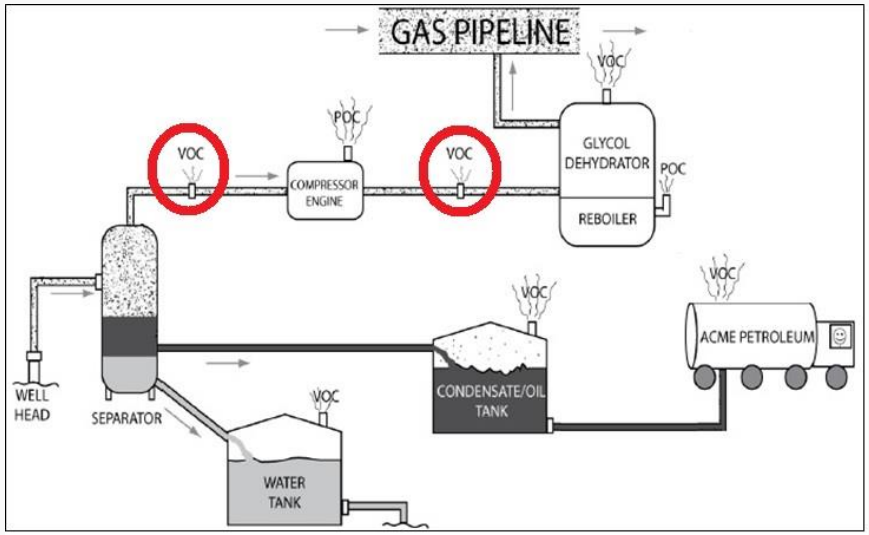
EPA photo.

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
- Emission factors from “Protocol for Equipment Leak Emission Estimates” (EPA, 1995)

Gas-Actuated Pneumatic Pumps

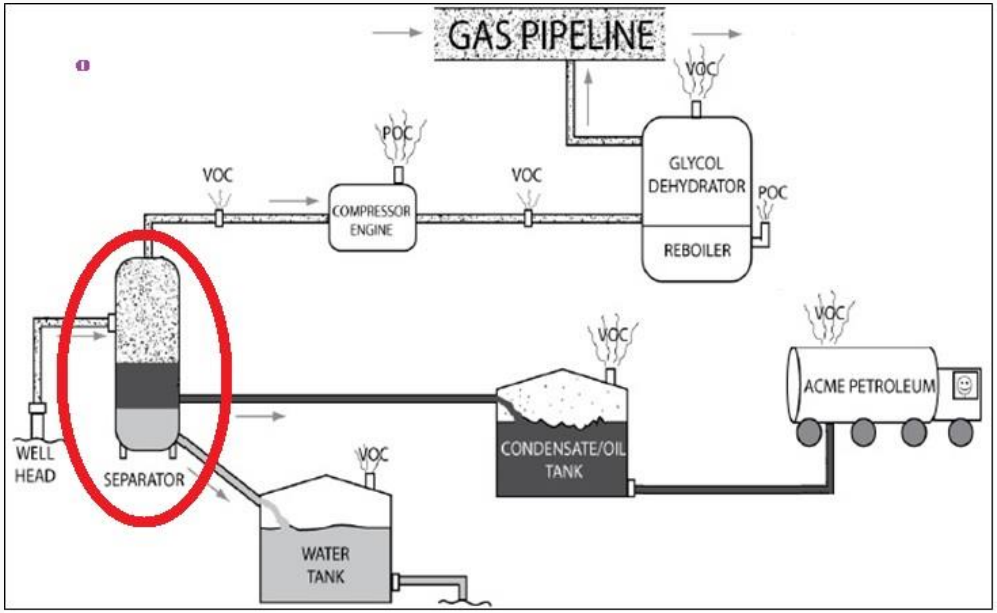
- Small gas-driven plunger pumps used to provide a constant supply of chemicals or lubricants
- Commonly used in sites where electric power is unavailable
- Gas-actuated pumps vent by design

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)
  - H_2S content (to estimate SO_2)

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

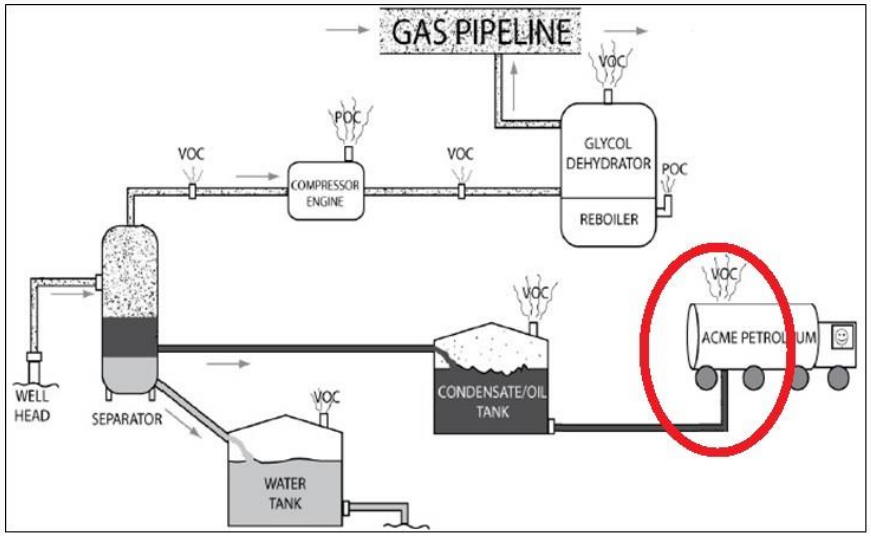
- Used to remove accumulation of fluids in the wellbore
- Also known as “well blowdowns”
- May be controlled (flaring or plunger lifts)

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

$$L = 12.46 \times \left(\frac{S \times V \times MW_{gas}}{T} \right)$$

Pneumatic Devices

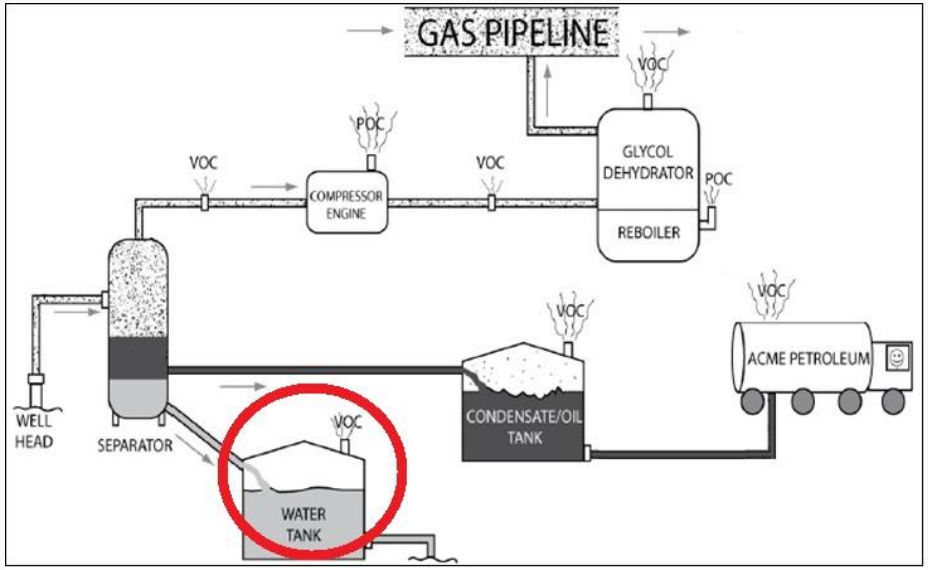
- Use high-pressure gas to produce mechanical motion (levers, switches)
- Largest CH_4 source under Subpart W and in the GHG EI (production sector)
- 2nd largest VOC source as calculated by the Tool

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 OOOOa

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



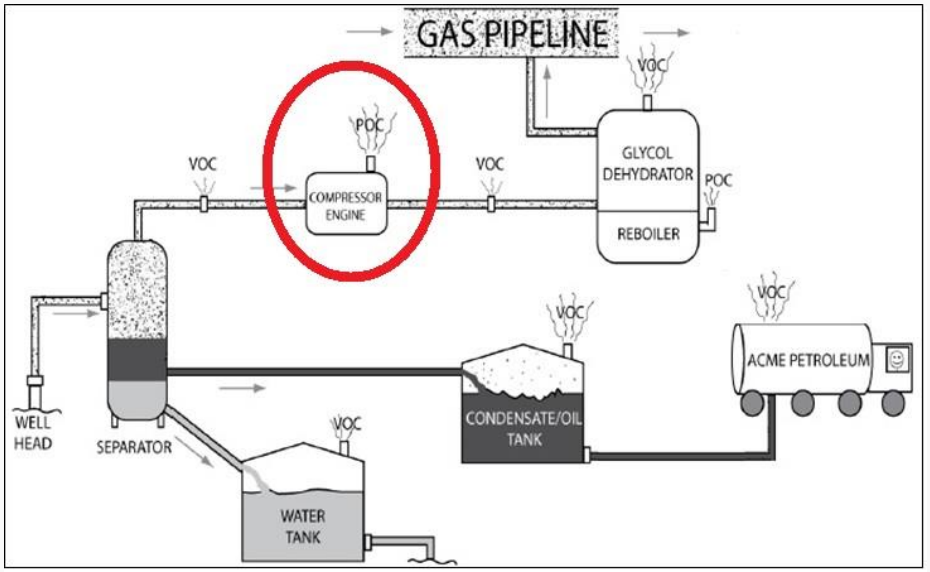
Source : Texas Commission on Environmental Quality Air Permit Reference Guide APDG 5942

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_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)
  - https://www.tceq.texas.gov/airquality/airmod/project/pj_report_ei.html
- 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
  - 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

Temperature: 95.00 deg. F
Pressure: 994.70 psia
Flow Rate: 2.48e+005 scfh

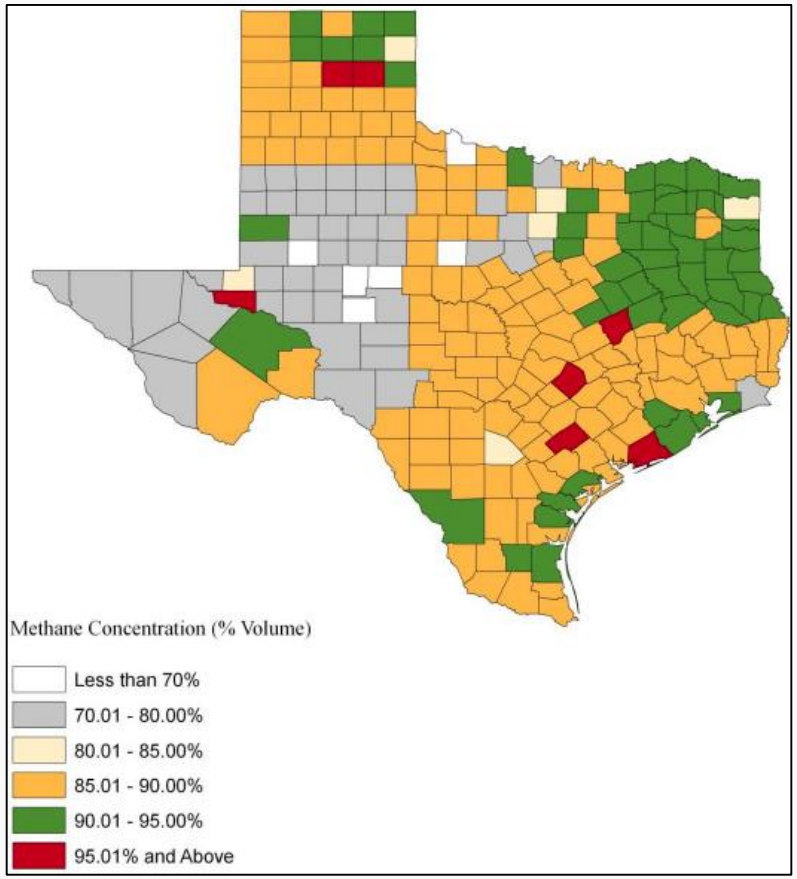
Component	Conc. (vol%)	Loading (lb/hr)
Water	1.08e-001	1.27e+001
Carbon Dioxide	1.90e-001	5.46e+001
Hydrogen Sulfide	9.99e-005	2.22e-002
Nitrogen	1.02e-001	1.86e+001
Methane	8.96e+001	9.39e+003
Ethane	5.67e+000	1.12e+003
Propane	2.33e+000	6.71e+002
Isobutane	5.93e-001	2.25e+002
n-Butane	5.95e-001	2.26e+002
Isopentane	2.33e-001	1.10e+002
n-Pentane	1.62e-001	7.63e+001
Cyclopentane	9.99e-003	4.58e+000
n-Hexane	5.59e-002	3.15e+001
Cyclohexane	4.29e-002	2.36e+001
Other Hexanes	6.99e-002	3.94e+001
Heptanes	4.10e-002	2.68e+001
Methylcyclohexane	3.60e-002	2.31e+001
Benzene	1.60e-002	8.16e+000
Toluene	1.30e-002	7.82e+000
Ethylbenzene	9.99e-004	6.93e-001
Xylenes	4.00e-003	2.77e+000
C8+ Heavies	1.21e-001	1.35e+002

DRY GAS STREAM

Temperature: 95.00 deg. F
Pressure: 994.70 psia
Flow Rate: 2.48e+005 scfh

Component	Conc. (vol%)	Loading (lb/hr)
Water	4.17e-003	4.90e-001
Carbon Dioxide	1.89e-001	5.42e+001
Hydrogen Sulfide	9.59e-005	2.13e-002
Nitrogen	1.02e-001	1.86e+001
Methane	8.97e+001	9.39e+003
Ethane	5.68e+000	1.11e+003
Propane	2.33e+000	6.69e+002
Isobutane	5.93e-001	2.25e+002
n-Butane	5.94e-001	2.25e+002
Isopentane	2.32e-001	1.09e+002
n-Pentane	1.61e-001	7.59e+001
Cyclopentane	9.79e-003	4.48e+000
n-Hexane	5.56e-002	3.13e+001
Cyclohexane	4.15e-002	2.28e+001
Other Hexanes	6.96e-002	3.91e+001
Heptanes	4.05e-002	2.65e+001
Methylcyclohexane	3.47e-002	2.22e+001
Benzene	1.18e-002	5.99e+000
Toluene	8.47e-003	5.09e+000
Ethylbenzene	5.94e-004	4.12e-001
Xylenes	2.00e-003	1.38e+000
C8+ Heavies	1.17e-001	1.30e+002

GRI-GLYCalc Gas Composition



GRI-GLYCalc Dehydrator Emissions

CONTROLLED REGENERATOR EMISSIONS

Component	lbs/hr
Hydrogen Sulfide	<0.0001
Methane	0.0088
Ethane	0.0096
Propane	0.0123
Isobutane	0.0061
n-Butane	0.0081
Isopentane	0.0027
n-Pentane	0.0025
Cyclopentane	0.0006
n-Hexane	0.0009
Cyclohexane	0.0025
Other Hexanes	0.0011
Heptanes	0.0006
Methylcyclohexane	0.0014
Benzene	0.0065
Toluene	0.0027
Ethylbenzene	0.0001
Xylenes	0.0004
C8+ Heavies	<0.0001
Total Emissions	0.0668
Total Hydrocarbon Emissions	0.0668
Total VOC Emissions	0.0484
Total HAP Emissions	0.0106
Total BTEX Emissions	0.0097

FLASH TANK OFF GAS

Component	lbs/hr
Hydrogen Sulfide	0.0001
Methane	4.5066
Ethane	1.2750
Propane	0.8493
Isobutane	0.2991
n-Butane	0.3260
Isopentane	0.1343
n-Pentane	0.1012
Cyclopentane	0.0081
n-Hexane	0.0389
Cyclohexane	0.0362
Other Hexanes	0.0479
Heptanes	0.0287
Methylcyclohexane	0.0277
Benzene	0.0127
Toluene	0.0096
Ethylbenzene	0.0005
Xylenes	0.0018
C8+ Heavies	0.0356
Total Emissions	7.7396
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	: AP42
Control Efficiency	: 95.0%
Known Separator Stream	: Low Pressure Oil
Entering Air Composition	: No
Production Rate	: 301.2[bbl/day]
Days of Annual Operation	: [illegible]

-- Emission Summary

Item	Uncontrolled [ton/yr]	Uncontrolled [lb/hr]	Controlled [ton/yr]	Controlled [lb/hr]
Total HAPs	14.210	3.244	0.711	0.162
Total HC	566.994	129.451	28.350	6.473
VOCs, C2+	500.099	114.178	25.005	5.709

-- Emission Composition

No	Component	Uncontrolled [ton/yr]	Uncontrolled [lb/hr]	Controlled [ton/yr]	Controlled [lb/hr]
1	H2S	0.000	0.000	0.000	0.000
2	O2	0.000	0.000	0.000	0.000
3	CO2	3.783	0.864	3.783	0.864
4	N2	1.607	0.367	1.607	0.367
5	C1	66.895	15.273	3.345	0.764
6	C2	113.476	25.908	5.674	1.295
7	C3	141.081	32.210	7.054	1.611
14	C8	8.178	1.867	0.409	0.093
15	[illegible]	1.717	0.392	0.086	0.020
16	C10+	0.023	0.005	0.001	0.000
17	Benzene	0.489	0.112	0.024	0.006
18	Toluene	1.242	0.284	0.062	0.014
19	E-Benzene	0.147	0.034	0.007	0.002
20	Xylenes	1.259	0.287	0.063	0.014
21	n-C6	11.006	2.513	0.550	0.126
22	22[illegible]Methylp	0.064	0.015	0.003	0.001

BREAK

NATIONAL EMISSIONS INVENTORY (NEI)

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

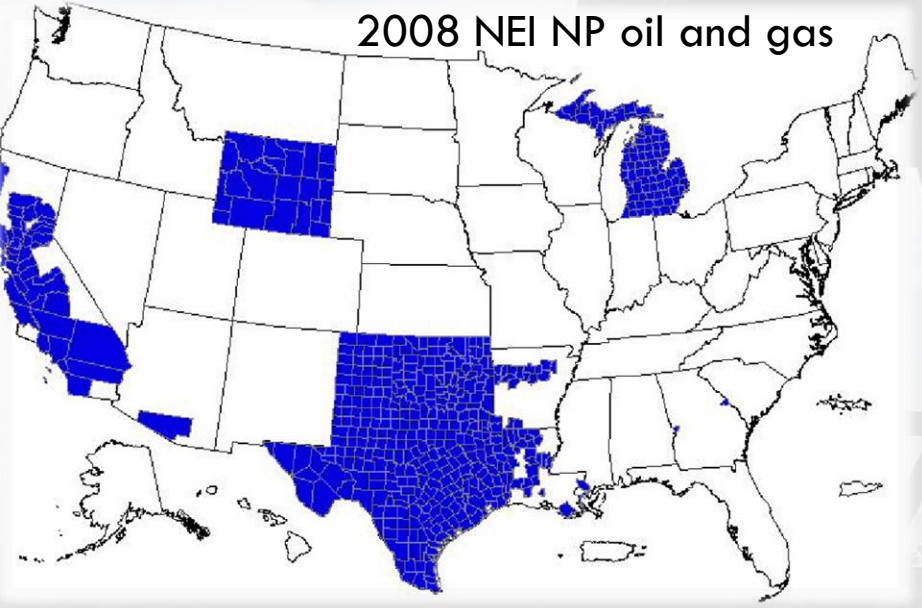
States are responsible for the emissions estimates

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

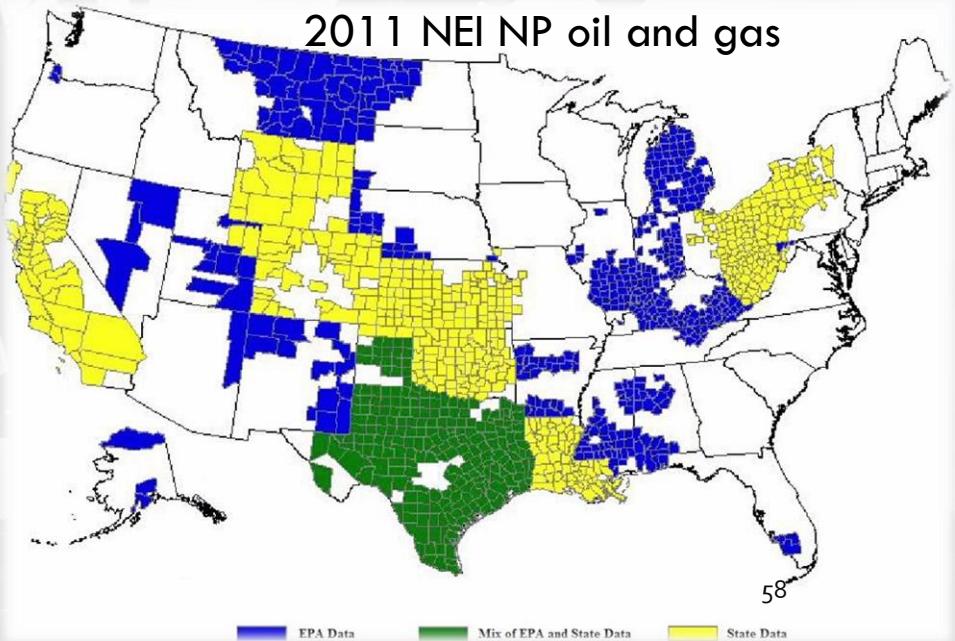
- EPA methods are assumptions about activity and emissions rates that can be improved with local understanding

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

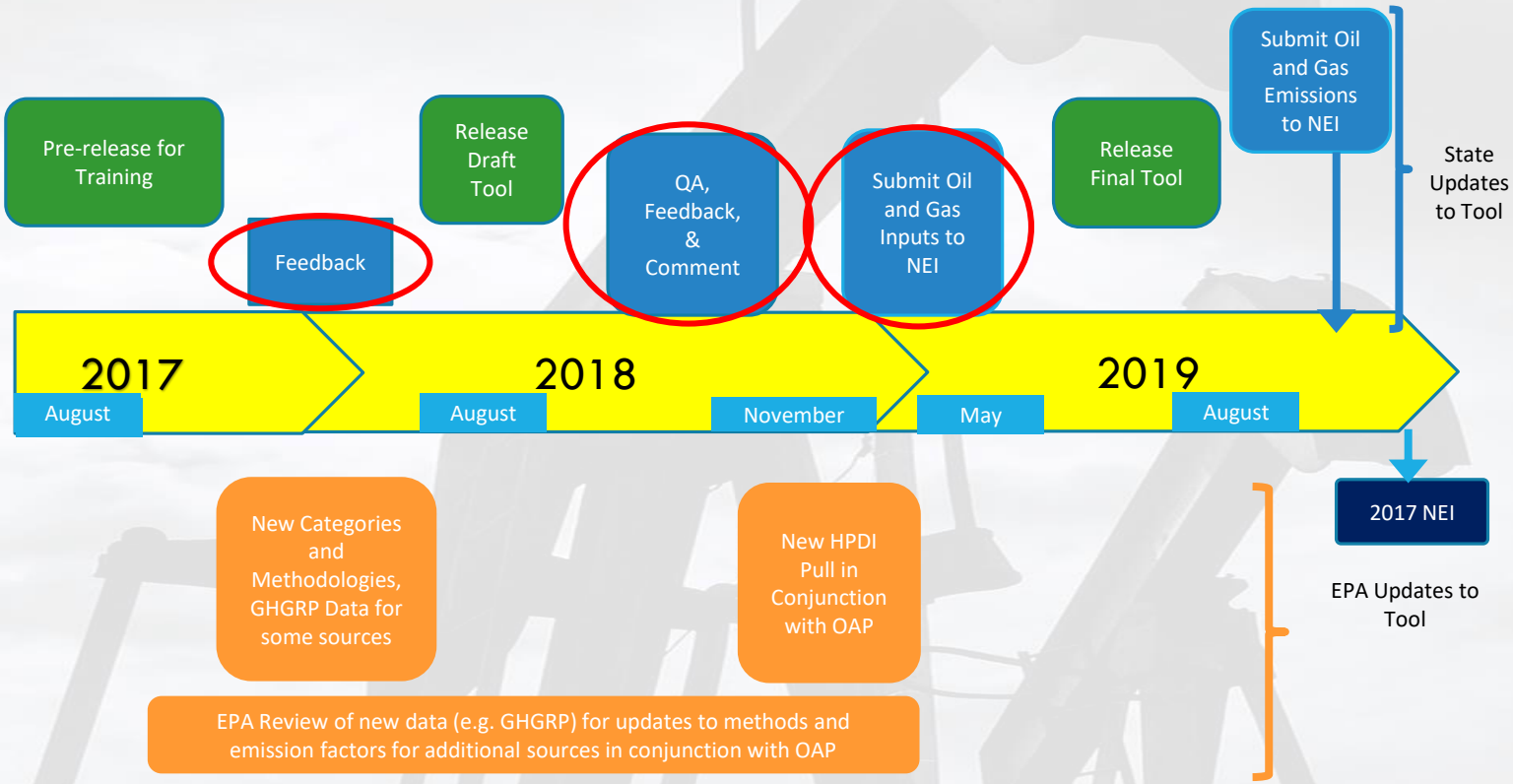
Outcome from this lean event included:

- 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

Action	Date
EPA posts draft tool and estimates	8/31/2018
SLT comments due	11/30/2018
SLTs submit inputs or emissions for Category 3 tools	12/1/18 -5/31/2019
EPA posts revised tools and estimates	2/28/2019
EPA posts final tools and estimates using SLT submitted inputs	8/31/2019
2017 v1 NEI Release in EIS for nonpoint	12/31/2019
2017 v1 Public Release	1/31/2020

OIL AND GAS 2017 NEI TIMELINE



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!

2017 NEI PLANS (BUDGET RELIANT)

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/updates
  - 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

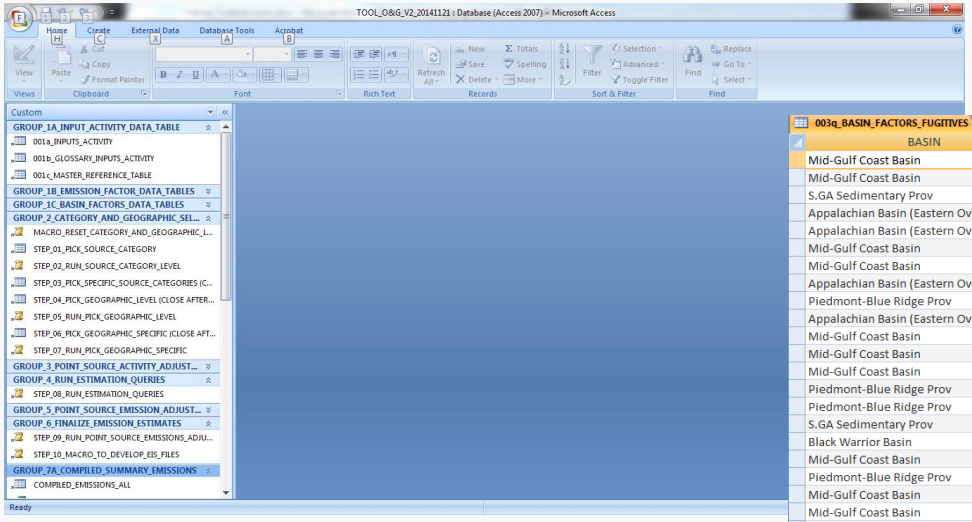
- National Oil and Gas Committee
- ERG Staff
  - Bebhinn Do
  - Stacie Enoch
  - Karla Faught
  - Steve Mendenhall
  - Stephen Treimel
  - Jody Tisano

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

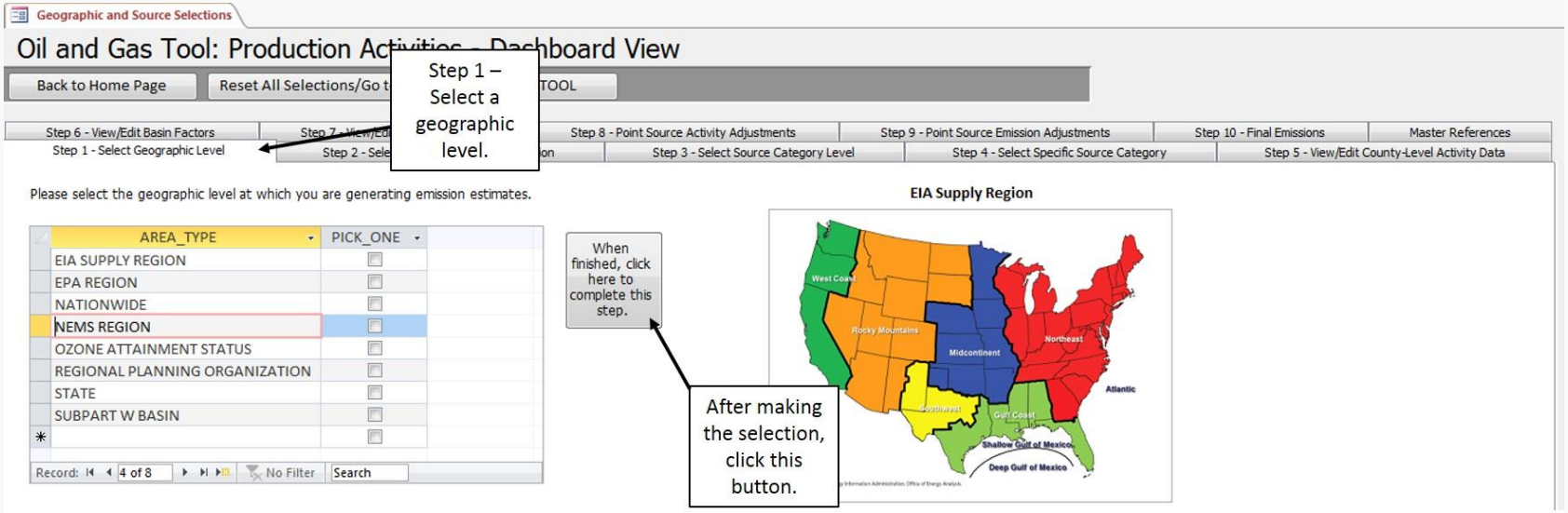
Where We Were

- 2011 Oil and Gas Tool
  - Converted from Excel Workbook to Access
  - 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:
  - Drilling
  - Mud Degassing
  - Hydraulic Fracturing
  - Well Completions

2014 Tool Coverage – Source Categories

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

2014 Tool Coverage – Pollutants

- Criteria Pollutants:
  - CO, NH_3, NO_x, PM10-PRI, PM2.5-PRI, SO_2, VOC
- HAPs:
  - BTEX, formaldehyde, and Other HAPs
- Other Pollutants:
  - 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

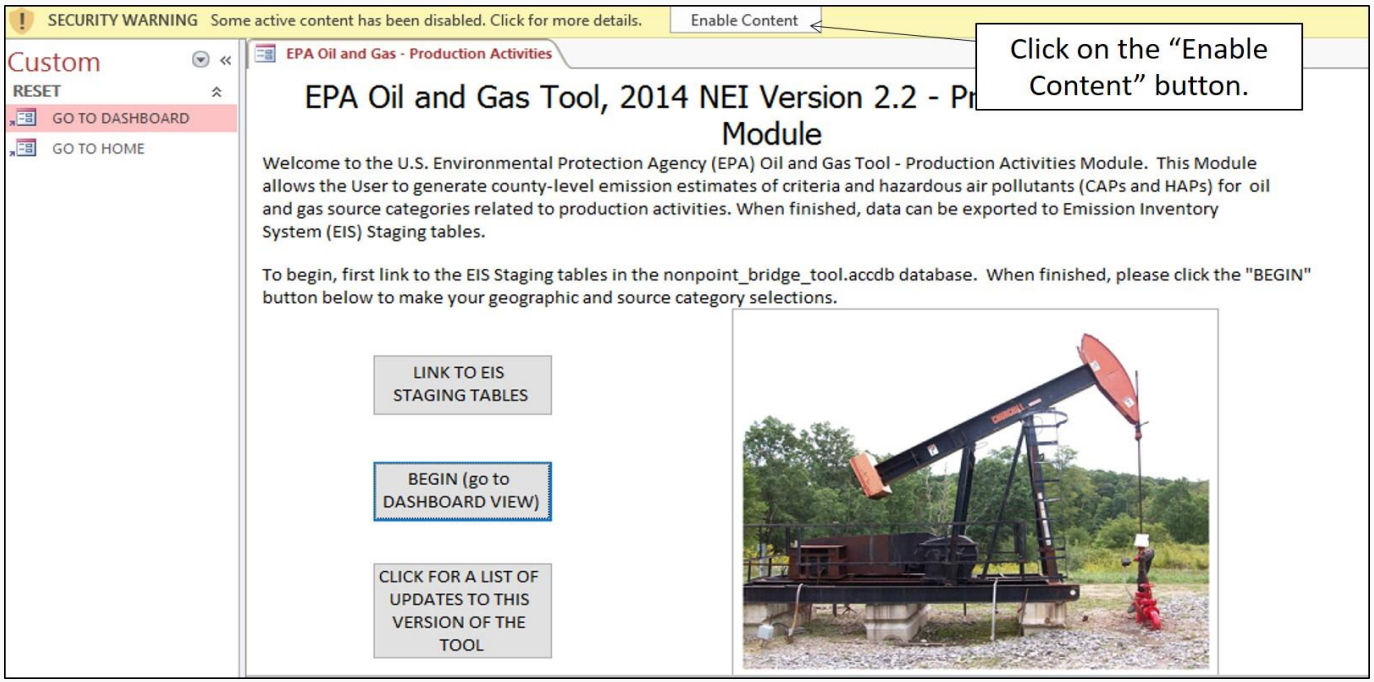
- Source category coverage: 54 SCCs from 18 source categories
- Pollutant coverage: 50 pollutants
- Geographic coverage: 34 states, 1157 counties, 65 basins
- Emission records generated:
  - From Tool = 939,493
  - To EIS = 749,096

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

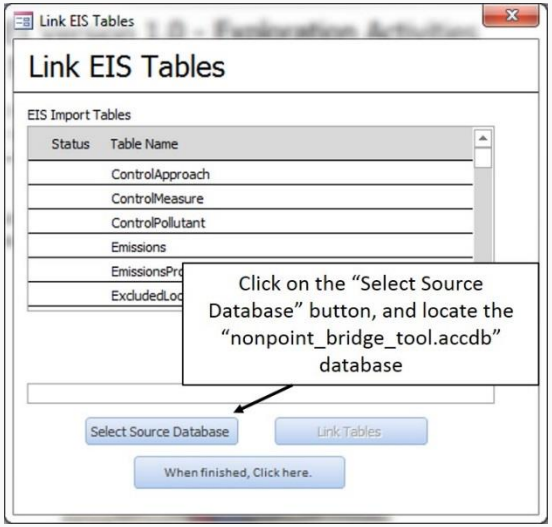
Production Sources – Getting Started

- If using the Tool for the first time from unzipping, then you will need to “Enable Content”



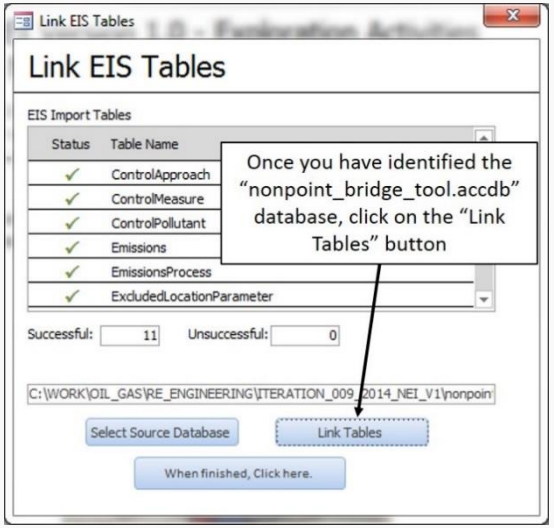
Production Sources – Linking to EIS Staging Tables

- 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.



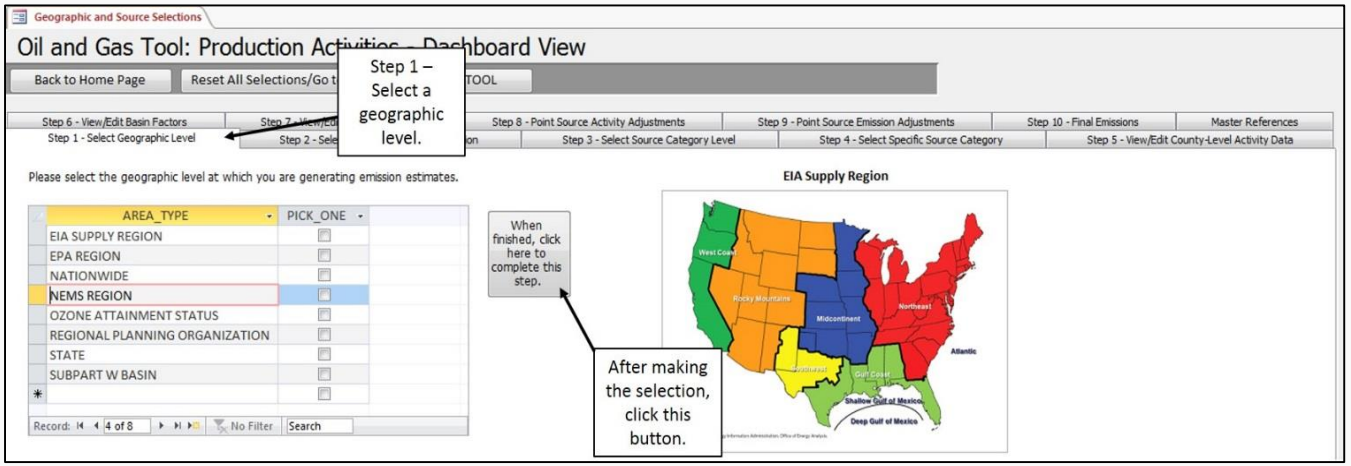
Production Sources – Linking to EIS Staging Tables

- 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.



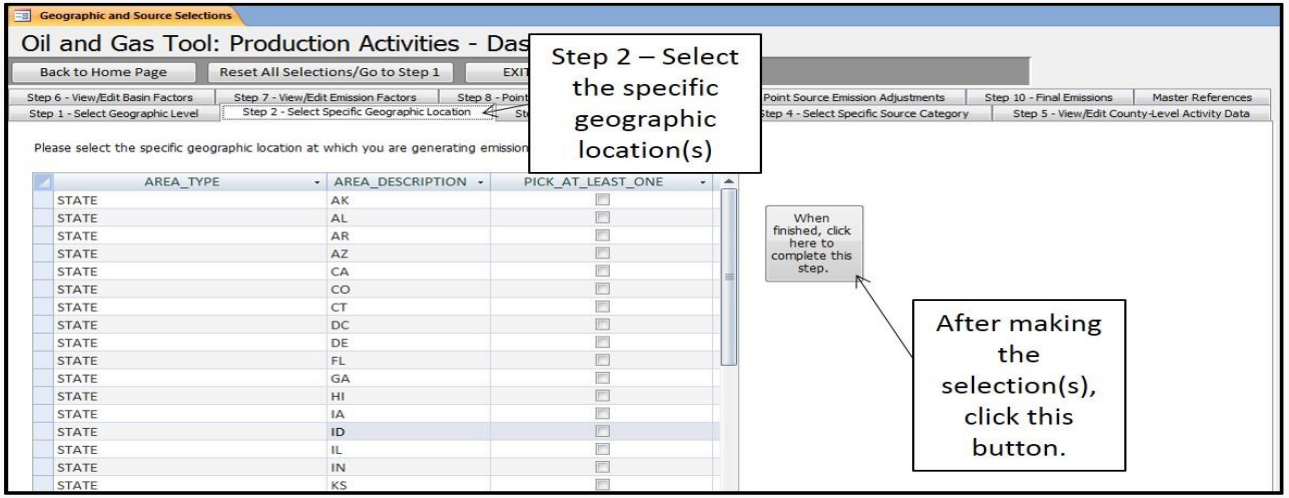
Production Sources – Step 1

- 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.



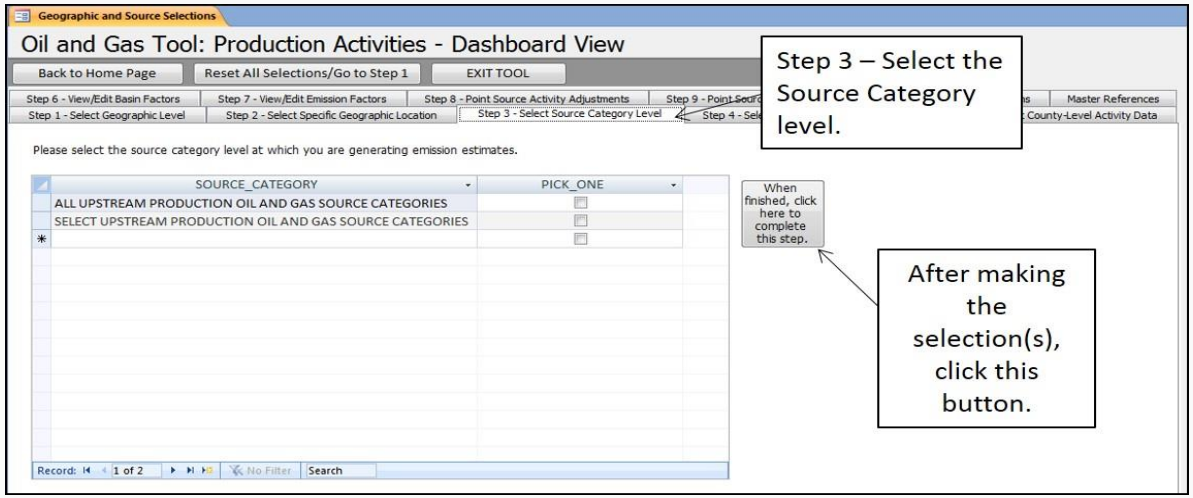
Production Sources – Step 2

- 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.



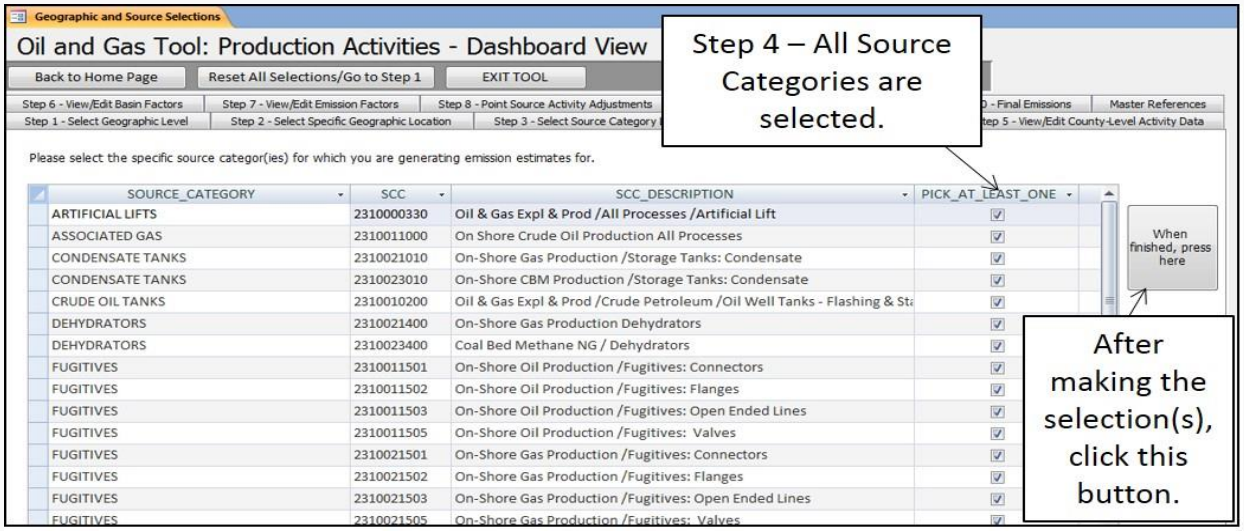
Production Sources – Step 3

- The User may generate emission estimates for <u>all</u> oil and gas production source categories or <u>individually</u> 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.



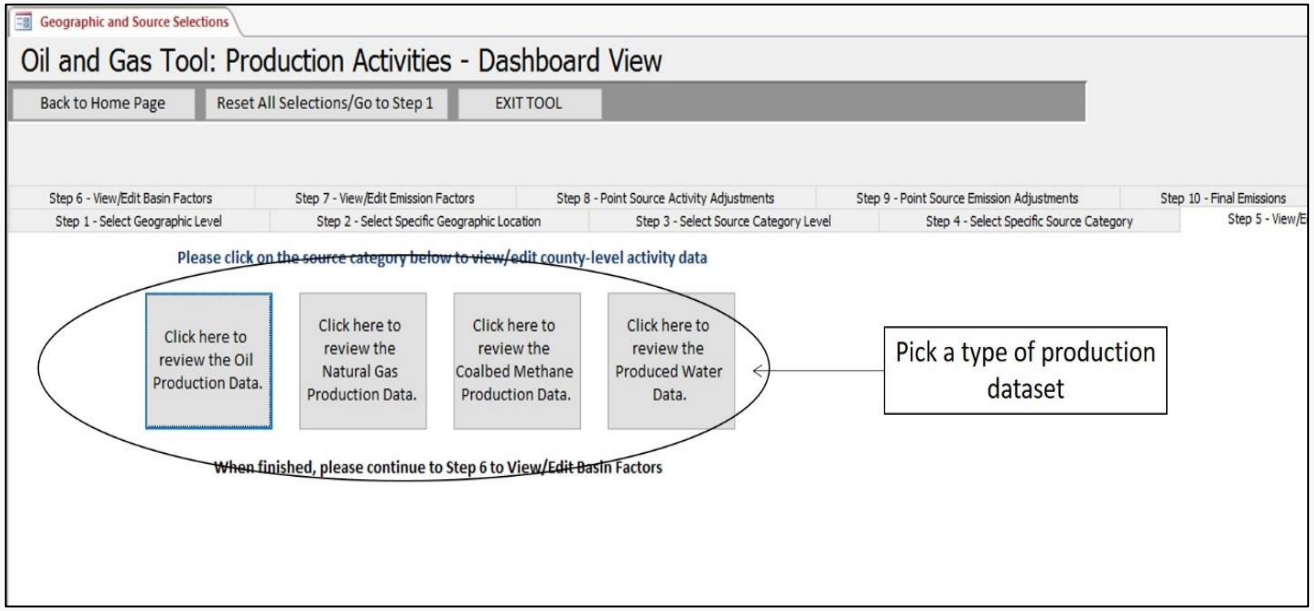
Production Sources – Step 4

- 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.



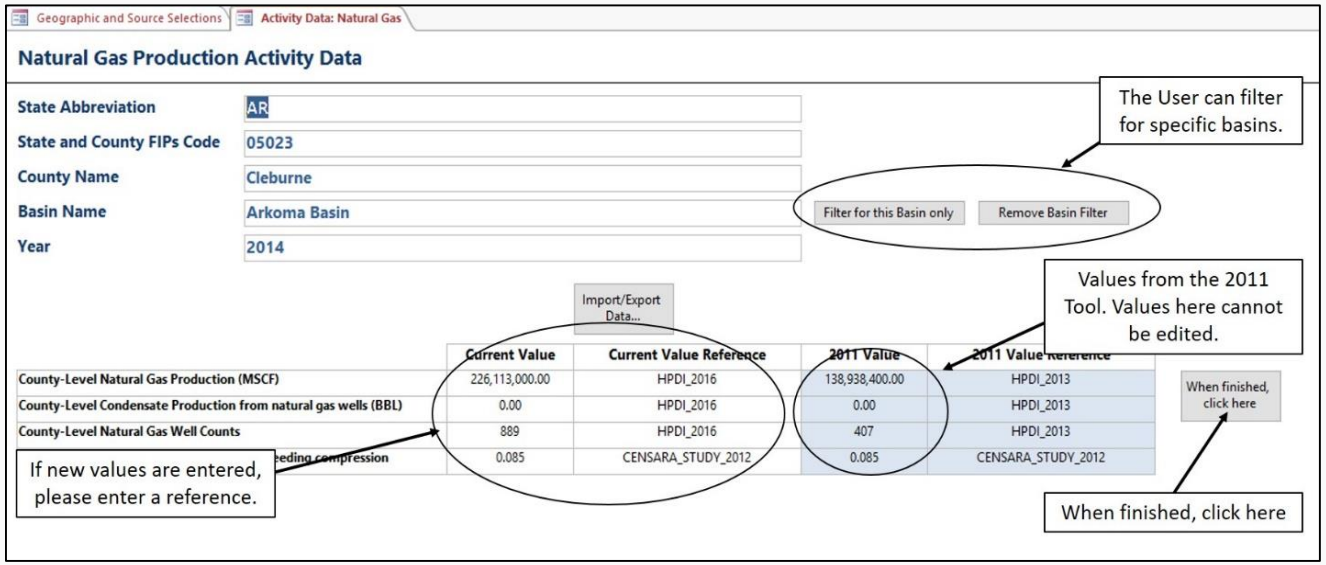
Production Sources – Step 5

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



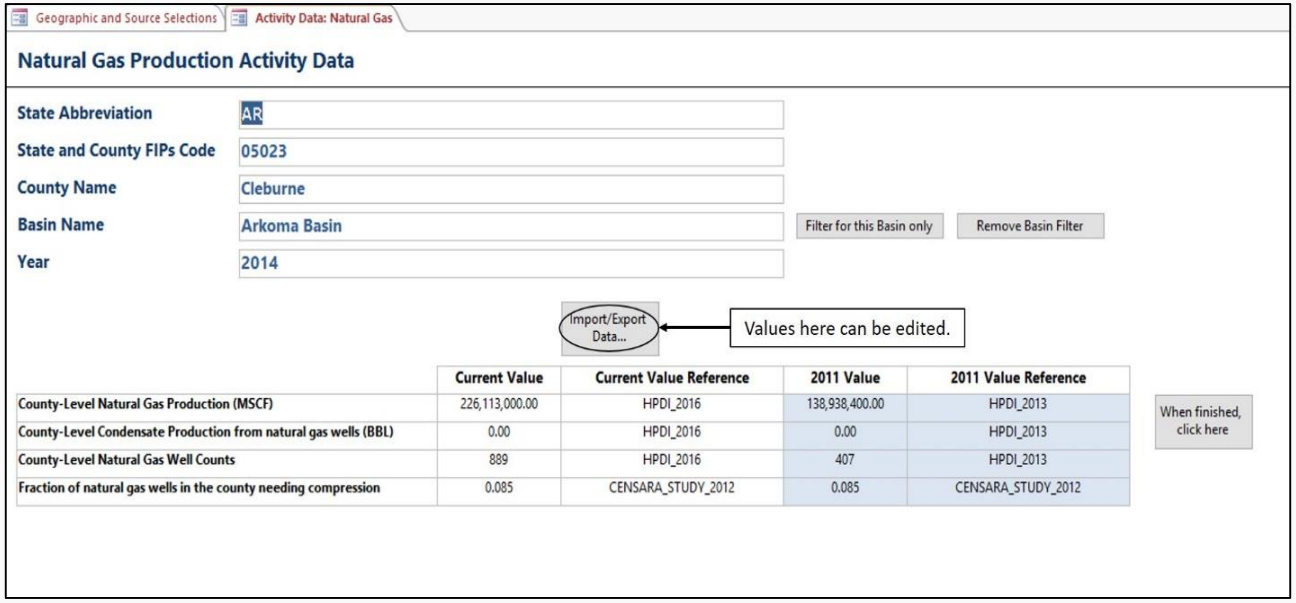
Production Sources – Step 5 (cont.)

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



Production Sources – Step 5 (cont.)

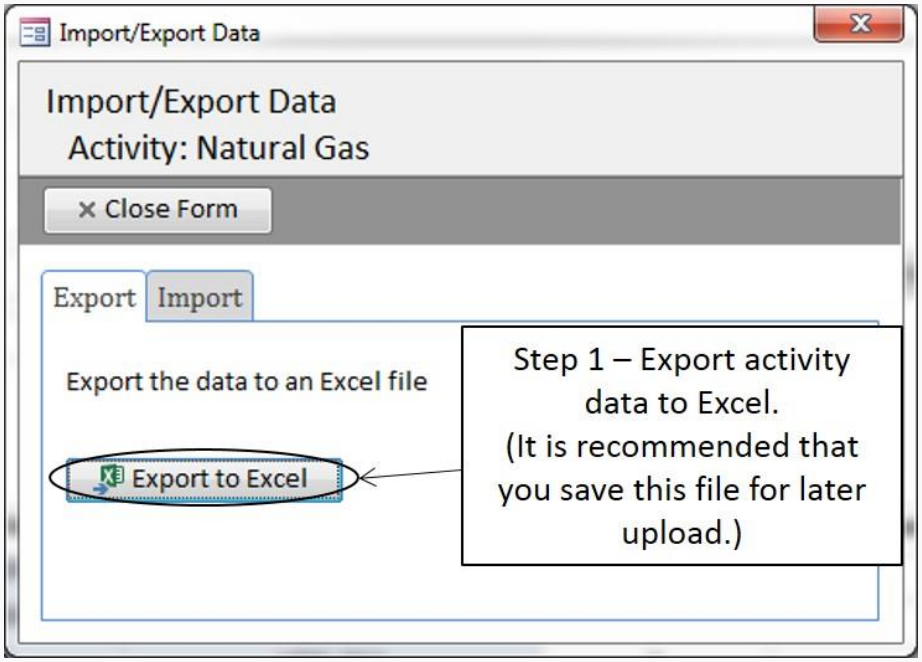
- The User may also edit activity data in MS-Excel by using the "Import/Export Data…" button.



	Current Value	Current Value Reference	2011 Value	2011 Value Reference
County-Level Natural Gas Production (MSCF)	226,113,000.00	HPDI_2016	138,938,400.00	HPDI_2013
County-Level Condensate Production from natural gas wells (BBL)	0.00	HPDI_2016	0.00	HPDI_2013
County-Level Natural Gas Well Counts	889	HPDI_2016	407	HPDI_2013
Fraction of natural gas wells in the county needing compression	0.085	CENSARA_STUDY_2012	0.085	CENSARA_STUDY_2012

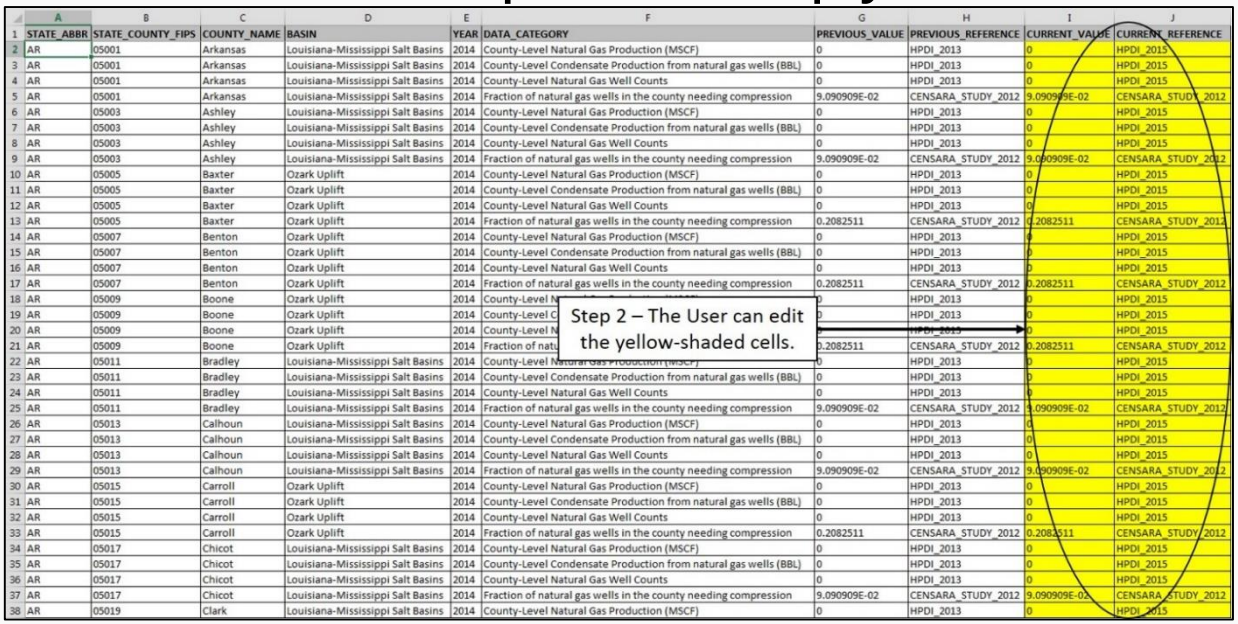
Production Sources – Step 5 (cont.)

- 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.)

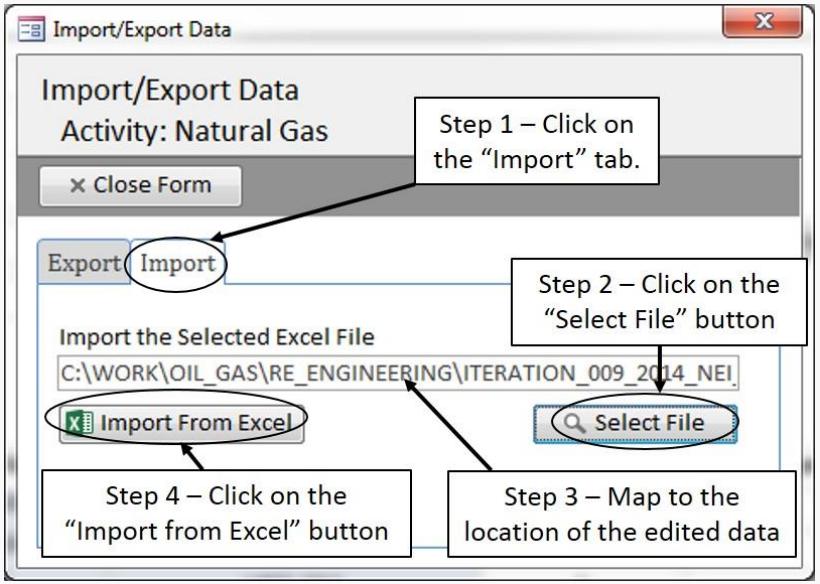
- A MS-Excel workbook will open when finished exporting. It is required that the User save this file to the hard drive for later upload. In the Excel file, the User can only edit the yellow shaded cells. When completed, simply save the file.



	A	B	C	D	E	F	G	H	I	J
1	STATE_ABBR	STATE_COUNTY_FIPS	COUNTY_NAME	BASIN	YEAR	DATA_CATEGORY	PREVIOUS_VALUE	PREVIOUS_REFERENCE	CURRENT_VALUE	CURRENT_REFERENCE
2	AR	05001	Arkansas	Louisiana-Mississippi Salt Basins	2014	County-Level Natural Gas Production (MSCF)	0	HPDI_2013	0	HPDI_2015
3	AR	05001	Arkansas	Louisiana-Mississippi Salt Basins	2014	County-Level Condensate Production from natural gas wells (BBL)	0	HPDI_2013	0	HPDI_2015
4	AR	05001	Arkansas	Louisiana-Mississippi Salt Basins	2014	County-Level Natural Gas Well Counts	0	HPDI_2013	0	HPDI_2015
5	AR	05001	Arkansas	Louisiana-Mississippi Salt Basins	2014	Fraction of natural gas wells in the county needing compression	9.090909E-02	CENSARA_STUDY_2012	9.090909E-02	CENSARA_STUDY_2012
6	AR	05003	Ashley	Louisiana-Mississippi Salt Basins	2014	County-Level Natural Gas Production (MSCF)	0	HPDI_2013	0	HPDI_2015
7	AR	05003	Ashley	Louisiana-Mississippi Salt Basins	2014	County-Level Condensate Production from natural gas wells (BBL)	0	HPDI_2013	0	HPDI_2015
8	AR	05003	Ashley	Louisiana-Mississippi Salt Basins	2014	County-Level Natural Gas Well Counts	0	HPDI_2013	0	HPDI_2015
9	AR	05003	Ashley	Louisiana-Mississippi Salt Basins	2014	Fraction of natural gas wells in the county needing compression	9.090909E-02	CENSARA_STUDY_2012	9.090909E-02	CENSARA_STUDY_2012
10	AR	05005	Baxter	Ozark Uplift	2014	County-Level Natural Gas Production (MSCF)	0	HPDI_2013	0	HPDI_2015
11	AR	05005	Baxter	Ozark Uplift	2014	County-Level Condensate Production from natural gas wells (BBL)	0	HPDI_2013	0	HPDI_2015
12	AR	05005	Baxter	Ozark Uplift	2014	County-Level Natural Gas Well Counts	0	HPDI_2013	0	HPDI_2015
13	AR	05005	Baxter	Ozark Uplift	2014	Fraction of natural gas wells in the county needing compression	0.2082511	CENSARA_STUDY_2012	0.2082511	CENSARA_STUDY_2012
14	AR	05007	Benton	Ozark Uplift	2014	County-Level Natural Gas Production (MSCF)	0	HPDI_2013	0	HPDI_2015
15	AR	05007	Benton	Ozark Uplift	2014	County-Level Condensate Production from natural gas wells (BBL)	0	HPDI_2013	0	HPDI_2015
16	AR	05007	Benton	Ozark Uplift	2014	County-Level Natural Gas Well Counts	0	HPDI_2013	0	HPDI_2015
17	AR	05007	Benton	Ozark Uplift	2014	Fraction of natural gas wells in the county needing compression	0.2082511	CENSARA_STUDY_2012	0.2082511	CENSARA_STUDY_2012
18	AR	05009	Boone	Ozark Uplift	2014	County-Level N	0	HPDI_2013	0	HPDI_2015
19	AR	05009	Boone	Ozark Uplift	2014	County-Level C	0	HPDI_2013	0	HPDI_2015
20	AR	05009	Boone	Ozark Uplift	2014	County-Level N	0	HPDI_2013	0	HPDI_2015
21	AR	05009	Boone	Ozark Uplift	2014	Fraction of natu	0.2082511	CENSARA_STUDY_2012	0.2082511	CENSARA_STUDY_2012
22	AR	05011	Bradley	Louisiana-Mississippi Salt Basins	2014	County-Level Natural Gas Production (MSCF)	0	HPDI_2013	0	HPDI_2015
23	AR	05011	Bradley	Louisiana-Mississippi Salt Basins	2014	County-Level Condensate Production from natural gas wells (BBL)	0	HPDI_2013	0	HPDI_2015
24	AR	05011	Bradley	Louisiana-Mississippi Salt Basins	2014	County-Level Natural Gas Well Counts	0	HPDI_2013	0	HPDI_2015
25	AR	05011	Bradley	Louisiana-Mississippi Salt Basins	2014	Fraction of natural gas wells in the county needing compression	9.090909E-02	CENSARA_STUDY_2012	9.090909E-02	CENSARA_STUDY_2012
26	AR	05013	Calhoun	Louisiana-Mississippi Salt Basins	2014	County-Level Natural Gas Production (MSCF)	0	HPDI_2013	0	HPDI_2015
27	AR	05013	Calhoun	Louisiana-Mississippi Salt Basins	2014	County-Level Condensate Production from natural gas wells (BBL)	0	HPDI_2013	0	HPDI_2015
28	AR	05013	Calhoun	Louisiana-Mississippi Salt Basins	2014	County-Level Natural Gas Well Counts	0	HPDI_2013	0	HPDI_2015
29	AR	05013	Calhoun	Louisiana-Mississippi Salt Basins	2014	Fraction of natural gas wells in the county needing compression	9.090909E-02	CENSARA_STUDY_2012	9.090909E-02	CENSARA_STUDY_2012
30	AR	05015	Carroll	Ozark Uplift	2014	County-Level Natural Gas Production (MSCF)	0	HPDI_2013	0	HPDI_2015
31	AR	05015	Carroll	Ozark Uplift	2014	County-Level Condensate Production from natural gas wells (BBL)	0	HPDI_2013	0	HPDI_2015
32	AR	05015	Carroll	Ozark Uplift	2014	County-Level Natural Gas Well Counts	0	HPDI_2013	0	HPDI_2015
33	AR	05015	Carroll	Ozark Uplift	2014	Fraction of natural gas wells in the county needing compression	0.2082511	CENSARA_STUDY_2012	0.2082511	CENSARA_STUDY_2012
34	AR	05017	Chicot	Louisiana-Mississippi Salt Basins	2014	County-Level Natural Gas Production (MSCF)	0	HPDI_2013	0	HPDI_2015
35	AR	05017	Chicot	Louisiana-Mississippi Salt Basins	2014	County-Level Condensate Production from natural gas wells (BBL)	0	HPDI_2013	0	HPDI_2015
36	AR	05017	Chicot	Louisiana-Mississippi Salt Basins	2014	County-Level Natural Gas Well Counts	0	HPDI_2013	0	HPDI_2015
37	AR	05017	Chicot	Louisiana-Mississippi Salt Basins	2014	Fraction of natural gas wells in the county needing compression	9.090909E-02	CENSARA_STUDY_2012	9.090909E-02	CENSARA_STUDY_2012
38	AR	05019	Clark	Louisiana-Mississippi Salt Basins	2014	County-Level Natural Gas Production (MSCF)	0	HPDI_2013	0	HPDI_2015

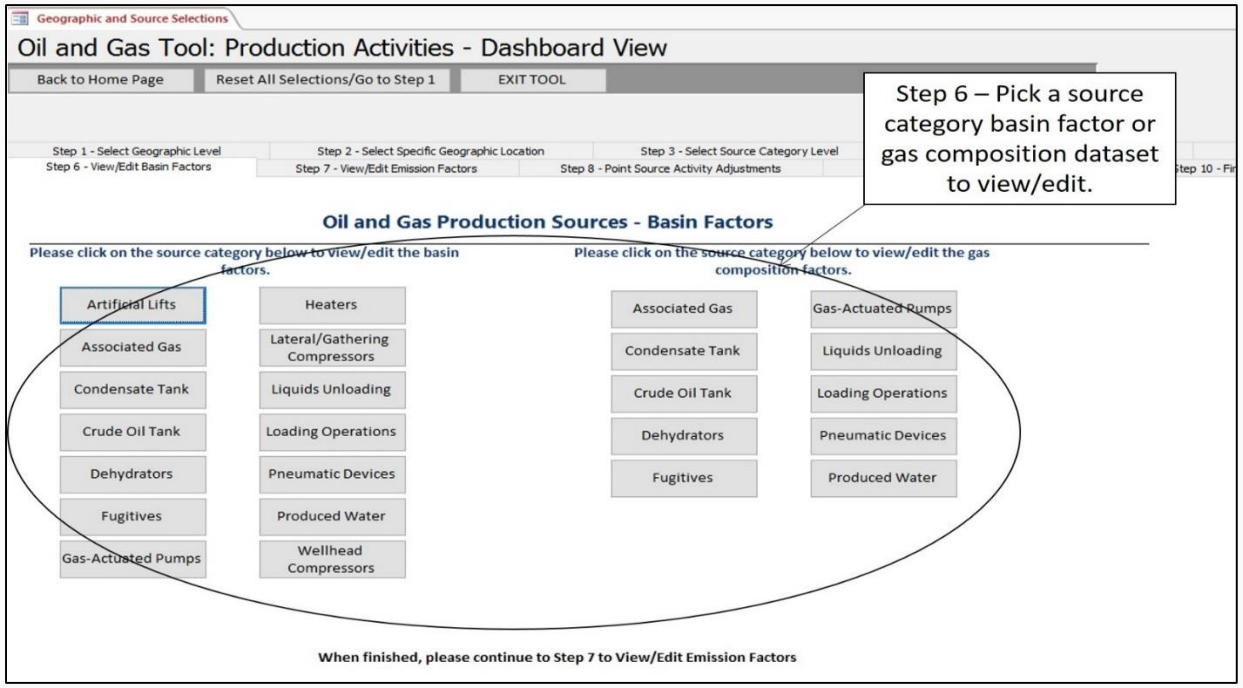
Production Sources – Step 5 (cont.)

- 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.



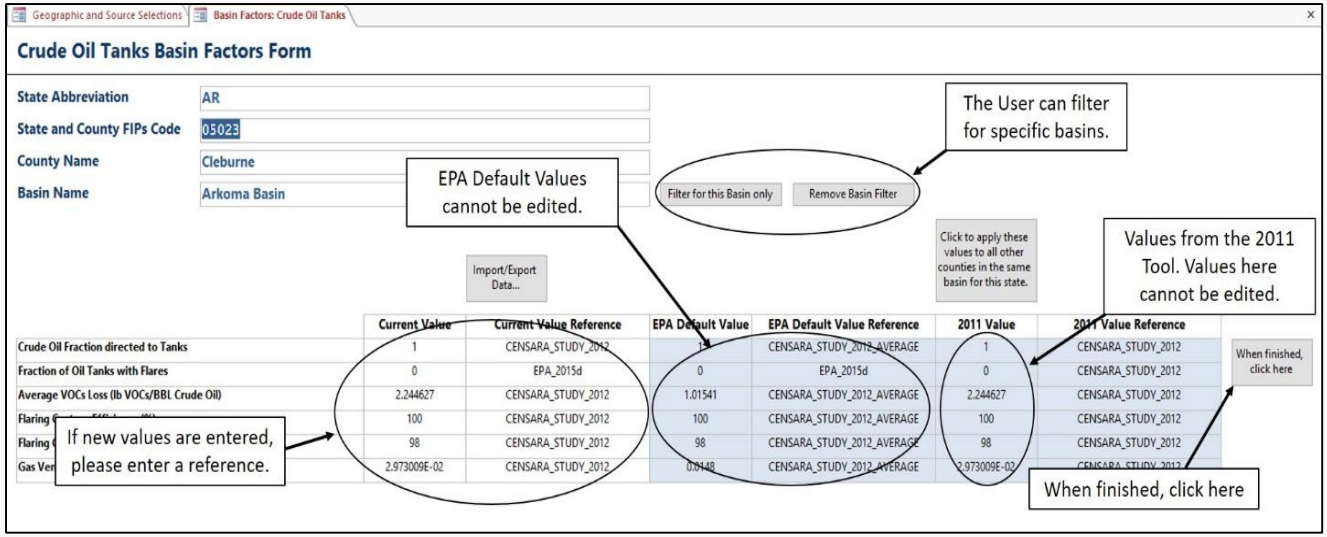
Production Sources – Step 6

- 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.



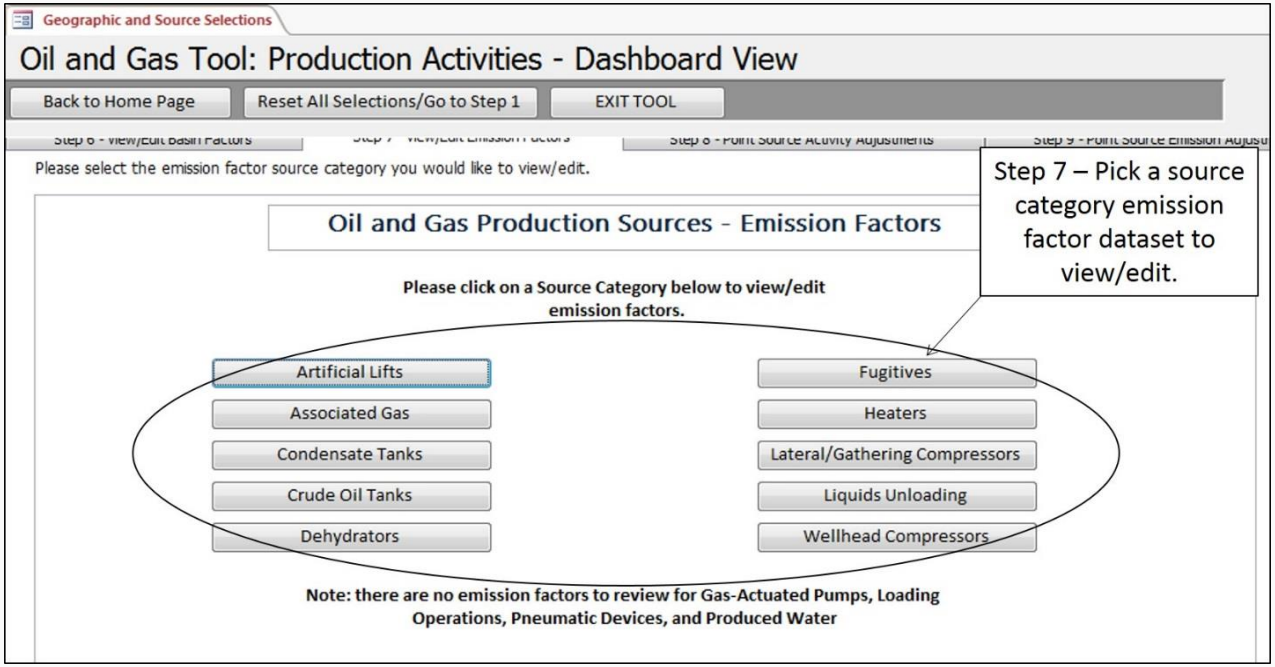
Production Sources – Step 6 (cont.)

- 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.



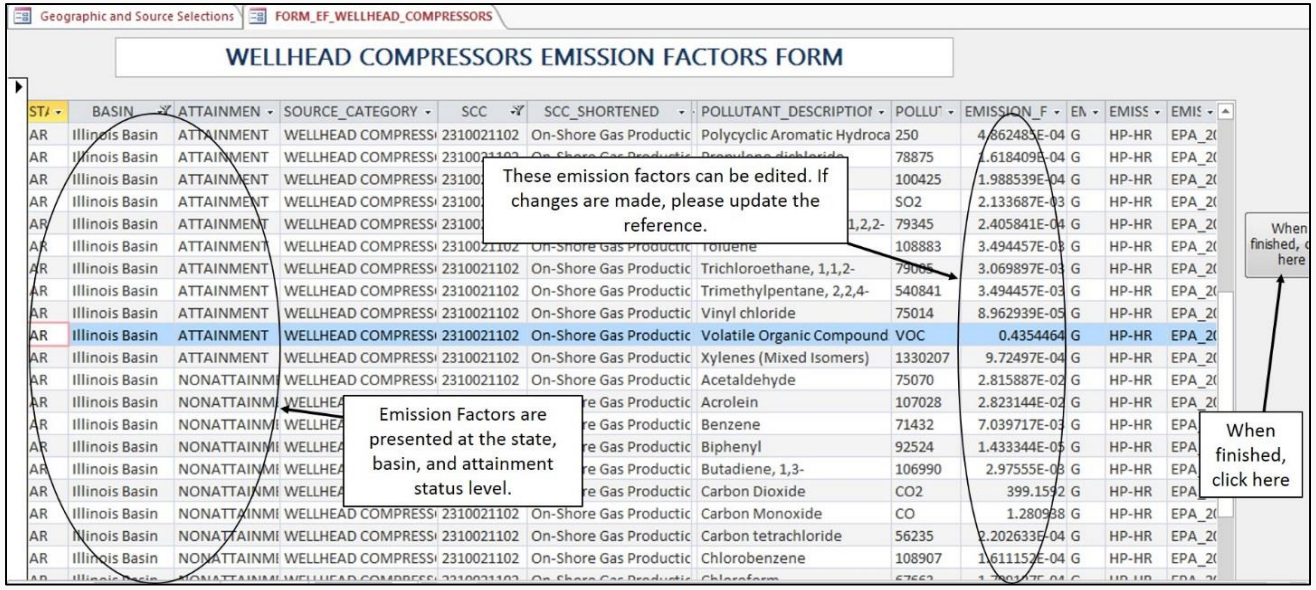
Production Sources – Step 7

- 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.

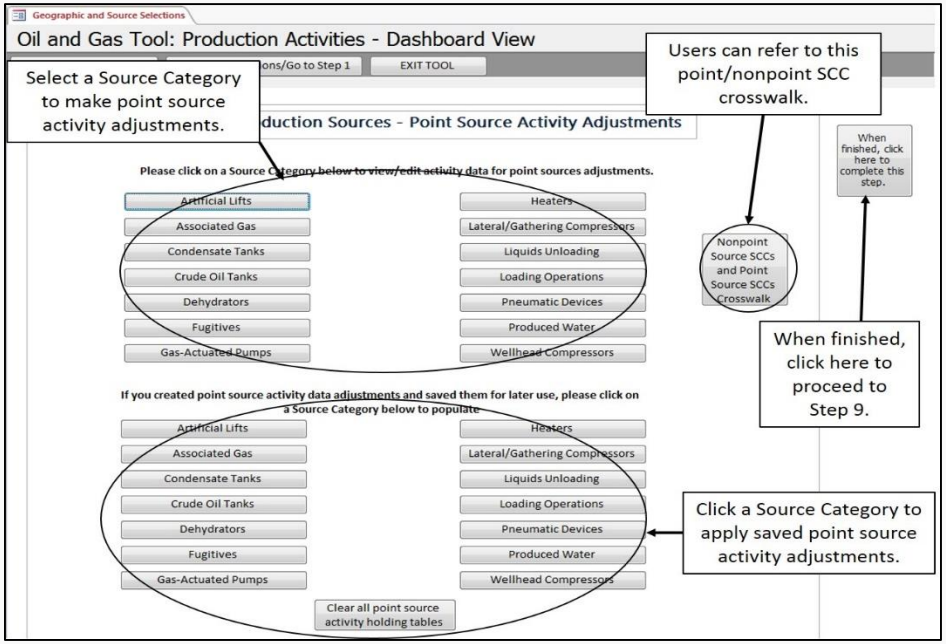


Production Sources – Step 8

- In Step 8, the User may account for emissions that are to be reported to the point sources emissions inventory.
- Activity adjustments are preferred
  - Well counts
  - Liquids production
  - Etc.
- Emissions adjustments are also an option
  - NOx
  - VOC
  - Etc.

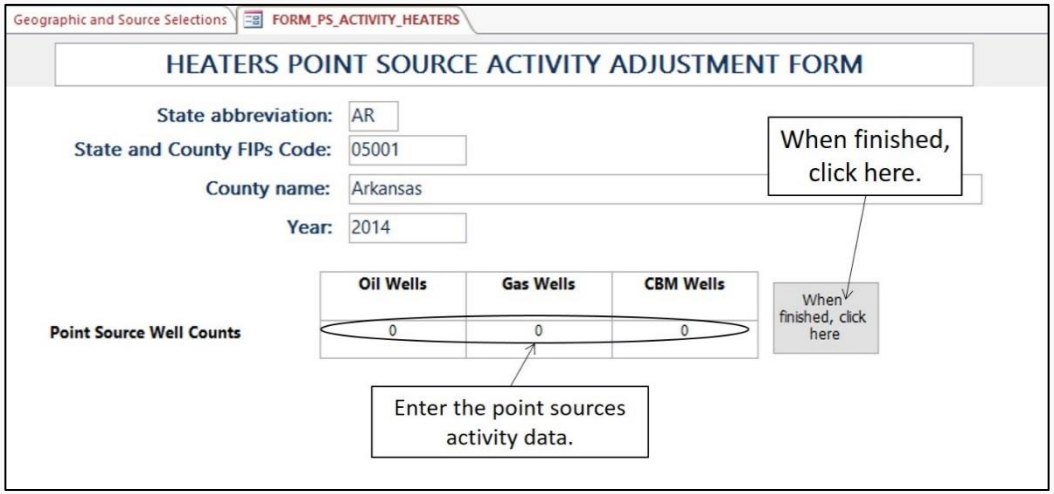
Production Sources – Step 8 (cont.)

- 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.



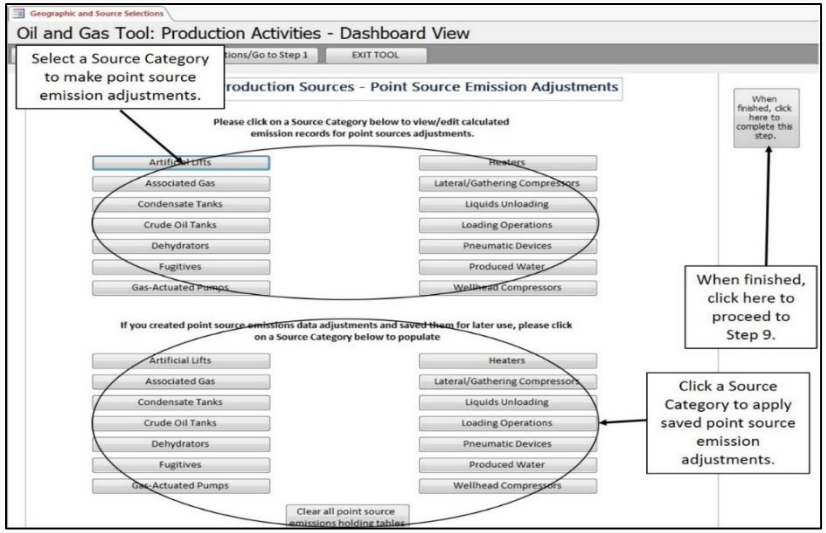
Production Sources – Step 8 (cont.)

- 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).



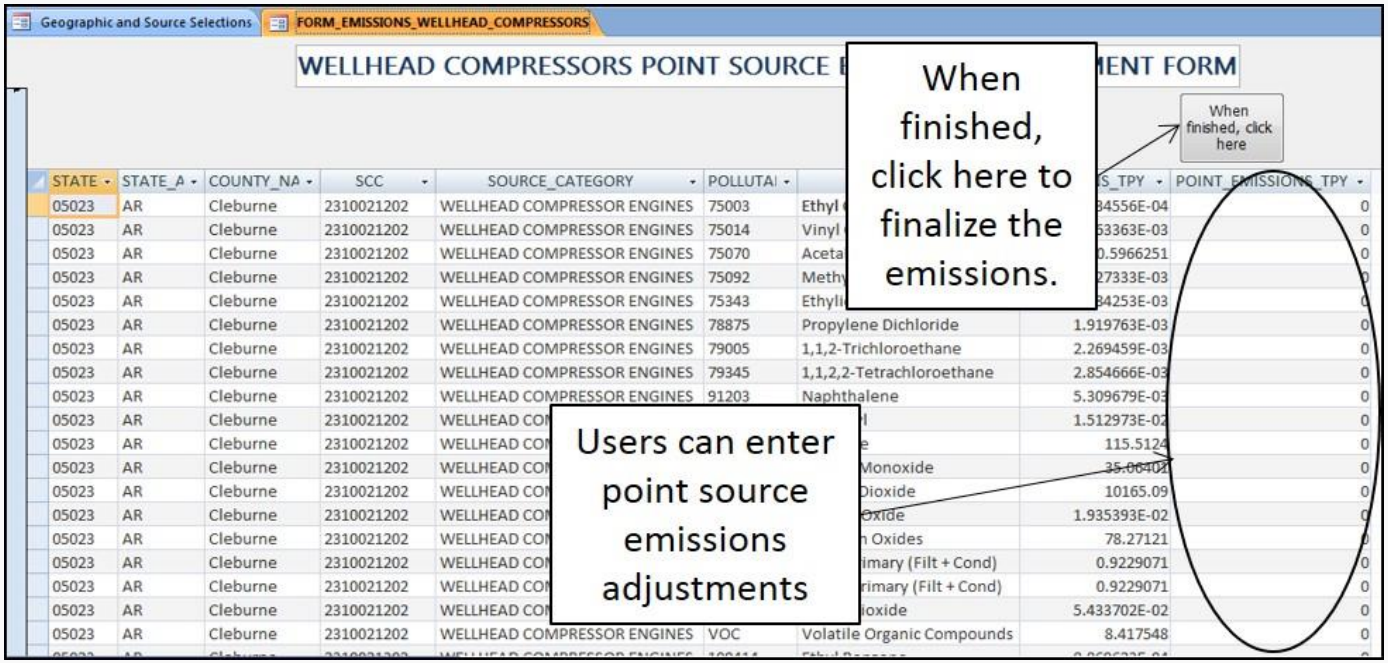
Production Sources – Step 9

- 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.



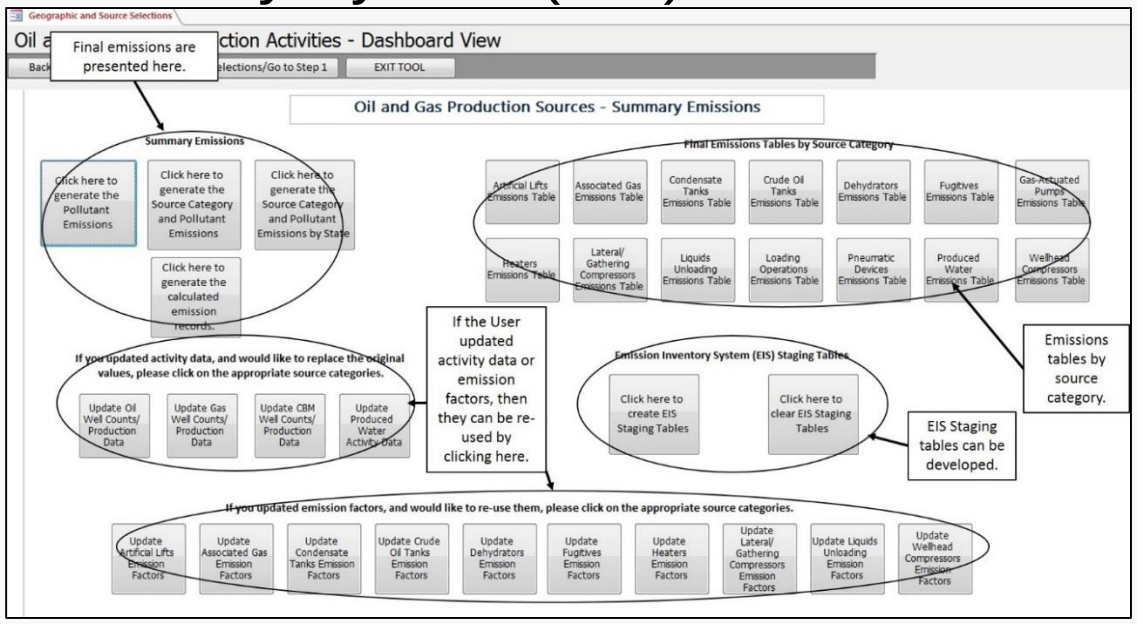
Production Sources – Step 9 (cont.)

- Point source emission estimates are to be entered in the "POINT_EMISSIONS_TPY" field.



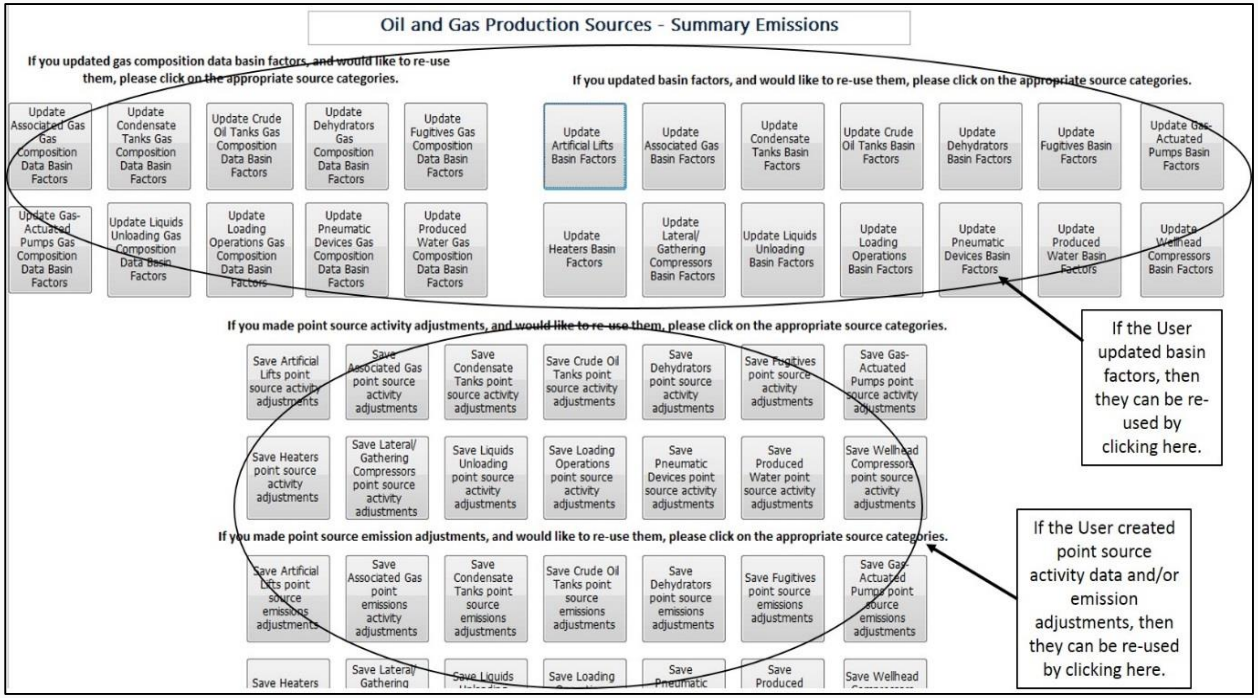
Production Sources – Step 10

- 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.

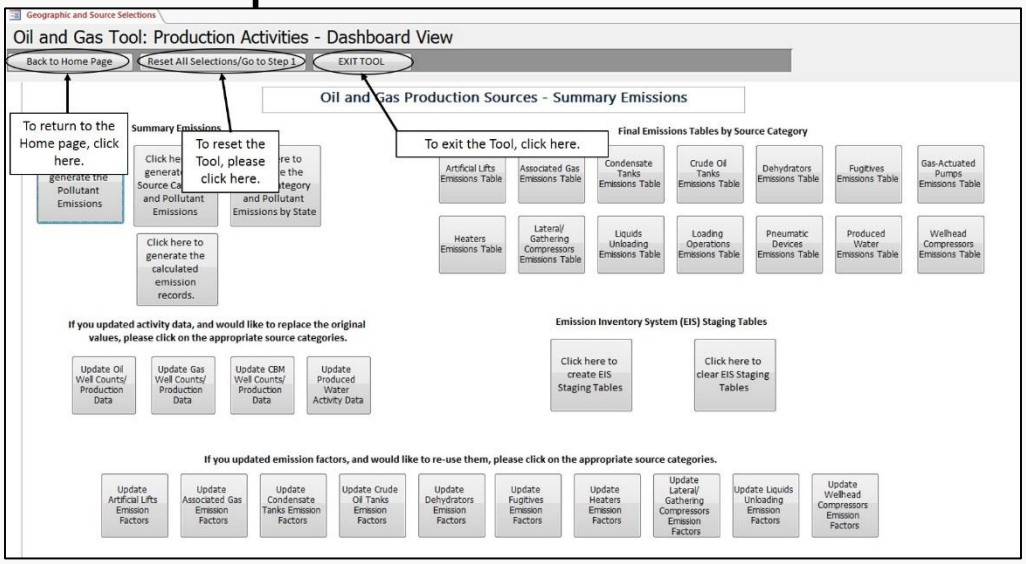


Additional Notes

- In the EIS Staging Tables, the following tables are populated:
  - ControlApproach
  - ControlMeasure
  - ControlPollutant
  - Emissions
  - EmissionsProcess
  - Location
  - ReportingPeriod
- The Exploration Module runs the same way as the Production Module.

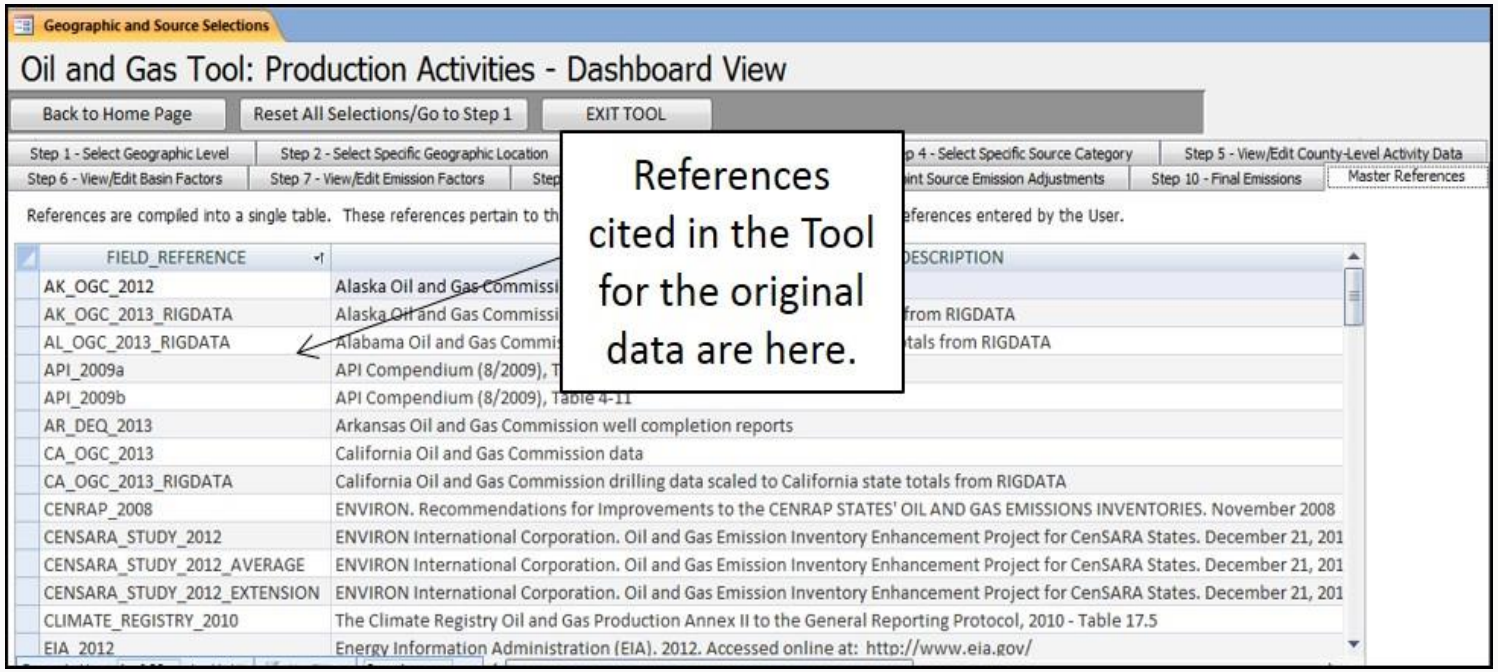
Additional Notes (cont.)

- 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.

(*please have both the Production and Exploration modules open*)

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 nonattainment areas (current factor = 3.07359 g/hp-hr. Using the tool, assess:
  - Impact of total NOx emissions within nonattainment counties.
  - Impact of total NOx emissions within nonattainment 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