

AREA SOURCE CATEGORIES

The following sections contain individual reports for the categories included in the Utah Area Source Inventory. Included is an explanation of the emission factors, equations used in calculating the emissions for the category. The references listed at the end of this document are available from UDAQ on request.

The category spreadsheets for the episode years are included in the various annual workbooks. These spreadsheets calculate the emissions and contain a list of assumptions and emission factors for the specific categories. These workbooks are available upon request.

Some categories that are included in the annual workbooks were not used in the modeling process because emissions from these categories do not occur or are minimal during the winter season. The categories not included in the modeling process are designated.

AGRICULTURAL BURNING

NOT INCLUDED IN PM_{2.5} EPISODES

AGRICULTURAL BURNING

This category includes burning of crop chaff, stock, and stubble from farming fields. It is estimated that the fuel loading is 4.5 tons stock per acre.

Fuel Loading and Emission Factors						
Fuel loading	PM ₁₀	PM _{2.5}	CO	NM-VOC	NO _x	SO _x
(tons per acre)	(Lbs per ton fuel)					
4.5	17	17	169	11.6	5	0

The equation used to calculate the agricultural burning emissions is:

$$\text{Pollutant (tons/yr)} = \frac{\text{Acres burned} \times \text{fuel loading (4.5 tons per acre)} \times \text{emission factor (lbs/ton)}}{2000 \text{ lbs/ton}}$$

References

Information from the following references is used to calculate the agricultural burning emissions:

MATERIAL	INFORMATION PROVIDED
“2008 National Emissions Inventory Data & Documentation” from EPA’s website http://www.epa.gov/ttn/chief/net/2008inventory.html (see Reference 7)	Fuel loading and emission factors
"Inventory of Agriculture Burning in Utah” from a survey conducted by Utah State University. (see Reference 48)	Acres burned
2001 - 2009: Data is supplied by Regional Economic Information System, Bureau of Economic Analysis, "Employment by Industry." (Reference 5)	Agricultural employment
“Employment by Area and Industry Detailed Industries” prepared by the Governor’s Office of Planning and Budget. (see Reference 6)	Agricultural employment 2020 through 2050
Telephone conversation with Governor’s Office of Planning and Budget on 2010-2020 employment projections (see 2.b iii Reference 1)	Agricultural employment 2010

AGRICULTURAL HARVESTING

NOT INCLUDED IN PM_{2.5} EPISODES

AGRICULTURAL HARVESTING

This category covers the PM₁₀ and PM_{2.5} stirred up from the field during crop harvesting. It is assumed that all soil conditions remain constant, and the number and nature of tractor movements for a given crop is the same for Utah and California. It is assumed that potato, onions and miscellaneous vegetables acreages remain constant and are distributed using each county's percentage of total harvested crops.

CROP	PM ₁₀ EMISSION FACTOR	UNIT
Wheat	5.80	Lbs/acre
Barley	5.80	Lbs/acre
Corn	1.70	Lbs/acre
Oats	5.80	Lbs/acre
Hay	1.68	Lbs/acre
Potatoes	1.68	Lbs/acre
Onions	1.68	Lbs/acre
Dry Beans	1.68	Lbs/acre
Fruit	.08	Lbs/acre

	Percentage	Average PM _{2.5}
PM _{2.5} % of PM ₁₀	15%	0.43

The equation used to calculate the agricultural harvesting emissions is:

$$PM_{10} \text{ (tons/yr)} = \frac{\text{Harvested acres} \times \text{emission factor}}{2000 \text{ lbs/ton}}$$

$$PM_{2.5} \text{ (tons/yr)} = PM_{10} \times 0.15$$

References

Information from the following references is used to calculate the agricultural harvesting emissions:

MATERIAL	INFORMATION PROVIDED
Western Governors' Association's "WRAP Fugitive Dust Handbook," Chapter 10, September 7, 2006 (see Reference 56)	Emission factors and calculation method
"Utah Agricultural Statistics and Utah Department of Agricultural and Food Annual Report" for the years 2007, 2008, 2009, and 2010 prepared by the Utah Department of Agriculture and Food and the United States Department of Agriculture National Agricultural Statistics Service (see Reference 33)	Acres of crops harvested

AGRICULTURAL LAND PREPARATION

NOT INCLUDED IN PM_{2.5} EPISODES

AGRICULTURAL LAND PREPARATION

This category covers the PM₁₀ and PM_{2.5} stirred up from the field during the preparation for crop planting. It is assumed that all soil conditions remain constant, and the number and nature of tractor movements for a given crop is the same for Utah and California. It is assumed that potato, onions, and miscellaneous vegetables acreages remain constant and distributed using each county's percentage of total harvested crops.

POLLUTANT	EMISSION FACTOR	UNIT
PM ₁₀	4.04	Lbs/acre-pass
PM _{2.5}	20%	PM ₁₀

TRACTOR PASSES PER ACRE	
CROP TYPE	PASSES PER ACRE
Wheat	4
Barley	6
Corn	6
Oats	3
Hay	1.25
Potatoes	3
Misc. crops	3
Dry Beans	3

The equations used to calculate the agricultural preparation emissions are:

$$PM_{10} \text{ (tons/yr)} = \frac{\text{Harvested acres} \times \text{passes per acre} \times \text{emission factor}}{2000 \text{ lbs/ton}}$$

$$PM_{2.5} \text{ (tons/yr)} = PM_{10} \times 0.20$$

References

Information from the following references is used to calculate the agricultural land preparation emissions:

MATERIAL	INFORMATION PROVIDED
<p>“Agricultural Soil Preparation Fugitive Dust Emissions” presented by Patrick Gaffney to the Western Sources Air Resources Council on July 25, 1996, (see Reference 57)</p>	<p>Annual passes per acre for specific crops and PM₁₀ per acre-pass emission factor</p>
<p>“Session VII Reconciling Fugitive Dust Emissions w/Ambient Data” presented by Thompson G. Pace of US EPA in Denver, Colorado on March 2004 (see Reference 59)</p>	<p>Annual passes per acre for specific crops</p>
<p>“Examination of the Multiplier Used to Estimate PM_{2.5} Fugitive Dust Emissions from PM₁₀” by Thompson G. Pace of US EPA (see Reference 58)</p>	<p>Percentage of PM10 that is PM2.5</p>
<p>“Utah Agricultural Statistics and Utah Department of Agricultural and Food Annual Report” for the years 2007, 2008, 2009, and 2010 prepared by the Utah Department of Agriculture and Food and the United States Department of Agriculture National Agricultural Statistics Service (see Reference 33)</p>	<p>Acres of crops harvested</p>

AGRICULTURAL, LIVESTOCK

AGRICULTURAL, LIVESTOCK

This category covers PM₁₀, PM_{2.5}, VOCs, and NH₃ from various types of livestock. It includes sheep, swine, turkeys, chickens, and cattle.

The emission factors are as follows:

LIVESTOCK	VOC (LBS/HEAD/YR)	NH ₃ (LBS/HEAD/YR)
Cattle	12.8	50.5
Chickens	0.19	.593
Turkeys	0.19	1.89
Swine	4.6	20.30
Sheep	0.96	7.43

The equations to calculate the livestock emissions are:

$$\text{VOC (tons/yr)} = \frac{\text{Number of animals annualized} \times \text{emission factor}}{2000 \text{ lbs/ton}}$$

$$\text{NH}_3 \text{ (tons/yr)} = \frac{\text{Number of animals annualized} \times \text{emission factor}}{2000 \text{ lbs/ton}}$$

Note: Turkeys and hogs are assumed to live 6 months from birth to market.

It is estimated that 10 percent of beef cattle are in feedlots during a year and each animal creates 17 pounds of PM₁₀ per year.

The equations to calculate the PM₁₀ and PM_{2.5} emissions from feedlots are:

$$\text{PM}_{10} \text{ (tons/year)} = \frac{\text{total number of cattle} \times 0.1 \text{ (\% in feedlots)} \times 17 \text{ (lbs/head/yr)}}{2000 \text{ lbs/ton}}$$

$$\text{PM}_{2.5} \text{ (tons/year)} = \text{PM}_{10} \times 0.15$$

The equations to calculate the PM₁₀ and PM_{2.5} emissions from dairy cattle are:

$$\text{PM}_{10} \text{ (tons/year)} = \frac{\text{number of milk cows} \times 2.45 \text{ (lbs/head/yr)}}{2000 \text{ lbs/ton}}$$

$$\text{PM}_{2.5} \text{ (tons/year)} = \text{PM}_{10} \times 0.15$$

References

Information from the following references is used to calculate the emissions from livestock:

MATERIAL	INFORMATION PROVIDED
EPA's "Emission Inventory Improvement Program, Fugitive Dust from Beef Cattle Feedlots"	Percentage of cattle in feedlots and PM ₁₀ emission factor
"Utah Agricultural Statistics and Utah Department of Agricultural and Food Annual Report" for the years 2007, 2008, 2009, and 2010 prepared by the Utah Department of Agriculture and Food and the United States Department of Agriculture National Agricultural Statistics Service (see Reference 33)	Animal population
"Development and Selection of Ammonia Emission Factors" (Battye Report), by R. Battye, et al., Aug. 1994, Table 7-1 (see Reference 60)	Ammonia emission factors
California Air Resource Board's "Section 7.6 Livestock Husbandry" report (see Reference 61)	VOC emission factors
Norbest website: www.norbest.com/a_moroni_fees.cfm (see Reference 34)	Number of turkeys
"Derivation of Agricultural Gas-Phase Ammonia Emissions and Application to the Cache Valley" 2007 thesis by Kori D. Moore (see Reference 62)	Percentage of cattle in feedlots, Cache County head counts
Western Governors' Association's "WRAP Fugitive Dust Handbook," Chapter 13, September 7, 2006 (see Reference 56)	PM ₁₀ Emission factor for diary cattle

AGRICULTURAL UNPAVED ROADS

AGRICULTURAL UNPAVED ROADS

This category covers PM₁₀ and PM_{2.5} from unpaved agricultural roads. It is assumed that there is 175-vehicle miles travel (VMT) per each 40-acre parcel of land harvested. This equates to 4.375 VMT per acre.

Pollutant	Emission Factor	Unit
PM ₁₀	2.27	Lbs/VMT

The PM₁₀ estimates are made using the following equation:

$$PM_{10} \text{ (tons/year)} = \frac{\text{Acres harvested} \times 4.375 \text{ VMT/acre} \times 2.27 \text{ lbs/VMT}}{2000 \text{ lbs/ton}}$$

$$PM_{2.5} \text{ (tons/year)} = PM_{10} \times 0.1$$

References

Information from the following references is used to calculate the agricultural unpaved roads emissions:

MATERIAL	INFORMATION PROVIDED
“Utah Agricultural Statistics and Utah Department of Agricultural and Food Annual Report” for the years 2007, 2008, 2009, and 2010 prepared by the Utah Department of Agriculture and Food and the United States Department of Agriculture National Agricultural Statistics Service (see Reference 33)	Acres harvested.
“Reconciling Urban Fugitive Dust Emissions Inventory and Ambient Source Contribution Estimates: Summary of Current Knowledge and Needed Research,” John G. Watson and Judith C. Chow, May 2000, Page 3-24 (see Reference 63)	VMT per acre and PM ₁₀ emission factor
Western Governors’ Association’s “WRAP Fugitive Dust Handbook” (see Reference 56)	PM _{2.5} emission factor

ANIMALS, DOMESTIC

ANIMALS, DOMESTIC

This category covers NH₃ from dogs and cats.

The emission factors are as follows:

Animal Type	Animal Ratio to Population	Emission Factors (lbs/animal/year)
Cat	.083	.348
Dog	.122	2.17

The estimates of animals are made using the following equation:

$$\text{Number of Animals} = \text{Population} \times \text{Animal Ratio}$$

The NH₃ estimates are made using the following equation:

$$\text{NH}_3 \text{ (tons/year)} = \frac{\text{\# of Animals} \times \text{Emission Factor}}{2000 \text{ lbs/ton}}$$

References

Information from the following references is used to calculate the wild animal emissions:

MATERIAL	INFORMATION PROVIDED
“Utah Population Estimates Committee Total Population by County: 1940 – 2009,” Governor’s Office of Planning and Budget (see Reference 1)	Population
“Population by Area,” Governor’s Office of Planning and Budget, 2008 Baseline Projections,” (see Reference 2)	Population
“Development of an Updated Gridded Ammonia Emission Inventory for the Southern California Air Basin,” Environ International Corporation (see Reference 65)	Emission factors
“Development of the Ammonia Emission Inventory for the Southern California Air Quality Study,” Page G-4 and G-5, September 1991, Radian Corporation (see Reference 64)	Ratio of cats and dogs to population

ANIMALS, WILD

ANIMALS, WILD

This category covers NH₃ from wild animals. It includes antelope, elk, moose, and deer. Other animals are considered significantly small to be covered by “Biogenic NH₃” that is estimated in another section of this inventory.

Animal Type	Emission Factors Lbs NH₃/head per year
Antelope	6.3 (no SCC)
Deer	10
Elk	37.8
Moose	56 (no SCC)

The NH₃ estimates are made using the following equation:

$$\text{NH}_3 \text{ (tons/year)} = \frac{\# \text{ of Head} \times \text{Emission Factor}}{2000 \text{ lbs/ton}}$$

References

Information from the following references is used to calculate the wild animal emissions:

MATERIAL	INFORMATION PROVIDED
“Technical Support Study 15: Evaluation and Improvement of Methods for Determining Ammonia Emissions in the San Joaquin Valley,” Table 2.5, dated January 23, 1998 (see Reference 66)	Emission Factors
E-mail from Steve Cranney, Jim Karpowitz, and Steve Flinders of the Utah Department of Natural Resources (see Reference 36)	Head count
“Utah Big Game Annual Report” for the years 2006, 2007, and 2008 Utah Division of Wildlife Resources (see Reference 35)	Head count

ASPHALT PAVING

**EMULSIFIED ASPHALT NOT INCLUDED IN PM_{2.5} EPISODES BECAUSE IT
CANNOT BE LAID DURING COLD WEATHER**

ASPHALT PAVING

Emissions were determined using the amount of cutback and emulsified paving asphalt used in Utah in 2006.

The equation used to estimate VOC emissions from the asphalt is as follows:

$$\text{VOC} = \frac{\text{Barrels Used/county} \times \text{Emission Factor}}{2000 \text{ lbs/ton}}$$

Cutback Emission Factor – 88 lbs/barrel

Emulsified Emission Factor – 9.2 lbs/barrel

The amount of asphalt statewide from paving roads was ratioed to individual counties using lane miles of pavement in each county. The vehicle miles traveled growth rate was used to estimate amount of asphalt used for years other than 2006.

References

Information from the following references is used to calculate the asphalt paving emissions:

MATERIAL	INFORMATION PROVIDED
“2008 National Emissions Inventory Data & Documentation” from EPA’s website http://www.epa.gov/ttn/chief/net/2008inventory.html (see Reference 7)	Emission factors and calculation equation
“Lane Miles,” Utah Department of Transportation contact (see Reference 37)	1997 through 2009 historical lane miles of pavement by county
“Utah Air Quality Rules,” Effective 6-3-2010 R307-341 (see Reference 83)	Cutback Asphalt rules

AUTOBODY REFINISHING

AUTOBODY REFINISHING

This category includes emissions from autobody refinishing. The VOC emission factor used for this category is 89 lbs/employee/year.

The equation used to calculate VOC from autobody refinishing is as follows:

$$\text{VOC (tons/year)} = \frac{89 \text{ lbs/employee/year} \times \text{employees}}{2000 \text{ lbs/ton}} - \text{Any double counting from point sources}$$

References

Information from the following references is used to calculate the autobody refinishing emissions:

MATERIAL	INFORMATION PROVIDED
“2008 National Emissions Inventory Data & Documentation” from EPA’s website http://www.epa.gov/ttn/chief/net/2008inventory.html (see Reference 7)	Employees and emission factor.
Query from UDAQ database for point source emissions within the domain (see Reference 42)	Double counting information
“Utah Population Estimates Committee Total Population by County: 1940 – 2009,” Governor’s Office of Planning and Budget (see Reference 1)	Population used for projections
“Population by Area,” Governor’s Office of Planning and Budget, 2008 Baseline Projections,” (see Reference 2)	Population

BAKERY – YEAST

BAKERY – YEAST

This category estimates the VOCs from yeast emissions. It does not include fuel consumption emissions. It is estimated that each person eats 70 lbs of leavened products per year.

The VOC emission factors are listed in the following table:

PRODUCT TYPE	EMISSION FACTOR (Lbs of VOC/1000 lbs of product)	ESTIMATED CONSUMPTION FRACTIONS
Straight-dough	0.5	25 %
Sponge-dough (midpoint)	6.5	75 %
Weighted Average	5.0	

The VOC from this category is calculated using the following equation:

$$\text{VOC (tons/year)} = \frac{\text{County population} \times 70 \text{ lbs per person} \times \text{Weighted Ave. Emission Factor}}{2000 \text{ lbs/ton}}$$

References

Information from the following references is used to calculate the yeast emissions from bakeries:

MATERIAL	INFORMATION PROVIDED
“Utah Population Estimates Committee Total Population by County: 1940 – 2009,” Governor’s Office of Planning and Budget (see Reference 1)	Population
“Population by Area,” Governor’s Office of Planning and Budget, 2008 Baseline Projections,” (see Reference 2)	Population
“Emissions Inventory Improvement Program (EIIP),” Vol. III, “Area Source Category Method Abstract – Bakeries”	Product consumption factor and emission factors

BIOGENICS

NOT INCLUDED IN PM_{2.5} EPISODES

BIOGENICS

This category was not included in the PM_{2.5} SIP inventory because of the temperature during episode days.

CHARCOAL GRILLING

CHARCOAL GRILLING

This category includes charcoal grilling and charbroiling. It is estimated that an average restaurant with a charbroiler cooks 1,160 lbs of ground beef weekly. The number of restaurants in Salt Lake City and Davis County was determined. Using this data, in conjunction with population estimates, led to the following estimates:

TYPE OF EQUIPMENT	TONS OF MEAT/PERSON
Chain-Driven Charcoal Grilling	0.00654
Underfired Charcoal Broilers	0.02044
Deep Fat Frying	0.10053
Flat Griddle	0.03060
Clamshell Griddle	0.01122

The VOC emission factors for this category are as follows:

EQUIPMENT	VOC EMISSION FACTOR	UNIT
Chain-Driven Charbroilers	4.0021	Lbs/ton of meat
Underfired Charbroilers	3.9183	Lbs/ton of meat
Deep Fat Frying	0.1290	Lbs/ton of meat
Flat Griddle Frying	0.3551	Lbs/ton of meat
Clamshell Griddles	0.0365	Lbs/ton of meat

The CO emission factors for this category are as follows:

EQUIPMENT	CO EMISSION FACTOR	UNIT
Chain-Driven Charbroilers	13.3648	Lbs/ton of meat
Underfired Charbroilers	12.8175	Lbs/ton of meat
Deep Fat Frying	0	Lbs/ton of meat
Flat Griddle Frying	0.7332	Lbs/ton of meat
Clamshell Griddles	0	Lbs/ton of meat

The PM₁₀ emission factors for this category are as follows:

EQUIPMENT	PM₁₀ EMISSION FACTOR	UNIT
Chain-Driven Charbroilers	15.9961	Lbs/ton of meat
Underfired Charbroilers	32.6661	Lbs/ton of meat
Deep Fat Frying	0	Lbs/ton of meat
Flat Griddle Frying	5.9225	Lbs/ton of meat
Clamshell Griddles	1.0061	Lbs/ton of meat

The PM_{2.5} emission factors for this category are as follows:

EQUIPMENT	PM_{2.5} EMISSION FACTOR	UNIT
Chain-Driven Charbroilers	15.5062	Lbs/ton of meat
Underfired Charbroilers	31.5779	Lbs/ton of meat
Deep Fat Frying	0	Lbs/ton of meat
Flat Griddle Frying	4.5011	Lbs/ton of meat
Clamshell Griddles	0.8523	Lbs/ton of meat

The emission estimates were calculated using the following equation:

$$\text{Pollutant (tons/year)} = \frac{\text{County population} \times \text{tons of meat/person} \times \text{emission factor}}{2000 \text{ lbs/ ton}}$$

References

Information from the following references is used to calculate the charcoal grilling emissions:

MATERIAL	INFORMATION PROVIDED
“Emission Inventory Improvement Program (EIIP),” Vol. III, (12/00 ed.), “Area Source Category Method Abstract – Charcoal Broiling”	Calculation methodology
“Restaurants in Davis County, Utah,” Davis County Government website (see Reference 67)	Number of restaurants
“Chefmoz Dining Guide,” chefmoz website (see Reference 68)	Number of restaurants in Salt Lake County
“Utah Population Estimates Committee Total Population by County: 1940 – 2009,” Governor’s Office of Planning and Budget (see Reference 1)	Population
“Population by Area,” Governor’s Office of Planning and Budget, 2008 Baseline Projections,” (see Reference 2)	Population
"Documentation for the Final 2002 Nonpoint Sector (Feb 2006 version) National Emission Inventory for Criteria and Hazardous Air Pollutants," Appendix A-16 (see Reference 55)	Emission factors

COMBUSTION

COAL

COMBUSTION COAL - COMMERCIAL

The amount of coal burned is for the entire state. The number of units that heat with coal is used to distribute the coal among the counties.

The residential usage is assumed to be five percent of the coal used in the county and commercial usage is assumed to be 95 percent of the coal used in the county.

The emission factors used in the calculations are as follows:

POLLUTANT	EMISSION FACTOR	UNIT
VOC	.05	lbs/ton
NO _x	11	lbs/ton
CO	5	lbs/ton
SO _x	30.4	lbs/ton
PM ₁₀	13.04	lbs/ton
PM _{2.5}	2.44	lbs/ton

Coal distribution ratio was calculated as follows:

All coal burning units were summed. A ratio was calculated by dividing the individual county units by the total state units. The total coal burned in the state (less point source usage) was multiplied by each county ratio to find the amount of coal burned in a particular county.

The emission estimates were calculated using the following equation:

$$\text{Pollutant} = \frac{\text{Tons of coal burned in the county} \times \text{emission factor}}{2000 \text{ lbs/ton}} - \text{Point Source Usage}$$

References

Information from the following references is used to calculate the residential coal-burning emissions:

MATERIAL	INFORMATION PROVIDED
"Table DP-1. Profile of General Demographic Characteristics: 2000," from U.S. Census Bureau, Census 2000 (see Reference 20)	Units burning with coal by county
"Annual Review and Forecast of Utah Coal Production and Distribution 2008" Table A4, entitled "Consumption of Coal in Utah by End Use, 1960-2009 (see Reference 21)	Utah consumption of coal by residential and commercial users
"Documentation for the Final 2002 Nonpoint Sector (Feb 2006 version) National Emission Inventory for Criteria and Hazardous Air Pollutants," Appendix A-39 (see Reference 55)	Emission factors
Query of UDAQ database for point sources burning coal (see Reference 23)	Double counting information

COMBUSTION COAL - RESIDENTIAL

The amount of coal burned is for the entire state. The number of homes that heat with coal is used to distribute the coal among the counties.

The residential usage is assumed to be five percent of the coal used in the county and commercial usage is assumed to be 95 percent of the coal used in the county.

The emission factors used in the calculations are as follows:

POLLUTANT	EMISSION FACTOR	UNIT
VOC	10	lbs/ton
NO _x	9.1	lbs/ton
CO	275	lbs/ton
SO _x	24.818.6	lbs/ton
PM ₁₀	6.24	lbs/ton
PM _{2.5}	3.84	lbs/ton

Coal distribution ratio was calculated as follows:

All coal burning units were summed. A ratio was calculated by dividing the individual county units by the total state units. The total coal burned in the state was multiplied by each county ratio to find the amount of coal burned in a particular county.

The emission estimates were calculated using the following equation:

$$\text{Pollutant} = \frac{\text{Tons of coal burned in the county} \times \text{emission factor}}{2000 \text{ lbs/ton}}$$

References

Information from the following references is used to calculate the residential coal-burning emissions:

MATERIAL	INFORMATION PROVIDED
“Table DP-1. Profile of General Demographic Characteristics: 2000,” from U.S. Census Bureau, Census 2000 (see Reference 20)	Units burning with coal by county
“Annual Review and Forecast of Utah Coal Production and Distribution 2008” Table A4, entitled “Consumption of Coal in Utah by End Use, 1960-2009 (see Reference 21)	Utah consumption of coal by residential and commercial users
“2008 National Emissions Inventory Data & Documentation” from EPA’s website http://www.epa.gov/ttn/chief/net/2008inventory.html (see Reference 7)	Residential Emission factors

COMBUSTION

KEROSENE

COMBUSTION KEROSENE – COMMERCIAL

The amount of kerosene burned is for the entire state. The number of units that heat with kerosene is used to distribute the kerosene among the counties.

The split between residential and commercial is calculated using the consumption of petroleum products in Utah by end use to find the percentage of residential and percentage of commercial usage.

The emission factors used in the calculations are as follows:

POLLUTANT	EMISSION FACTOR	UNIT
VOC	0.3279	lbs/1000 gals
NO _x	19.29	lbs/1000 gals
CO	4.82	lbs/1000 gals
SO _x	284	lbs/1000 gals
PM ₁₀	2.295	lbs/1000 gals
PM _{2.5}	2.0539	lbs/1000 gals

Kerosene distribution ratio was calculated as follows:

All kerosene burning units were summed. A ratio was calculated by dividing the individual county units by the total state units. The total kerosene burned in the state (less point source usage) was multiplied by each county ratio to find the amount of kerosene burned in a particular county.

The emission estimates were calculated using the following equation:

$$\text{Pollutant} = \frac{\text{Gallons of kerosene burned in the county} \times \text{emission factor}}{2000 \text{ lbs/ton}}$$

References

Information from the following references is used to calculate the commercial kerosene-burning emissions:

MATERIAL	INFORMATION PROVIDED
"Table DP-1. Profile of General Demographic Characteristics: 2000," from U.S. Census Bureau, Census 2000 (see Reference 20)	Units burning with kerosene by county
"Utah Energy and Mineral Statistics," Table 3.18 entitled "Consumption of Petroleum Products in Utah, 1960-2009" and Table 3.19 entitled "Consumption of Petroleum Products in Utah by End Use, 1960-2008" (see Reference 14)	Utah consumption of kerosene by Commercial users
"Documentation for the Final 2002 Nonpoint Sector (Feb 2006 version) National Emission Inventory for Criteria and Hazardous Air Pollutants," Appendix A-48 (see Reference 55)	Emission factors
Query of UDAQ database for point sources burning kerosene (see Reference 26)	Double counting information
"Emission Inventory Improvement Program (EIIP)," Vol. III, (12/00 ed.), "Area Source Category Abstract – Fuel Oil and Kerosene Combustion"	Calculation methodology
"Utah Population Estimates Committee Total Population by County: 1940 – 2009," Governor's Office of Planning and Budget (see Reference 1)	Population
"Population by Area," Governor's Office of Planning and Budget, 2008 Baseline Projections," (see Reference 2)	Population

COMBUSTION KEROSENE – RESIDENTIAL

The amount of kerosene burned is for the entire state. The number of units that heat with kerosene is used to distribute the kerosene among the counties.

The split between residential and commercial is calculated using the consumption of petroleum products in Utah by end use to find the percentage of residential and percentage of commercial usage.

The emission factors used in the calculations are as follows:

POLLUTANT	EMISSION FACTOR	UNIT
VOC	28.4	lbs/1000 gals
NO _x	729	lbs/1000 gals
CO	202.5	lbs/1000 gals
SO _x	1725.3	lbs/1000 gals
PM ₁₀	96.39	lbs/1000 gals
PM _{2.5}	86.265	lbs/1000 gals

Kerosene distribution ratio was calculated as follows:

All kerosene burning units were summed. A ratio was calculated by dividing the individual county units by the total state units. The total kerosene burned in the state was multiplied by each county ratio to find the amount of kerosene burned in a particular county.

The emission estimates were calculated using the following equation:

$$\text{Pollutant} = \frac{\text{Gallons of kerosene burned in the county} \times \text{emission factor}}{2000 \text{ lbs/ton}}$$

References

Information from the following references is used to calculate the residential kerosene-burning emissions:

MATERIAL	INFORMATION PROVIDED
“Table DP-1. Profile of General Demographic Characteristics: 2000,” from U.S. Census Bureau, Census 2000 (see Reference 20)	Units burning with kerosene by county
“Utah Energy and Mineral Statistics,” Table 3.18 entitled “Consumption of Petroleum Products in Utah, 1960-2008” and Table 3.19 entitled “Consumption of Petroleum Products in Utah by End Use, 1960-2008” (see Reference 14)	Utah consumption of kerosene by residential users
“2008 National Emissions Inventory Data & Documentation” from EPA’s website http://www.epa.gov/ttn/chief/net/2008inventory.html (see Reference 7)	Emission factors
“Emission Inventory Improvement Program (EIIP),” Vol. III, (12/00 ed.), “Area Source Category Abstract – Fuel Oil and Kerosene Combustion”	Calculation methodology
“Utah Population Estimates Committee Total Population by County: 1940 – 2009,” Governor’s Office of Planning and Budget (see Reference 1)	Population
“Population by Area,” Governor’s Office of Planning and Budget, 2008 Baseline Projections,” (see Reference 2)	Population growth rate

COMBUSTION

LPG

COMBUSTION LPG – COMMERCIAL

The amount of LPG burned is for the entire state. The number of units that heat with LPG is used to distribute the LPG among the counties.

The split between residential and commercial is calculated using the consumption of petroleum products in Utah by end use to find the percentage of residential and percentage of commercial usage.

The emission factors used in the calculations are as follows:

POLLUTANT	EMISSION FACTOR	UNIT
VOC	20.0926	lbs/kbbls
NO _x	365.32	lbs/kbbls
CO	306.8688	lbs/kbbls
SO _x	2.19192	lbs/kbbls
PM ₁₀	27.76432	lbs/kbbls
PM _{2.5}	27.76432	lbs/kbbls

LPG distribution ratio was calculated as follows:

All LPG burning units were summed. A ratio was calculated by dividing the individual county units by the total state units. The total LPG burned in the state (less point source usage) was multiplied by each county ratio to find the amount of LPG burned in a particular county.

The emission estimates were calculated using the following equation:

$$\text{Pollutant} = \frac{\text{kbbls of LPG burned in the county} \times \text{emission factor}}{2000 \text{ lbs/ton}}$$

References

Information from the following references is used to calculate the commercial LPG emissions:

MATERIAL	INFORMATION PROVIDED
"Table DP-1. Profile of General Demographic Characteristics: 2000," from U.S. Census Bureau, Census 2000 (see Reference 20)	Units burning with LPG by county
"Utah Energy and Mineral Statistics," Table 3.18 entitled "Consumption of Petroleum Products in Utah, 1960-2008" and Table 3.19 entitled "Consumption of Petroleum Products in Utah by End Use, 1960-2008" (see Reference 14)	Utah consumption of LPG by commercial users
"Documentation for the Final 2002 Nonpoint Sector (Feb 2006 version) National Emission Inventory for Criteria and Hazardous Air Pollutants," Appendix A-52 (see Reference 55)	Emission factors
Query of UDAQ database for point sources burning LPG (see Reference 27)	Double counting information
"Utah Population Estimates Committee Total Population by County: 1940 – 2009," Governor's Office of Planning and Budget (see Reference 1)	Population
"Population by Area," Governor's Office of Planning and Budget, 2008 Baseline Projections," (see Reference 2)	Population growth rate

COMBUSTION LPG – RESIDENTIAL

The amount of LPG burned is for the entire state. The number of units that heat with LPG is used to distribute the LPG among the counties.

The split between residential and commercial is calculated using the consumption of petroleum products in Utah by end use to find the percentage of residential and percentage of commercial usage.

The emission factors used in the calculations are as follows:

POLLUTANT	EMISSION FACTOR	UNIT
VOC	21.9110	lbs/kbbls
NO _x	562.8	lbs/kbbls
CO	159.6	lbs/kbbls
SO _x	2.3903	lbs/kbbls
PM ₁₀	2.0716	lbs/kbbls
PM _{2.5}	1.71304	lbs/kbbls

LPG distribution ratio was calculated as follows:

All LPG burning units were summed. A ratio was calculated by dividing the individual county units by the total state units. The total LPG burned in the state was multiplied by each county ratio to find the amount of LPG burned in a particular county.

The emission estimates were calculated using the following equation:

$$\text{Pollutant} = \frac{\text{Gallons of LPG burned in the county} \times \text{emission factor}}{2000 \text{ lbs/ton}}$$

References

Information from the following references is used to calculate the residential LPG emissions:

MATERIAL	INFORMATION PROVIDED
<p>“Table DP-1. Profile of General Demographic Characteristics: 2000,” from U.S. Census Bureau, Census 2000 (see Reference 20)</p>	<p>Units burning with LPG by county</p>
<p>“Utah Energy and Mineral Statistics,” Table 3.18 entitled “Consumption of Petroleum Products in Utah, 1960-2008” and Table 3.19 entitled “Consumption of Petroleum Products in Utah by End Use, 1960-2008” (see Reference 14)</p>	<p>Utah consumption of LPG by residential users</p>
<p>“2008 National Emissions Inventory Data & Documentation” from EPA’s website http://www.epa.gov/ttn/chief/net/2008inventory.html (see Reference 7)</p>	<p>Emission factors</p>
<p>“Utah Population Estimates Committee Total Population by County: 1940 – 2009,” Governor’s Office of Planning and Budget (see Reference 1)</p>	<p>Population</p>
<p>“Population by Area,” Governor’s Office of Planning and Budget, 2008 Baseline Projections,” (see Reference 2)</p>	<p>Population growth rate</p>

COMBUSTION

NATURAL GAS

COMBUSTION NATURAL GAS

Questar Gas Company reported the natural gas consumption on a county level in 2005 through 2008. The 2008 amount was grown by the percent the population increased for the years 2009 and 2010.

Questar Gas Company estimates that there is 1,075 Btu per cubic foot of gas at standard conditions.

Residential burning

The following table lists the emission factors for residential burning of natural gas:

POLLUTANT	EMISSION FACTOR (LBS/MMCF)
VOC	5.5
CO	40
NO _x	94
SO _x	0.6
PM ₁₀	.52
PM _{2.5}	.43

The emission estimates are calculated using the following equation:

$$\begin{array}{l} \text{Total amount} \\ \text{of natural gas} \\ \text{burned (MMCF)} \end{array} \times \frac{\text{Pollutant emission factor}}{2000 \text{ lbs/ton}} = \text{Tons of pollutant}$$

Commercial and Institutional burning

The following table lists the emission factors for commercial and institutional burning of natural gas:

POLLUTANT	EMISSION FACTOR (LBS/MMCF)
VOC	5.5
CO	84
NO _x	100
SO _x	0.6
PM ₁₀	7.6
PM _{2.5}	7.6

The natural gas burned by point sources within the domain is subtracted from the total commercial and institutional natural gas reported for the county. This prevents counting the emissions in both the Area Source Inventory and the Point Source Inventory (double counting).

References

Information from the following references is used in calculating the emissions from natural gas burning:

MATERIAL	INFORMATION PROVIDED
Letter dated October 23, 1991, from Roland Gow of Questar Gas Company (see Reference 69)	1,075 Btu per cubic foot of gas
Natural gas consumption by county Questar Gas Company (see Reference 29)	Natural gas consumption
“Utah Population Estimates Committee Total Population by County: 1940 – 2009,” Governor’s Office of Planning and Budget (see Reference 1)	Population
“Population by Area,” Governor’s Office of Planning and Budget, 2008 Baseline Projections,” (see Reference 2)	Population growth rate
Query of UDAQ database for point sources burning Natural Gas (see Reference 30)	Double counting information
"Documentation for the Final 2002 Nonpoint Sector (Feb 2006 version) National Emission Inventory for Criteria and Hazardous Air Pollutants," Appendix A-54 and Appendix A-140 (see Reference 55)	Commercial emission factors
“2008 National Emissions Inventory Data & Documentation” from EPA’s website http://www.epa.gov/ttn/chief/net/2008inventory.html (see Reference 7)	Residential emission factors
“Development and Selection of Ammonia Emission Factors” (Battye Report), by R. Battye, et al., Aug. 1994, Table 7-1 (see Reference 60)	Ammonia emission factors

COMBUSTION

OIL

COMBUSTION OIL – DISTILLATE

Distillate residential and commercial oil is included in this category. The amount of oil burned is for the entire state. The number of units heating with oil is used to distribute the oil to the county level.

The split between residential and commercial is calculated using the consumption of petroleum products in Utah by end use to find the percentage of residential and percentage of commercial usage.

The equation used to split residential and commercial oil is:

$$\text{Residential Oil} = \text{Total distillate oil burned in Utah} \times \frac{\text{percentage of residential consumption}}{\text{consumption}}$$

$$\text{Commercial Oil} = \text{Total distillate oil burned in Utah} \times \frac{\text{percentage of commercial consumption}}{\text{consumption}}$$

The emission factors used in the calculations for residential distillate oil are as follows:

POLLUTANT	EMISSION FACTOR	UNIT
VOC	0.7	lbs/kgals
NO _x	18	lbs/kgals
CO	5	lbs/kgals
SO _x	42.6	lbs/kgals
PM ₁₀	2.38	lbs/kgals
PM _{2.5}	2.13	lbs/kgals

Residential oil distribution ratio was calculated as follows:

All oil burning units were summed. A ratio was calculated by dividing the individual county units by the total state units. The total residential oil burned in the state was multiplied by each county ratio to find the amount of oil burned in a particular county.

The emission estimates were calculated using the following equation:

$$\text{Pollutant} = \frac{\text{kgallons of residential oil burned in the county} \times \text{emission factor}}{2000 \text{ lbs/ton}}$$

Commercial distillate oil

The following table lists the emission factors for commercial distillate oil:

POLLUTANT	EMISSION FACTOR	UNITS
VOC	0.34	Lbs/kgals
NO _x	20	Lbs/kgals
CO	5	Lbs/kgals
SO _x	43.2	Lbs/kgals
PM ₁₀	2.38	Lbs/kgals
PM _{2.5}	2.13	Lbs/kgals

Commercial oil distribution ratio was calculated as follows:

All oil burning units were summed. A ratio was calculated by dividing the individual county units by the total state units. The total commercial oil burned in the state (less point source usage) was multiplied by each county ratio to find the amount of oil burned in a particular county.

The emission estimates were calculated using the following equation:

$$\text{Pollutant} = \frac{\text{kgallons of commercial oil burned in the county} \times \text{emission factor}}{2000 \text{ lbs/ton}}$$

References

Information from the following references is used in calculating the emissions from distillate oil burning:

MATERIAL	INFORMATION PROVIDED
"Table DP-1. Profile of General Demographic Characteristics: 2000," from U.S. Census Bureau, Census 2000 (see Reference 20)	Units burning with distillate oil by county
"Utah Energy and Mineral Statistics," Table 3.18 entitled "Consumption of Petroleum Products in Utah, 1960-2008" and Table 3.19 entitled "Consumption of Petroleum Products in Utah by End Use, 1960-2008" (see Reference 14)	Oil consumption and residential and commercial split
"Utah Population Estimates Committee Total Population by County: 1940 – 2009," Governor's Office of Planning and Budget (see Reference 1)	Population
"Population by Area," Governor's Office of Planning and Budget, 2008 Baseline Projections," (see Reference 2)	Population growth rate
Query of UDAQ database for point sources burning Distillate Oil (see Reference 25)	Double counting information
"Documentation for the Final 2002 Nonpoint Sector (Feb 2006 version) National Emission Inventory for Criteria and Hazardous Air Pollutants," Appendix A-138 (see Reference 55)	Commercial Emission factors
"2008 National Emissions Inventory Data & Documentation" from EPA's website http://www.epa.gov/ttn/chief/net/2008inventory.html (see Reference 7)	Residential emission factors

COMBUSTION OIL - RESIDUAL

Residual residential and commercial oil is included in this category. The amount of oil burned is for the entire state. The number of units heating with oil is used to distribute the oil to the county level.

The split between residential and commercial is calculated using the consumption of petroleum products in Utah by end use to find the percentage of residential and percentage of commercial usage.

The equation used to split residential and commercial oil is:

Residential Oil = Total residual oil burned in Utah x percentage of residential
consumption

Commercial Oil = Total residual oil burned in Utah x percentage of commercial
consumption

The emission factors used in the calculations for residential residual oil are as follows:

POLLUTANT	EMISSION FACTOR	UNIT
VOC	0.713	lbs/kgals
NO _x	18	lbs/kgals
CO	5	lbs/kgals
SO _x	43.2	lbs/kgals
PM ₁₀	1.62	lbs/kgals
PM _{2.5}	1.3	lbs/kgals

Residential residual oil distribution ratio was calculated as follows:

All oil burning units were summed. A ratio was calculated by dividing the individual county units by the total state units. The total residential oil burned in the state was multiplied by each county ratio to find the amount of oil burned in a particular county.

The emission estimates were calculated using the following equation:

Pollutant = $\frac{\text{kgallons of residential oil burned in the county} \times \text{emission factor}}{2000 \text{ lbs/ton}}$

Commercial residual oil

The following table lists the emission factors for commercial residual oil are as follows:

POLLUTANT	EMISSION FACTOR	UNITS
VOC	1.13	lbs/kgals
NO _x	55	lbs/kgals
CO	5	lbs/kgals
SO _x	47.7	lbs/kgals
PM ₁₀	5.15	lbs/kgals
PM _{2.5}	2.856	lbs/kgals

Commercial oil distribution ratio was calculated as follows:

All oil burning units were summed. A ratio was calculated by dividing the individual county units by the total state units. The total commercial oil burned in the state (less point source usage) was multiplied by each county ratio to find the amount of oil burned in a particular county.

The emission estimates were calculated using the following equation:

$$\text{Pollutant} = \frac{\text{kgallons of commercial oil burned in the county} \times \text{emission factor}}{2000 \text{ lbs/ton}}$$

References

Information from the following references is used in calculating the emissions from residual oil burning:

MATERIAL	INFORMATION PROVIDED
"Table DP-1. Profile of General Demographic Characteristics: 2000," from U.S. Census Bureau, Census 2000 (see Reference 20)	Units burning with distillate oil by county
"Utah Energy and Mineral Statistics," Table 3.18 entitled "Consumption of Petroleum Products in Utah, 1960-2008" and Table 3.19 entitled "Consumption of Petroleum Products in Utah by End Use, 1960-2008" (see Reference 14)	Oil consumption and residential and commercial split
"2008 National Emissions Inventory Data & Documentation" from EPA's website http://www.epa.gov/ttn/chief/net/2008inventory.html (see Reference 7)	Residential emission factors
"Utah Population Estimates Committee Total Population by County: 1940 – 2009," Governor's Office of Planning and Budget (see Reference 1)	Population
"Population by Area," Governor's Office of Planning and Budget, 2008 Baseline Projections," (see Reference 2)	Population growth rate
"Documentation for the Final 2002 Nonpoint Sector (Feb 2006 version) National Emission Inventory for Criteria and Hazardous Air Pollutants," Appendix A-57 (see Reference 55)	Commercial emission factors
Query of UDAQ database for point sources burning Residual Oil (see Reference 28)	Double counting information

COMBUSTION

WOOD

COMBUSTION WOOD BURNING

There are several different types of wood burning equipment included in this category. Included are fireplaces with and without inserts, conventional wood stoves, non-catalytic wood stoves and catalytic wood stoves.

Fireplaces

The number of homes with fireplaces was determined. Adjustments were made for the fact that some homes have more than one fireplace and not everyone burns wood. An adjustment was made for fireplaces that are not used. The number of fireplaces with inserts was included in the wood stove calculations. The other fireplaces were separated into 2 categories; those used for heat and those used for aesthetics.

The amount of wood burned in each type of fireplace was determined using consumption rates. Each county was designated as either urban or rural and the wood consumption was adjusted. The final allocation was adjusted so that the desired urban and rural split was achieved.

Emission factors were used from EPA's "Emission Inventory Improvement Program (EIIP)" except for VOC which is from "New Methodology for Estimating Emissions from Residential Wood Combustion," presentation by Roy Huntley on June 3, 2008.

The factors and adjustments used for fireplaces are:

Burner Type	VOC (lbs/ton)	CO (lbs/ton)	NO _x (lbs/ton)	SO _x (lbs/ton)	PM ₁₀ (lbs/ton)	PM _{2.5} (% of PM10)	PM _{2.5} (lbs/ton)
Fireplaces without inserts	18.9	252.6	2.6	0.4	34.6	93.00	32.178

Use of Fireplace	Cords of Wood per year per fireplace
Heating	0.656
Aesthetics	0.069

More than one fireplace – multiply by 1.17

Fireplaces not using wood - 26% burn gas

Fireplaces not used - 42%

Urban counties burn 68% of wood

A county is considered urban if more than 50% of the people live in cities and towns.

Wood Stoves and Inserts

The number of homes with wood stoves and inserts was determined. An adjustment was made for the fact that some homes have more than one wood stove and some homes are mainly heated with wood stoves. Some use the wood as a secondary source of heat. The total amount of wood consumed by the residential sector was determined. The wood was allocated to the counties by the number of units that burn wood. An adjustment was made for the counties that are urban or rural. The type of wood stove was also apportioned.

The emission factors and adjustments used for wood stoves were as follows:

Burner Type	% of Stoves	VOC Emissions (lbs/ton)	CO Emissions (lbs/ton)	NO_x Emissions (lbs/ton)	SO_x Emissions (lbs/ton)	PM₁₀ Emissions (lbs ton)
Conventional stoves	92%	53.00	230.80	2.80	0.40	30.60
Non-catalytic stoves	5.7%	12.00	140.80	0	0.40	14.60
Catalytic stoves	2.3%	15.00	107.00	2.00	0.40	16.20

Urban counties use 35% of the wood for stoves and inserts

Rural counties use 68% of the wood for stoves and inserts

For inserts the split is 50/50.

PM_{2.5} is 93% of PM₁₀

Controls

UDAQ's rule R307-302 prohibits use of fireplaces and stoves during certain conditions in Davis, Salt Lake, Utah, and Weber Counties. Credit for this control was taken during the modeling process.

References

Information from the following references is used in calculating emissions from wood burning:

MATERIAL	INFORMATION PROVIDED
“Emission Inventory Improvement Program (EIIP),” Vol. III, (1/31/01 ed.), Chapter 2, “Residential Wood Combustion,” Table 2.4-1	Emission factors
“New Methodology for Estimating Emissions from Residential Wood Combustion,” presented by Roy Huntley of EPA (see Reference 70)	VOC emission factor for fireplaces.
EPA Workshop April 2, 2004, “Session VII: Combustion Area Sources, Residential Wood Combustion,” (see Reference 71)	Methodology
EPA Chief Newsletter Volume XII, No. 2 Fall 2001, “Improved Emission Inventory Methodologies,” by Roy Huntley, US EPA (see Reference 73)	Methodology
U.S. Department of Commerce, “American Housing Survey for the United States: 2005,” (see Reference 31)	Wood burning units in Utah
U.S. Census Bureau Table “P5 Urban and Rural,” (see Reference 72)	Designation of rural and urban counties.
“Utah Energy and Mineral Statistics,” Table 6.6 entitled “Renewable Energy Consumption in Utah, 1960-2007” (see Reference 14)	Wood consumption by residential sector
“Utah Air Quality Rules,” of the Utah Division of Air Quality (see Reference 83)	Controls on wood burning.

CONSTRUCTION BUILDINGS

CONSTRUCTION BUILDINGS

This category estimates the PM₁₀ and PM_{2.5} emissions from construction of buildings.

The emission factors for the different type of residential construction are:

Type of Structure	Acres Disturbed	PM10 EF	Units	Duration (Months)
Single Family w/basement	0.25	0.011	Tons/acre/month	6
Single Family wo/basement	0.25	0.032	Tons/acre/month	6
Two Family	0.33	0.032	Tons/acre/month	6
Apartment	0.5	0.11	Tons/acre/month	12

The amount of PM_{2.5} is estimated to be 20 percent of the PM₁₀ amount.

The equation used for calculating PM₁₀ is:

$$PM_{10} \text{ (tons/year)} = \text{Number of type of structure} \times \text{acres disturbed} \times \text{EF} \times \text{duration}$$

The equation used for calculating PM_{2.5} is:

$$PM_{2.5} \text{ (tons/year)} = PM_{10} \times 0.20$$

The emission factors for the non-residential construction are:

$$PM_{10} \text{ EF} = 0.11 \text{ tons/acre/month} \times 11 \text{ months} \times 1.6 \text{ acres/ million dollars}$$

$$PM_{2.5} \text{ EF} = PM_{10} \text{ EF} \times 0.2$$

PM ₁₀ EF/MM\$	1.93600
PM _{2.5} EF/MM\$	0.3872

The equation used for calculating non-residential emissions is:

$$\text{Emissions (tons/year)} = \frac{\text{Cost of construction} \times \text{EF}}{1000000}$$

References

Information from the following references is used in calculating emissions from building construction:

MATERIAL	INFORMATION PROVIDED
AP42, Section 13.2.3, “Heavy Construction Operations,” (1/95 ed.), and Section 12.2.4.1 “Aggregate Handling & Storage Piles,” (1/95 ed.)	Methodology
“2008 National Emissions Inventory Data & Documentation” from EPA’s website http://www.epa.gov/ttn/chief/net/2008inventory.html (see Reference 7)	Residential emission factors, disturbed acres, and duration of construction
“Documentation for the Final 2002 Nonpoint Sector (Fed 06 version) National Emission Inventory for Criteria and Hazardous Air Pollutants (see Reference 55)	PM ₁₀ /PM _{2.5} ratio and percent of structures with basements
“Utah Economic & Business Review,” Bureau of Economic and Business Research (BEBR), “Table 3: Year-to-date Dwelling Units by Type for State, Cities and Counties (see Reference 39)	Number and type of buildings constructed in 1995 through 2009
“Utah Economic & Business Review,” Bureau of Economic and Business Research (BEBR), “Table 2: Year-to-date Summary Data for State, Cities, and Counties” (see Reference 40)	Number and type of buildings constructed
“Fine Dust Particle Emissions,” presented by Chatten Cowherd, Midwest Research Institute, July 22, 1998 (see Reference 75)	PM ₁₀ emission factor for non-residential construction activities
“Session VII Area Source Overview – Construction,” sections Fugitive Dust from Construction Activities and Non-Residential Construction presented by Roy Huntley of EPA in Denver 2004 (see Reference 74)	Equation for calculation of non-residential construction

CONSTRUCTION

ROAD

NOT INCLUDED IN PM_{2.5} EPISODES

CONSTRUCTION – ROAD

This category covers road construction throughout Utah. The increase in the amount of paved lane miles from one year to the next is assumed to be constructed roads. The lane width is assumed to be 15 feet wide to account for the shoulder and easement area affected by construction equipment. A decrease in lane miles from one year to the next is assumed to be caused by abandoning or removing roadways.

The PM₁₀ emission factor is 0.42 tons per acre per construction month.

Following equation is used to calculate the emissions:

Acres increase

$$\frac{\text{New lane miles} \times 5280 \text{ ft/mile} \times 15 \text{ ft wide}}{43560 \text{ acres/ft}^2}$$

PM₁₀ emissions

$$\text{Acres increase} \times 0.42 \text{ tons/acre/month} \times 12 \text{ months per job}$$

The PM_{2.5} factor is .0084 tons per acre per construction month.

PM_{2.5} emissions

$$\text{Acres increase} \times 0.084 \text{ tons per acre} \times 12 \text{ months per job}$$

References

Information from the following references is used in calculating emissions from road construction:

MATERIAL	INFORMATION PROVIDED
"Lane Miles," Utah Department of Transportation contact (see Reference 37)	1997 through 2009 historical lane miles of pavement by county
"Documentation for the Final 2002 Nonpoint Sector (Feb 2006 version) National Emission Inventory for Criteria and Hazardous Air Pollutants," Appendix A-30 (see Reference 55)	Emission factors

DRY CLEANING

DRY CLEANING

This category includes VOC emissions from dry cleaners that are not included in the Point Source Inventory. The Environmental Protection Agency (EPA) removed Perchloroethylene from their VOC list; therefore, it is not included in these emissions.

The VOCs from dry cleaning are estimated to be 467 lbs per employee.

The following is the equation used to calculate emissions:

$$\text{VOC} = \frac{\text{Number of employees} \times 467 \text{ lbs/employee}}{2000 \text{ lbs/ton}} - \text{Point Source Emissions}$$

References

Information from the following references is used in calculating emissions from dry cleaning facilities:

MATERIAL	INFORMATION PROVIDED
"2008 National Emissions Inventory Data & Documentation" from EPA's website http://www.epa.gov/ttn/chief/net/2008inventory.html (see Reference 7)	Emission factors and number of employees

FIRES
FOREST
(Wild & Prescribed)

NOT INCLUDED IN PM_{2.5} EPISODES

**FIRES
FOREST
(Wild & Prescribed)**

The counties in Utah vary in the density of forest areas. A fuel load factor has been assigned to each county within Utah to adjust for these differences. The fuel load factor ranges from 0.3 to 1.0. Inspecting the statewide terrain and assessing probable areas that will burn determine these factors. Sparsely-forested counties are assigned a fuel load factor of 0.3, richly-forested counties are assigned a load factor of 1.0, and mid-range counties are assigned a load factor between these two.

The conversion units used are 907.2 kg/ton and 2.471 acres/hectare.

The emission factors used in the calculations are listed in the following table:

PM₁₀	PM_{2.5}	NO_x	VOC	CO	UNITS
153		36	215	1260	Kilograms of pollutant/hectare burned
0.068	0.0612	0.016	0.096	0.562	Tons of pollutant/acre burned

The conversion of emission factors from kilograms of pollutant/hectare burned to tons of pollutant/acre burned is done as follows:

Converting to tons

$$\frac{\text{kilograms of pollutant/hectare burned}}{907.2 \text{ kilograms/ton burned}}$$

Converting to acres

$$\frac{\text{Tons of Pollutant/hectare burned}}{2.471 \text{ acres/hectare}}$$

Following is the equation used to estimate emissions:

$$\text{Acres burned} \times \text{load factor} \times \text{tons of pollutant/acre burned}$$

Controls

Prescribed burning is controlled under local and state rules. Rule R307-202 specifies under what conditions prescribed fires may occur. Rule R307-204 has requirements for smoke management for wild fires, prescribed fires and wildland fire use events.

References

Information from the following references is used in calculating emissions from forest fires:

MATERIAL	INFORMATION PROVIDED
AP42, Section, "Wildfires and Prescribed Burning," (10/96 ed.), Table 13.1-2, row heading "Intermountain (Region 4)"	Emission factor
"Emission Inventory Improvement Program (EIIP)," Vol. III, (1/31/01 ed.), Wild Fires	Emission factors (PM _{2.5})
"Documentation for the Final 1999 Nonpoint Area Source National Emission Inventory for Hazardous Air Pollutants (Version 3)," A-57 (see Reference 76)	HAP emission factors
Acres burned for 2005 – 2008 from the US Bureau of Land Management (see Reference 32)	Acres burned
"Utah Air Quality Rules," of the Utah Division of Air Quality (see Reference 83)	Controls on open burning and fires.

FIRES

STRUCTURE

FIRES STRUCTURE

Structure fires are estimated using an emission factor indexed to population.

The factor used is 2.3 fires per 1000 people. Each fire is estimated to include 1.15 tons of material burned.

The emission factors used are listed below:

POLLUTANT	EMISSION FACTOR	UNIT
PM ₁₀	10.8	Lbs/ton of material burned
VOC	11	Lbs/ton of material burned
CO	60	Lbs/ton of material burned
NO _x	1.4	Lbs/ton of material burned

Following is the equation used to calculate emissions:

Number of fires

$$\frac{\text{Population} \times 2.3 \text{ fires}}{1000 \text{ people}}$$

Material burned

$$\text{Number of fires} \times 1.15 \text{ tons of material}$$

Emissions

$$\frac{\text{Tons of material burned} \times \text{emission factor}}{2000 \text{ lbs/ton}} = \text{Tons of pollutant}$$

References

Information from the following references is used in calculating the emissions from structure fires:

MATERIAL	MATERIAL PROVIDED
"Utah Population Estimates Committee Total Population by County: 1940 – 2009," Governor's Office of Planning and Budget (see Reference 1)	Population
"Population by Area," Governor's Office of Planning and Budget, 2008 Baseline Projections," (see Reference 2)	Population
"Emission Inventory Improvement Program (EIIP)," Vol. III, (1/27/99 ed.), Chapter 18, "Structure Fires," Table 18.4-1	Emission factors, consumption factors, and material burned per fire
"Documentation for the Final 1999 Nonpoint Area Source National Emission Inventory for Hazardous Air Pollutants (Version 3)," A-83 (see Reference 76)	HAP emission factors

FIRES

VEHICLE

FIRES VEHICLE

The number of vehicle fires that occur during a year is estimated to be 1.25 fires per 1000 people. The amount of material burned per fire is estimated to be 0.25 tons.

Emission factors used to calculate emissions are listed in the following table:

POLLUTANT	EMISSION FACTOR	UNIT
PM ₁₀	100	Lbs/ton of material burned
VOC	32	Lbs/ton of material burned
CO	125	Lbs/ton of material burned
NO _x	4	Lbs/ton of material burned

Following is the equation used to calculate emissions:

Number of fires

$$\frac{\text{Population} \times 1.25 \text{ fires}}{1000 \text{ people}}$$

Tons of material burned

$$\text{Number of fires} \times 0.25 \text{ tons}$$

Pollutant emissions

$$\frac{\text{Tons burned} \times \text{emission factor}}{2000 \text{ lbs/ton}}$$

References

Information from the following references is used in calculating the emissions from vehicle fires:

MATERIAL	MATERIAL PROVIDED
“Utah Population Estimates Committee Total Population by County: 1940 – 2009,” Governor’s Office of Planning and Budget (see Reference 1)	Population
“Population by Area,” Governor’s Office of Planning and Budget, 2008 Baseline Projections,” (see Reference 2)	Population
Utah Fire Incident Reporting System, Utah Fire Marshal’s Office (see Reference 77)	1.25 fires per 1000 people
“Emissions Inventory Improvement Program,” Vol. III, (5/15/00 ed.), “Area Source Category Method Abstract – Vehicle Fires”	0.25 tons of material per fire and emission factors

FUEL DISTRIBUTION

FUEL DISTRIBUTION

This category includes emissions from bulk terminals, Stage I, and underground storage of fuel. The statewide fuel distribution is apportioned to individual counties using vehicle miles traveled (VMT) estimates. Gasoline and gasohol are treated the same.

The percentage of total statewide fuel for each county is calculated by dividing the county VMT by the total statewide VMT.

The equation to determine the amount of gasoline used in a county is:

$$\frac{\text{County VMT}}{\text{Total VMT}} \times \text{Total gallons of gasoline}$$

Emission factors (EF) for tank car loading are calculated using the following equation:

$$12.46 \times (\text{SPM/T}) \times ((1-\% \text{ efficiency})/100)$$

The control efficiency is taken for the control on tanker trucks. The variables used in this equation for the individual types of fuel are listed in the following table:

Counties with Stage 1

YEAR	*RVP	S	P	M	**T	% Efficiency	Lbs/kgal
2007	14.625	1	3.781	59.507	482.19	93.834	0.35873
2008	14.625	1	4.290	59.507	488.19	93.834	0.40203
2009 Jan.	14.625	1	4.518	59.507	490.69	93.834	0.42121
2009 Dec	14.625	1	4.518	59.507	490.69	93.834	0.42121
2010	14.625	1	3.822	59.507	482.69	93.834	0.36219

*The RVP is calculated using the RVP for the months of January and February.

**The temperatures were calculated using the Max and Min temperatures for January and February.

OTHER COUNTIES

YEAR	RVP	S	P	M	T	% Efficiency	Lbs/kgal
2007	14.625	0.6	3.781	59.500	482.19	93.834	0.21507
2008	14.625	0.6	4.290	59.500	488.19	93.834	0.24103

YEAR	RVP	S	P	M	T	% Efficiency	Lbs/kgal
2009 Jan.	14.625	0.6	4.518	59.500	490.69	93.834	0.25253
2009 Dec.	14.625	0.6	4.518	59.500	490.69	93.834	0.25253
2010	14.625	0.6	3.822	59.500	482.69	93.834	0.21715

Emission factors used for calculating emissions from tanks in transit are as follows:

FUEL	COUNTIES WITH STAGE 1 LBS/KGALS	OTHER COUNTIES LBS/KGALS
Gasoline	.06	.005

Emissions emitted during unloading for tank trucks at service stations are:

AREA	LBS/KGALS
Counties with Stage 1	0.3
Other Counties	11.5

Emission factors for breathing loss at service stations are as follows:

FUEL	Lb/kgals
Gasoline	1.00

Controls

Davis, Salt Lake, Utah, and Weber Counties have had Stage 1 for all PM_{2.5} episode years.

Box Elder, Cache, Tooele, and Washington Counties have had Stage 1 since April 2009.

These controls were taken into account in the various episode years.

AVIATION GASOLINE

Amount of aviation gasoline consumed and airports with aviation gasoline dispensing was determined.

The percentage of total statewide fuel for each county is calculated by dividing the county aircraft landing and takeoffs (LTO) by the total statewide LTO.

The number of valves and seals was estimated for each airport that distributes aviation gasoline by contacting different size airports.

Equipment	Emission Factor	Unit
Valves	0.573201882	Lbs/valve/day
Seal	5.952481079	Lbs/valve/day
Loading of aircraft	.0136	Lbs/gallon

Valve emissions are calculated using the following equation:

$$\frac{\text{Number of valves} \times \text{emission factor} \times \text{days operated}}{2000 \text{ lbs/ton}}$$

Seal emissions are calculated using the following equation:

$$\frac{\text{Number of seals} \times \text{emission factor} \times \text{days operated}}{2000 \text{ lbs/ton}}$$

Emissions from the loading of aircraft are calculated using the following equation:

$$\frac{\text{Gallons of fuel} \times \text{emission factor}}{2000 \text{ lbs/ton}}$$

References

Information from the following references is used in calculating the emissions from fuel distribution:

MATERIAL	MATERIAL PROVIDED
“Emission Inventory Improvement Program (EIIP),” Vol. III, “Chapter 11, “Gasoline Marketing (Stage I and Stage II)”	Gasoline/Gasohol emission factors
AP42, Chapter 5.2, “Transportation and Marketing of Petroleum Liquids,” (6/08 ed.)	Equation for loading emissions
AP42, Chapter 7.1, “Liquid Storage Tanks,” (9/97 ed.)	Vapor pressure data
Utah State University’s GIS Climate Search website http://climate.usurf.usu.edu/products/output.php (see Reference 10)	Minimum and maximum temperatures
National Weather Service – NWS Salt Lake City SLC Annual Mean Temperature (see Reference 9)	Mean temperatures
“Utah Motor Fuel Reports” for 1995 through 2009 from the Utah Tax Commission (see Reference 11)	Consumption of fuel in Utah

MATERIAL	MATERIAL PROVIDED
2006 through 2009 “Vehicle Miles of Travel (VMT) by County by Ownership,” Utah Highway Performance Monitoring System and Traffic on Utah Highways, Department of Transportation (see Reference 51)	VMTs
“Vehicle Miles Traveled (VMT) Projections for PM _{2.5} Emissions Inventory from the Wasatch Front Regional Council, Mountainland Association of Governments, and UDAQ’s Mobil Section (see Reference 51)	VMTs
“Air Pollution Engineering Manual, “ Air Waste Management Association (see Reference 78)	Calculation of true vapor pressure
"Documentation for the Final 2002 Nonpoint Sector (Feb 2006 version) National Emission Inventory for Criteria and Hazardous Air Pollutants," Appendix A-8 through A-16 (see Reference 55)	HAP emission factors
“Documentation for the Final 1999 Nonpoint Area Source National Emission Inventory for Hazardous Air Pollutants (Version 3),” A-34 through A- 37 (see Reference 76)	HAP emission factors
“Table C1. Estimated Consumption of Vehicle Fuels in the United States, by Fuel Type, 2004-2008,” and 2003 – 2008 (see Reference 18)	Consumption of fuel in the United States 2003 through 2008
“Utah Energy and Mineral Statistics,” Table 3.18 entitled “Consumption of Petroleum Products in Utah, 1960-2008” (see Reference 14)	Aviation gasoline consumption
“FAA Aerospace Forecast Fiscal Years 2010-2030,” from the Federal Aviation Administration (see Reference 13)	Projections
“2004, 2005, 2007, and 2008 Aircraft Operations,” from the UDAQ Mobile Section, (see Reference 16)	Landing and take offs
“Utah Continuous Airport System Plan 2007,” Utah Department of Transportation (see Reference 15)	Landing and take offs and airports that have jet fuel
“Form 5010-1(5-91),” U.S. Department of Transportation Federal Aviation Administration (see Reference 17)	Landing and take offs and airports that have gasoline
“Utah Air Quality Rules,” Effective 6-3-2010 R307-328, 342 (see Reference 83)	Gasoline Stage 1 implementation dates and tank tightness rules

GRAPHIC ARTS

GRAPHIC ARTS

This category includes estimates of VOC emissions from graphic art processes not covered under the Point Source Inventory. The emissions for all years are based on the employment estimates for each county.

The VOC emission factor in lbs/employee/year is 1482 for all graphic art applications.

The equation used to calculate VOC emissions is:

$$\frac{\text{Employees in county} \times 1482 \text{ lbs/employee/year}}{2000 \text{ lbs/ton}} - \text{Point Source Emissions}$$

References

Information from the following references is used in calculating the emissions from graphic arts:

MATERIAL	MATERIAL PROVIDED
"Documentation for the Final 2002 Nonpoint Sector (Feb 2006 version) National Emission Inventory for Criteria and Hazardous Air Pollutants," Appendix A (see Reference 55)	HAP emission factors
"2008 National Emissions Inventory Data & Documentation" from EPA's website http://www.epa.gov/ttn/chief/net/2008inventory.html (see Reference 7)	Number of employees and emission factor
Query of UDAQ database (see Reference 45)	Point source emissions
"Utah Population Estimates Committee Total Population by County: 1940 – 2009," Governor's Office of Planning and Budget (see Reference 1)	Population for projecting
"Population by Area," Governor's Office of Planning and Budget, 2008 Baseline Projections," (see Reference 2)	Population for projecting

**HUMAN PERSPIRATION,
RESPIRATION
& CIGARETTE SMOKING**

HUMAN PERSPIRATION, RESPIRATION & CIGARETTE SMOKING

This category is an estimate of the ammonia emissions from human perspiration, respiration and cigarette smoking. The emission factors are:

ACTIVITY	EMISSION FACTOR
Human perspiration	0.55 lbs/person/year
Human respiration	0.0035 lbs/person/year
Cigarette smoking	0.022 lbs/person/year
SUM	0.5755 lbs/person/year

The equation used to calculate the ammonia emissions from these activities is:

$$\frac{\text{County Population} \times \text{EF}}{2000 \text{ lbs/ton}}$$

References

Information from the following references is used in calculating the emissions from the above activities:

MATERIAL	INFORMATION PROVIDED
“Utah Population Estimates Committee Total Population by County: 1940 – 2009,” Governor’s Office of Planning and Budget (see Reference 1)	Population
“Population by Area,” Governor’s Office of Planning and Budget, 2008 Baseline Projections,” (see Reference 2)	Population
“Development of the Ammonia Emission Inventory for the Southern California Air Quality Study,” September 1991, Radian Corporation G-2 through G-5 (see Reference 64)	Emission Factors

LANDFILLS

LANDFILLS

This category covers 22 landfills within the PM_{2.5} domain. VOC emissions are based on 1996 calculations using EPA's "Landfill" software.

The 1996 values were adjusted for the change in the k-factor within the model from 0.04 to 0.02. Dividing the 1996 VOC value by 2 makes this adjustment. Emissions are converted from megagrams to tons.

It is assumed that methane emissions are equal to the amount of VOC emissions.

The PM₁₀ emissions are from covering the landfill on a daily basis. The emissions do not include dust from roads. The emissions from roads are covered in the category "Non-Agricultural Unpaved Roads."

The landfills emitted an estimated 180.49 tons of PM₁₀ and served 1687500 people or 0.214 lbs of PM₁₀ per person (180.49/1687500).

PM₁₀ and VOC emissions per person from landfills are assumed to be the same from year to year.

Emission factors used are:

EMISSION FACTORS		
PM ₁₀	0.214	LBS/PERSON
PM _{2.5}	0.0525	LBS/PERSON
NH ₃	0.007	TONS/VOC TONS

The equations used for estimating emissions are:

Conversion of Mg to tons of VOCs

$$\frac{\text{Mgrams from software} \times 1000 \text{ kgram/Mgrams} \times 2.2046 \text{ lbs/kgram}}{2000 \text{ lbs/ton}}$$

PM₁₀ emissions

$$\text{Emission factor} \qquad \qquad \qquad 0.214 \text{ lbs/person/year}$$

Emissions

$$\frac{0.214 \text{ lbs/person/year} \times \text{number of people served} - \text{Point Source PM}_{10}}{2000 \text{ lbs/tons}}$$

References

Information from the following references is used in calculating the emissions from landfills:

MATERIAL	INFORMATION PROVIDED
“Utah Population Estimates Committee Total Population by County: 1940 – 2009,” Governor’s Office of Planning and Budget (see Reference 1)	Population
“Population by Area,” Governor’s Office of Planning and Budget, 2008 Baseline Projections,” (see Reference 2)	Population
EPA “Landfill” software	VOC emissions from landfill
“Final 1997 Gridded Ammonia Emission Inventory Update for the South Coast Air Basin,” by Charles W. Botsford, page 10-1 (see Reference 79)	Ammonia emission factor
Query of UDAQ’s inventory database (see Reference 47)	Double counting information

**LEAKING UNDERGROUND
STORAGE TANKS
(LUST)**

**LEAKING UNDERGROUND
STORAGE TANKS
(LUST)**

This category covers VOCs from leaking underground storage tanks. It is estimated that each remediation project emits 5.11 tons of VOC per year. The number of remediation projects is determined and assumed to have emissions for one year.

The VOC emissions from leaking underground storage tanks are calculated as follows:

$$\frac{\text{Number of remediations reported} \times 5.11 \text{ tons}}{2000 \text{ lbs/ton}}$$

References

Information from the following references is used in calculating the emissions from LUST sites:

MATERIAL	INFORMATION PROVIDED
Facility list of remediations dated 3-19-09, from the Department of Environmental Quality, Division of Emergency Response and Remediation (see Reference 46)	Number of LUST projects per county
“Emission Inventory Improvement Program (EIIP),” Vol. III, “Area Source Category Method Abstract-Remediation of Leaking Underground Storage Tanks”	Emission Factor

NON-AGRICULTURAL UNPAVED ROADS

NON-AGRICULTURAL UNPAVED ROADS

This category covers non-agricultural unpaved roads. It is estimated that all unpaved non-agricultural roads receive one-tenth the frequency of travel as agricultural roads (1/10 x 175) vehicle miles traveled (VMT) per 40 acres or 0.4375 VMT/acre). The emission factor used for the calculations is 2.27 lbs of PM₁₀ per VMT.

Following are the equations used to calculate emissions for this category:

Land area conversion to acres

$$\text{km}^2 \times 247.1 \text{ acres/km}^2$$

Estimated county acres without paved access by reviewing state map.

$$\text{Acres} \times \text{percent of county with non-farm unpaved roads}$$

Estimated VMT/year

$$\text{Acres with non-farm unpaved roads} \times 0.4375 \text{ VMT/acre}$$

PM₁₀ emissions

$$\frac{\text{VMT} \times 2.27 \text{ lbs PM}_{10}/\text{VMT}}{2000 \text{ lbs/ton}}$$

It is assumed that the amount of land without paved access within a county does not change substantially. Therefore, the emissions are assumed to stay the same for all years.

References

Information from the following references is used in calculating the emissions from non-agricultural unpaved roads:

MATERIAL	INFORMATION PROVIDED
<p>“Reconciling Urban Fugitive Dust Emissions Inventory and Ambient Source Contribution Estimates: Summary of Current Knowledge and Needed Research,” John G. Watson and Judith C. Chow, May 2000, Page 3-20 and 3-24 (see Reference 63)</p>	<p>VMT per acre and PM₁₀ emission factor</p>
<p>E-mail listing land area for counties in Utah (see Reference 8)</p>	<p>County land area</p>
<p>AP 42 Chapter 13.2.2, “Unpaved Roads,” (9/98 ed.), page 13.2.2-3</p>	<p>PM₁₀ emission factor per VMT</p>

**NONROAD
AIRCRAFT MAINTENANCE**

**NONROAD
AIRCRAFT MAINTENANCE**

Emissions are estimated to be one percent of aircraft emissions at all Utah airports. This was determined by a 1992 Division of Air Quality phone survey of aircraft maintenance staff.

The equation used to estimate emissions is:

Aircraft emissions x 1%

References

Information from the following references is used in calculating the emissions from nonroad aircraft maintenance:

MATERIAL	INFORMATION PROVIDED
"Statewide Non-Road Mobile Aircraft Emissions Inventory" for 2005, 2007, 2008, and 2009 from the Division of Air Quality Mobile Section (see Reference 50)	Emissions from aircraft.

OPEN BURNING AND INCINERATION

OPEN BURNING AND INCINERATION

Municipal Solid Waste Burning

The burning of municipal solid waste is illegal in Utah except where no public or licensed disposal service is available. It is estimated that there is no burning in urban areas. It is estimated that 28 percent of the total amount of waste generated would be burned without restrictions. It is estimated that there is 10 percent illegal burning in rural areas.

The emission factors are:

POLLUTANT	FACTOR	UNIT
NO _x	6	Lb/ton entire refuse weight
VOC	8.556	Lb/ton actually burned
CO	85	Lb/ton entire refuse weight
SO _x	1	Lb/ton entire refuse weight
PM ₁₀	38	Lb/ton actually burned
PM _{2.5}	34.8	Lb/ton actually burned

The equation used to estimate emissions from open burning is:

Tons of waste

(Population x 0.69 tons/person/year)

Tons of waste burned without restriction

Tons of waste x 28 percent

NO_x, CO, and SO_x emissions

$\frac{\text{Tons of waste} \times \text{emission factors} \times 10\% \text{ burned}}{2000 \text{ lbs/ton}}$

VOC, PM₁₀, and PM_{2.5} emissions

$\frac{\text{Tons of waste burned} \times \text{emission factors} \times 10\% \text{ burned}}{2000 \text{ lbs/ton}}$

References

Information from the following references is used in calculating the emissions from open burning:

MATERIAL	MATERIAL PROVIDED
"2008 National Emissions Inventory Data & Documentation" from EPA's website http://www.epa.gov/ttn/chief/net/2008inventory.html (see Reference 7)	Emission Factor
"Emission Inventory Improvement Program (EIIP)," Vol. III, Chapter 16, "Open Burning"	Amount of waste generated per person
"Emission Inventory Improvement Program (EIIP)," "Residential Household Waste Open Burning."	Amount of waste burned
Utah Administrative Code, R307-202-2 (see Reference 83)	Backup documentation for reduction in burning emissions
"Utah Population Estimates Committee Total Population by County: 1940 – 2009," Governor's Office of Planning and Budget (see Reference 1)	Population
"Population by Area," Governor's Office of Planning and Budget, 2008 Baseline Projections," (see Reference 2)	Population
U.S. Census Bureau Table "P5 Urban and Rural," (see Reference 72)	Designation of rural and urban counties.
"Documentation for the Final 2002 Nonpoint Sector (Feb 2006 version) National Emission Inventory for Criteria and Hazardous Air Pollutants," Appendix A (see Reference 55)	HAP emission factors

OPEN BURNING AND INCINERATION

Yard Waste Burning

The burning of yard waste is illegal in Utah except where no public or licensed disposal service is available. It is estimated that 28 percent of the total amount of waste generated would be burned without restrictions. It is estimated that there is no burning in urban counties and 10 percent burning in rural areas.

The emission factors are:

POLLUTANT	FACTOR	UNIT
NO _x	6	Lb/ton entire refuse weight
VOC	8.556	Lb/ton actually burned
CO	85	Lb/ton entire refuse weight
SO _x	1	Lb/ton entire refuse weight
PM ₁₀	38	Lb/ton actually burned
PM _{2.5}	34.8	Lb/ton actually burned

The equation used to estimate emissions from open burning is:

Tons of waste

(Population x 0.1168 tons/person/year)

Tons of waste burned without restriction

Tons of waste x 28 percent

NO_x, CO, and SO_x emissions

Tons of waste x emission factors x 10 % burned
2000 lbs/ton

VOC, PM₁₀, and PM_{2.5} emissions

Tons of waste burned x emission factors x 10% burned
2000 lbs/ton

References

Information from the following references is used in calculating the emissions from open burning:

MATERIAL	MATERIAL PROVIDED
"Emission Inventory Improvement Program (EIIP)," Vol. III, Chapter 16, "Open Burning" page 16.4-3	Emission Factor
Utah Administrative Code, R307-202-2 (see Reference 83)	Backup documentation for reduction in burning emissions
"Utah Population Estimates Committee Total Population by County: 1940 – 2009," Governor's Office of Planning and Budget (see Reference 1)	Population
"Population by Area," Governor's Office of Planning and Budget, 2008 Baseline Projections," (see Reference 2)	Population
U.S. Census Bureau Table "P5 Urban and Rural," (see Reference 72)	Designation of rural and urban counties.
"Documentation for the Final 2002 Nonpoint Sector (Feb 2006 version) National Emission Inventory for Criteria and Hazardous Air Pollutants," Appendix A (see Reference 55)	HAP emission factors

PESTICIDE APPLICATION

NOT INCLUDED IN PM_{2.5} EPISODES

PESTICIDE APPLICATION

This category includes emissions from the application of pesticides. The emissions are indexed to harvested acres of crops and population. The amount of harvested potatoes and mixed vegetables is estimated to be 150 acres per year. Harvested acres of wheat, barley, corn, oats, and hay are actual values for the years 1996 through 2009. The agricultural employment growth rate is used to estimate harvest acres for 2010.

The emission factors used to calculate this category are as follows:

EMISSION FACTORS		
Commercial/consumer Emission Factors	1.78	Lbs of VOC/capita
Agricultural consumption factor	3.5	Lbs pesticide/year/harvested acre
Agricultural emissions factor	0.90	Lb of VOC/lb of pesticide

Following equations are used to calculate emissions:

Emissions of commercial/consumers

$$\frac{\text{Population} \times 1.78 \text{ lbs/person}}{2000 \text{ lbs/ton}}$$

Emissions of agricultural pesticide application

$$\frac{\text{Acres harvested} \times 3.5 \text{ lbs pesticide/acre} \times 0.90 \text{ lb VOC/lb pesticide}}{2000 \text{ lbs/ton}}$$

TOTAL

Emissions of commercial/consumers + Emissions of agricultural pesticide application

References

Information from the following references is used in calculating the emissions from pesticide application:

MATERIAL	MATERIAL PROVIDED
“Emission Inventory Improvement Program” Vol. III, Chapter 9, “Pesticides – Agricultural and Nonagricultural”	Background data and emission factors
“Emission Inventory Improvement Program” Vol. III, Chapter 5, “Consumer & Commercial Solvent Use.”	Background data and emission factors
“Utah Population Estimates Committee Total Population by County: 1940 – 2009,” Governor’s Office of Planning and Budget (see Reference 1)	Population
“Population by Area,” Governor’s Office of Planning and Budget, 2008 Baseline Projections,” (see Reference 2)	Population
“2008 National Emissions Inventory Data & Documentation” from EPA’s website http://www.epa.gov/ttn/chief/net/2008inventory.html (see Reference 7)	Consumer Emission Factor
“Utah Agricultural Statistics and Utah Department of Agricultural and Food Annual Report” for the years 2007, 2008, 2009, and 2010 prepared by the Utah Department of Agriculture and Food and the United States Department of Agriculture National Agricultural Statistics Service (see Reference 33)	Harvested acres

SAND AND GRAVEL

SAND AND GRAVEL

This category includes emissions from sand and gravel sites that submit inventories but are not defined as point sources.

The calculations are completed by the companies and totals are submitted to UDAQ.

The emissions are divided into two SCCs, one for the emissions from off-road mobile equipment and one for fugitives from processes.

References

Emission information from the following references is used:

MATERIAL	MATERIAL PROVIDED
Sand and Gravel inventory submittals (see Reference 52)	Emissions

**SEWER TREATMENT
PUBLICLY-OWNED TREATMENT
WORKS AND
RELATED PROCESSES**

**SEWER TREATMENT
PUBLICLY-OWNED TREATMENT
WORKS AND
RELATED PROCESSES**

POTW Emissions

This category includes waste disposal, treatment and removal, and wastewater treatment emissions.

Future year emissions are calculated based on 1999 emissions from 19 POTWs that are projected onto the whole state, indexed to human populations by county.

The equation used to estimate emissions per capita is:

$$\frac{\text{1999 tons of emissions}}{\text{1999 pop}}$$

The equation used to estimate current year emissions is:

$$\text{Emissions per capita} \times \text{population of current year}$$

Miscellaneous Sewage Sources

The equation used to estimate affected population:

$$\text{Current population} \times \text{percentage of population affected (infant \% and homeless \%)}$$

The equation used to estimate emissions:

$$\frac{\text{Affected population} \times \text{emission factor}}{2000 \text{ lbs/ton}}$$

References

Information from the following references is used in calculating the emissions from waste disposal and treatment:

MATERIAL	MATERIAL PROVIDED
"Utah Population Estimates Committee Total Population by County: 1940 – 2009," Governor's Office of Planning and Budget (see Reference 1)	Population
"Population by Area," Governor's Office of Planning and Budget, 2008 Baseline Projections," (see Reference 2)	Population
Memorandum from Dana Coe to Steve Parkin dated June 2, 2000, (see Reference 80)	Emission factor for sludge
"Biosolids Permit Universe (FY' 1999), Utah Department of Environmental Quality, Division of Water Quality (see Reference 81)	Amount of waste
"Final 1997 Gridded Ammonia Emission Inventory Update for the South Coast Air Basin," by Charles W. Botsford, page 4-1 (see Reference 79)	Ammonia emission factor
"Development of the Ammonia Emission Inventory for the Southern California Air Quality Study," September 1991, Radian Corporation G-2 through G-5 (see Reference 64)	Emission Factors

SOLVENT CLEANING AND DEGREASING

SOLVENT CLEANING AND DEGREASING

This category covers solvent cleaning and degreasing from automobile repair, electronic & electrical, and other. Automobile manufacturing is not included because this type of source would be covered in the Point Source Inventory.

The emission factors used for this category are as follows:

Solvent, Application	Emission Factor, VOC (lbs/employee/year)
Degreasing	30.5

The equation for estimating VOC emissions is:

$$\frac{\text{Employee} \times \text{Emission factor}}{2000 \text{ lbs/ton}} = \text{Point Source emissions}$$

Davis and Salt Lake Counties have controls in place for surface coatings. The control efficiency (28%) from AP42 Table 4.6-3 was applied to these counties.

References

Information from the following references is used in calculating the emissions from solvent cleaning and degreasing:

MATERIAL	MATERIAL PROVIDED
“2008 National Emissions Inventory Data & Documentation” from EPA’s website http://www.epa.gov/ttn/chief/net/2008inventory.html (see Reference 7)	Emission Factor and number of employees
Query of UDAQ database (see Reference 44)	Point source solvent emissions
“Utah Air Quality Rules,” Effective 6-3-2010 R307-335 (see Reference 83)	Degreasing rules

SOLVENT
CONSUMER USE

SOLVENT CONSUMER USE

This category includes solvent use by consumers.

The emission factors used for this category are as follows:

Solvent, Application	Emission Factor, VOC, (tons/year)
Personal Care Products	1.9
Household Products	1.8
Automotive Aftermarket Products	1.36
Adhesives and Sealants	0.57
Coatings and Related Products	0.95
Miscellaneous Products	0.07
TOTAL, Emission Factors Above	6.65

The equation for estimating VOC emissions is:

$$\frac{\text{Population} \times 6.65 \text{ lbs/person/year}}{2000 \text{ lbs/ton}}$$

References

Information from the following references is used in calculating the emissions from consumer solvent use:

MATERIAL	MATERIAL PROVIDED
“Utah Population Estimates Committee Total Population by County: 1940 – 2009,” Governor’s Office of Planning and Budget (see Reference 1)	Population
“Population by Area,” Governor’s Office of Planning and Budget, 2008 Baseline Projections,” (see Reference 2)	Population
“Emission Inventory Improvement Program (EIIP),” Vol. III, (8/02/96 ed.), Chapter 5, “Solvent Use”	Methodology

MATERIAL	MATERIAL PROVIDED
"2008 National Emissions Inventory Data & Documentation" from EPA's website http://www.epa.gov/ttn/chief/net/2008inventory.html (see Reference 7)	Emission factors
"Documentation for the Final 2002 Nonpoint Sector (Feb 2006 version) National Emission Inventory for Criteria and Hazardous Air Pollutants," Appendix A (see Reference 55)	HAP emission factors

SURFACE COATINGS

ARCHITECTURAL

SURFACE COATINGS ARCHITECTURAL

This category covers emissions from the coating/painting of buildings.

VOC emission factors for Utah’s architectural surface coatings with states without rules are 3.09 lbs of VOCs per person. (Estimate for states with rules is 2.41 lbs/person)

The equation used to estimate VOC emissions is:

$$\frac{\text{Population} \times 3.09}{2000 \text{ lbs/ton}} - \text{Point Source Emissions}$$

References

Information from the following references is used in calculating the emissions from architectural surface coating:

MATERIAL	MATERIAL PROVIDED
“Utah Population Estimates Committee Total Population by County: 1940 – 2009,” Governor’s Office of Planning and Budget (see Reference 1)	Population
“Population by Area,” Governor’s Office of Planning and Budget, 2008 Baseline Projections,” (see Reference 2)	Population
Emission Inventory Improvement Program (EIIP),” Vol. III, (11/8/95 ed.), Chapter 3, “Architectural Surface Coating”	Background
“2008 National Emissions Inventory Data & Documentation” from EPA’s website http://www.epa.gov/ttn/chief/net/2008inventory.html (see Reference 7)	Emission factors
Query of the UDAQ database (see Reference 41)	Point Sources using architectural coatings

SURFACE COATINGS

INDUSTRIAL

**SURFACE COATINGS
INDUSTRIAL**

This category covers emissions from the coating/painting of industrial units.

Following are the emission factors for industrial surface coating processes:

COATING TYPE OR OPERATION	EMISSION FACTOR, VOC, (lbs/employee/year)
Metal Furniture	772
Wood Furniture and Fixtures	244
Metal Containers	2326
Machinery and Equipment	109
Appliances	249
Other Transportation Equipment	164
Sheet, Strip, and Coil	2877
Factory Finished Wood	43
Electrical	24.7
Other Product Coatings	136
Marine Coatings	198
Paper, Film, and Foil	735
Railroad	222
Aircraft	15
	(lbs/person/year)
Special Purpose Industrial Maintenance Coatings	1.1
Other Special Maintenance Coatings	0.007

The equation used to estimate the above emissions for uncontrolled counties is:

$$\frac{\text{Population} \times \text{emission factor}}{2000 \text{ lbs/ton}} - \text{Point source emissions}$$

Or

$$\frac{\text{Employee} \times \text{emission factor}}{2000 \text{ lbs/ton}} - \text{Point source emissions}$$

Salt Lake and Davis Counties have controls in place for the following surface coating processes: Metal products, wood furniture, metal manufacturing, flat wood coating, and paper, foil, film coating.

The control efficiencies were obtained from AP42 Table 4.2.2.1-3. The equation used to estimate the controlled categories in Salt Lake and Davis Counties is:

$\frac{(\text{Population} \times \text{emission factor}) \times (1 - \text{Control efficiency})}{2000 \text{ lbs/ton}}$ - Point source emissions

Or

$\frac{(\text{Employee} \times \text{emission factor}) \times (1 - \text{Control efficiency})}{2000 \text{ lbs/ton}}$ - Point source emissions

References

Information from the following references is used in calculating the emissions from industrial surface coating:

MATERIAL	MATERIAL PROVIDED
“2008 National Emissions Inventory Data & Documentation” from EPA’s website http://www.epa.gov/ttn/chief/net/2008inventory.html (see Reference 7)	Emission factors and employees
“Utah Population Estimates Committee Total Population by County: 1940 – 2009,” Governor’s Office of Planning and Budget (see Reference 1)	Population
“Population by Area,” Governor’s Office of Planning and Budget, 2008 Baseline Projections,” (see Reference 2)	Population
"Documentation for the Final 2002 Nonpoint Sector (Feb 2006 version) National Emission Inventory for Criteria and Hazardous Air Pollutants," Appendix A (see Reference 55)	HAP emission factors
Query of the UDAQ database (see Reference 43)	Point Sources using surface coatings
“Utah Air Quality Rules,” Effective 6-3-2010 R307-340-7, 340-10, 340-11, 340-5, and 343 (see Reference 83)	Rules for various coating processes

SURFACE COATINGS

TRAFFIC MARKINGS

NOT INCLUDED IN PM_{2.5} EPISODES

SURFACE COATINGS TRAFFIC MARKINGS

This category covers emissions from the coating/painting of traffic markings.

Following are the emission factors for traffic markings:

COATING TYPE OR OPERATION	EMISSION FACTOR, VOC, (lbs/annual-lane-mile)
Solvent-based	69
Water-based	13

The water-based factor applies per the Utah Department of Transportation. Actual lane-miles are used for 2000 through 2008. The lane-miles are changed based on vehicle miles traveled growth rates for other years.

The equation used to estimate traffic markings is:

$$\frac{\text{Lane-miles} \times \text{water-based emission factor}}{2000 \text{ lbs/ton}}$$

References

Information from the following references is used in calculating the emissions from traffic markings surface coating:

MATERIAL	MATERIAL PROVIDED
"Lane Miles," Utah Department of Transportation contact (see Reference 37)	1997 through 2009 historical lane miles of pavement by county
Emission Inventory Improvement Program (EIIP)," Vol. III, (5/17/97 ed.), Chapter 14, "Traffic Markings"	Emission Factors
"Documentation for the Final 2002 Nonpoint Sector (Feb 2006 version) National Emission Inventory for Criteria and Hazardous Air Pollutants," Appendix A (see Reference 55)	HAP emission factors

TANK CLEANING

TANK CLEANING

This category includes facilities that clean tanks and drums.

The VOC emission factor for this process is 0.686 lbs/tank.

The number of tanks cleaned is calculated using the number of tanks cleaned in Salt Lake and Davis Counties. This information was from the Federal Highway Administration Department of Motor Carriers. It is rationed to the population.

References

Information from the following references is used in calculating the emissions from traffic markings surface coating:

MATERIAL	MATERIAL PROVIDED
“Utah Population Estimates Committee Total Population by County: 1940 – 2009,” Governor’s Office of Planning and Budget (see Reference 1)	Population
“Population by Area,” Governor’s Office of Planning and Budget, 2008 Baseline Projections,” (see Reference 2)	Population
Phone message from Bruce Holmes of US Department of Transportation (see Reference 82)	Number of cargo tanks cleaned

REFERENCE DOCUMENTS

Activity data, emission factors, and other background information were obtained from the following sources in use in the annual episode emissions calculations. Excerpts from these documents containing the information are available upon request from UDAQ.

EPA's "AP42" and "Emissions Inventory Improvement Program" documents were also used as references. Excerpts from these documents are not included in this list because they are readily available on the following websites:

<http://www.epa.gov/ttn/chief/efpac/abefpac.html>

<http://www.epa.gov/ttn/chief/eiip/techreport/index.html>

- 1 "Utah Population Estimates Committee, Total Population by County: 1940-2009," Utah Governor's Office of Planning and Budget
- 2 "Population by Area," Utah Governor's Office of Planning and Budget, 2008 Baseline Projections
- 3 "Table 1. Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico: April 1, 2000 to July 1, 2009," U.S. Census Bureau, Population Division
- 4 "Table 2. Projections of the Population from the 2008 National Projections and High, Low, Constant, and Zero Net International Migration Series for the United States: 2010 to 2050," Population Division, U.S. Census Bureau
- 5 "Employment by Industry," Regional Economic Information System Bureau of Economic Analysis
- 6 "Employment by Area and Industry Detailed Industries," Utah Governor's Office of Planning and Budget
- 7 "2008 National Emissions Inventory Data & Documentation" from EPA's website <http://www.epa.gov/ttn/chief/net/2008inventory.html>
- 8 Email from Patrick Barickman of the Utah Division of Air Quality, 10-17-2000 listing the land area for the counties in Utah
- 9 "Salt Lake City Annual Mean Temperature," National Weather Service
"Population All areas for 2008," Utah Department of Workforce Services
- 10 "GIS Climate Search," Utah Climate Center at Utah State University

- 11 “Utah Motor Fuel Report,” and “Utah Aviation Fuel Report,” Utah Tax Commission
- 12 “Table 22 Total Jet Fuel and Aviation Gasoline Fuel Consumption U.S. Civil Aviation Aircraft,” U.S. Department of Transportation Federal Aviation Administration
- 13 “FAA Aerospace Forecast Fiscal Years 2010-2030,” U.S. Department of Transportation Federal Aviation Administration
- 14 “Utah Energy and Mineral Statistics,” Office of Energy
<http://geology.utah.gov/emp/energydata/index.htm>
- 15 “Utah Continuous Airport System Plan 2007,” Utah Department of Transportation
- 16 “2004, 2005, 2007, and 2008 Aircraft Operations,” from the UDAQ Mobile Section
- 17 “Airport Master Record, Form 5010-1(5-91),” U.S. Department of Transportation Federal Aviation Administration
- 18 “Table C1. Estimated Consumption of Vehicle Fuels in the United States, by Fuel Type,” 2003-2008, US Energy Information Administration
- 19 “Annual Energy Outlook 2010 Early Release Overview, December 2009, Energy Information Administration
- 20 Tables DP-1, 2, 3, & 4 “Profile of General Demographic Characteristics, Selected Social Characteristics, Economic Characteristics, and Housing Characteristics: 2000,” US Bureau of the Census
- 21 “Annual Review and Forecast of Utah Coal Production and Distribution 2008,” Utah Geological Survey a Division of Utah Department of Natural Resources, 2010
- 22 “Annual Energy Outlook 2010 with Projections to 2035,” US Energy Information Administration
- 23 Point source coal consumption from UDAQ emissions database
- 24 “Annual Energy Outlook 2010 Early Release,” US Energy Information Administration
- 25 Point source distillate oil consumption

- 26 Point source kerosene consumption
- 27 Point source LPG consumption
- 28 Point source residual oil consumption
- 29 Natural Gas consumption 1996, 1999, 2000, 2002, 2005, 2006, 2007, and 2008 from Questar
- 30 Point source natural gas consumption
- 31 “American Housing Survey for the United States: 2005, US Department of Housing and Urban Development, US Department of Commerce
- 32 2007, 2009, and 2010 Fire data from Utah Division of Natural Resources, Forestry, Fire & State lands, and the Bureau of Land Management.
- 33 “Utah Agricultural Statistics and Utah Department of Agriculture and Food Annual Report” for the years 2004 - 2010 prepared by the Utah Department of Agriculture and Food and the United States Department of Agriculture National Agricultural Statistics Service
- 34 “Moroni Feed Company Utah’s Turkey Production and Processing Industry,” Norbest website.
- 35 “Utah Big Game Annual Reports,” for 2006, 2007, and 2008 from the Department of Natural Resources.
- 36 1997 – 2000 Wildlife Headcount from the Utah Department of Natural Resources, Wildlife Resources, Steve Cranney and Steve Flinders
- 37 “Lane Miles – Total Roads (State, City, County, and Federal),” for the years 1994– 2009 from the Department of Transportation.
- 38 “Annual Statistical Summary” for the years 2006 – 2009, from the Utah Department of Transportation
- 39 “Table 3: year-to-date Dwelling Units by Type for State, Cities and Counties,” for years 2006 – 2009, Utah Construction Information Database, Bureau of Economic and Business Research, University of Utah
- 40 “Table 2: Year to Date Summary Data for State. Cities, and Counties,” for the years 2006 – 2009, Bureau of Economic and Business Research, University of Utah

- 41 Point Source emissions from Architectural painting for the years 2007 – 2008 from the UDAQ emissions database
- 42 Point Source consumption of automobile coatings for the years 2007 – 2008 from the UDAQ emissions database
- 43 Point Source surface coating consumption from the years 2007 – 2008 from the UDAQ emissions database
- 44 Point Source solvent consumption (degreasing) from the years 2007 – 2008 from the UDAQ emissions database
- 45 Point Source emissions from graphic arts from the years 2000 – 2008 from the UDAQ emissions database
- 46 Leaking Underground Storage Tanks for the years 2000 – 2009 from the Utah Division of Environmental Response and Remediation
- 47 2008 Landfill Inventory Summaries
- 48 “Agricultural Burning in Utah and the Regional Haze Rule, Executive Summary and the Inventory of Agricultural Burning in Utah Counties,” conducted July 2003, Utah State University Extension in Collaboration with the Utah Farm Bureau Federation
- 49 Drycleaners in Utah by County from the UDAQ Toxics Section
- 50 Aircraft emissions for 2007 – 2009 from the UDAQ mobile section
- 51 “Vehicle Miles of Travel (VMT) by County by Ownership,” for years 2006-2009 from the Utah Highway Performance Monitoring System and Traffic on Utah Highways and “Vehicle Miles Traveled (VMT) Projections for PM_{2.5} Emissions Inventory from the Wasatch Front Regional Council, Mountainland Association of Governments, and UDAQ’s Mobil Section
- 52 2008 Emission Inventories for Sand and Gravel Sites from the UDAQ inventories received from sources
- 53 “Table 2. Quantity and Value of Shipments of Paint and Allied Products,” for years 2006 – 2008 from the US Census Bureau
- 54 Sewer Point Sources from company inventory submissions
- 55 “Documentation for the Final 2002 Nonpoint Sector (Feb 06 version) National Emission Inventory for Criteria and Hazardous Air Pollutants,” prepared by E.H. Pechan & Associates, Inc. for EPA

- 56 “WRAP Fugitive Dust Handbook,” prepared by Countess Environmental for Western Governors’ Association September 7, 2006
- 57 “Agricultural Soil Preparation Fugitive Dust Emissions” presented by Patrick Gaffney to the Western Sources Air Resources Council on July 25, 1996
- 58 “Examination of the Multiplier Used to Estimate PM_{2.5} Fugitive Dust Emissions from PM₁₀,” presented by Thompson G. Pace, US EPA
- 59 “Session VII, Reconciling Fugitive Dust Emissions w/ Ambient Data,” presented by Thompson G Pace, US EPA, Denver, CO, March, 2004
- 60 “Development and Selection of Ammonia Emission Factors,” by R. Battye, W. Battye, C. Overcash, and S. Fudge for US EPA
- 61 “Section 7.6, Livestock Husbandry,” updated by Patrick Gaffney of CARB
- 62 “Derivation of Agricultural Gas-Phase Ammonia Emissions and Application to the Cache Valley,” by Kori D. Moore, Utah State University
- 63 “Reconciling Urban Fugitive Dust Emissions Inventory and Ambient Source Contribution Estimates: Summary of Current Knowledge and Needed Research,” prepared by John G. Watson and Judith C. Chow, May, 2000
- 64 “Development of the Ammonia Emission Inventory for the Southern California Air Quality Study,” Prepared by Radian Corporation, September 1991
- 65 “Development of an Updated Gridded Ammonia Emission Inventory for the South Coast Air Basin, presented by Gerard E. Mansell and James Koizumi
- 66 “Technical Support Study 15: Evaluation and Improvement of Methods for Determining Ammonia Emissions in the San Joaquin Valley, by Dana L. Coe, January 23, 1998
- 67 “Davis County Government, Restaurants in Davis County, Utah”
- 68 “Chef moz Dining Guide”
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- 70 “New Methodology for Estimating Emissions from Residential Wood Combustion,” by Roy Huntley, EPA
- 71 “Session VII: Combustion Area Sources, Residential Wood Combustion”

- 72 “P5. Urban and Rural (7) – Universe: Total population,” from the US Census Bureau
- 73 “Improved Emission Inventory Methodologies,” Chief Newsletter,” US EPA, Fall 2001
- 74 “Session VII Area Source Overview-Construction, Roy Huntley, US EPA January 2004
- 75 “Fine Dust Particle Emissions,” Chatten Cowherd, Midwest Research Institute, Kansas City, Missouri, July 22, 1998
- 76 “Documentation for the Final 1999 Nonpoint Area Source National Emission Inventory for Hazardous Air pollutants (Version 3), ERG, Inc, August 26, 2003
- 77 “Utah Fire Incident Reporting System,” Office of State Fire Marshal
- 78 “Air Pollution Engineering Manual,” Air & Waste Management Association
- 79 “Final 1997 Gridded Ammonia Emission Inventory Update for the South Coast Air Basin,” Mark Chitjian and James Koizumi, South Coast Air Quality Management District, August 2000
- 80 Dana Coe June 2, 2000, memorandum on Recommended revisions to the ammonia inventory
- 81 “Biosolid Permit Universal (FY 1999)”
- 82 Telephone message from Bruce Williams of US Department of Transportation
- 83 “Utah Air Quality Rules January 1, 2011”
- 84 Regression analysis of lane miles for 2010.