

2011 Uinta Basin Oil and Gas Emissions Estimates Technical Document

Prepared by:
Kiera Harper
Utah Division of Air Quality

August 14, 2013

In 2006, Environ (sponsored by the Independent Petroleum Association of Mountain States (IPAMS) and the Western Regional Air Partnership (WRAP)) conducted a study to compile baseline emissions estimates from the oil and gas industry for Utah's Uinta Basin, including Uintah, Duchesne, Carbon, Emery, and Grand County. Emissions estimates for NO_x, VOCs, CO, SO_x, and PM10 were inventoried through examining various processes of the oil and gas extraction and production cycle (Table 1 & 2). Spud counts (commencement of drilling by drill rigs for oil, gas, and water injection wells) were also included to estimate the total emissions from drilling processes.

In 2009 Environ was tasked with projecting the 2006 baseline emissions to 2012. Production, well, and spud count values were analyzed and then extrapolated to the year 2012. Once values were obtained for production, well, and spud counts, a simple equation (Equation 1) could be used to create a growth (scaling) factor to be applied to the 2006 baseline emissions.

Table 1: 2006 WRAP oil and gas emissions estimate for the Uinta Basin (Duchesne and Uintah County).

2006 Estimates	NO _x (tons/year)		VOCs (tons/year)		CO (tons/year)		SO _x (tons/year)		PM10 (tons/year)	
	Duchesne	Uintah	Duchesne	Uintah	Duchesne	Uintah	Duchesne	Uintah	Duchesne	Uintah
Compressor engines	149.82	1354.87	34.64	313.21	157.37	1423.11	0.00	0.00	2.07	18.75
Condensate tank flaring	0.33	0.25	0.00	0.00	1.79	1.38	0.00	0.00	0.00	0.00
Drill rigs	1238.28	3062.16	107.57	266.00	467.48	1156.05	93.70	231.70	91.68	226.73
Heaters	217.55	595.53	12.43	34.02	184.87	506.08	1.43	3.91	17.14	46.92
Pneumatic devices	0.00	0.00	3629.17	9920.59	0.00	0.00	0.00	0.00	0.00	0.00
Pneumatic pumps	0.00	0.00	2053.93	5614.18	0.00	0.00	0.00	0.00	0.00	0.00
Venting - blowdowns	0.00	0.00	25.52	230.44	0.00	0.00	0.00	0.00	0.00	0.00
Venting - initial completions	0.00	0.00	30.72	207.80	0.00	0.00	0.00	0.00	0.00	0.00
Venting - recompletions	0.00	0.00	4.75	32.10	0.00	0.00	0.00	0.00	0.00	0.00
Workover rigs	5.36	134.64	0.50	12.45	2.16	54.14	0.44	11.15	0.44	11.14
Unpermitted Fugitives	0.00	0.00	465.08	1271.30	0.00	0.00	0.00	0.00	0.00	0.00
Miscellaneous engines	34.98	95.76	8.45	23.12	12.67	34.68	0.02	0.05	0.17	0.45
Artificial Lift	1396.51	760.99	430.91	234.82	1612.03	878.43	0.74	0.40	60.26	32.84
Truck Loading of Condensate	0.00	0.00	11.72	111.49	0.00	0.00	0.00	0.00	0.00	0.00
Gas Plant Truck Loading	0.00	0.00	0.31	2.92	0.00	0.00	0.00	0.00	0.00	0.00
Venting - Compressor Startup	0.00	0.00	72.12	651.21	0.00	0.00	0.00	0.00	0.00	0.00
Venting - Compressor Shutdown	0.00	0.00	68.35	617.24	0.00	0.00	0.00	0.00	0.00	0.00
Dehydrator	10.05	90.91	1697.36	15327.27	8.44	76.36	0.00	0.00	0.76	6.91
Dehydrator Flaring	0.01	0.07	0.00	0.00	0.04	0.38	0.00	0.00	0.00	0.00
Initial completion Flaring	0.15	0.36	0.00	0.00	0.79	1.96	0.00	0.00	0.00	0.00
Condensate tank	0.00	0.00	571.77	5439.26	0.00	0.00	0.00	0.00	0.00	0.00
Oil Tank	0.00	0.00	9177.96	5001.29	0.00	0.00	0.00	0.00	0.00	0.00
Permitted Sources	655.69	1294.17	260.14	990.34	783.86	0.00	0.38	4.21	5.18	18.53
Truck Loading of Oil	0.00	0.00	616.18	335.77	0.00	0.00	0.00	0.00	0.00	0.00
Totals	3708.73	7389.72	19279.56	46636.82	3231.51	4132.58	96.71	251.43	177.71	362.26

Table 2: 2006 WRAP oil and gas emissions estimate for the Uinta Basin (Carbon, Emery, and Grand County).

2006 Estimates Description	NO _x (tons/year)			VOCs (tons/year)			CO (tons/year)			SO _x (tons/year)			PM10 (tons/year)		
	Carbon	Emery	Grand	Carbon	Emery	Grand	Carbon	Emery	Grand	Carbon	Emery	Grand	Carbon	Emery	Grand
Compressor engines	549.17	107.74	45.59	126.95	24.91	10.54	576.83	113.17	47.89	0.00	0.00	0.00	7.60	1.49	0.63
Condensate tank flaring	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00
Drill rigs	254.81	102.82	120.70	22.13	8.93	10.48	96.20	38.82	45.57	19.28	7.78	9.13	18.87	7.61	8.94
Heaters	107.74	40.44	54.31	6.16	2.31	3.10	91.56	34.37	46.16	0.71	0.27	0.36	8.49	3.19	4.28
Pneumatic devices	0.00	0.00	0.00	297.05	162.78	906.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pneumatic pumps	0.00	0.00	0.00	126.80	78.03	512.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Venting - blowdowns	0.00	0.00	0.00	26.48	1.88	7.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Venting - initial completions	0.00	0.00	0.00	1.67	0.27	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Venting - recompletions	0.00	0.00	0.00	0.26	0.04	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Workover rigs	28.84	7.20	78.95	2.67	0.67	7.30	11.60	2.90	31.75	2.39	0.60	6.54	2.39	0.60	6.53
Unpermitted Fugitives	0.00	0.00	0.00	36.67	20.39	116.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Miscellaneous engines	17.32	6.50	8.73	4.18	1.57	2.11	6.27	2.35	3.16	0.01	0.00	0.00	0.08	0.03	0.04
Artificial Lift	0.06	0.86	26.08	0.02	0.26	8.05	0.07	0.99	30.10	0.00	0.00	0.01	0.00	0.04	1.13
Truck Loading of Condensate	0.00	0.00	0.00	3.09	0.02	0.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gas Plant Truck Loading	0.00	0.00	0.00	0.08	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Venting - Compressor Startup	0.00	0.00	0.00	74.84	5.31	21.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Venting - Compressor Shutdown	0.00	0.00	0.00	70.94	5.03	20.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dehydrator	36.85	7.23	3.06	1795.88	133.45	516.52	30.95	6.07	2.57	0.00	0.00	0.00	2.80	0.55	0.23
Dehydrator Flaring	0.03	0.01	0.00	0.00	0.00	0.00	0.16	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Initial completion Flaring	0.03	0.01	0.01	0.00	0.00	0.00	0.16	0.07	0.08	0.00	0.00	0.00	0.00	0.00	0.00
Condensate tank	0.00	0.00	0.00	150.77	0.76	32.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oil Tank	0.00	0.00	0.00	0.42	5.62	171.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Permitted Sources	28.85	0.00	360.63	1.03	0.00	68.94	19.39	0.00	123.26	0.41	0.00	0.27	3.16	0.00	4.68
Truck Loading of Oil	0.00	0.00	0.00	0.03	0.38	11.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Totals	1023.71	272.81	698.08	2748.13	452.61	2428.93	833.21	198.76	330.57	22.80	8.65	16.32	43.39	13.50	26.46

Equation (1): $F = C_2/C_1$

where:

F is the growth (scaling) factor

C₂ is the count or value for various production, well, and spud counts for the year interested in

C₁ is the count or value for various production, well, and spud counts for 2006

The 2012 emissions estimated were the product of the 2006 baseline emissions and the growth factor. To determine the appropriate growth factor for the various processes in the Uinta Basin for oil and gas, scaling parameters were used based on the well count, spud count, gas well production, oil well production, and gas well condensate (Table 3).

Table 3. Scaling parameter for each oil and gas source category considered in this inventory (Bar-Ilan).

Description	Projection Parameter
Heaters	total well count
Drill rigs	spud count
Workover rigs	total well count
Pneumatic devices	total well count
Fugitives	total well count
Truck loading of condensate liquid	gas well condensate
Truck loading of oil	oil well oil production
Gas plant truck loading	gas well condensate
Venting - initial completions	spud count
Initial completion flaring	spud count
Venting - recompletions	spud count
Venting - blowdowns	total gas production
Venting – compressor startups	total gas production

Venting – compressor shutdowns	total gas production
Condensate tanks	gas well condensate
Oil tanks	oil well oil production
Miscellaneous engines	total well count
Pneumatic pumps	conv. well count
Initial completion flaring	spud count
Compressor Engines	total gas production
Dehydrators	total gas production
Dehydrator flaring	total gas production
Artificial lift engines	oil well oil production
Permitted sources	total gas production

The Utah Division of Air Quality was tasked with creating an emissions inventory for the year 2011 in which production, well, and spud values were already completed and available. Production counts for the Uinta Basin counties for the years 2006 and 2011 for oil, natural gas, gas well condensate, produced water, producing wells, and spuds were obtained from the Utah Division of Oil, Gas, and Mining (DOGGM) via their Data Research Center (DOGGM, 2012). The DOGGM data was then compiled and queried in Microsoft Access in-house. The 2006 and 2011 counts are contained in Table 4.

DOGGM does not collect values for gas well condensate and all condensate is reported to them as oil. To obtain condensate, oil production strictly from gas wells had to be summed to obtain total condensate production. Once that value is obtained, condensate totals had to be subtracted from the total oil production to reflect true values for oil and condensate production. In an email conversation, Amnon Bar-Ilan, an author for Environ’s Phase III Uinta Basin Emissions Inventory, stated that their emissions inventory was calculated with condensate and oil well production separate, but in the report oil and condensate production values are reported together as total oil production (Harper). If oil well production and gas well condensate were summed, the total would be the oil production value in the report.

Production values for the year 2006 varied slightly from Environ’s Phase III report, which is most likely due to amendments made by the oil and gas companies in the Uinta Basin after the report was completed in 2007. Even though values were different from the Environ report, the new totals had to be used to ensure that the growth factors were accurate for 2011 (Table 5).

For the 2011 inventory, permitted sources were not scaled but were totaled from 2011 actual emission reports and potential to emit reports (PTEs). Various compressor stations and gas processing plants were found throughout the basin, some of which were not permitted, but were added to the inventory in the non-permitted sources category. Permitted compressor stations and gas plants that were already included in Utah’s point source inventory are not included in this inventory under non-permitted sources.

Table 4. Production counts for oil, natural gas, produced water, gas well condensate, producing wells, and spuds for the years 2006 and 2011. The data was compiled and queried from DOGM (DOGM, 2012).

Year	County	Oil Prod. (BBls)	Conv. Gas Prod. (MCF)	CBM Gas Prod. (MCF)	Total Gas Prod. (MCF)	Water Prod. (BBls)	Gas Condensate (BBls)	Conv. Well Count	CBM Well Count	Total Well Count	Spuds
2006	Duchesne	6,265,162	22,530,227	-	22,530,227	17,973,903	137,752	1,474	-	1,474	277
2006	Uintah	3,396,826	203,511,421	308,152	203,819,573	44,736,926	1,560,268	4,029	6	4,035	685
2006	Carbon	43,362	20,496,544	62,069,296	82,565,840	18,327,224	27,913	91	639	730	57
2006	Emery	4,036	951,436	15,247,456	16,198,892	6,596,841	216	56	218	274	23
2006	Grand	125,626	6,854,659	-	6,854,659	34,988	9,263	368	-	368	27
2011	Duchesne	11,632,011	39,335,557	-	39,335,557	29,729,921	300,575	2,470	-	2,470	351
2011	Uintah	4,638,591	298,130,158	-	298,130,158	52,785,474	2,315,647	6,152	-	6,152	524
2011	Carbon	-	48,687,464	41,597,340	90,284,804	16,953,851	73,358	351	665	1,016	94
2011	Emery	3,233	3,439,746	8,975,948	12,415,694	4,534,571	62	77	201	278	1
2011	Grand	70,795	4,127,064	-	4,127,064	35,707	11,915	329	-	329	2

Table 5. 2011 growth (scaling) factors for the Uinta Basin.

2011 Scaling Factors	Oil Prod.	Gas Prod.	CBM Gas Prod.	Total Gas Prod.	Water Prod.	Condensate	Conv. Well Count	CBM Well Count	Total Well Count	Spuds
Duchesne	1.86	1.75	-	1.75	1.65	2.18	1.68	-	1.68	1.27
Uintah	1.37	1.46	0.00	1.46	1.18	1.48	1.53	0.00	1.52	0.76
Carbon	0.00	2.38	0.67	1.09	0.93	2.63	3.86	1.04	1.39	1.65
Emery	0.80	3.62	0.59	0.77	0.69	0.29	1.38	0.92	1.01	0.04
Grand	0.56	0.60	-	0.60	1.02	1.29	0.89	-	0.89	0.07

After emission estimates were totaled for the various processes in the oil and gas industry (refer to Table 1), estimates were totaled for the year 2011 for NO_x, VOCs, CO, SO_x, and PM10 (Table 6 & 7).

The WRAP Phase III inventory for 2006 estimates that approximately 95% of the NO_x and VOC emissions in Uintah County are located within tribal and Indian Country boundaries. In Duchesne County approximately 50% of the NO_x and VOC emissions are located on those lands. It is important to point out that this inventory is not broken up into separate Indian Country/Non-Indian Country inventories like a portion of WRAPs's inventory was.

Table 6. 2011 Uinta Basin oil and gas emissions estimate (Duchesne and Uintah County).

2011 Estimates Description	NOx (tons/year)		VOCs (tons/year)		CO (tons/year)		SOx (tons/year)		PM10 (tons/year)	
	Duchesne	Uintah	Duchesne	Uintah	Duchesne	Uintah	Duchesne	Uintah	Duchesne	Uintah
Compressor engines	109.86	833.61	4.84	36.71	162.11	1230.01	0.00	0.00	0.04	0.27
Condensate tank flaring	0.72	0.38	0.00	0.00	3.90	2.05	0.00	0.00	0.00	0.00
Drill rigs	1569.08	2342.44	136.30	203.48	592.37	884.34	118.73	177.25	116.18	173.44
Heaters	364.55	907.99	20.83	51.87	309.80	771.61	2.40	5.97	28.72	71.53
Pneumatic devices	0.00	0.00	6081.45	15125.52	0.00	0.00	0.00	0.00	0.00	0.00
Pneumatic pumps	0.00	0.00	3441.80	8572.46	0.00	0.00	0.00	0.00	0.00	0.00
Venting - blowdowns	0.00	0.00	44.55	8211.95	0.00	0.00	0.00	0.00	0.00	0.00
Venting - initial completions	0.00	0.00	38.93	158.96	0.00	0.00	0.00	0.00	0.00	0.00
Venting - recompletions	0.00	0.00	6.01	24.56	0.00	0.00	0.00	0.00	0.00	0.00
Workover rigs	8.98	205.29	0.83	18.99	3.61	82.54	0.74	17.01	0.74	16.98
Unpermitted Fugitives	0.00	0.00	779.33	1938.31	0.00	0.00	0.00	0.00	0.00	0.00
Miscellaneous engines	58.62	146.00	14.15	35.25	21.23	52.87	0.03	0.08	0.28	0.69
Artificial Lift	2592.79	1039.19	800.04	320.66	2992.92	1199.56	1.37	0.55	111.89	44.84
Truck Loading of Condensate	0.00	0.00	25.57	165.46	0.00	0.00	0.00	0.00	0.00	0.00
Gas Plant Truck Loading	0.00	0.00	0.67	4.33	0.00	0.00	0.00	0.00	0.00	0.00
Venting - Compressor Startup	0.00	0.00	125.91	952.54	0.00	0.00	0.00	0.00	0.00	0.00
Venting - Compressor Shutdown	0.00	0.00	119.34	902.85	0.00	0.00	0.00	0.00	0.00	0.00
Dehydrator	17.55	132.97	2963.42	22419.44	14.74	111.70	0.00	0.00	1.33	10.11
Dehydrator Flaring	0.01	0.10	0.00	0.00	0.07	0.56	0.00	0.00	0.00	0.00
Initial completion Flaring	0.18	0.28	0.00	0.00	1.00	1.50	0.00	0.00	0.00	0.00
Condensate tank	0.00	0.00	1247.60	8072.58	0.00	0.00	0.00	0.00	0.00	0.00
Oil Tank	0.00	0.00	17039.95	6829.59	0.00	0.00	0.00	0.00	0.00	0.00
Permitted Sources (from emissions and PTEs)	2723.03	524.53	876.49	345.43	771.50	596.73	30.19	9.85	8.20	4.47
Non-Permitted Sources	1959.24	3486.41	1099.19	2022.09	866.12	2201.09	10.22	37.57	36.11	98.54
Truck Loading of Oil	0.00	0.00	1144.02	458.52	0.00	0.00	0.00	0.00	0.00	0.00
Totals	9404.61	9619.18	36011.24	76871.54	5739.38	7134.55	163.67	248.26	303.48	420.88

Table 7. 2011 Uinta Basin oil and gas emissions estimate (Carbon, Emery, and Grand County).

2011 Estimates Description	NOx (tons/year)			VOCs (tons/year)			CO (tons/year)			SOx (tons/year)			PM10 (tons/year)		
	Carbon	Emery	Grand	Carbon	Emery	Grand	Carbon	Emery	Grand	Carbon	Emery	Grand	Carbon	Emery	Grand
Compressor engines	600.51	82.58	27.45	138.82	19.09	6.35	630.76	86.74	28.83	0.00	0.00	0.00	8.31	1.14	0.38
Condensate tank flaring	0.01	0.00	0.01	0.00	0.00	0.00	0.03	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00
Drill rigs	420.21	4.47	8.94	36.50	0.39	0.78	158.64	1.69	3.38	31.80	0.34	0.68	31.11	0.33	0.66
Heaters	149.95	41.03	48.56	8.57	2.34	2.77	127.43	34.87	41.26	0.99	0.27	0.32	11.81	3.23	3.83
Pneumatic devices	0.00	0.00	0.00	413.43	165.16	810.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pneumatic pumps	0.00	0.00	0.00	489.10	107.30	458.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Venting - blowdowns	0.00	0.00	0.00	138.66	59.81	308.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Venting - initial completions	0.00	0.00	0.00	2.75	0.01	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Venting - recompletions	0.00	0.00	0.00	0.42	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Workover rigs	40.14	7.31	70.59	3.71	0.68	6.53	16.14	2.94	28.38	3.33	0.61	5.85	3.32	0.60	5.84
Unpermitted Fugitives	0.00	0.00	0.00	51.04	20.68	103.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Miscellaneous engines	24.11	6.60	7.81	5.82	1.59	1.89	8.73	2.39	2.83	0.01	0.00	0.00	0.11	0.03	0.04
Artificial Lift	0.00	0.69	14.69	0.00	0.21	4.53	0.00	0.79	16.96	0.00	0.00	0.01	0.00	0.03	0.63
Truck Loading of Condensate	0.00	0.00	0.00	8.12	0.00	0.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gas Plant Truck Loading	0.00	0.00	0.00	0.21	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Venting - Compressor Startup	0.00	0.00	0.00	81.84	4.07	13.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Venting - Compressor Shutdown	0.00	0.00	0.00	77.57	3.86	12.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dehydrator	40.29	5.54	1.84	1963.78	102.29	310.98	33.85	4.65	1.55	0.00	0.00	0.00	3.06	0.42	0.14
Dehydrator Flaring	0.03	0.00	0.00	0.00	0.00	0.00	0.17	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Initial completion Flaring	0.05	0.00	0.00	0.00	0.00	0.00	0.27	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Condensate tank	0.00	0.00	0.00	396.25	0.22	41.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oil Tank	0.00	0.00	0.00	0.00	4.50	96.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Permitted Sources (from emissions and PTEs)	148.40	0.00	367.08	123.06	0.00	53.36	81.64	0.00	116.58	2.46	0.00	1.64	30.98	0.00	1.80
Non-Permitted Sources	104.72	227.06	134.74	63.88	222.38	214.24	124.88	216.96	115.35	0.19	47.85	0.14	4.75	33.40	4.00
Truck Loading of Oil	0.00	0.00	0.00	0.00	0.30	6.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Totals	1528.42	375.28	681.71	4003.53	714.88	2453.35	1182.54	351.05	355.18	38.77	49.07	8.64	93.46	39.19	17.32

Future Direction for More Accurate Oil and Gas Emissions

To vastly improve the emission estimates in the Uinta Basin, a new study needs to be conducted (done by a contractor like Environ), much like the WRAP 2006 study. A new study should account for changes in the industry in the Basin that cannot be accounted for in the Utah DOGM database, such as updated number of heaters, pneumatic devices, compressors, dehydrators, tanks, pipelines, etc., and their associated emissions and emission factors. A new study would also account for other changes in the industry such as implementing green completions, better practices, updated machinery, etc. Creating a system that would automatically update changes (like the number of heaters, etc.) by the producers to the UDAQ database and subsequently updating an emissions inventory would be the best for staying abreast of current emissions. Currently, the best practices for the emissions inventory is updating the WRAP emissions by using surrogates and scaling factors, but eventually those baseline WRAP emissions will no longer be valid due to an ever evolving industry.

Given that the majority of emissions in Uintah County and nearly half of emissions in Duchesne County are on Indian Country land, working closely with the producers would be paramount to understanding the elements and changes in the industry and also creating complete numbers for the oil and gas industry on Indian Country land.

References

Bar-Ilan, A., Friesen, R., Parikh, R., Grant, J., Pollack, A. K., Henderer, D., Pring, D., Sgamma, K., Development of 2012 Oil and Gas Emissions Projections for the Uinta Basin, Environ, Novato, California, USA, available at http://wrapair.org/forums/ogwg/documents/2009-03_12_Projection_Emissions_Uinta_Basin_Technical_Memo_03-25.pdf, 2009.

Friesen, R., Parikh, R., Grant, J., Bar-Ilan, A., Pollack, A. K., Henderer, D., Pring, D., Sgamma, K., Schlagel, P.: Development of Baseline 2006 Emissions from Oil and Gas Activity in the Uinta Basin, Environ, Novato, California, USA, available at http://wrapair.org/forums/ogwg/documents/2009-03_06_Baseline_Emissions_Uinta_Basin_Technical_Memo_03-25.pdf, 2009.

Harper, Kiera. "Re: Question On Phase III for Uinta Basin" E-mail to Amnon Bar-Ilan. 10 Dec. 2012.

Utah Division of Oil, Gas, and Mining (DOGGM): http://oilgas.ogm.utah.gov/Data_Center, last access: December 2012.