Uinta Basin

How we understand the O&G sector universe

Operators Meeting 9/3/15

2016-008149-0015825

Outline

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

2016-008149-0015826

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

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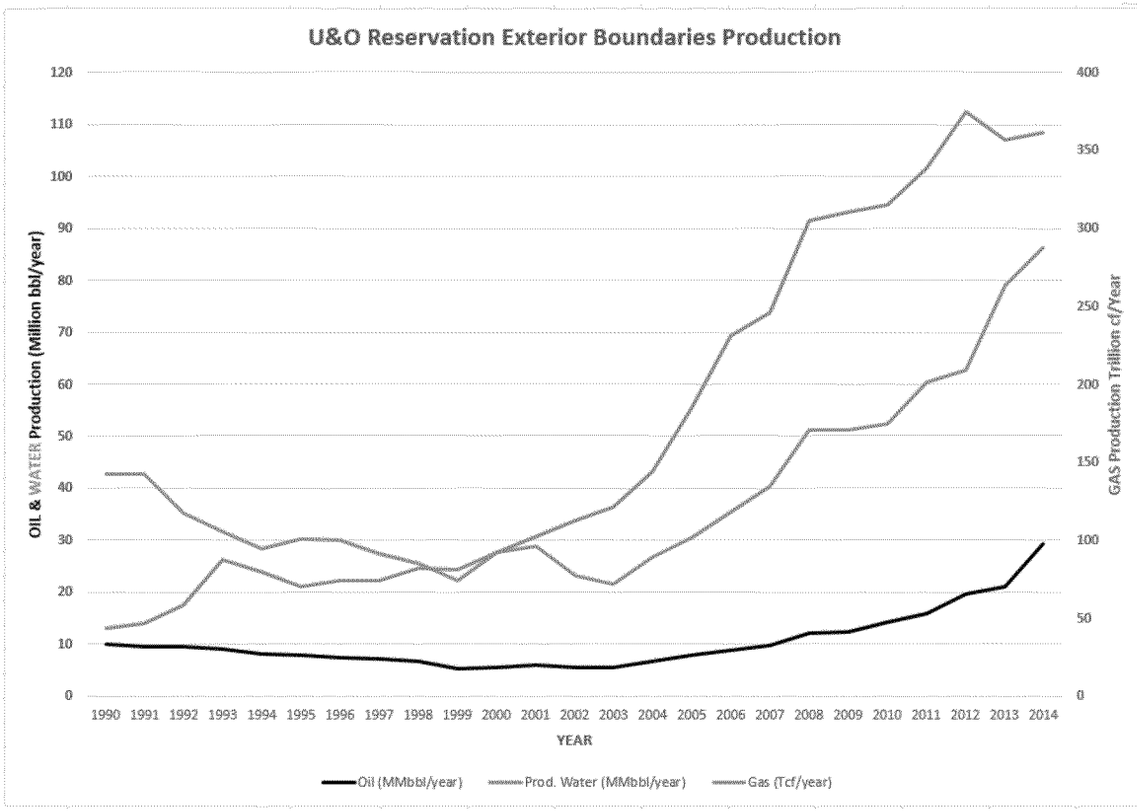
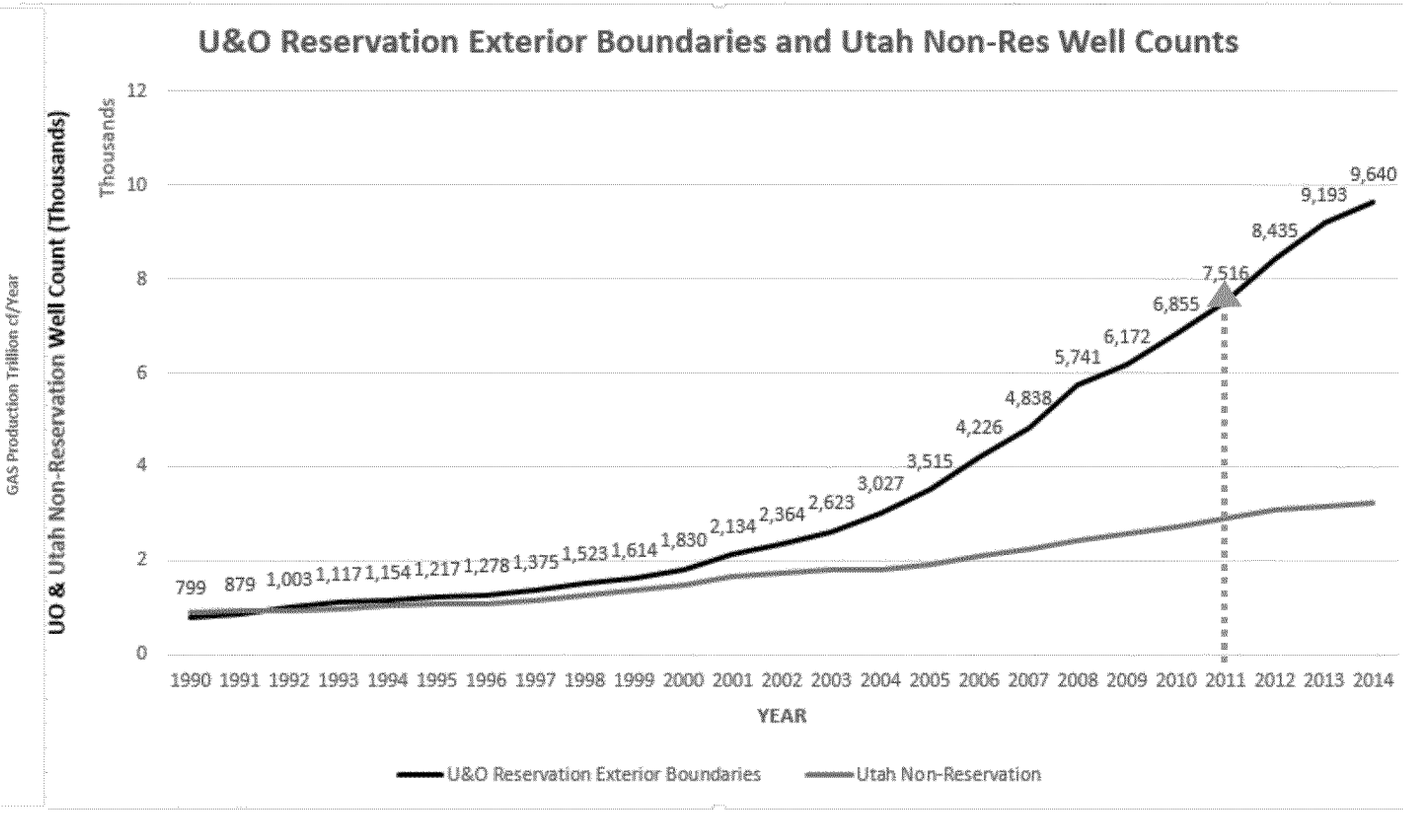
Background





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

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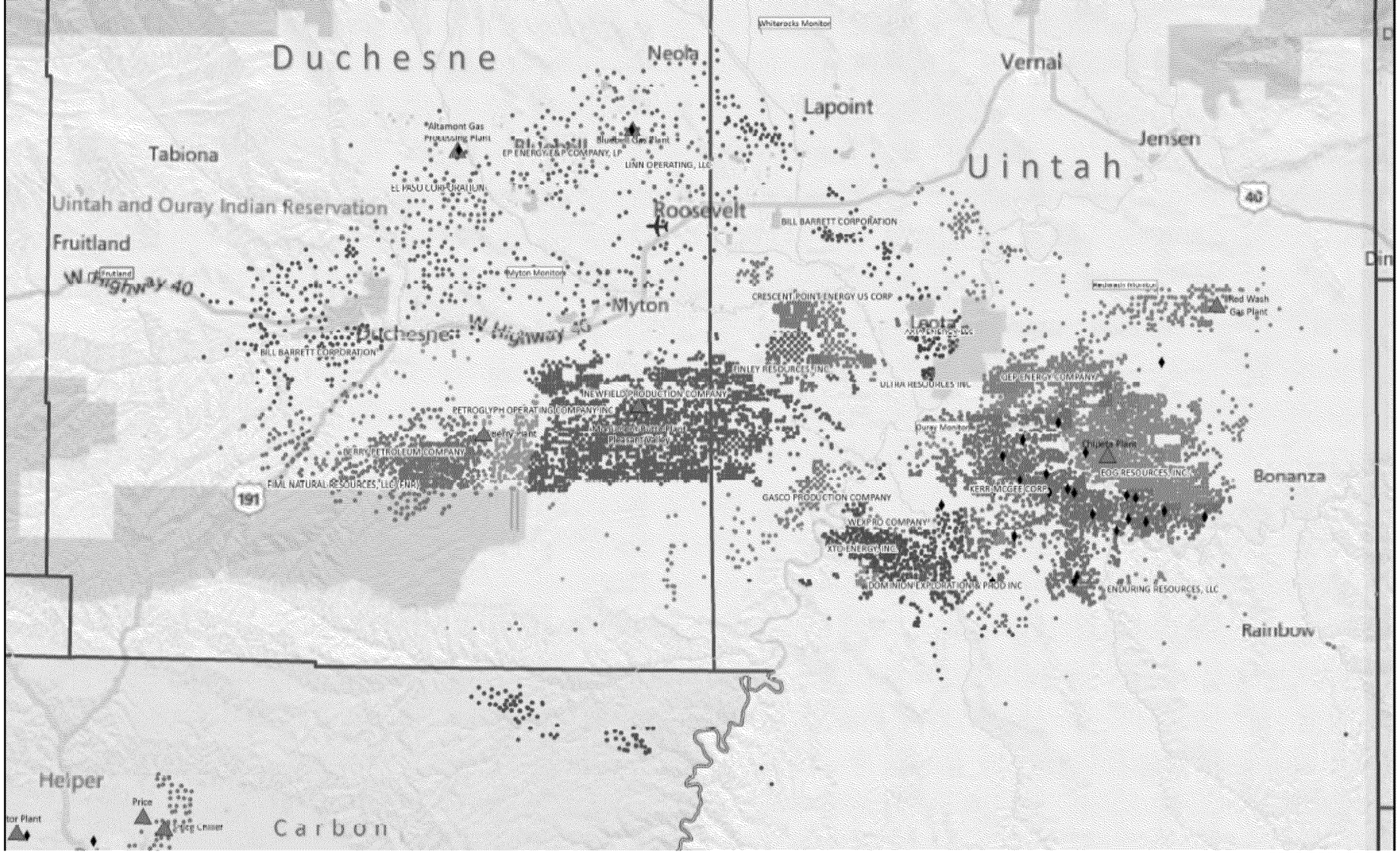
Top 20 Producers

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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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

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

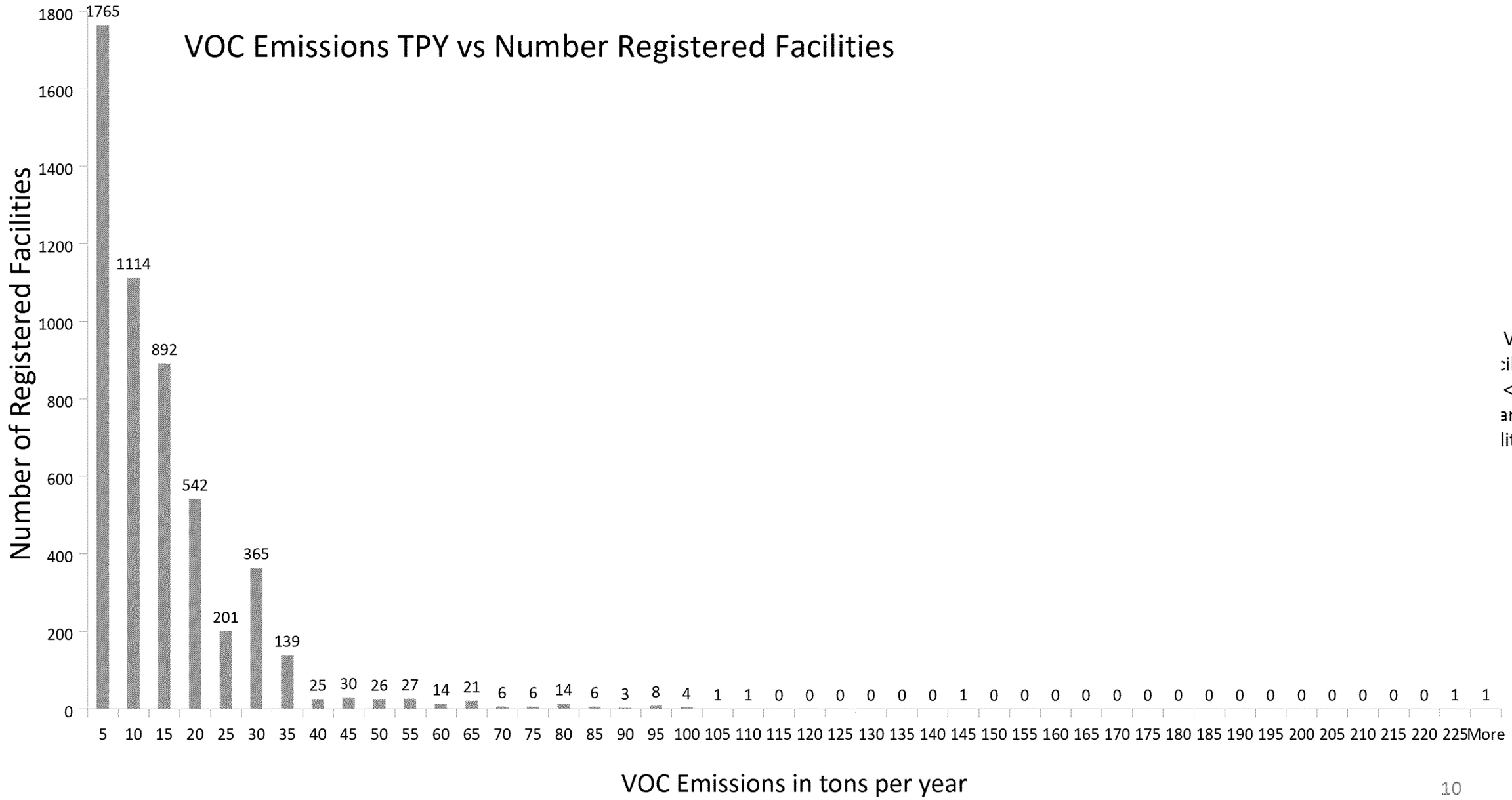
EPA's Greenhouse Gas Reporting Program - Subpart W covers the Petroleum and Natural Gas Systems. Defines Uinta Basin as the counties of Carbon, Daggett, Duchesne, Uintah and Wasatch.

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**

268 facilities have emission controls on tanks

Tribal Minor Source Registrations, cont'd



VOC TPY
:ilities <5
<10, etc.
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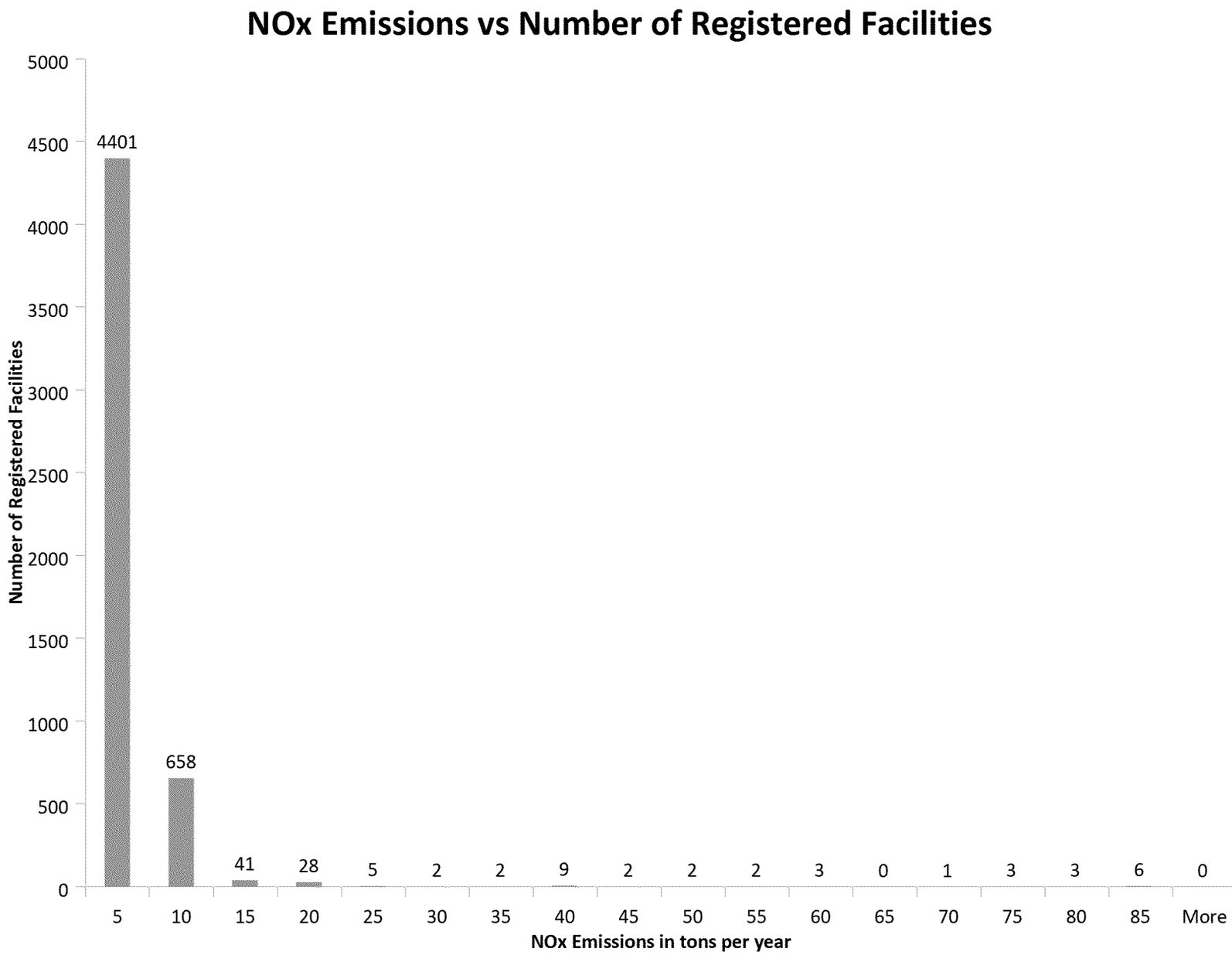
Tribal Minor Source Registrations, cont'd



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

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

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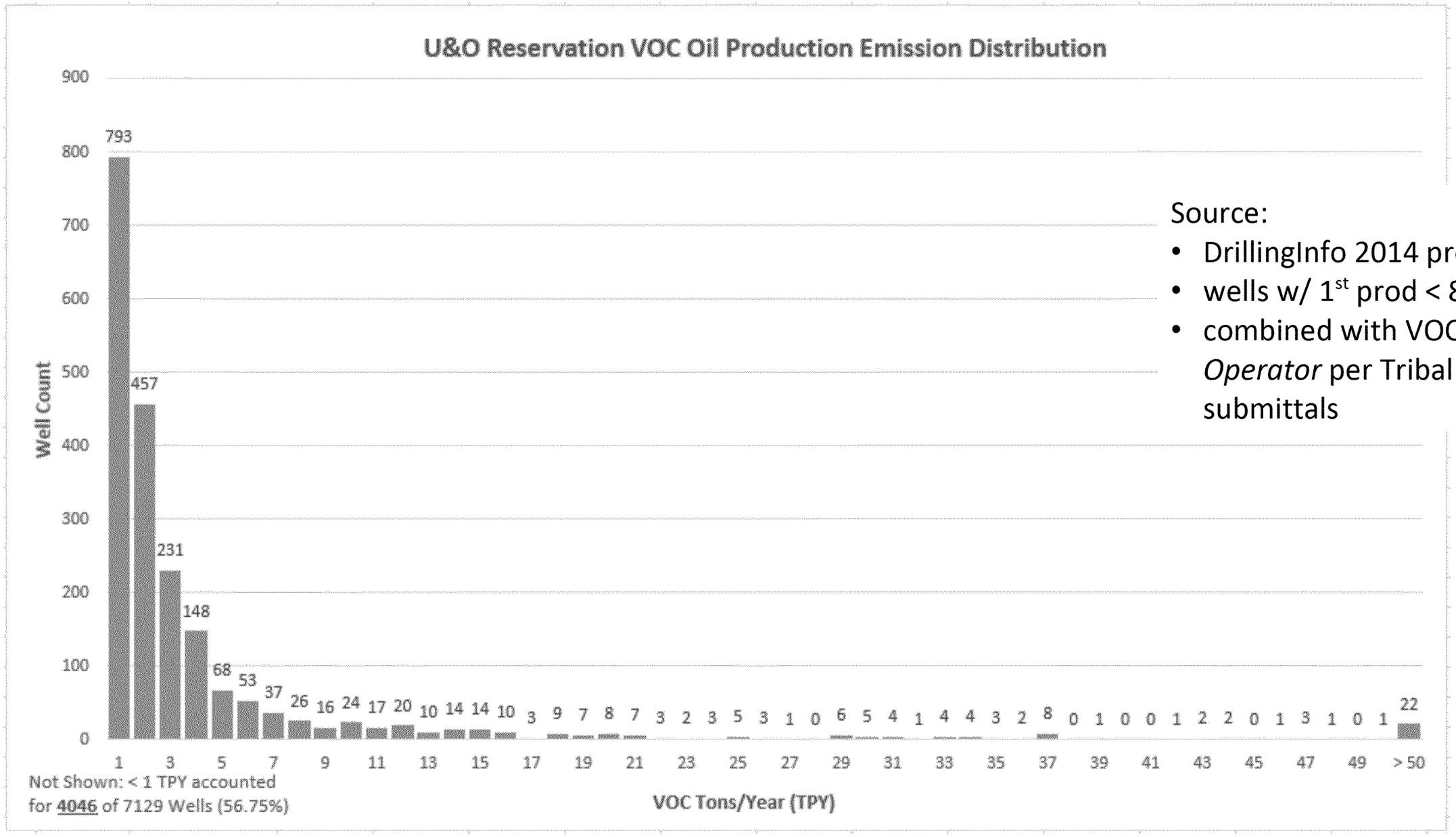
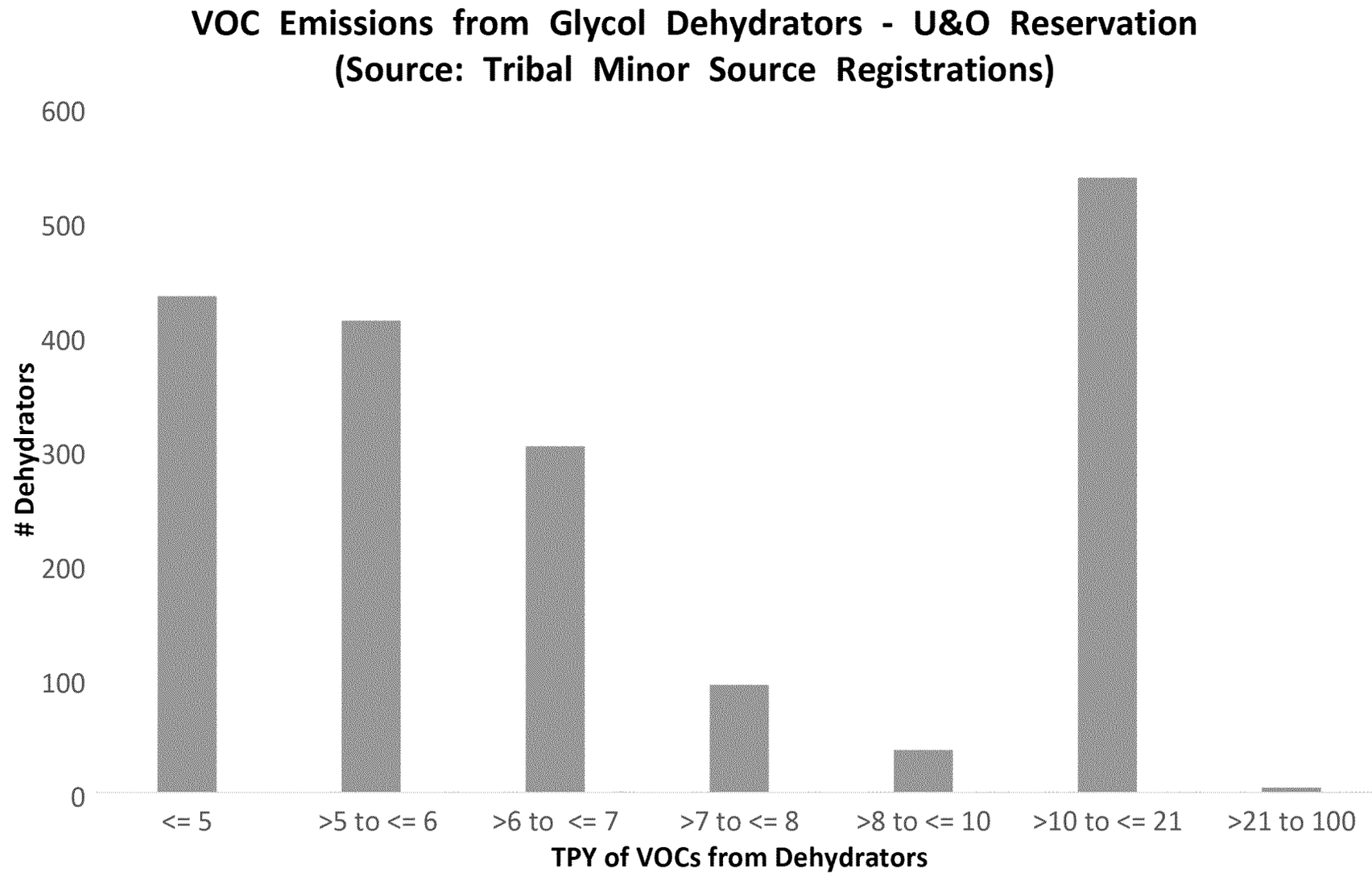
<=1 and <2



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



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

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	

Speciation Profiles for Dehys

2016-008149-0015841

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

2016-008149-0015842

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

2016-008149-0015843

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		

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.