# Uinta Basin

## How we understand the O&G sector universe

Operators Meeting 9/3/15



2016-008149-0045230

# Outline

- Air Quality metrics
- Emissions data available
- Tribal Minor Source Registration data
- Data gaps



2016-008149-0045231

# Air Quality

4th Max 8-hour O3, ppb (NAAQS = 75 ppb)

| Year | Dinosaur | Vernal | New Vernal | Redwash | Ouray | Roosevelt | Myton | Whiterocks | ENEFIT Dragon Road | Fruitland | Rangely |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2007 | 63 | | | | | | | | | | |
| 2008 | 66 | | | | | | | | | | |
| 2009 | 63 | | | 67 | 67 | | | | | | |
| 2010 | 68 | | | 98 | 117 | | | | | | 58 |
| 2011 | 90 | | | 100 | 116 | | 111 | 68 | | 65 | 73 |
| 2012 | 75 | 64 | | 67 | 70 | 67 | 71 | 69 | 72 | 70 | 69 |
| 2013 | 113 | 102 | | 114 | 132 | 104 | 109 | 95 | 82 | 62 | 91 |
| 2014 | 64 | 62 | | 63 | 79 | 62 | 67 | 64 | | 64 | 62 |

| Design Values | Dinosaur | Vernal | New Vernal | Redwash | Ouray | Roosevelt | Myton | Whiterocks | ENEFIT Dragon Road | Fruitland | Rangely |
|---|---|---|---|---|---|---|---|---|---|---|---|
| '09-'11 | 73.7 | | | 88.3 | 100.0 | | | | | | |
| '10-'12 | 77.7 | | | 88.3 | 101.0 | | | | | | 66.7 |
| '11-'13 | 92.7 | | | 93.7 | 106.0 | | 97.0 | 77.3 | | 65.7 | 77.7 |
| '12-'14 | 84.0 | 76.0 | | 81.3 | 93.7 | 77.7 | 82.3 | 76.0 | | 65.3 | 74.0 |

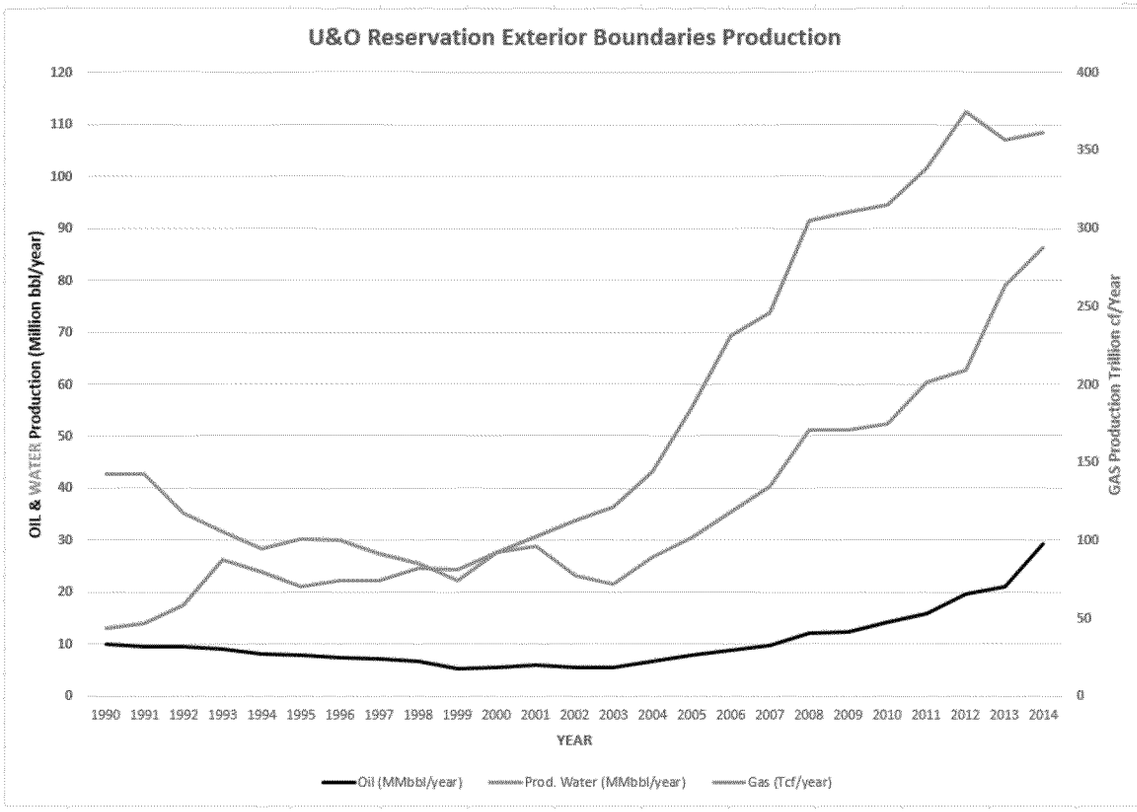
| Air Quality Index: | |
|---|---|
| Green | Good Air Quality |
| Yellow | Moderate Air Quality |
| Orange | Unhealthy for Sensitive Groups Air Quality |
| Red | Unhealthy Air Quality |
| Purple | Very Unhealthy Air Quality |

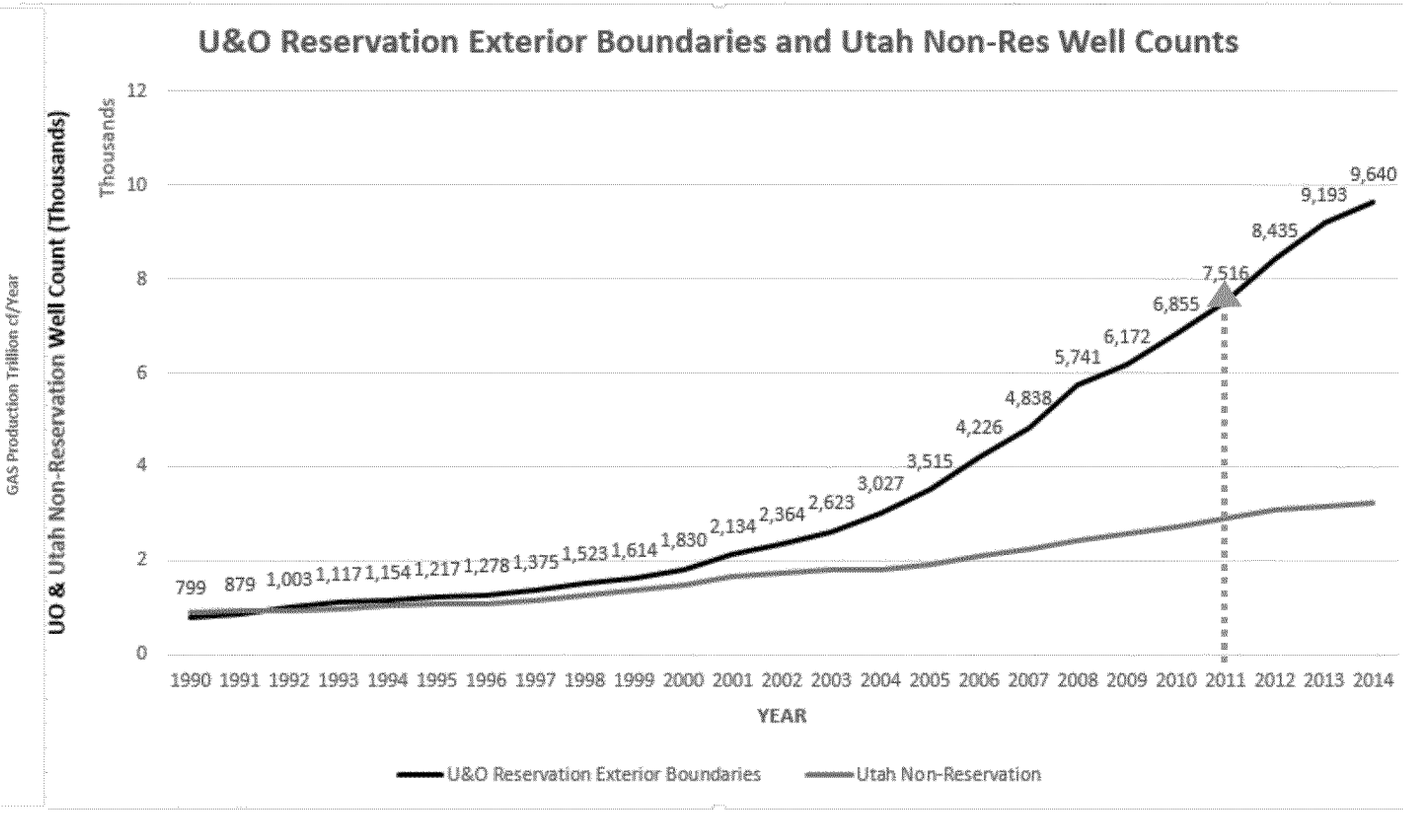
| Nonattainment Designation Classification | Design Value (ppb) | | |
|---|---|---|---|
| | Current 75 ppb Ozone NAAQS | 70 ppb Ozone NAAQS (Estimated) | 65 ppb Ozone NAAQS (Estimated) |
| Marginal | 76 - <86 | 71 - <80 | 66 - <75 |
| Moderate | 86 - <100 | 80 - <93 | 75 - <87 |
| Serious | 100 - <113 | 93 - <105 | 87 - <98 |
| Severe | 113 - <119 | 105 - <111 | 98 - <103 |
| Extreme | 119 - <175 | 111 - <163 | 103 - <152 |



2016-008149-0045232

# Background




~75% of oil & gas production in Uinta Basin within exterior boundaries of Uintah & Ouray Indian Reservation



2016-008149-0045233

# Top 20 Producers

| Within the exterior boundaries of U&O | | |
|---|---|---|
| **Within Exterior Boundaries U&O Current Operator** | **Number of Wells (2014)** | **OIL Produced Barrels (2014)** |
| NEWFIELD PRODUCTION COMPANY | 1,409 | 7,043,408 |
| EP ENERGY E&P COMPANY, LP | 261 | 4,571,164 |
| BILL BARRETT CORPORATION | 284 | 3,151,243 |
| CRESCENT POINT ENERGY US CORP | 240 | 2,752,210 |
| BERRY PETROLEUM COMPANY | 578 | 2,171,577 |
| ULTRA RESOURCES INC | 82 | 1,397,871 |
| PETROGLYPH OPERATING COMPANY INC | 229 | 1,193,947 |
| AXIA ENERGY LLC | 43 | 1,106,170 |
| QEP ENERGY COMPANY | 793 | 1,074,473 |
| KERR-MCGEE CORP. | 2,706 | 1,042,197 |
| LINN OPERATING, LLC | 374 | 984,680 |
| EL PASO CORPORATION | 68 | 856,407 |
| EOG RESOURCES, INC. | 1,319 | 655,458 |
| FINLEY RESOURCES, INC. | 85 | 559,420 |
| DEVON ENERGY CORPORATION | 9 | 204,067 |
| QUINEX ENERGY CORP | 17 | 180,084 |
| CITATION OIL AND GAS CORPORATION | 43 | 125,897 |
| XTO ENERGY, INC. | 416 | 97,486 |
| GASCO PRODUCTION COMPANY | 123 | 74,545 |
| HARVEST (US) HOLDINGS, INC | 8 | 50,859 |
| SUM TOP 20 | 9,087 | 29,293,163 |
| Compared to TOTAL 2014 U&O: | 9,640 | 29,499,562 |
| **Top 20 acount for** | **94%** | **99%** |
| **43** | Operators account for remainder | |

| Within exterior boundaries of U&O | | |
|---|---|---|
| **Within Exterior Boundaries U&O Current Operator** | **Number of Wells (2014)** | **GAS Produced Mcf (2014)** |
| KERR-MCGEE CORP. | 2,706 | 203,382,460 |
| EOG RESOURCES, INC. | 1,319 | 35,547,477 |
| QEP ENERGY COMPANY | 793 | 24,401,675 |
| BERRY PETROLEUM COMPANY | 578 | 15,826,652 |
| NEWFIELD PRODUCTION COMPANY | 1,409 | 11,888,643 |
| BILL BARRETT CORPORATION | 284 | 11,389,526 |
| XTO ENERGY, INC. | 416 | 10,740,094 |
| EP ENERGY E&P COMPANY, LP | 261 | 8,395,942 |
| GASCO PRODUCTION COMPANY | 123 | 6,759,713 |
| LINN OPERATING, LLC | 374 | 5,740,810 |
| WHITING OIL AND GAS CORPORATION | 22 | 3,664,200 |
| DOMINION EXPLORATION & PROD INC | 152 | 3,402,929 |
| CRESCENT POINT ENERGY US CORP | 240 | 2,854,439 |
| EL PASO CORPORATION | 68 | 2,486,421 |
| PETROGLYPH OPERATING COMPANY INC | 229 | 2,163,362 |
| ULTRA RESOURCES INC | 82 | 1,450,111 |
| AXIA ENERGY LLC | 43 | 1,406,147 |
| ENDURING RESOURCES, LLC | 74 | 1,213,888 |
| WEXPRO COMPANY | 64 | 1,081,372 |
| MILLER, DYER & CO. LLC | 4 | 879,279 |
| SUM TOP 20 | 9,241 | 354,675,140 |
| Compared to TOTAL 2014 U&O: | 9,640 | 361,612,254 |
| **Top 20 acount for** | **96%** | **98%** |
| **43** | Operators account for remainder | |



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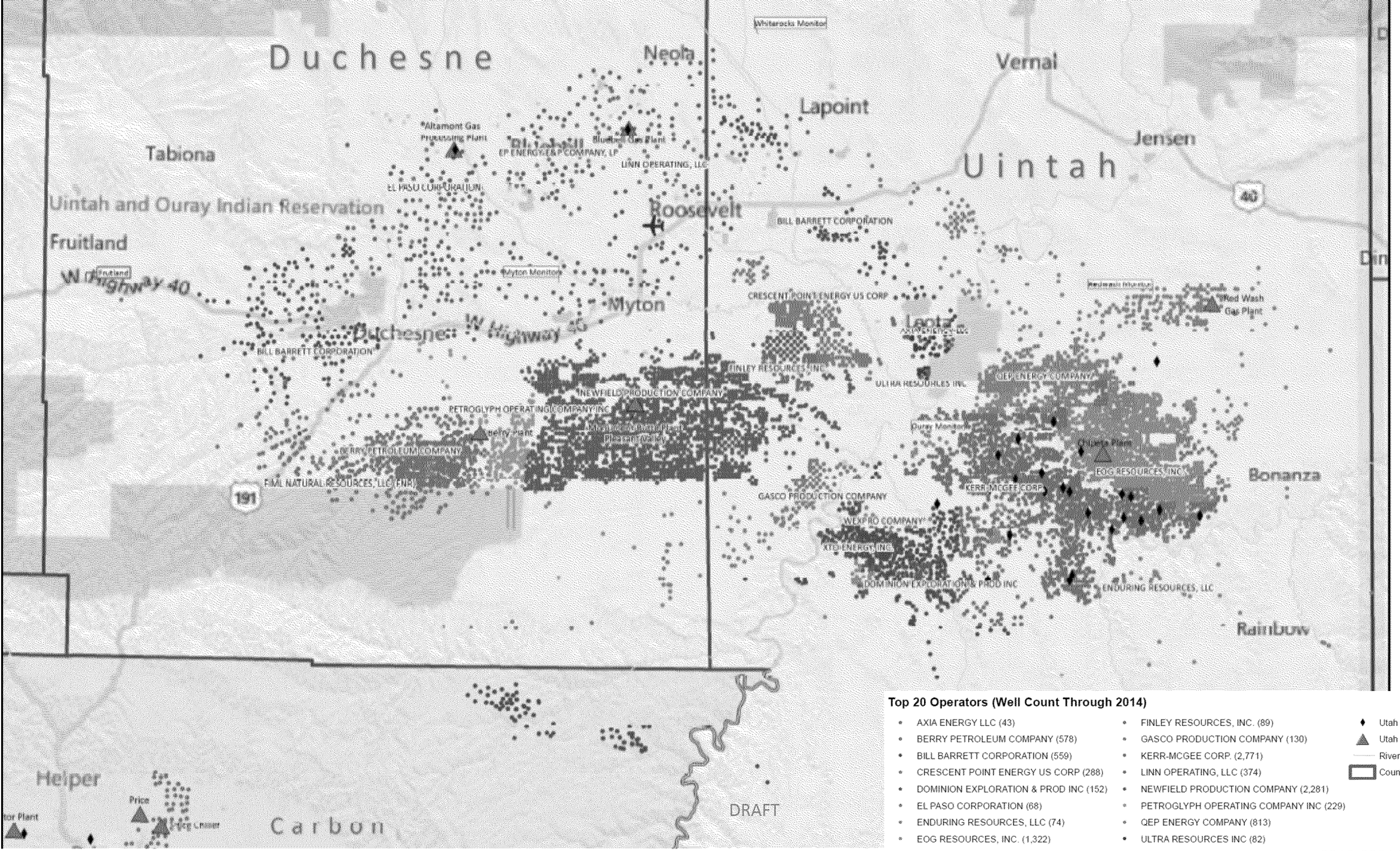


**Top 20 Operators (Well Count Through 2014)**

- AXIA ENERGY LLC (43)
- BERRY PETROLEUM COMPANY (578)
- BILL BARRETT CORPORATION (559)
- CRESCENT POINT ENERGY US CORP (288)
- DOMINION EXPLORATION & PROD INC (152)
- EL PASO CORPORATION (68)
- ENDURING RESOURCES, LLC (74)
- EOG RESOURCES, INC. (1,322)
- FINLEY RESOURCES, INC. (89)
- GASCO PRODUCTION COMPANY (130)
- KERR-MCGEE CORP. (2,771)
- LINN OPERATING, LLC (374)
- NEWFIELD PRODUCTION COMPANY (2,281)
- PETROGLYPH OPERATING COMPANY INC (229)
- QEP ENERGY COMPANY (813)
- ULTRA RESOURCES INC (82)

- Utah Gas Compressors (35)
- Utah Gas Plants (11)
- Rivers
- County Boundary

# WRAP – Phase III Emission Inventory

| UINTA BASIN - WRAP PH.III | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2006 Emissions (tons/year) | | | | | 2012 Emissions (tons/year) | | | | |
| Description | NOx | VOC | CO | SOx | PM10 | NOx | VOC | CO | SOx | PM10 |
| Dehydrator | 148 | 19,470 | 124 | 0 | 11 | 225 | 30,665 | 189 | 0 | 17 |
| Pneumatic devices | 0 | 14,916 | 0 | 0 | 0 | 0 | 25,083 | 0 | 0 | 0 |
| Oil Tank | 0 | 14,357 | 0 | 0 | 0 | 0 | 20,722 | 0 | 0 | 0 |
| Pneumatic pumps | 0 | 8,386 | 0 | 0 | 0 | 0 | 14,322 | 0 | 0 | 0 |
| Condensate tank | 0 | 6,195 | 0 | 0 | 0 | 0 | 21,719 | 0 | 0 | 0 |
| Unpermitted Fugitives | 0 | 1,910 | 0 | 0 | 0 | 0 | 3,212 | 0 | 0 | 0 |
| Permitted Sources | 2,339 | 1,320 | 927 | 5 | 32 | 3,184 | 4,355 | 2,517 | 8 | 48 |
| Truck Loading of Oil | 0 | 964 | 0 | 0 | 0 | 0 | 1,391 | 0 | 0 | 0 |
| Venting - Compressor Startup | 0 | 825 | 0 | 0 | 0 | 0 | 1,300 | 0 | 0 | 0 |
| Venting - Compressor Shutdown | 0 | 782 | 0 | 0 | 0 | 0 | 1,233 | 0 | 0 | 0 |
| Artificial Lift | 2,184 | 674 | 2,522 | 1 | 94 | 3,053 | 955 | 34,750 | 2 | 136 |
| Compressor engines | 2,207 | 510 | 2,318 | 0 | 31 | 3,169 | 695 | 4,236 | 0 | 46 |
| Drill rigs | 4,779 | 415 | 1,804 | 362 | 354 | 4,773 | 362 | 1,507 | 3 | 236 |
| Venting - blowdowns | 0 | 292 | 0 | 0 | 0 | 0 | 460 | 0 | 0 | 0 |
| Venting - initial completions | 0 | 241 | 0 | 0 | 0 | 0 | 332 | 0 | 0 | 0 |
| Truck Loading of Condensate | 0 | 127 | 0 | 0 | 0 | 0 | 445 | 0 | 0 | 0 |
| Heaters | 1,016 | 58 | 863 | 7 | 80 | 1,671 | 95 | 1,420 | 11 | 132 |
| Miscellaneous engines | 163 | 39 | 59 | 0 | 1 | 199 | 63 | 201 | 0 | 1 |
| Venting - recompletions | 0 | 37 | 0 | 0 | 0 | 0 | 51 | 0 | 0 | 0 |
| Workover rigs | 255 | 24 | 103 | 21 | 21 | 271 | 22 | 91 | 0 | 15 |
| Gas Plant Truck Loading | 0 | 3 | 0 | 0 | 0 | 0 | 12 | 0 | 0 | 0 |
| Condensate tank flaring | 1 | 0 | 3 | 0 | 0 | 2 | 0 | 9 | 0 | 0 |
| Dehydrator Flaring | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| Initial completion Flaring | 1 | 0 | 3 | 0 | 0 | 1 | 0 | 4 | 0 | 0 |
| **Total** | **13,093** | **71,546** | **8,727** | **396** | **623** | **16,547** | **127,495** | **44,925** | **24** | **631** |

Western Regional Air Partnership (WRAP) defines the Uinta Basin as wholly including the counties of Carbon, Duchesne, Emery, Grand, Uintah and Wasatch

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2016-008149-0045236

# GHGRP-W – 2013 Data

Summary data collected by the Greenhouse Gas Reporting Program for 2013
This data was reported to EPA by facilities as of 8/18/2014.
All emissions data is presented in units of metric tons of carbon dioxide equivalent using GWP's from IPCC's AR4 (see FAQs tab)

| Facility Id | FRS Id | Facility Name | Basin | Total reported emissions from Onshore Oil & Gas Production | Total Emissions from Onshore Oil & Gas Production by Gas: CO2 emissions (non-biogenic) | Methane (CH4) emissions | Nitrous Oxide (N2O) emissions |
|---|---|---|---|---|---|---|---|
| 1009282 | 110002994190 | 575 Uinta Basin QEP Energy Company | 575 - Uinta Basin | 418,397 | 29,157 | 389,205 | 35 |
| 1008167 | 110055512529 | Berry Petroleum Company - Unita Basin 575 | 575 - Uinta Basin | 111,371 | 15,647 | 95,699 | 24 |
| 1009357 | 110028136700 | Bill Barrett Corporation - Uinta Basin (575) | 575 - Uinta Basin | 212,379 | 66,835 | 145,436 | 108 |
| 1007481 | 110015761996 | ConocoPhillips' Uinta (575) | 575 - Uinta Basin | 76,965 | 536 | 76,429 | |
| 1008086 | 110002004964 | Crescent Point Energy U.S. Corp - Uinta Basin ( | 575 - Uinta Basin | 32,222 | 6,037 | 26,170 | 15 |
| 1008354 | 110034207481 | EOG Resources, Inc. 575 Uinta basin | 575 - Uinta Basin | 562,551 | 1,513 | 561,038 | 1 |
| 1009350 | 110054613539 | EP Energy E&P 575 Uinta basin | 575 - Uinta Basin | 132,740 | 5,533 | 127,204 | 4 |
| 1008109 | 110055512271 | Gasco Energy Uintah Basin Operations | 575 - Uinta Basin | 55,180 | 611 | 54,569 | 1 |
| 1008407 | 110055512388 | Newfield.575.Uinta | 575 - Uinta Basin | 106,375 | 54,682 | 51,617 | 77 |
| 1009165 | 110028136700 | Uinta Basin - AAPG Province 575 | 575 - Uinta Basin | 440,990 | 60,028 | 380,955 | 7 |
| 1008169 | 110032607089 | Uinta Basin Wexpro Company | 575 - Uinta Basin | 18,550 | 11 | 18,539 | |
| 1011221 | 110014428770 | Ultra Resources/Uintah Basin | 575 - Uinta Basin | 43,960 | 37,665 | 6,277 | 18 |
| 1009389 | 110055516035 | XTO Energy Inc 575 Uintah | 575 - Uinta Basin | 174,221 | 13,688 | 160,492 | 42 |

EPA's Greenhouse Gas Reporting Program - Subpart W covers the Petroleum and Natural Gas Systems. Defines Uinta Basin as the counties of Carbon, Daggett, Duchesne, Uintah and Wasatch.



2016-008149-0045237

# Tribal Minor Source Registrations

| Operator | # Registrations | PM10 | PM25 | SO2 | NOx | CO | VOC |
|---|---|---|---|---|---|---|---|
| EOG Resources, Inc. | 1,274 | | | | 255 | 220 | 18,702 |
| XTO Energy, Inc | 568 | 53 | 53 | 90 | 4,851 | 4,313 | 17,607 |
| Kerr-McGee Oil and Gas Onshore LP | 1,969 | | | 3 | 1,890 | 1,627 | 13,994 |
| QEP Energy Company | 684 | 22 | 22 | 2 | 944 | 808 | 5,107 |
| Newfield Production Company | 268 | 44 | 44 | 2 | 889 | 1,118 | 3,337 |
| Bill Barrett Corporation | 75 | 19 | 19 | 42 | 318 | 308 | 1,195 |
| Ultra Resources, Inc. | 65 | 28 | 28 | 4 | 377 | 734 | 905 |
| Berry Petroleum Company | 44 | 10 | 10 | 1 | 428 | 501 | 700 |
| Koch Exploration Company | 32 | 1 | 1 | 0 | 9 | 9 | 608 |
| Crescent Point Energy U.S. Corp | 69 | 13 | 7 | 0 | 176 | 273 | 493 |
| Anadarko Uintah Midstream, LLC | 18 | 1 | 1 | 0 | 916 | 121 | 458 |
| EP Energy E&P Company, L.P. | 35 | 5 | 5 | 0 | 137 | 137 | 420 |
| Whiting Petroleum Company | 36 | 1 | 1 | 0 | 10 | 8 | 237 |
| El Paso Midstream Group, Inc | 37 | | | | | | 132 |
| QEP Field Services Company | 5 | 4 | 4 | 1 | 127 | 96 | 82 |
| Rosewood Resources, Inc. | 9 | 1 | 1 | 0 | 49 | 16 | 59 |
| US Oil Sands (Utah), Inc. | 1 | 3 | 1 | 13 | 71 | 55 | 42 |
| Enduring Resources, LLC | 6 | 0 | 0 | 0 | 5 | 4 | 42 |
| Red Rock Gathering Company, LLC | 3 | 1 | 1 | 0 | 89 | 50 | 40 |
| Ute Energy, LLC | 4 | 1 | 1 | 0 | 7 | 8 | 37 |
| Gasco Energy, Inc | 6 | 1 | 1 | 0 | 10 | 22 | 31 |
| Axia Energy, LLC | 2 | 0 | 0 | 0 | 5 | 9 | 15 |
| Monarch Natural Gas, LLC | 2 | 0 | 0 | 0 | 34 | 20 | 14 |
| American Gilsonite Company | 1 | 20 | 20 | 0 | 3 | 5 | 9 |
| Rhine Construction | 1 | 4 | 2 | | | | 5 |
| Mid-America Pipeline Company, LLC | 1 | 1 | 1 | 1 | 70 | 94 | 5 |
| Red Leaf Resources, Inc. | 1 | 9 | 2 | 1 | 21 | 7 | 3 |
| | | | | | | | |
| Total registrations, 8/25/2015 | **5,216** | 241 | 223 | 161 | 11,690 | 10,562 | **64,278** |

234 facilities have emission controls on tanks

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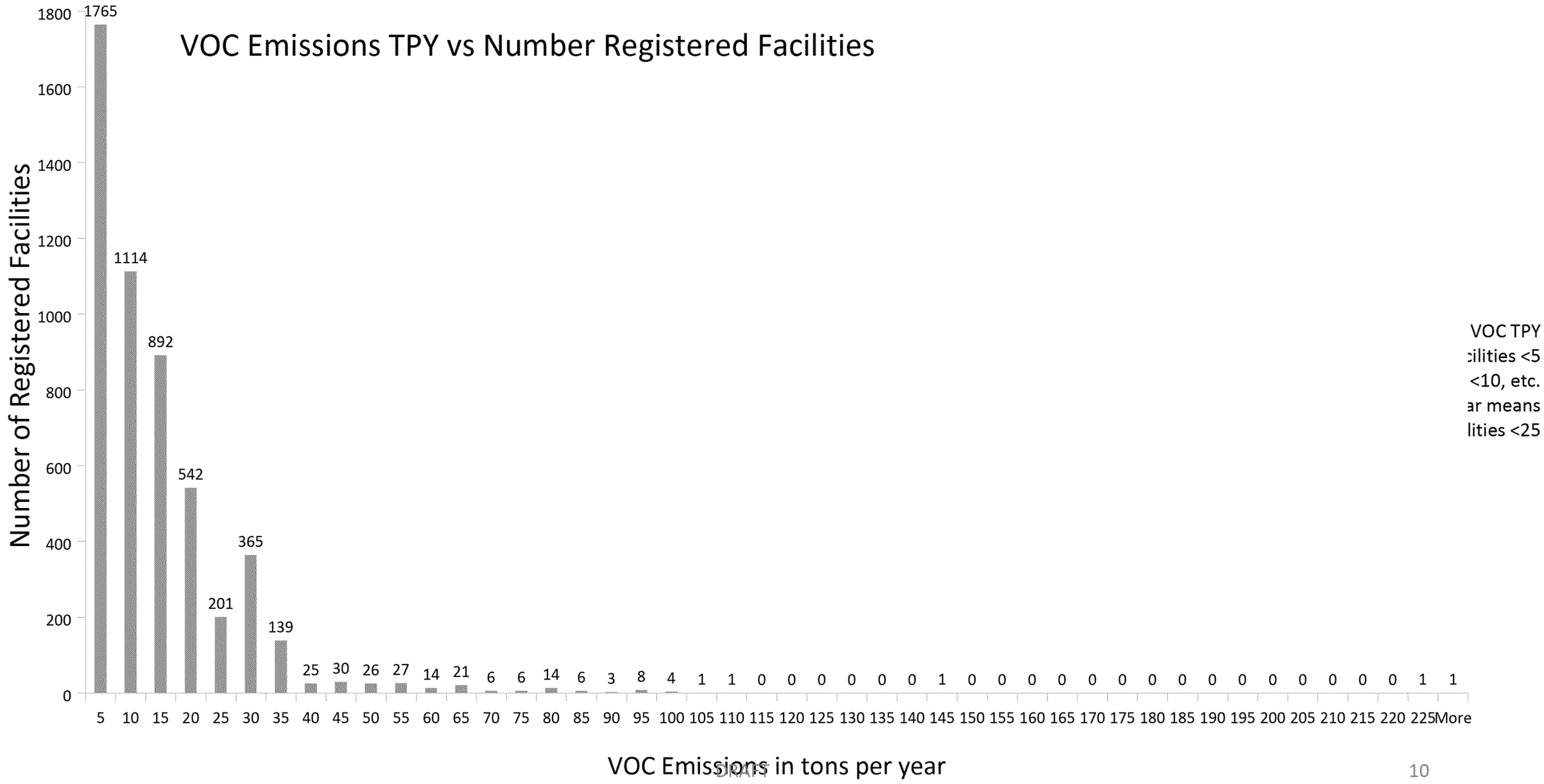
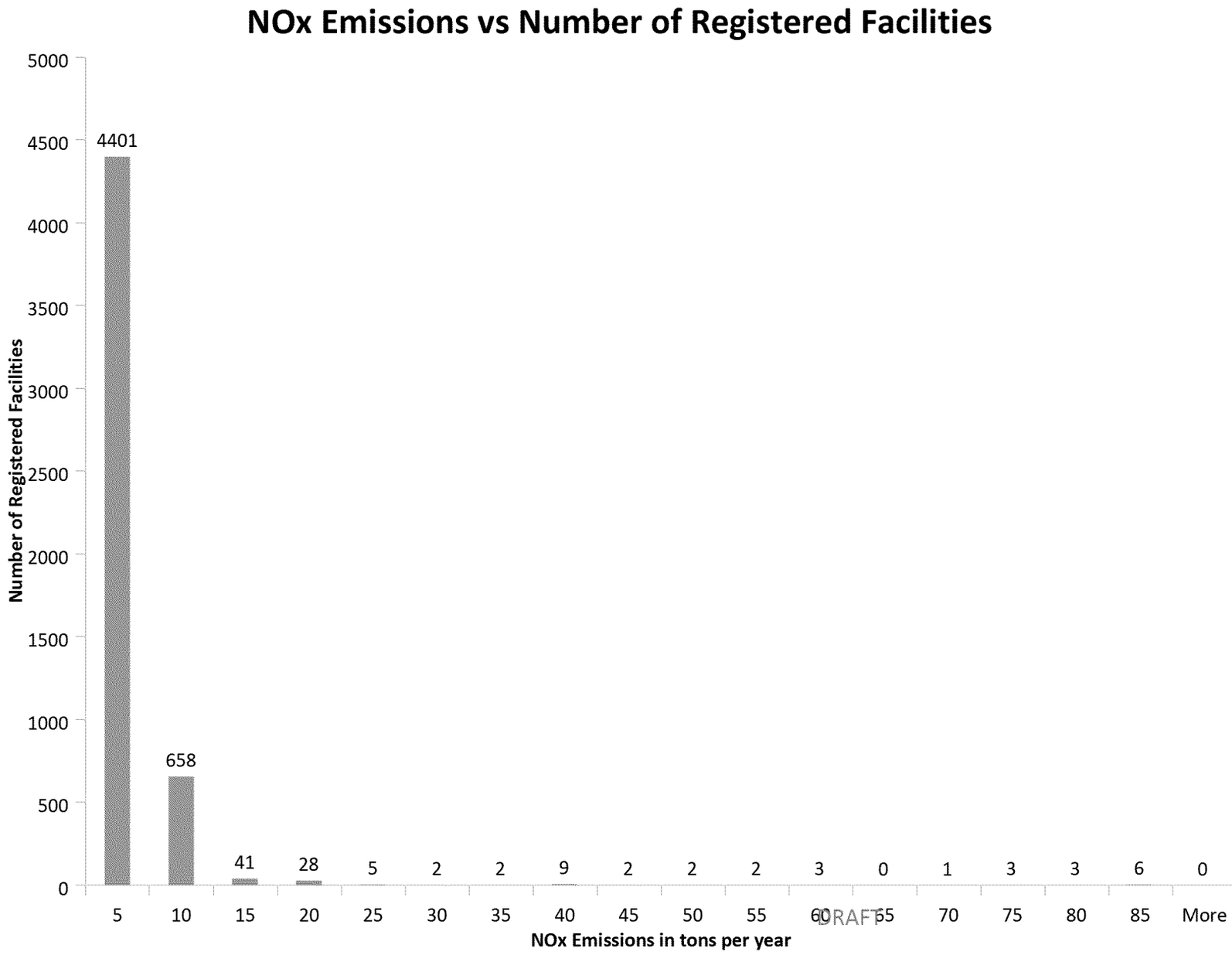
# Tribal Minor Source Registrations, cont'd




VOC TPY
:ilities <5
<10, etc.
ar means
lities <25

# Tribal Minor Source Registrations, cont'd




Note: X-axis NOx TPY
"5" is 0< facilities <5
"10" <=5 facility <15, etc.
58 on "10" TPY NOx bar means
20<= 658 facilities <25

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2016-008149-0045240

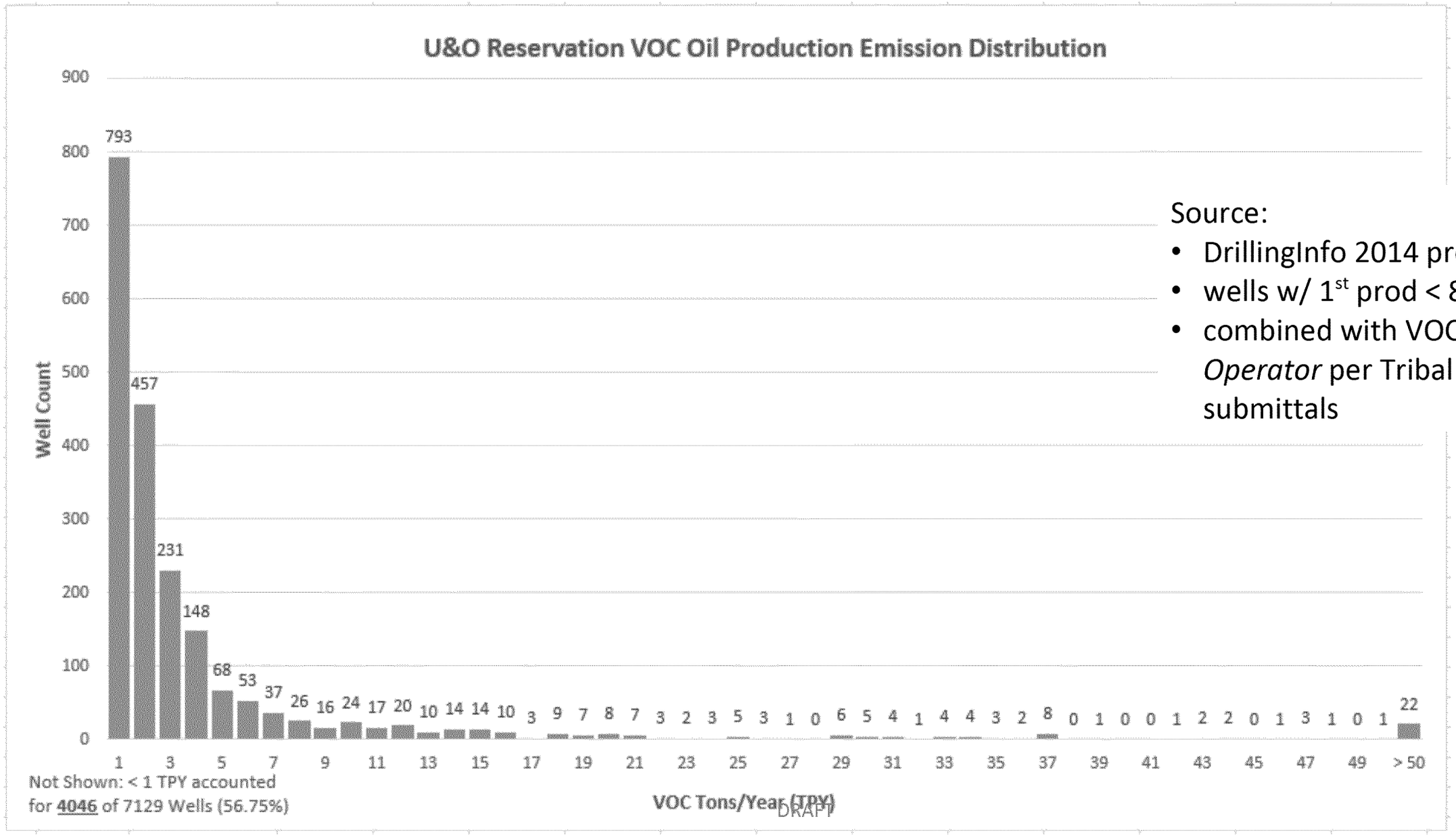
# Tank Data (E&P Tanks & GOR)

| Weighted Average VOC lb/bbl = | 10.6 |
|---|---|

| Operator | Separator T (°F) | Separator P (psig) | API Gravity Sales Oil AVG | VOC lb/bbl AVG | VOC lb/bbl Std. Deviati |
|---|---|---|---|---|---|
| A | 82 | 57 | 62.0 | **6.5** | 0.0 |
| B | 160 | 30-38 | 40.9 | **1.0** | 0.2 |
| C | 74-75 | 108-138 | 52.0 | **5.9** | 1.8 |
| D | 60-99 | 200-380 | 51.4 | **1.1** | 0.0 |
| F | 100-168 | 30-85 | 39.6 | **1.3** | 0.5 |
| G | 70 | 64 | 32.0 | **0.6** | 0.0 |
| H | 40-157 | 17-330 | 50.8 | **46.0** | 24.6 |
| H | 50-72 | 110-135 | 65.4 | **8.8** | 15.0 |
| I | 50-157 | 80-600 | 50.1 | **5.4** | 5.3 |
| J | 100-108 | 52-700 | 47.4 | **4.2** | 6.2 |
| K | 40-80 | 25-190 | 44.1 | **0.3** | 0.1 |
| L | 45-90 | 200-325 | 63.7 | **7.2** | 1.7 |
| M | 158 | 40 | 34.4 | **1.1** | 0.0 |
| N | N/A | N/A | | **N/A** | N/A |
| O | 64-163 | 60-70 | 30.1 | **0.4** | 0.0 |
| P | 80 | 65 | 57.0 | **4.6** | 3.9 |
| Q | N/A | N/A | | **1.0** | 1.7 |
| R | 48 | 90 | 54.6 | **8.2** | 0.0 |
| S | N/A | AVG | | **2.2** | 0.0 |

Source: Tribal MS Registrations

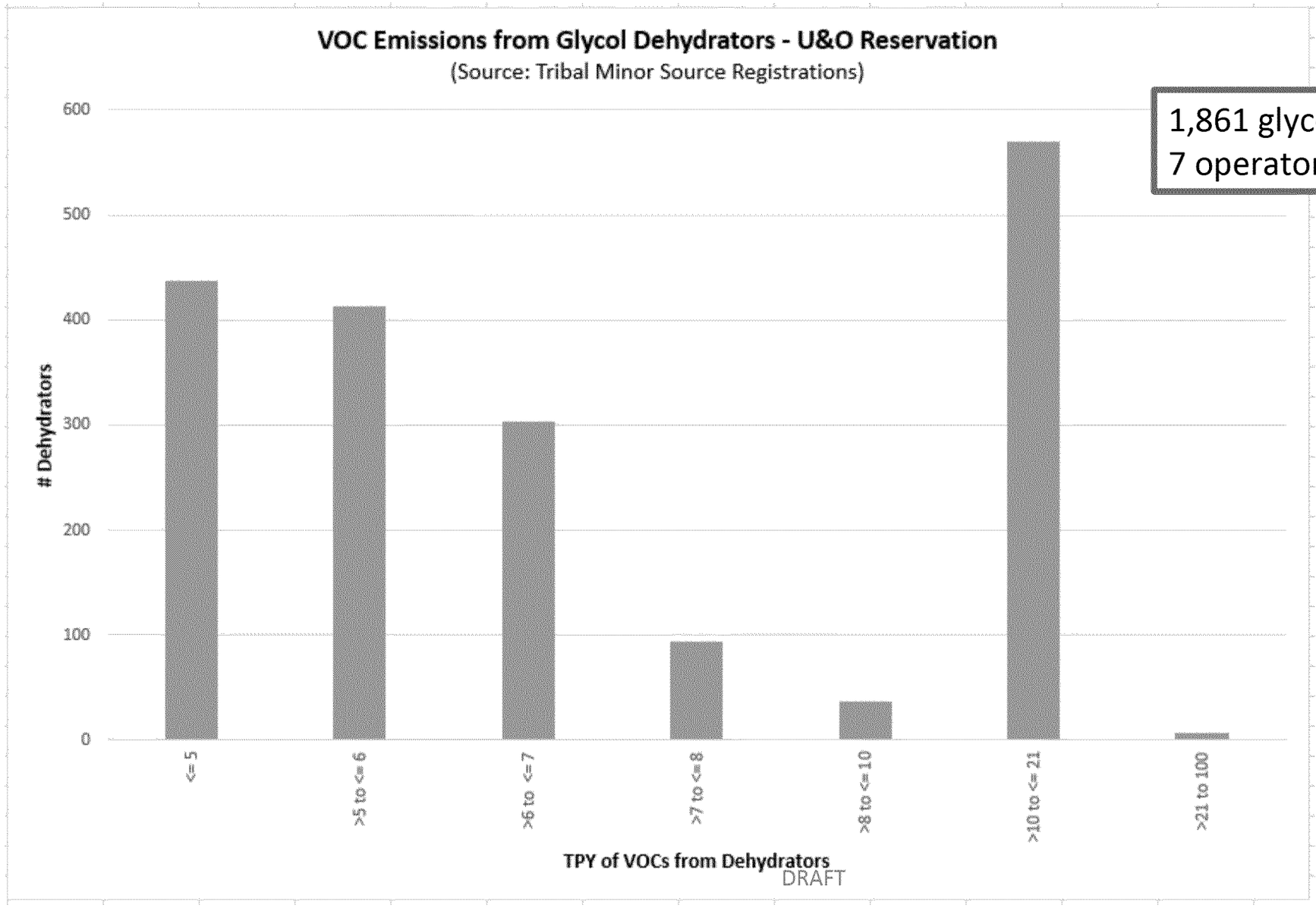
<=1 and <2




Source:

- DrillingInfo 2014 production
- wells w/ 1st prod < 8/23/11
- combined with VOC lb/bbl *by Operator* per Tribal MSR submittals

# Glycol Dehydrators on U&O Reservation




1,861 glycol dehydrators
7 operators

# Normalized Pressurized Liquid Sample Speciation Profile – (mol %)

## E&P TANKS

| Operator | A | C | D | F | G | H | I | J | K | L | O | P | R |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| H2S | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| O2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| CO2 | 0.08 | 0.19 | 0.03 | 0.01 | 0.17 | 0.24 | 0.15 | 0.05 | 0.02 | 0.23 | 0.14 | 0.01 | 0.10 |
| N2 | 0.01 | 0.00 | 0.00 | 0.01 | 0.02 | 0.02 | 0.00 | 0.01 | 0.01 | 0.00 | 0.02 | 0.00 | 0.01 |
| C1 | 1.40 | 6.46 | 2.32 | 0.38 | 3.13 | 7.06 | 6.38 | 2.66 | 1.16 | 9.74 | 2.64 | 0.15 | 3.70 |
| C2 | 1.77 | 2.21 | 1.09 | 0.25 | 0.70 | 2.56 | 2.96 | 1.73 | 0.71 | 6.09 | 0.60 | 0.57 | 1.70 |
| C3 | 4.82 | 2.83 | 1.37 | 0.43 | 1.07 | 4.33 | 2.99 | 2.75 | 1.11 | 9.14 | 0.95 | 2.41 | 4.39 |
| i-C4 | 2.82 | 1.35 | 0.67 | 0.22 | 0.88 | 2.08 | 1.00 | 1.64 | 0.54 | 3.61 | 0.77 | 1.73 | 2.26 |
| n-C4 | 5.97 | 2.73 | 1.27 | 0.59 | 1.11 | 4.29 | 2.48 | 2.38 | 1.11 | 6.86 | 1.05 | 3.55 | 5.12 |
| i-C5 | 4.31 | 2.46 | 1.33 | 0.44 | 1.05 | 3.56 | 1.46 | 3.23 | 1.02 | 4.13 | 0.97 | 4.14 | 4.08 |
| n-C5 | 4.19 | 2.57 | 1.82 | 0.93 | 1.00 | 3.72 | 2.27 | 2.82 | 1.18 | 4.33 | 0.94 | 3.86 | 4.51 |
| C6 | 6.51 | 3.45 | 16.77 | 12.29 | 1.53 | 4.73 | 4.43 | 3.24 | 0.31 | 4.11 | 4.02 | 6.51 | 5.41 |
| C7 | 17.75 | 19.21 | 28.81 | 16.74 | 4.43 | 20.09 | 12.70 | 9.01 | 7.80 | 16.00 | 5.85 | 18.71 | 18.41 |
| C8 | 18.64 | 12.48 | 12.54 | 12.50 | 5.89 | 8.92 | 7.84 | 11.44 | 15.88 | 6.07 | 7.26 | 19.43 | 16.39 |
| C9 | 7.44 | 8.65 | 6.06 | 10.48 | 4.22 | 5.97 | 5.10 | 5.60 | 8.53 | 4.08 | 5.60 | 6.84 | 5.90 |
| C10+ | 11.61 | 20.24 | 5.72 | 28.75 | 72.44 | 20.80 | 38.71 | 46.28 | 50.03 | 14.97 | 65.47 | 15.52 | 16.99 |
| Benzene | 0.56 | 0.88 | 2.43 | 1.56 | 0.31 | 0.83 | 1.02 | 0.36 | 0.37 | 0.57 | 0.39 | 1.18 | 1.34 |
| Toluene | 3.28 | 3.92 | 6.08 | 2.74 | 0.38 | 2.76 | 3.25 | 1.96 | 3.62 | 2.57 | 0.66 | 5.21 | 2.57 |
| E-Benzene | 0.26 | 0.39 | 0.30 | 0.38 | 0.05 | 0.34 | 0.30 | 0.19 | 0.43 | 0.27 | 0.07 | 0.46 | 0.21 |
| Xylenes | 3.41 | 5.43 | 3.69 | 2.29 | 0.50 | 3.20 | 3.37 | 2.45 | 5.27 | 3.31 | 0.63 | 4.86 | 1.51 |
| n-C6 | 5.17 | 3.24 | 7.03 | 7.97 | 1.12 | 3.87 | 2.89 | 2.19 | 0.87 | 3.35 | 1.89 | 4.86 | 5.36 |
| 224Trimethylp | 0.00 | 1.30 | 0.67 | 1.03 | 0.00 | 0.63 | 0.69 | 0.00 | 0.04 | 0.54 | 0.10 | 0.00 | 0.00 |
| API Sales Oil | 62.0 | 52.0 | 51.4 | 39.6 | 32.0 | 50.8 | 50.1 | 47.4 | 44.1 | 63.7 | 30.1 | 57.0 | 54.6 |



2016-008149-0045244

## TOG Condensate Tank Emission Profiles: values reported in weight %

| Species | A | C | D | H | I | J | K | L | P | R |
|---|---|---|---|---|---|---|---|---|---|---|
| Methane | 6.2997 | 26.4868 | 42.5441 | 13.0250 | 15.2277 | 18.8200 | 41.5324 | 15.5540 | 0.7173 | 12.5141 |
| Ethane | 11.2580 | 18.1956 | 18.1926 | 12.6239 | 24.9393 | 21.8901 | 21.2591 | 17.2700 | 5.1086 | 10.7620 |
| Propane | 26.8229 | 19.0308 | 11.9138 | 26.0258 | 31.2682 | 32.9904 | 17.4148 | 34.5372 | 30.5980 | 36.3504 |
| Propylene | - | - | - | - | - | - | - | - | - | - |
| Isobutane (or 2-Methylpr | 11.6633 | 7.7761 | 3.0643 | 9.8883 | 5.0718 | 7.8964 | 4.3806 | 9.8265 | 18.0008 | 10.1963 |
| N-butane | 18.6914 | 11.8718 | 4.0404 | 13.5358 | 11.7698 | 9.1849 | 6.2354 | 13.2771 | 22.4188 | 14.9828 |
| Isopentane (or 2-Methyll | 7.4490 | 4.7392 | 1.9953 | 7.4246 | 3.1223 | 3.7800 | 2.6155 | 3.6517 | 7.8238 | 5.0941 |
| N-pentane | 5.4619 | 3.7033 | 1.9751 | 5.5026 | 3.8963 | 2.4515 | 2.1749 | 2.7245 | 4.9544 | 4.0176 |
| N-hexane | 2.3255 | 1.3176 | 2.3995 | 4.0770 | 0.7668 | 0.4988 | 0.4274 | 0.5787 | 1.4481 | 1.2907 |
| Isomers of pentane | - | - | - | - | - | - | - | - | - | - |
| Isomers of hexane | 3.6207 | 1.8203 | 7.2618 | 1.2800 | 1.1982 | 0.9608 | 0.1958 | 0.9225 | 3.1309 | 1.6971 |
| Isomers of heptane | 3.8975 | 2.8853 | 4.5450 | 4.6626 | 1.6431 | 0.8830 | 1.6757 | 1.2016 | 3.4996 | 2.0047 |
| Isomers of octane | 1.5184 | 1.0730 | 0.6245 | 0.5906 | 0.3199 | 0.3168 | 1.1290 | 0.1425 | 1.3677 | 0.5657 |
| Benzene | 0.2076 | 0.2431 | 0.6298 | 0.5383 | 0.2493 | 0.1042 | 0.1344 | 0.0844 | 0.2276 | 0.2581 |
| Toluene | 0.3921 | 0.2763 | 0.5517 | 0.3972 | 0.2422 | 0.1524 | 0.4307 | 0.1068 | 0.3364 | 0.1565 |
| Ethylbenzene | 0.0231 | 0.0061 | 0.0040 | 0.0127 | 0.0091 | - | 0.0011 | 0.0038 | 0.0161 | 0.0000 |
| Cumene | - | - | - | - | - | - | - | - | - | - |
| trimethylbenzene | - | - | - | - | - | - | - | - | - | - |
| M, O, & p-xylene | 0.1384 | 0.1494 | 0.0444 | 0.1057 | 0.0881 | 0.0187 | 0.1602 | 0.0388 | 0.1218 | 0.0549 |
| 2,2,4-trimethylpentane | - | 0.2 | 0.0 | 0.1 | 0.1 | - | 0.0 | 0.0374 | 0.0 | - |
| C7 | - | - | - | - | - | - | - | - | - | - |
| C8 | - | - | - | - | - | - | - | - | - | - |
| C9 | 0.2306 | 0.2473 | 0.1583 | 0.1167 | 0.0661 | 0.0508 | 0.2268 | 0.0327 | 0.2078 | 0.0549 |
| C10+ | 0.0000 | 0.0264 | 0.0081 | 0.0460 | 0.0071 | 0.0010 | 0.0056 | 0.0098 | 0.0201 | 0.0000 |
| C-5 Cycloparaffins | - | - | - | - | - | - | - | - | - | - |
| C-6 Cycloparaffins | - | - | - | - | - | - | - | - | - | - |
| C-7 Cycloparaffins | - | - | - | - | - | - | - | - | - | - |
| C-8 Cycloparaffins | - | - | - | - | - | - | - | - | - | - |
| Unidentified | - | - | - | - | - | - | - | - | - | - |
| Total | 100.000 | 100.000 | 100.000 | 100.000 | 100.000 | 100.000 | 100.000 | 100.000 | 100.000 | 100.000 |
| Total M,E | 17.558 | 44.682 | 60.737 | 25.649 | 40.167 | 40.710 | 62.792 | 32.824 | 5.826 | 23.276 |
| API Gravity Sales Oil | 62.0 | 52.0 | 51.4 | 50.7 | 50.1 | 47.4 | 44.1 | 63.7 | 57.0 | 54.6 |

## TOG Oil Tank Emission Profiles: values reported in weight %

| Species | F | G | O |
|---|---|---|---|
| Methane | 6.6536 | 38.9561 | 43.0950 |
| Ethane | 5.1882 | 15.3404 | 13.0040 |
| Propane | 6.8041 | 17.0285 | 15.1236 |
| Propylene | | | |
| Isobutane (or 2-Methylpropane) | 2.5083 | 8.7806 | 7.6546 |
| N-butane | 5.2310 | 8.2504 | 7.3244 |
| Isopentane (or 2-Methylbutane) | 2.4480 | 3.9064 | 3.2775 |
| N-pentane | 3.5651 | 2.8085 | 2.3326 |
| N-hexane | 13.9475 | 0.8053 | 1.1838 |
| Isomers of pentane | | | |
| Isomers of hexane | 22.2600 | 1.3730 | 3.3331 |
| Isomers of heptane | 16.9461 | 1.5205 | 1.9171 |
| Isomers of octane | 5.5348 | 0.7228 | 0.8322 |
| Benzene | 2.5466 | 0.1951 | 0.2032 |
| Toluene | 1.7094 | 0.0775 | 0.2757 |
| Ethylbenzene | 0.0899 | 0.0050 | 0.0057 |
| Cumene | | | |
| trimethylbenzene | | | |
| M, O, & p-xylene | 0.6178 | 0.0325 | 0.0392 |
| 2,2,4-trimethylpentane | 1.0701 | 0.0000 | 0.0449 |
| C7 | | | |
| C8 | | | |
| C9 | 2.2552 | 0.1976 | 0.2850 |
| C10+ | 0.6241 | 0.0000 | 0.0684 |
| C-5 Cycloparaffins | | | |
| C-6 Cycloparaffins | | | |
| C-7 Cycloparaffins | | | |
| C-8 Cycloparaffins | | | |
| Unidentified | | | |
| Total | 100.000 | 100.000 | 100.000 |
| Total M,E | 11.8418 | 54.2965 | 56.0990 |
| API Gravity Sales Oil | 39.6 | 32.0 | 30.1 |

# Normalized Speciation Profile – Tank Flash Emissions (mol %) GOR

| OperatorName | Operator M | Operator B | Operator Q |
|---|---|---|---|
| # of Registrations | 79 | 34 | 261 |
| H2S | 0.00 | 0.00 | 0.00 |
| N | 1.46 | 0.64 | 0.57 |
| CO2 | 0.60 | 0.12 | 0.53 |
| C1 | 30.92 | 9.45 | 39.11 |
| C2 | 18.23 | 14.34 | 16.32 |
| C3 | 23.34 | 19.62 | 16.16 |
| i-C4 | 4.69 | 5.13 | 3.57 |
| n-C4 | 10.70 | 15.61 | 8.76 |
| 2,2-Dimethylpropane | 0.00 | 0.05 | 0.03 |
| i-C5 | 3.41 | 6.80 | 3.31 |
| n-C5 | 4.07 | 10.72 | 4.39 |
| 2,2-Dimethylbutane | 0.00 | 0.22 | 0.04 |
| Cyclopentane | 0.00 | 0.32 | 0.37 |
| 2,3-Dimethlybutane | 0.00 | 0.43 | 0.05 |
| 2 Methylpentane | 0.00 | 2.43 | 1.16 |
| 3 Methylpentane | 0.00 | 1.35 | 0.50 |
| n-Hexane | 1.17 | 5.88 | 1.75 |
| Methylcyclopentane | 0.00 | 0.74 | 0.53 |
| Benzene | 0.07 | 0.36 | 0.13 |
| Cyclohexane | 0.00 | 0.81 | 0.40 |
| 2-Methylhexane | 0.00 | 0.53 | 0.17 |
| 3-Methylhexane | 0.00 | 0.48 | 0.18 |
| 2,2,4-Trimethylpentane | 0.00 | 0.00 | 0.04 |
| n-Heptane | 0.00 | 1.73 | 0.53 |
| Methylcyclohexane | 0.00 | 0.67 | 0.36 |
| Toluene | 0.05 | 0.23 | 0.10 |
| Other C8's | 0.24 | 0.41 | 0.31 |
| n-Octane | 0.00 | 0.20 | 0.07 |
| Ethylbenzene | 0.00 | 0.00 | 0.00 |
| M&P Xylenes | 0.01 | 0.02 | 0.03 |
| O-Xylenes | 0.00 | 0.00 | 0.01 |
| Other C9's | 0.05 | 0.03 | 0.06 |
| n-Nonane | 0.00 | 0.01 | 0.01 |
| Other C10's | 0.01 | 0.00 | 0.02 |
| n-Decane | 0.00 | 0.00 | 0.01 |
| Undecanes+ | 0.00 | 0.00 | 0.02 |
| API Sales Oil | 34.44 | 40.93 | |

## TOG Glycol Dehydrator Profiles: values reported in weight %

| Species | D | H | J | K | L | O | Q |
|---|---|---|---|---|---|---|---|
| Methane | 35.1081 | 70.2166 | 2.3921 | 5.1952 | 4.7237 | 7.0977 | 32.4064 |
| Ethane | 6.0119 | 4.6730 | 0.9287 | 1.0633 | 2.9450 | 2.1288 | 5.1459 |
| Propane | 5.5688 | 2.2560 | 1.0283 | 0.9727 | 3.9224 | 5.0649 | 6.0543 |
| iso-butane | 1.8251 | 1.1025 | 1.0107 | 0.4236 | 1.5972 | 1.6909 | 1.5343 |
| n-butane | 3.1199 | 1.0694 | 0.9905 | 0.6419 | 2.9889 | 5.0614 | 3.4084 |
| iso-pentane | 1.5603 | 0.7675 | 1.1281 | 0.4032 | 1.6175 | 2.0513 | 1.3302 |
| n-pentane | 1.5158 | 0.4858 | 0.6800 | 0.3854 | 1.4671 | 2.8849 | 1.8152 |
| n-hexane | 1.1044 | 0.3586 | 0.8094 | 1.0153 | 1.3915 | 2.3667 | 0.8794 |
| isomers of pentane | - | - | - | - | - | - | - |
| isomers of hexane | 1.2714 | 0.6131 | 1.4415 | 0.8268 | 1.4196 | 2.3253 | 1.4090 |
| isomers of heptane | 2.4693 | 0.8790 | 2.8676 | 2.8166 | 4.3165 | 5.6727 | 0.3634 |
| isomers of octane | - | - | - | - | - | - | - |
| C-5 Compounds | - | - | - | - | - | - | - |
| C-6 Compounds | - | - | - | - | - | - | - |
| C-7 Compounds | - | - | - | - | - | - | - |
| C8+ | 7.9572 | 2.3245 | 10.6949 | 39.8952 | 16.8508 | 2.1291 | 10.5201 |
| Benzene | 4.6812 | 4.4616 | 35.7903 | 9.2118 | 8.7877 | 18.8657 | 7.7701 |
| Isomers of propyl benzene | - | - | - | - | - | - | - |
| Isomers of butyl benzene | - | - | - | - | - | - | - |
| Toluene | 12.0282 | 5.7070 | 29.1334 | 16.1865 | 22.1154 | 21.3574 | 13.2197 |
| Cumene | - | - | - | - | - | - | - |
| 1,2,4-trimethylbenzene | - | - | - | - | - | - | - |
| Ethyl-Benzene | 0.5441 | 0.1968 | 0.7627 | 0.4152 | 0.7902 | 1.7069 | 2.5963 |
| Xylenes | 9.3590 | 3.1154 | 6.4650 | 14.1930 | 15.2746 | 6.5196 | 9.6954 |
| 224 Trimethylpentane | 0.0928 | 0.0292 | 0.0644 | 0.0839 | 0.1378 | 0.2763 | 0.0230 |
| C-5 cycloparaffins | - | - | - | - | - | - | - |
| C-6 cycloparaffins | 2.0008 | 0.6167 | 1.0848 | 2.1937 | 3.9102 | 5.9079 | 0.9689 |
| C-7 cycloparaffins | 3.7817 | 1.1273 | 2.7274 | 4.0767 | 5.7438 | 6.8926 | 0.8601 |
| Total | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 |
| Total M,E | 41.1200 | 74.8896 | 3.3209 | 6.2585 | 7.6688 | 9.2265 | 37.5523 |

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## TOG "Raw Gas" Profiles: values reported in weight %

| Species | D | E | F | G | H | J | K | L | M | O | P | Q | R |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Methyl alcohol | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Methane | 74.3315 | 80.7657 | 59.0542 | 67.6564 | 79.2213 | 89.6366 | 79.4964 | 75.3122 | 59.7317 | 47.5473 | 76.0519 | 84.5296 | 68.6577 |
| Ethane | 10.1399 | 7.7534 | 12.9509 | 8.9401 | 7.9579 | 4.6836 | 8.6587 | 9.8878 | 14.1182 | 9.5711 | 8.1062 | 5.1428 | 9.3049 |
| Propane | 7.0328 | 4.2630 | 9.9904 | 10.9700 | 5.6784 | 1.7871 | 4.2611 | 5.7556 | 14.1391 | 15.0314 | 6.7065 | 4.6372 | 10.0007 |
| Propylene | - | - | - | - | - | - | - | - | - | - | - | - | - |
| iso-butane | 1.7900 | 1.2675 | 2.3867 | 2.0815 | 1.6057 | 0.9822 | 1.1672 | 1.6511 | 2.5640 | 3.6825 | 1.6946 | 0.9494 | 2.5416 |
| n-butane | 2.5148 | 1.5897 | 5.1265 | 4.3353 | 2.1045 | 0.6426 | 1.3673 | 2.1854 | 4.7111 | 10.7118 | 2.4062 | 1.7660 | 3.7248 |
| iso-pentane | 1.1145 | 0.8668 | 2.2238 | 1.5238 | 1.0186 | 0.6507 | 0.7006 | 1.1311 | 1.4868 | 3.7446 | 1.1757 | 0.6880 | 1.5904 |
| n-pentane | 0.8948 | 0.6268 | 2.5107 | 1.4378 | 0.6622 | 0.2821 | 0.5311 | 0.9105 | 1.3644 | 3.8191 | 0.9009 | 0.7941 | 1.3519 |
| n-hexane | 0.3784 | - | 1.1031 | - | 0.2429 | 0.1594 | 0.4837 | 0.4880 | 0.4074 | 0.4903 | 0.5775 | 0.2461 | 0.5828 |
| isomers of pentane | - | - | - | - | - | - | - | - | - | - | - | - | - |
| isomers of hexane | 0.5639 | 2.8670 | 1.5314 | 2.1540 | 0.4771 | 0.4071 | 0.7257 | 0.7056 | 0.6105 | 5.0019 | 0.7931 | 0.5317 | 0.9087 |
| isomers of heptane | 0.4139 | - | 1.2560 | 0.7824 | 0.2049 | 0.2494 | 0.8110 | 0.6539 | 0.3771 | 0.1274 | 0.7177 | 0.0287 | 0.5148 |
| isomers of octane | - | - | - | - | - | - | - | - | - | - | - | - | - |
| C8+ | 0.1881 | - | 0.9889 | - | 0.5270 | 0.1097 | 1.1819 | 0.4330 | 0.2065 | 0.0720 | 0.0082 | 0.3434 | 0.1907 |
| Benzene | 0.0486 | - | 0.2271 | 0.0203 | 0.0324 | 0.1647 | 0.0610 | 0.0728 | 0.0238 | 0.0167 | 0.1569 | 0.0738 | 0.0397 |
| Toluene | 0.0803 | - | 0.1264 | 0.0198 | 0.0229 | 0.0960 | 0.0906 | 0.0864 | 0.0263 | 0.0170 | 0.0385 | 0.0833 | 0.0631 |
| Cumene | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1,2,4-trimethylbenzene | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Ethyl-Benzene | 0.0023 | - | 0.0129 | 0.0005 | 0.0006 | 0.0019 | 0.0058 | 0.0034 | 0.0030 | 0.0004 | - | 0.0097 | 0.0022 |
| Xylenes | 0.0293 | - | 0.0555 | 0.0064 | 0.0100 | 0.0128 | 0.0435 | 0.0430 | 0.0131 | 0.0057 | - | 0.0322 | 0.0226 |
| 224 Trimethylpentane | 0.0322 | - | - | 0.0097 | 0.0164 | 0.0145 | 0.0250 | 0.0469 | 0.0450 | 0.0094 | 0.0747 | 0.0085 | 0.0389 |
| C-5 cycloparaffins | - | - | - | - | - | - | - | - | - | - | - | - | - |
| C-6 cycloparaffins | 0.1816 | - | 0.2333 | - | 0.1065 | 0.0380 | 0.1927 | 0.2318 | 0.0840 | 0.1008 | 0.2854 | 0.0737 | 0.1910 |
| C-7 cycloparaffins | 0.2631 | - | 0.2222 | 0.0622 | 0.1107 | 0.0816 | 0.1964 | 0.4017 | 0.0882 | 0.0507 | 0.3061 | 0.0618 | 0.2737 |
| C-8 cycloparaffins | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Unidentified | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Total M,E | 84.5 | 88.5 | 72.0 | 76.6 | 87.2 | 94.3 | 88.2 | 85.2 | 73.8 | 57.1 | 84.2 | 89.7 | 78.0 |

# Data Gaps – Research shows …

- Discrepancy between top-down measurements and bottom-up emission inventories
    - In UB, airborne measurements ~8.9% of gas produced to atmosphere compared to GHGRP-W ~ 1.0%
    - In UB, Ozone modeling shows low negative bias for VOCs and methane by factor of 1.8 and 4.8 respectively



2016-008149-0045250

# Data Gaps – Research shows …

- Skewed emission distributions, fat tail, "super-emitter" … a small number of sources account for a large % of emissions – **not fixed in time or space**

  - Wellpads – 86 natural gas wellsites … ~5% sites → ~60% of emissions
  - Midstream Compressor Stations - 114 CSs … 30% sites → ~80% of emissions
  - Gas Plants - 16 gas processing plants … 45% sites → ~80% of emissions
  - Transmission Compressor Stations – 45 CSs … 10% sites → ~ 50% of emissions
  - Abandoned Wells – 19 abandoned wells… 3 of the 19 wells had CH4 flow rates three orders of magnitude larger than the median flow rate
  - Well Liquid Unloading – 107 wells with liquid unloadings …
    - w/o plunger lift: 20% wells → 83% of emissions
    - w/ plunger lift and manual: 20% wells → 65% of emissions
    - w/ plunger lift and automatic: 20% wells → 72% of emissions
  - Pneumatic Controllers – 377 controllers … 20% devices → 96% of emissions



2016-008149-0045251

# Facility Wide Emission Data (MERLIN)

## Existing Source Registration Form (FORM REG)

| Pollutant | Total Actual Emissions (tpy) | Total Allowable or Potential Emissions (TPY) |
|---|---|---|
| PM | | |
| $PM_{10}$ | | |
| $PM_{2.5}$ | | |
| $SO_2$ | | |
| $NO_x$ | | |
| CO | | |
| VOC | | |
| Pb | | |
| Fluorides | | |
| $H_2SO_4$ | | |
| $H_2S$ | | |
| TRS | | |
| RSC | | |

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Allowable Emissions (See also, Potential to Emit): Emissions rate of a source calculated using the maximum rated capacity of the source (unless the source is subject to practically and legally enforceable limits which restrict the operating rate, or hours of operation, or both) and the most stringent of the following:

Any applicable standards as set forth in 40 CFR parts 60 and 61;

Any applicable Tribal or Federal Implementation Plan emissions limitation, including those with a future compliance date; or

Any emissions rate specified as a federally enforceable permit condition, including those with a future compliance date.