

How do we calculate Kennecott’s annual contribution to our airshed?

1. First, let’s see how the total PM_{2.5} in an airshed is determined.

PM_{2.5} can be emitted directly from sources as particles or can be emitted as a precursor. Precursor emissions are those that are not particles originally but can turn into particles when they react in the atmosphere. Pollutants that can react to form PM_{2.5} are SO₂, NO_x, and VOCs.

$$PM_{2.5} + SO_2 + NO_x + VOC = \text{Total } PM_{2.5} \text{ emissions}$$

The Environmental Protection Agency (EPA) has identified our PM_{2.5} airshed as Salt Lake County, Davis County, and parts of Weber, Box Elder and Tooele Counties. This airshed has been classified as a Non-Attainment Area (NAA) for PM_{2.5}.

2. To calculate Kennecott’s contribution of PM_{2.5} emissions in our airshed, we first have to determine the total PM_{2.5} emissions in the airshed.

Currently, the Utah Division of Air Quality (UDAQ) utilizes the statewide emissions inventory compiled from 2008 for PM_{2.5} State Implementation Plan (SIP) purposes.

The total PM_{2.5} airshed emissions can be determined by *adding together the total emissions* for PM_{2.5}, SO₂, NO_x and VOC in the airshed. (Please note that although the list below identifies SO_x as a criteria pollutant, Kennecott reports SO₂ for air emissions inventory purposes separate from SO₃ and other sulfur oxides.)

County	Source	CO	NOx	PM10	PM2.5	SOx	VOC
Salt Lake	Area Source	2,660.62	2,575.67	5,565.25	1,621.62	126.34	15,196.96
	Non-Road Mobile	54,393.21	6,062.80	415.33	394.06	288.55	4,560.12
	On-Road Mobile	122,156.78	11,514.46	7,221.08	233.55	77.78	8,447.05
	Point Source	5,032.83	10,842.71	4,527.05	1,487.60	5,822.04	2,283.82
	Biogenics	1,754.02	0.00	0.00	0.00	0.00	11,341.57
	Wildfires	181.64	5.17	21.98	19.78	0.00	31.03
	Total	186,179.10	31,000.81	17,750.68	3,756.61	6,314.71	41,860.54
Weber	Area Source	1,942.75	755.45	1,897.69	586.36	29.41	3,677.21
	Non-Road Mobile	9,829.81	1,443.78	102.64	96.42	69.50	1,074.46
	On-Road Mobile	27,081.84	2,651.06	1,469.47	37.93	14.44	2,052.42
	Point Source	1,570.12	698.99	364.88	93.62	41.19	127.28
	Biogenics	985.53	0.00	0.00	0.00	0.00	7,245.95
	Wildfires	1,124.00	32.00	136.00	122.40	0.00	192.00
	Total	42,534.05	5,581.28	3,970.67	936.73	154.54	14,369.32
Davis	Area Source	843.42	749.17	2,596.98	665.69	20.02	3,863.15
	Non-Road Mobile	10,864.20	1,815.88	148.49	136.68	70.78	1,324.75
	On-Road Mobile	39,874.73	4,299.29	2,267.24	128.47	22.94	2,561.82
	Point Source	852.47	1,308.94	266.47	140.17	934.54	3,369.32
	Biogenics	949.40	0.00	0.00	0.00	0.00	6,447.29
	Wildfires	0.00	0.00	0.00	0.00	0.00	0.00
	Total	53,384.22	8,173.28	5,279.19	1,071.00	1,048.28	17,566.33
Box Elder	Area Source	7,014.26	418.95	3,121.78	1,104.29	20.55	2,491.28
	Non-Road Mobile	9,160.53	1,741.90	112.07	104.16	95.18	2,172.03
	On-Road Mobile	22,990.65	3,394.24	1,474.01	137.08	8.74	1,352.52
	Point Source	900.78	473.26	757.39	72.81	66.33	173.61
	Biogenics	6,990.18	0.00	0.00	0.00	0.00	33,584.82
	Wildfires	2,141.22	60.96	259.08	233.17	0.00	365.76
	Total	49,197.62	6,089.31	5,724.33	1,651.51	190.80	40,140.02
Tooele	Area Source	655.14	290.17	2,579.64	520.72	74.09	1,092.28
	Non-Road Mobile	3,871.96	998.09	56.50	51.49	64.69	912.24
	On-Road Mobile	18,763.45	3,883.98	1,928.73	223.12	8.57	1,375.13
	Point Source	711.52	1,790.78	903.93	420.32	133.04	504.04
	Biogenics	8,209.46	0.00	0.00	0.00	0.00	39,129.88
	Wildfires	276.00	7.86	33.39	30.06	0.00	47.15
	Total	32,487.53	6,970.88	5,502.20	1,245.71	280.38	43,060.70

$$= 57,815.56 \quad = 8,661.56 \quad = 7,988.71 \quad = 156,996.91$$

Total PM_{2.5} emissions in PM_{2.5} airshed = 231,462.74 tons per year

3. Now we know the total PM_{2.5} emissions in our airshed, let's calculate the percentage of emissions in our airshed from Kennecott.

In order to determine this, emissions from all Kennecott Utah Copper facilities must be added together for PM_{2.5}, SO₂, NO_x and VOCs. In the 2008 Annual Emissions from Point Sources by County, you can see Kennecott's sources under the Salt Lake County emissions.

2008 Annual Emissions from Point Sources by County								
County	Site ID	Name	CO	NOX	Emissions (tons/year)			
					PM10-PR	PM2.5-PR	SOX	VOC
Salt Lake	12776	Geneva Rock Products: Mount Jordan Operations	2.82	9.32	217.05	30.78	1.97	1.12
	10565	Geneva Rock Products: Point of the Mountain (Hansen-Lehi) Facility	58.26	102.12	68.07	11.31	14.14	18.61
	11792	G-L Industries, Inc.: Laminated Wood Beam Manufacturing Plant						5.95
	10407	Granite Construction Company: Cottonwood Facility	52.74	85.95	23.43	5.20	3.38	14.94
	14032	Granite Mill & Fixture Company: Custom Millwork						3.50
	11691	Graphic Packaging International, LLC.: Salt Lake City Bag Manufacturing Plant	2.84	3.12	0.15	0.15	0.01	13.66
	10580	Hallmark Cabinet Company: Wood Cabinet and Furniture Manufacturing Plant	0.26	0.30	0.09	0.03	0.00	6.84
	12088	Hanson Structural Precast Eagle: Precast/Prestress Concrete Manufacturing Facility	4.19	9.43	13.03	2.27	0.79	2.23
	12394	Harman Music: Audio Components Manufacturing	0.20	0.24	0.02	0.02		1.98
	13102	Harper Contracting, Inc.: Daybreak Aggregate & Concrete Plant	10.92	30.04	6.82	6.87	2.60	3.54
	11481	Harper Contracting: Pit #16 Farley's Canyon	14.34	60.84	14.32	2.63	4.45	3.24
	11557	Harper Contracting: Pit #5 - Salt Lake County	0.91	2.99	3.70	0.51	0.29	0.46
	10569	Harper-Kilgore, LLC: Pit #10	53.72	42.52	23.45	2.24	6.65	18.00
	11388	Hexcel Corporation: Salt Lake Operations	38.79	102.06	36.91	19.96	10.51	69.89
	14009	HK Systems: Automated Storage & Retrieval Machine Mfg						2.36
	10428	Hudson Printing Company: Hudson Printing	4.15	4.38	3.45	1.77	0.01	5.95
	10440	IASIS Healthcare: Salt Lake Regional Medical Center	2.42	6.16	0.29	0.29	1.86	0.25
	11044	ICU Medical, Inc.: Salt Lake Medical Products Manufacturing	1.26	1.50	0.11	0.03	0.01	6.85
	10477	Interon Incorporated: Wood Furniture Mfg. Facility	0.09	0.10	0.01	0.01		7.60
	13308	Intermountain Health Care: Intermountain Medical Center - Murray	11.60	6.60	1.04	1.04	0.83	0.30
	10405	Intermountain Health Care: TOSH - The Orthopedic Specialty Hospital	2.17	1.29	0.20	0.20	0.03	0.07
	11150	Interstate Brands West Corporation: Interstate Brands Company - Salt Lake	1.48	1.70	0.13	0.13	0.01	3.14
	10423	Interstate Brick Company: Brick Manufacturing Plant	68.55	33.52	25.81	2.84	10.72	3.03
	11583	Jack B. Parsons Company: California Ready Mix Facility - Directors Row	0.84	2.12	2.65	1.33	0.20	0.28
	12224	Jack's Tire and Oil Incorporated: Tire Retreading Facility - Salt Lake City	0.26	0.31	1.66	0.02	0.00	1.44
	10501	Kennecott Barney's Canyon Mining Company: Barney's Canyon Mine	0.34	1.65	0.09	0.06	0.05	0.30
	10346	Kennecott Utah Copper Corporation: Smelter & Refinery	109.75	154.25	154.25	149.53	970.08	8.95
	10571	Kennecott Utah Copper LLC: Mine & Copperton Concentrator	2,021.56	4,845.85	2,914.70	737.65	2.79	446.27
	10572	Kennecott Utah Copper LLC: Power Plant/ Lab/ Tailings Impoundment	135.46	2,555.18	109.30	38.90	3,144.97	14.72
	12066	Kern River Gas Transmission Company: Salt Lake City Compressor Station	12.63	63.29	5.87	0.87	0.21	10.94
	10439	Lakeview Rock Products: North Salt Lake Pit	16.75	53.56	17.30	6.56	5.55	6.04
	10449	LDS Church Printing Center: Salt Lake Printing Center - LDS Church	1.54	1.81	15.05	7.59	0.01	5.70
	10578	LDS Church: LDS Central Heating Plant	9.95	11.84	0.90	0.90	0.07	0.85
	10347	LDS Hospital: LDS Hospital	6.50	3.88	0.58	0.06	0.04	0.20
	13091	Linde Hydrogen Plant: Hydrogen Gas Production	8.10	19.40	4.40	4.40	0.30	10.40
	10443	Maaco Auto Painting & Bodyworks: Sandy Automobile Body Repair and Painting Facility						2.68
	13306	Marotech Polysell: Seals Manufacturer	0.00	0.00	0.00	0.00	0.00	7.72
	11392	Mark Steel Corporation: Jordan Steel Equipment Manufacturing Plant	1.17	1.17	0.12		0.09	0.03
	12740	Marko Foam Products: Packaging & Other Foam Products Manufacturing	1.07	1.25	0.09	0.09	0.01	15.30
	13060	Masoo Retail Cabinet Group LLC: Cabinet Manufacturing Plant	4.56	5.28	0.39		0.03	8.29
	10380	Materials Packaging Corporation: Dry Mix Cement Plant	3.38	5.91	12.10	5.86	0.32	0.52
	11199	Midwestern Fabricators, LLC: Fiberglass Manufacturing Plant						0.47
	10557	Mog Salt Lake Operations	0.15	0.37	0.04	0.04	0.02	16.92
	10350	Mountain Cement Company: Shipping Terminal						3.33
	10348	Murray City Power Department: Electrical Generation Plant	11.40	7.19	0.92	0.92	0.05	0.30
	13150	Newspaper Agency Corp (MediaOne): 4770 South 5600 West	0.80	0.95	0.07	0.07	0.01	7.23
	10512	O.C. Tanner Company: O.C. Tanner Manufacturing Facility	0.10	0.78	0.01			1.77
	10562	Olympia Sales Company: Cabinet Manufacturing Facility	0.27	0.32	7.96	4.28	0.00	20.87
10033	Owens Corning: Western Fiberglass - Salt Lake City Plant	11.25	1.42	23.21	21.35	1.03	3.86	
10355	PacifiCorp: Gadsby Power Plant	130.02	184.66	30.83	21.56	1.95	11.72	
11240	Penox Products: Salt Lake Plant	0.28	1.33	0.20	0.17	0.01	0.56	
10461	Primary Children's Medical Center: Primary Children's Medical Center	15.40	14.59	1.20		0.78	1.55	

	PM _{2.5} (tpy)	SO _x (tpy)	NO _x (tpy)	VOC (tpy)	Total
Smelter and Refinery	149.52	970.08	154.25	8.66	1,282.51
Mine and Concentrator	737.65	2.79	4845.85	446.27	6,032.56
Power Plant, Lab, Tailings	38.9	3144.97	2555.18	14.72	5,753.77
Barney's Canyon	0.09	0.05	1.69	0.09	1.92
Total	926.16	4,117.89	7,556.97	469.74	13,070.70

Total emissions of PM_{2.5} and precursors from Kennecott Utah Copper = 13,070.76 tons per year.

To calculate Kennecott's total contribution to the airshed, you must divide Kennecott's emissions (13,070.76 tons per year) by the total PM_{2.5} airshed emissions (231,462.79 tons per year) = .05647

To find the percentage of .05647, you must multiple it by 100. Therefore, Kennecott's total annual contribution of PM_{2.5} and precursors to the airshed = 5.647% or **5.65%**

How do we calculate Kennecott's typical winter day contribution to our airshed?

1. So, we've explained how we determine our annual emissions contribution, but what about winter time contribution? To calculate our winter time emissions contribution, we first have to look at the PM_{2.5} airshed (Salt Lake City Non-Attainment Area) Summary Emissions on a Typical Winter Inversion Weekday, measured by tons per day.

Summary Emissions Typical Winter Inversion Weekday Emissions (tpd)		2008 Baseline (E10_R10DM3)				
NA -Area	Source Category	PM2.5	NOX	VOC	NH3	SO2
Logan, UT-ID	Area Sources	0.452	1.747	6.116	11.614	0.322
	Mobile Sources	0.465	8.252	6.496	0.133	0.086
	NonRoad	0.109	1.055	1.890	0.000	0.066
	Point Sources	0.002	0.017	0.412	0.000	0.000
	Logan, UT-ID Total	1.0	11.1	14.9	11.7	0.5
Provo, UT	Area Sources	1.429	5.473	12.512	6.496	0.225
	Mobile Sources	1.621	31.622	16.788	0.483	0.344
	NonRoad	0.248	2.760	2.437		0.112
	Point Sources	0.258	0.894	0.605	0.284	0.026
	Provo, UT Total	3.6	40.9	32.3	7.3	0.7
Salt Lake City, UT	Area Sources	4.466	21.649	50.426	17.931	0.770
	Mobile Sources	6.142	119.040	65.575	2.037	1.414
	NonRoad	0.933	14.004	12.795		0.753
	Point Sources	4.674	23.676	7.283	0.637	10.178
	Salt Lake City, UT Total	16.2	178.4	136.1	20.6	13.1
Surrounding Areas	Area Sources	9.463	35.538	50.999	185.366	10.310
	Mobile Sources	2.867	65.508	28.559	0.612	0.419
	NonRoad	2.367	9.125	73.491	0.004	0.257
	Point Sources	7.161	185.795	2.664	2.306	113.149
	Surrounding Areas Total	21.9	296.0	155.7	188.3	124.1
Grand Total		42.7	526.4	339.0	227.9	138.4

SLC NAA	PM _{2.5}	NO _x	VOC	NH ₃	SO ₂	
Area	4.466	21.649	50.426	17.931	0.77	
Mobile	6.142	119.04	65.575	2.037	1.414	
Non-Road	0.933	14.004	12.795		0.753	
Point	4.674	23.676	7.283	0.637	10.178	
TOTAL	16.215	178.369	136.079	20.605	13.115	=364.383 tons per day

*Note: NH3 is included as a precursor to PM_{2.5}

2. Now that we know the winter time emissions in the Salt Lake City Non-Attainment Area on a typical winter inversion weekday are 364.383 tons per day, let's look at Kennecott's sources to calculate its contribution.

Salt Lake	Source ID	Source Name	PM2.5	NOX	VOC	NH3	SO2			
	10119	Chevron Refinery	0.462	2.752	0.607	0.024	1.655	0.102	0.931	
	10335	Tesoro Refinery	0.655	1.069	0.748	0.010	2.517	0.653	1.051	
	10346	Kennecott Smelter & Refinery	0.563	0.472	0.027	0.014	2.759	0.774	0.723	
	10348	Murray City Power	0.000	0.005	0.000		0.000	0.000	0.005	
	10354	University of Utah	0.022	0.291	0.021	0.008	0.003	0.041	0.215	
	10355	Pacificorp Gadsby	0.069	0.459	0.033	0.065	0.007	0.067	0.292	
	10414	Central Valley Water	0.004	0.034	0.137	0.000	0.003	0.004	0.033	
	10423	Interstate Brick Brick	0.158	0.105	0.009		0.034	0.209	0.137	
	10562	Olympia Sales Co.	0.013	0.001	0.057	0.000	0.000	0.000	0.001	
	10565	Geneva Rock Point of Mountain	0.071	0.275	0.051		0.038	0.082	0.303	
	10571	Kennecott Mine Concentrator	0.683	8.712	0.516	0.004	0.008	0.829	12.130	
	10572	Kennecott NC-UPP-Lab-Tailings	0.036	0.018	0.006	0.001	0.000	0.035	0.017	
	11386	Hexcel Corporation Salt Lake Operatio	0.047	0.245	0.170	0.072	0.025	0.091	0.323	
	12495	CER Generation II LLC - WVC	0.015	0.039	0.005		0.002	0.015	0.038	
Davis	10120	Bountiful City Power	0.001	0.002	0.000		0.000	0.067	0.216	
	10121	Hill Air Force Base Main	0.032	0.465	0.731	0.005	0.007	0.035	0.513	

KUC	PM2.5	NOX	VOC	NH3	SO2	
Smelter, Refinery	0.563	0.472	0.027	0.014	2.759	
Mine, Concentrator	0.683	8.712	0.516	0.004	0.008	
UPP, Lab, Tailings	0.036	0.018	0.006	0.001	0	
TOTAL	1.282	9.202	0.549	0.019	2.767	= 13.819 tons per day

Note: NH3 is included as a precursor to PM_{2.5}

3. Since we know the total winter time emissions in the Salt Lake City Non-Attainment Area and the total tons per day from Kennecott Utah Copper on a typical winter day, let's calculate Kennecott's contribution.

We can calculate the percentage by dividing Kennecott's contribution (13.819 tons per day) by the Salt Lake City Non-Attainment Area (364.383 tons per day), equaling .0379.

To get the percentage, multiple .0379 by 100 and you will get Kennecott's contribution to emissions on a typical wintertime day = 3.792 or **3.8%**.

It is possible that UDAQ will refine the calculations and basis for the typical winter day inventories. Kennecott will continue to communicate the most accurate information available from the agency.

In conclusion:

- Kennecott Utah Copper's *annual* contribution to PM_{2.5} emissions is **5.65%**
- Kennecott Utah Copper's *typical winter day* contribution to PM_{2.5} emissions is **3.8%** of total emissions.

Note: Since the 2008 statewide inventory was originally released, UDAQ has made minor refinements (latest was November 20, 2010) in order to accurately account for statewide emissions. As a result of refining the inventory, Kennecott's percentage contribution of emissions to the PM_{2.5} airshed has changed slightly from 5.8% to 5.65%. Prior to the revision, we publically stated our contribution as 5.8%. To avoid confusion, we continue to use the more conservative estimate of 5.8%.

Sources:

http://www.airquality.utah.gov/Planning/Emission-Inventory/2008_State/2008_Statewide_SummaryBySources_revised112210.pdf

http://www.airquality.utah.gov/Planning/Emission-Inventory/2008_State/2008_FormB_CountyDetails112210.pdf

http://www.airquality.utah.gov/Public-Interest/Current-Issues/pm2.5/SIP-TSD/TSD_for_Public_Comment_10-1-2012/3_Baseline_and_Projected_Inventories/3_a_General/3_a_ii%20Summary_Tables_2008-2014-2017-2019.pdf

http://www.airquality.utah.gov/Public-Interest/Current-Issues/pm2.5/SIP-TSD/TSD_for_Public_Comment_10-1-2012/3_Baseline_and_Projected_Inventories/3_b_Point%20Sources/3_b_iii_SUMMARY_TABLES_2008_2014_2017_2019.pdf