

Purpose:

This document outlines the method used to account for emissions from blowdown venting to incorporate in the 2017 Uinta Basin Emission Inventory (UBEI2017) and the changes estimated from findings in the Uinta Basin Composition Study¹ to reflect in UBEI2017-Update.

Background:

The Uinta Basin Oil & Gas Emission Inventory (UBEI) is made up of two main components: (1) Operator Workbooks where operators provide prescribed data elements and emission estimates, and (2) Gap-Filling for emissions sources not covered in the Operator Workbooks. Operators annually report to EPA's Greenhouse Gas Reporting Program, subpart W (Petroleum and Natural Gas Systems), methane emissions and activity counts for blowdown vent stacks.

For onshore petroleum and natural gas gathering and boosting activities, blowdown vent stacks² equipment or event types are grouped into the following seven categories: Facility piping (i.e., piping within the facility boundary other than physical volumes associated with distribution pipelines), pipeline venting (i.e., physical volumes associated with distribution pipelines vented within the facility boundary), compressors, scrubbers/strainers, pig launchers and receivers, emergency shutdowns (this category includes emergency shutdown blowdown emissions regardless of equipment type), and all other equipment with a physical volume greater than or equal to 50 cubic feet. If a blowdown event resulted in emissions from multiple equipment types and the emissions cannot be apportioned to the different equipment types, then the blowdown event is categorized as the equipment type that represented the largest portion of the emissions for the blowdown event.

Method:

1. From the EPA Greenhouse Gas Reporting Program, subpart W reporting from operators in the Uinta Basin, obtain the activity levels and resultant methane emissions (reported in metric tons). For Reporting Year 2017, operators in the Uinta Basin reported the following for the seven categories of blowdown vent activities:

¹ Uinta Basin Composition Study Comprehensive Final Report, Utah Division of Air Quality. March 31, 2020
<https://documents.deq.utah.gov/air-quality/planning/technical-analysis/DAQ-2020-004826.pdf>

² 40 CFR Part 98, §98.233(i)

GHGRP-W RY2017 UINTA BASIN (AAPG 575) - Blowdowns

Operator	# Blowdown Events By-Type							TOTAL
	Compressors	Emergency shutdowns	Facility piping	Pig launchers & receivers	Pipeline venting	Scrubbers/strainers	Other equip. w/ Volume ≥ 50 ft3	
Anadarko	2,016	35	11	484	144	72	148	2,910
Andeavor	822	22	6		10	2		862
Crescent Point				6,968				6,968
EnerVest	836	-	-	572	2	-	-	1,410
Kinder Morgan	258	1					5	264
Newfield					108			108
XTO	532							532
TOTAL	4,464	58	17	8,024	264	74	153	13,054

Operator	CH4 Emissions (MT)							TOTAL
	Compressors	Emergency shutdowns	Facility piping	Pig launchers & receivers	Pipeline venting	Scrubbers/strainers	Other equip. w/ Volume ≥ 50 ft3	
Anadarko	59	17	0	2	347	2	4	431
Andeavor	205	56	0		0	0		261
Crescent Point				13				13
EnerVest	8	-	-	2	3	-	-	13
Kinder Morgan	6	67					337	410
Newfield					143			143
XTO	6							6
TOTAL	284	140	0	17	493	2	341	1,277

There is not a sub-basin (i.e. county) breakdown of this data.

2. Obtain speciation data for a ratio of methane-to-VOC weight percent (Wt.%) for blowdowns of equipment and piping.

a) For UBEI2017:

From the 2014 UBEI, calculate the weighted average (based on # of facilities) of speciated gas streams provided by operators for 'produced natural gas composition' from oil and gas production to use as a surrogate ratio of methane-to-VOC emissions for the blowdowns from equipment and the pigging of gas gathering pipelines. From the weighted average of 'produced natural gas composition', the weight percent (mass of constituent/mass of whole gas) of methane (CH4) is 0.6849 and of VOCs is 0.1979.

$$0.1979 \times \frac{VOC \text{ ton}}{whole \text{ gas ton}} \div \left(0.6849 \times \frac{CH4 \text{ ton}}{whole \text{ gas ton}} \times \frac{(0.907185) \text{ MT}}{\text{ton}} \right) = 0.2889 \frac{VOC \text{ ton}}{CH4 \text{ MT}}$$

b) For UBEI2107-Update based on UBCS findings:

From the UBCS, use the average speciated "Raw Gas: Oil Wells" gas stream derived from 50 oil wellpads where gas samples were collected off the separators and analyzed and the "Raw Gas: Gas Wells" gas stream derived from 17 gas wellpads where gas samples were collected off the separators and analyzed. The UBCS speciation profiles are shown below:

Species (WEIGHT PERCENT)	UBCS Raw Gas: Gas Wells	UBCS Raw Gas: Oil Wells	UBEI 2017 Raw Gas	UBCS Flash Gas: Gas Wells	UBCS Flash Gas: Oil Wells	UBEI 2017 Flash Gas
METHANE	73.08	52.36	70.33	46.02	13.72	15.48
ETHANE	10.29	11.41	9.34	18.62	10.39	8.64
PROPANE	5.98	9.57	7.86	16.41	15.92	12.84
ISOBUTANE	1.70	2.24	-	4.72	4.74	-
N-BUTANE	2.17	5.05	5.19	6.11	12.09	12.35
ISOPENTANE	1.02	2.44	-	2.35	5.94	-
N-PENTANE	0.85	3.29	3.11	1.71	7.93	8.25
CYCLOPENTANE	0.05	0.26	-	0.09	0.63	-
N-HEXANE	0.48	2.30	2.48	0.77	6.60	16.64
CYCLOHEXANE	0.27	0.61	-	0.36	1.67	-
HEPTANES	1.54	5.34	0.46	1.23	11.60	6.70
METHYLCYCLOHEXANE	0.67	0.84	-	0.60	2.03	-
2,2,4 TRIMETHYLPENTAN	0.00	0.00	-	0.01	0.05	-
BENZENE	0.08	0.18	0.04	0.11	0.40	0.87
TOLUENE	0.25	0.29	0.05	0.25	0.56	0.77
ETHYLBENZENE	0.02	0.03	-	0.01	0.05	0.07
XYLENES	0.16	0.23	0.05	0.15	0.36	0.37
OCTANES	0.71	1.88	0.29	0.20	2.00	3.13
NONANES	0.15	0.38	0.13	0.26	2.87	2.09
DECANES+	0.52	1.33	0.66	0.03	0.46	11.80
total	100.00	100.00	100.00	100.00	100.00	100.00
average VOC Wt %	14.80	32.54	20.33	35.65	72.41	75.88
average MWwhole gas	19.39	24.17	20.10	-	-	-
average VOC/CH4 ratio	0.210	0.699	0.29	1.14	19.91	-

For blowdowns in oil production regions use the weighted average of "Raw Gas: Oil Wells", the weight fraction of methane (CH4) is 0.5236 and of VOCs is 0.3254.

$$\frac{0.3254 \times \frac{VOC \text{ ton}}{whole \text{ gas ton}}}{0.5236 \times \frac{CH4 \text{ ton}}{whole \text{ gas ton}} \times \frac{(0.907185) \text{ MT}}{\text{ton}}} = 0.6850 \frac{VOC \text{ ton}}{CH4 \text{ MT}}$$

For blowdowns in gas production regions use the weighted average of "Raw Gas: Gas Wells", the weight fraction of methane (CH4) is 0.7308 and of VOCs is 0.1480.

$$\frac{0.1480 \times \frac{VOC \text{ ton}}{\text{whole gas ton}}}{0.7308 \times \frac{CH4 \text{ ton}}{\text{whole gas ton}} \times \frac{(0.907185) \text{ MT}}{\text{ton}}} = 0.2232 \frac{VOC \text{ ton}}{CH4 \text{ MT}}$$

Allocate the GHGRP-W blowdown data to either oil producing regions or gas producing regions as follows:

Operator	CH4 Emissions (MT)							TOTAL
	Compressors	Emergency shutdowns	Facility piping	Pig launchers & receivers	Pipeline venting	Scrubbers/strainers	Other equip. w/ volume ≥ 50 ft3	
Anadarko	59	17	0	2	347	2	4	431
Andeavor	205	56	0		0	0		261
Crescent Point				13				13
EnerVest	8	-	-	2	3	-	-	13
Kinder Morgan	6	67					337	410
Newfield					143			143
XTO	6							6
TOTAL CH4	284	140	0	17	493	2	341	1,277
Raw Gas - Oil	6	67	-	13	143	-	337	566
Raw Gas - Gas	278	73	0	4	350	2	4	711
Raw Gas - Oil	0.6850	VOC ton/CH4 MT						
Raw Gas - Gas	0.2232	VOC ton/CH4 MT						
TOTAL VOC (ton)	66	62	0	10	176	0	232	546

3. Calculate VOC emissions from blowdowns in 2017.

a) For UBEI2017:

$$1,277 \text{ MT CH4} \times 0.2889 \frac{VOC \text{ ton}}{CH4 \text{ MT}} = 369 \text{ ton VOC}$$

b) For UBEI2107-Update based on UBCS findings:

In oil regions:

$$566 \text{ MT CH4} \times 0.6850 \frac{VOC \text{ ton}}{CH4 \text{ MT}} = 388 \text{ ton VOC}$$

In gas regions:

$$711 \text{ MT CH4} \times 0.2232 \frac{VOC \text{ ton}}{CH4 \text{ MT}} = 158 \text{ ton VOC}$$

Total for Uinta Basin: 388 + 158 = 546 Tons

VOC

Results:

We propose to adjust the UBEI2017 'Gap-Filling' line item, blowdowns, by replacing 369 TPY VOC with 546 TPY VOC (+177 TPY).

