# Utah Air Agencies Oil and Gas Emissions Inventory

Lexie Wilson[1], Greg Mortensen[1], Sheila Vance[1]
[1]*Utah Division of Air Quality*

## Background

The Utah Air Agencies Oil and Gas Emissions Inventory is a collaborative data collection project between the Utah Division of Air Quality (UDAQ), the Ute Tribe, and EPA Region 8. Every three years, oil and gas operators across Utah are asked to submit their equipment and activity data as part of a year-long survey. These data are compiled into a database by UDAQ and then shared with the Ute Tribe and EPA to inform air quality regulatory decisions related to oil and gas operations. The emissions inventory includes sources with criteria air pollutant emissions greater than 1 ton per year and less than 100 tons per year; these pollutants are most often volatile organic compounds (VOCs) and the oxides of nitrogen (NOx) – both are precursors to ozone. The Uinta Basin was recently designated an ozone nonattainment area, and the Utah Air Agencies Oil and Gas emissions inventory will be instrumental in reducing ozone concentrations in northeastern Utah.

## Methods & Development

In 2013 the Utah Division of Air Quality (UDAQ) along with EPA Region 8, and the Ute Tribe, started working to develop an up-to-date and improved oil and gas emissions inventory for the Basin. Previous inventories relied on a 2006 survey for the Uinta Basin, while Utah lacked the ability to capture the technological advancements that occurred since 2006. Inventory development involved the cooperation of various stakeholders, including federal and state regulators, oil and gas operators, and tribal entities. In 2015, an emissions inventory workbook and request for completion were sent to each Uinta Basin operator active in 2014. In 2016 the data was compiled into the 2014 Air Agencies Oil and Gas Emissions Inventory. The inventory workbook was updated in 2017 and was filled out by operators in 2018, comprising the 2017 Air Agencies Oil and Gas Emissions Inventory. UDAQ is now requiring triennial inventories for all oil and gas facilities on State jurisdiction and EPA Region 8 and the Ute Tribe are again participating to collect voluntary information on federal/tribal jurisdiction.

After operators submit their workbooks to UDAQ, each data entry undergoes a rigorous quality control check. After errors are corrected, data are entered into a SQLite database. Tables and visualizations summarizing the data are generated to share results with stakeholders and the public. Any emissions that cannot be captured through the survey are gap-filled using data analysis and statistical techniques informed by scientific studies. Finally all oil and gas emissions data are submitted to the National Emissions Inventory.

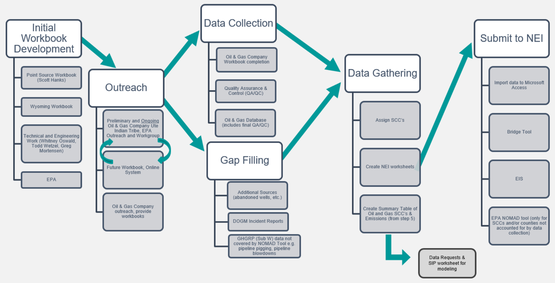



**Figure 1**: Flow chart describing the Air Agencies Oil and Gas Emissions Inventory process and workflow.

## Results

### Uinta Basin

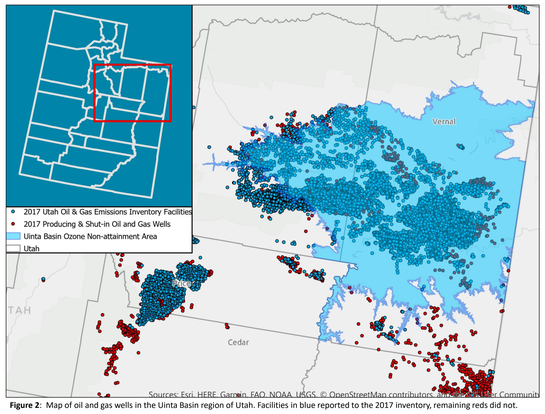


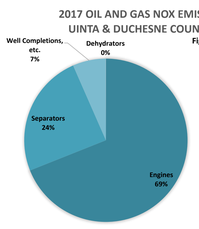

**Figure 2**: Map of oil and gas wells in the Uinta Basin region of Utah. Facilities in blue reported to the 2017 inventory, remaining reds did not.

| Description | NOx (tons/year) Duchesne | NOx (tons/year) Uintah | VOCs (tons/year) Duchesne | VOCs (tons/year) Uintah | CO (tons/year) Duchesne | CO (tons/year) Uintah | SOx (tons/year) Duchesne | SOx (tons/year) Uintah | PM10 (tons/year) Duchesne | PM10 (tons/year) Uintah | PM2.5 (tons/year) Duchesne | PM2.5 (tons/year) Uintah | CH2O (tons/year) Duchesne | CH2O (tons/year) Uintah |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2017 Utah O&G EI** | | | | | | | | | | | | | | |
| Dehydrators | | | 38.42 | 4,478.73 | | | | | | | | | | |
| Dehydrator Combustors | 0.44 | 4.90 | 0.01 | 0.02 | 1.54 | 21.19 | | | | | | | | |
| | | | 3,163.0 | 14,219.5 | | | | | | | | | | |
| Fugitives | | | 4 | 4 | | | | | | | | | | |
| Pneumatic Controllers | | | 937.43 | 2,990.46 | | | | | | | | | | |
| Pneumatic Pumps | | | 53.07 | 8,707.84 | | | | | | | | | | |
| RICE&Engines | 3,458.00 | 4,361.81 | 906.62 | 825.60 | 3,985.69 | 4,285.22 | 3.87 | 5.55 | 142.72 | 88.61 | 142.72 | 88.61 | 312.22 | 242.47 |
| Separators&Heaters | 1,337.75 | 1,434.67 | 73.60 | 78.98 | 1,124.08 | 1,206.28 | 8.03 | 8.62 | 101.70 | 109.14 | 101.70 | 109.14 | | |
| Tanks (Condensate) | | | 68.01 | 2,879.03 | | | | | | | | | | |
| Tanks (Oil) | | | 2,272.99 | 1,975.46 | | | | | | | | | | |
| Tanks (Water) | | | 128.31 | 1,015.01 | | | | | | | | | | |
| Tank Combustors | 18.72 | 12.80 | 0.27 | 0.25 | 67.15 | 41.26 | | | | | | | | |
| Truck Loading | | | 767.23 | 355.07 | | | | | | | | | | |
| Well Completions (Drilling) | 291.80 | 448.52 | 202.99 | 317.20 | 109.95 | 171.82 | | | 6.34 | 9.91 | 6.34 | 9.91 | | |
| Well Completions (Venting/Flaring) | 0.00 | 0.54 | 0.00 | 5.38 | 0.00 | 0.14 | | | | | | | | |
| Centrifuges | | | 0.00 | 9.79 | | | | | | | | | | |
| Solid Waste Disposal | | | 43.45 | 244.25 | | | | | | | | | | |
| Produced Water | | | 594.59 | 7,725.87 | | | | | | | | | | |
| **Control Effectiveness Adjustment for Tank Emissions (Gap Filling)** | | | | | | | | | | | | | | |
| Unintended Emissions from Water Tanks | | | 0.05 | 0.00 | | | | | | | | | | |
| Unintended Emissions from Condensate Tanks | | | 0.00 | 438.04 | | | | | | | | | | |
| Unintended Emissions from Oil Tanks | | | 2,349.80 | 720.80 | | | | | | | | | | |
| **Additional Sources (UDOGM Incident Reports Gap Filling)** | | | | | | | | | | | | | | |
| Midstream Vent (maint, startup/shutdown, malfunction) | 395.35 | 3.39 | 659.83 | 7.48 | 98.97 | 0.85 | | | | | | | | |
| Pipeline Leaks | 0.00 | 0.00 | 157.06 | 8.71 | 0.00 | 0.00 | | | | | | | | |
| **Additional Sources (Greenhouse Gas Emissions Inventory Gap Filling)** | | | | | | | | | | | | | | |
| Gas Well Venting (Blowdowns) | | | 63.02 | 6,581.96 | | | | | | | | | | |
| Pipeline Blowdowns and Pigging | | | 3.50 | 365.50 | | | | | | | | | | |
| **Oil and Gas Tool (Pending)** | | | | | | | | | | | | | | |
| Associated Gas Venting | | | | | | | | | | | | | | |
| CBM Well Venting (Blowdowns) | | | | | | | | | | | | | | |
| Mud Degassing | | | | | | | | | | | | | | |
| **All Sources** | | | | | | | | | | | | | | |
| **County Total (Duchesne & Uintah)** | 5,502.06 | 6,266.63 | 12,483.27 | 53,451.40 | 5,387.38 | 5,726.75 | 11.90 | 14.16 | 250.77 | 207.66 | 250.77 | 207.66 | 312.22 | 242.47 |
| **Combined Total (Duchesne + Uintah)** | **11,768.70** | | **65,934.68** | | **11,114.12** | | **26.07** | | **458.43** | | **458.43** | | **554.69** | |

**Table 1**: Summary of pollutants captured by the 2017 inventory in Uintah & Duchesne counties, **including gap filling**.

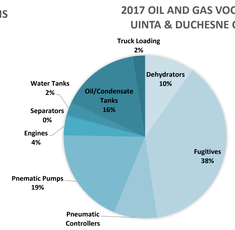
2017 OIL AND GAS NOX EMISSONS UINTA & DUCHESNE COUNTIES

Figure 4



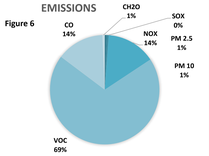

2017 OIL AND GAS VOC EMISSONS UINTA & DUCHESNE COUNTIES

Figure 5




UINTAH & DUCHESNE 2017 EMISSIONS

Figure 6




**Figures 4-6 (above)**: Pie charts showing equipment contributing to VOC and NOx emissions in the Uinta Basin, and total emissions by pollutant type in the Uinta Basin

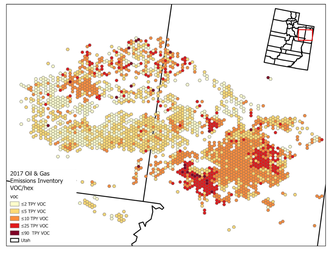



**Figure 7 (right)**: Map showing spatial distribution of VOCs in the Uinta Basin. Facilities were cast into hexagonal grids and colored increasingly darker red according to total VOCs (TPY) in that grid cell

### San Juan County

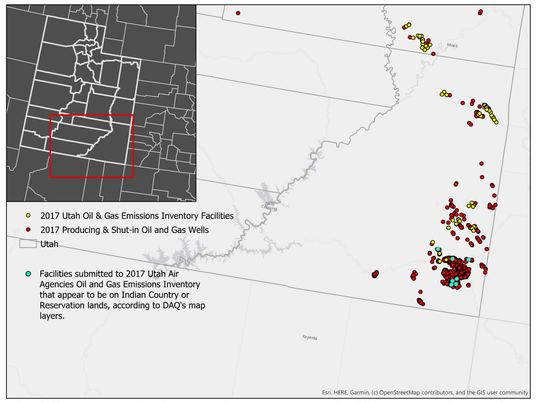
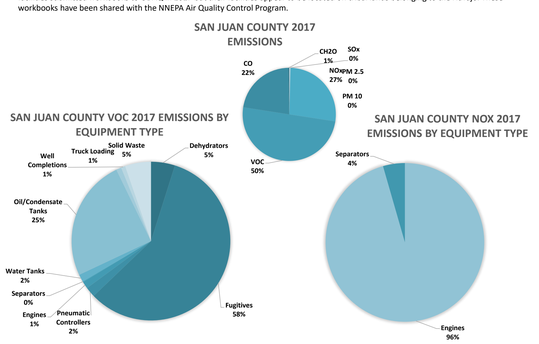
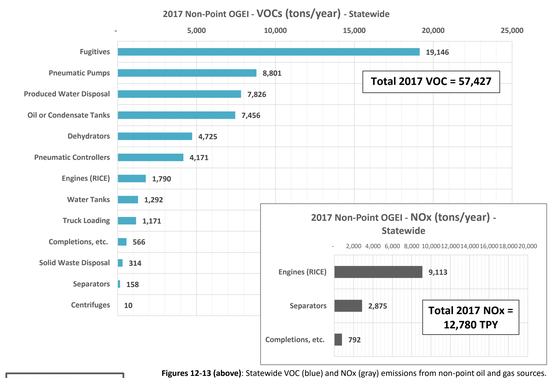



**Figure 8**: Map of oil and gas facilities in San Juan county. Yellow facilities were captured in the 2017 inventory, red facilities were not. Bright blue facilities submitted workbooks to UDAQ in 2017 but their facilities appear to be located on tribal lands belonging to the Navajo. These workbooks have been shared with the NNEPA Air Quality Control Program.




**Figures 9-11 (above)** : Pie charts showing equipment contributing to VOC and NOx emissions in San Juan County, and total emissions by pollutant type in San Juan County.

### Statewide




**Figures 12-13 (above)**: Statewide VOC (blue) and NOx (gray) emissions from non-point oil and gas sources.

NOTICE: All figures on this poster do NOT include point sources (facilities producing more than 100 tons per year of any criteria pollutant). They also do NOT include emissions from gap-filling analyses.

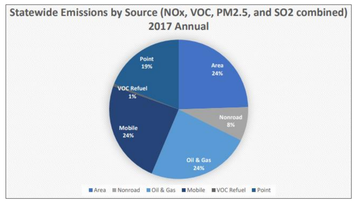



**Figure 14 (right)**: Statewide oil and gas emissions inventory compared to other statewide 2017 inventories.

## Improvements

The oil and gas emissions inventory is constantly improving. Each cycle we learn more about emissions sources and how to accurately estimate them. Since 2014, the following improvements were made to our emissions data collection and estimations:

- Produced water and solid waste data collected
- Updated default chemical speciation profile
- New emission factors
  - Water tanks
  - Well completions
  - Intermittent bleed pneumatic controllers
- Greater emphasis on midstream facilities

Additionally, more facilities reported to UDAQ in 2017 than 2014, improving our total data capture. In 2017, Air Agencies were able to estimate missing VOC emissions from scientific studies and other data sources (EPA's Greenhouse Gas Reporting Program and Utah Division of Oil, Gas, and Mining). Footage from infrared cameras informed the addition of VOC emissions from tanks with ineffective control devices, accomplished through a Monte Carlo simulation. External data sources shed light on emissions quantities that are difficult for operators to report in the workbooks, such as mud degassing and pigging.

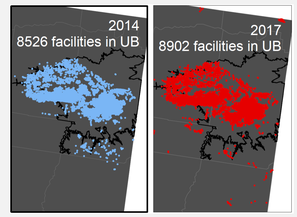



**Figure 15 (above)**: Comparison in number and spatial distribution of reporting facilities between 2014 and 2017

**Figure 16 (above)**: Images from the 2018 Aerial IR survey in the Uinta Basin [1]

## Next Steps

The 2020 Utah Air Agencies Emissions Inventory workbook is currently in development. The 2017 inventory will be used to model ozone in the Uinta Basin in coming years. However, VOC emissions in the inventory remain lower than monitored VOC concentrations in the Uinta Basin. Regulators and scientists continue to find ways to quantify and improve emissions estimations to close the gap between inventoried and monitored VOCs.

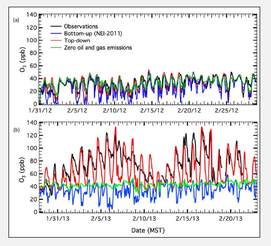



**Figure 17**: Top-down compared to bottom-up emissions inventories in the Uinta Basin in 2012 (low O3 year, top panel) and in 2013 (high O3 year, bottom panel). [2]

## References & Acknowledgements

[1] "Hydrocarbon Emission Detection Survey of Uinta Basin Oil and Gas Wells". November 2018. Bingham Research Center, Utah State University. https://usu.box.com/s/y3njm7wulu2gr4ffi8itdsism mud2rxf8

[2] Ahmadov, Ravan, et al. "Understanding high wintertime ozone pollution events in an oil-and natural gas-producing region of the western US." Atmospheric Chemistry and Physics 15.1 (2015): 411-429.

**Stay up to date on Utah's oil and gas emissions inventory, here:**
**https://deq.utah.gov/air-quality/oil-gas-statewide-emissions-inventory-program**

Lexie Wilson
(801) 536 - 0022
Department of Environmental Quality
Division of Air Quality
State of Utah
195 N 1950 W, Salt Lake City, UT 84116
www.linkedin.com/in/alexisleawilson

This work was funded by the Utah Division of Air Quality.
This inventory was made possible in part due to the data made available by oil and gas operators in Utah.
Special thanks to Cindy Beeler and Aaron Zull at EPA for their guidance in gap-filling the 2017 inventory, and Mike Natchees and his team at the Ute Tribe Air Program for their willingness to participate in this project.