Chapter 12
Criteria Air Pollutants

Summary Statistics from Tables in this Chapter

Source		
Table 12.1	Transportation's share of U.S. emissions, 2006	
	CO	*77.6%*
	NO_X	*58.3%*
	VOC	*35.5%*
	NH_3	*8.1%*
	PM-2.5	*9.0%*
	SO_2	*4.5%*
	PM-10	*2.6%*

Transportation accounts for the majority of carbon monoxide and nitrogen oxide emissions. Highway vehicles are responsible for the largest share of transportation emissions.

Table 12.1
Total National Emissions of the Criteria Air Pollutants by Sector, 2006
(millions of short tons/percentage)

Sector	CO	NO_x	VOC	PM-10	PM-2.5	SO_2	NH_3
Highway vehicles	**54.10**	**6.60**	**3.85**	**0.18**	**0.13**	**0.19**	**0.32**
	53.8%	*36.2%*	*22.1%*	*1.0%*	*2.8%*	*1.4%*	*7.9%*
Off-highway	**23.93**	**4.02**	**2.32**	**0.30**	**0.28**	**0.43**	**0.01**
	23.8%	*22.1%*	*13.3%*	*1.6%*	*6.1%*	*3.1%*	*0.3%*
Transportation total	**78.03**	**10.62**	**6.17**	**0.48**	**0.41**	**0.62**	**0.33**
	77.6%	*58.3%*	*35.5%*	*2.6%*	*9.0%*	*4.5%*	*8.1%*
Stationary source fuel combustion	**5.17**	**6.43**	**1.57**	**1.34**	**1.05**	**11.93**	**0.06**
	5.1%	*35.3%*	*9.0%*	*7.3%*	*22.9%*	*86.7%*	*1.4%*
Industrial processes	**2.39**	**0.89**	**6.89**	**1.16**	**0.52**	**1.10**	**0.15**
	2.4%	*4.9%*	*39.6%*	*6.3%*	*11.4%*	*8.0%*	*3.6%*
Waste disposal and recycling total	**1.67**	**0.11**	**0.39**	**0.31**	**0.29**	**0.03**	**0.04**
	1.7%	*0.6%*	*2.2%*	*1.7%*	*6.3%*	*0.2%*	*1.1%*
Miscellaneous	**13.30**	**0.18**	**2.37**	**15.13**	**2.31**	**0.09**	**3.46**
	13.2%	*1.0%*	*13.6%*	*82.1%*	*50.4%*	*0.6%*	*85.7%*
Total of all sources	**100.56**	**18.23**	**17.39**	**18.42**	**4.58**	**13.77**	**4.03**
	100.0%	*100.0%*	*100.0%*	*100.0%*	*100.0%*	*100.0%*	*100.0%*

Source:
U. S. Environmental Protection Agency, National Emission Inventory Air Pollutant Emission Trends website www.epa.gov/ttn/chief/trends. (Additional resources: www.epa.gov/oar/oaqps)

Note: CO = Carbon monoxide. NO_x = Nitrogen oxides. PM-10 = Particulate matter less than 10 microns. PM-2.5 = Particulate matter less than 2.5 microns. SO_2 = Sulfur dioxide. VOC = Volatile organic compounds. NH_3 = Ammonia.

The transportation sector accounted for more than 77% of the nation's carbon monoxide (CO) emissions in 2006. Highway vehicles are by far the source of the greatest amount of CO. For details on the highway emissions of CO, see Table 12.3.

Table 12.2
Total National Emissions of Carbon Monoxide, 1970–2006[a]
(million short tons)

Source category	1970	1980	1990	1995	2000	2006	Percent of total, 2006
Highway vehicles	163.23	143.83	110.26	83.88	68.06	54.10	53.8%
Other off-highway	11.37	16.69	21.45	23.88	24.18	23.93	23.8%
Transportation total	175.01	160.98	132.17	108.25	92.74	78.03	77.6%
Stationary fuel combustion total	4.63	7.30	5.51	5.93	4.79	5.17	5.1%
Industrial processes total	9.84	6.95	4.77	4.61	2.63	2.39	2.4%
Waste disposal and recycling total	7.06	2.90	1.67	1.19	1.85	1.67	1.7%
Miscellaneous total	7.91	15.02	13.30	7.30	12.96	13.30	13.2%
Total of all sources	**204.45**	**193.15**	**157.42**	**127.27**	**114.97**	**100.56**	**100.0%**

Source:
U. S. Environmental Protection Agency, National Emission Inventory Air Pollutant Emission Trends website www.epa.gov/ttn/chief/trends (Additional resources: www.epa.gov/oar/oaqps)

[a] The sums of subcategories may not equal total due to rounding.
[b] Recreational marine vessels.

Though gasoline-powered light vehicles continue to be responsible for the majority of carbon monoxide emissions from highway vehicles, the total pollution from light vehicles in 2005 is about a third of what it was in 1970. This is despite the fact that there were many more light vehicles on the road in 2005.

Table 12.3
Emissions of Carbon Monoxide from Highway Vehicles, 1970–2005[a]
(million short tons)

Source category	1970	1980	1990	1995	2000	2005	Percent of total, 2005
Gasoline powered							
Light vehicles & motorcycles	119.14	98.21	67.24	46.54	36.40	24.19	50.2%
Light trucks[b]	22.27	28.83	32.23	29.81	27.04	21.19	43.9%
Heavy vehicles	21.27	15.35	8.92	5.96	3.42	1.97	4.1%
Total	162.68	142.39	108.39	82.31	66.86	47.35	98.2%
Diesel powered							
Light vehicles	0.01	0.03	0.04	0.02	0.01	0.01	0.0%
Light trucks[b]	0.06	0.05	0.03	0.02	0.01	0.01	0.0%
Heavy vehicles	0.49	1.36	1.81	1.53	1.19	0.85	1.8%
Total	0.56	1.43	1.87	1.57	1.20	0.87	1.6%
Total							
Highway vehicle total	**163.23**	**143.83**	**110.26**	**83.88**	**68.06**	**48.22**	**100.0%**
Percent diesel	0.3%	1.0%	1.7%	1.9%	1.8%	1.8%	

Source:
U. S. Environmental Protection Agency, National Emission Inventory Air Pollutant Emission Trends website www.epa.gov/ttn/chief/trends (Additional resources: www.epa.gov/oar/oaqps)

[a] The sums of subcategories may not equal total due to rounding.
[b] Less than 8,500 pounds.

The transportation sector accounted for over half of the nation's nitrogen oxide (NOx) emissions in 2006, with the majority coming from highway vehicles. For details on the highway emissions of NOx, see Table 12.5.

Table 12.4
Total National Emissions of Nitrogen Oxides, 1970–2006[a]
(million short tons)

Source category	1970	1980	1990	1995	2000	2006	Percent of total, 2006
Highway vehicles	12.62	11.49	9.59	8.88	8.39	6.60	36.2%
Other off-highway	2.65	3.35	3.78	4.11	4.17	4.02	22.1%
Transportation total	15.28	14.84	13.37	12.99	12.56	10.62	58.3%
Stationary fuel combustion total	10.06	11.32	10.89	10.83	8.82	6.43	35.3%
Industrial processes total	0.78	0.56	0.80	0.77	0.81	0.89	4.9%
Waste disposal and recycling total	0.44	0.11	0.09	0.10	0.13	0.11	0.6%
Miscellaneous total	0.33	0.25	0.37	0.27	0.28	0.18	1.0%
Total of all sources	**26.89**	**27.08**	**25.52**	**24.96**	**22.60**	**18.23**	**100.0%**

Source:
U. S. Environmental Protection Agency, National Emission Inventory Air Pollutant Emission Trends website www.epa.gov/ttn/chief/trends (Additional resources: www.epa.gov/oar/oaqps)

[a] The sums of subcategories may not equal total due to rounding.

Heavy diesel-powered vehicles were responsible for nearly one-half (44.1%) of highway vehicle nitrogen oxide emissions in 2005, while light gasoline vehicles were responsible for the rest.

Table 12.5
Emissions of Nitrogen Oxides from Highway Vehicles, 1970–2005[a]
(million short tons)

Source category	1970	1980	1990	1995	2000	2005	Percent of total, 2005
Gasoline powered							
Light vehicles & motorcycles	8.54	6.63	4.26	3.05	2.31	1.63	25.5%
Light trucks[b]	1.54	1.58	1.50	1.46	1.44	1.56	24.4%
Heavy vehicles	0.72	0.62	0.57	0.52	0.45	0.38	5.9%
Total	10.81	8.83	6.33	5.03	4.20	3.57	55.9%
Diesel powered							
Light vehicles	0.00	0.03	0.04	0.02	0.01	0.00	0.0%
Light trucks[b]	0.07	0.05	0.02	0.01	0.01	0.01	0.2%
Heavy vehicles	1.76	2.59	3.19	3.82	4.18	2.81	44.0%
Total	1.83	2.66	3.26	3.85	4.19	2.82	44.1%
Total							
Highway vehicle total	**12.64**	**11.49**	**9.59**	**8.88**	**8.39**	**6.39**	**100.0%**
Percent diesel	14.5%	23.1%	34.0%	43.4%	49.9%	44.1%	

Source:
U. S. Environmental Protection Agency, National Emission Inventory Air Pollutant Emission Trends website www.epa.gov/ttn/chief/trends (Additional resources: www.epa.gov/oar/oaqps)

[a] The sums of subcategories may not equal total due to rounding.
[b] Less than 8,500 pounds.

The transportation sector accounted for over 35% of the nation's volatile organic compound (VOC) emissions in 2006, with the majority coming from highway vehicles. For details on the highway emissions of VOC, see Table 12.7.

Table 12.6
Total National Emissions of Volatile Organic Compounds, 1970–2006[a]
(million short tons)

Source category	1970	1980	1990	1995	2000	2006	Percent of total, 2006
Highway vehicles	16.91	13.87	9.39	6.75	5.33	3.85	22.1%
Off-highway	1.62	2.19	2.66	2.89	2.64	2.32	13.3%
Transportation total	18.53	16.06	12.05	9.64	7.97	6.17	35.5%
Stationary fuel combustion total	0.72	1.05	1.01	1.07	1.18	1.57	9.0%
Industrial processes total	12.33	12.10	9.01	9.71	7.21	6.89	39.6%
Waste disposal and recycling total	1.98	0.76	0.99	1.07	0.42	0.39	2.2%
Miscellaneous total	1.10	1.13	1.06	0.55	0.73	2.37	13.6%
Total of all sources	**34.66**	**31.10**	**24.12**	**22.04**	**17.51**	**17.39**	**100.0%**

Source:
U. S. Environmental Protection Agency, National Emission Inventory Air Pollutant Emission Trends website www.epa.gov/ttn/chief/trends (Additional resources: www.epa.gov/oar/oaqps)

[a] The sum of subcategories may not equal total due to rounding. The EPA's definition of volatile organic compounds excludes methane, ethane, and certain other nonphotochemically reactive organic compounds.

Gasoline-powered vehicles are responsible for over 95% of highway vehicle emissions of volatile organic compounds. VOC emissions from highway vehicles in 2005 were about one-quarter of the 1990 level.

Table 12.7
Emissions of Volatile Organic Compounds from Highway Vehicles, 1970–2005[a]
(thousand short tons)

Source category	1970	1980	1990	1995	2000	2005	Percent of total, 2005
Gasoline powered							
Light vehicles & motorcycles	11,996	9,304	5,690	3,768	2,903	2,111	51.8%
Light trucks[b]	2,776	2,864	2,617	2,225	1,929	1,629	39.9%
Heavy vehicles	1,679	1,198	633	421	256	171	4.2%
Total	16,451	13,366	8,940	6,414	5,088	3,911	95.9%
Diesel powered							
Light vehicles	8	16	18	9	3	2	0.0%
Light trucks[b]	41	28	15	10	4	6	0.1%
Heavy vehicles	411	459	415	315	230	159	3.9%
Total	460	503	448	335	238	167	4.1%
Total							
Highway vehicle total	**16,911**	**13,869**	**9,388**	**6,749**	**5,326**	**4,078**	**100.0%**
Percent diesel	2.7%	3.6%	4.8%	5.0%	4.5%	4.1%	

Source:
U. S. Environmental Protection Agency, National Emission Inventory Air Pollutant Emission Trends website www.epa.gov/ttn/chief/trends (Additional resources: www.epa.gov/oar/oaqps)

[a] The sums of subcategories may not equal total due to rounding.
[b] Less than 8,500 pounds.

The transportation sector accounted for just under 3% of the nation's particulate matter (PM-10) emissions in 2006. For details on the highway emissions of PM-10, see Table 12.9.

Table 12.8
Total National Emissions of Particulate Matter (PM-10), 1970–2006[a]
(million short tons)

Source category	1970	1980	1990	1995	2000	2006	Percent of total, 2006
Highway vehicles	0.48	0.43	0.39	0.30	0.23	0.18	1.0%
Off-highway	0.16	0.26	0.33	0.34	0.32	0.30	1.6%
Transportation total	0.64	0.69	0.72	0.64	0.55	0.48	2.6%
Stationary fuel combustion total	2.87	2.45	1.20	1.18	1.47	1.34	7.3%
Industrial processes total	7.67	2.75	1.04	0.95	0.71	1.16	6.3%
Waste disposal and recycling total	1.00	0.27	0.27	0.29	0.36	0.31	1.7%
Miscellaneous total	0.84	0.85	24.54	22.77	20.65	15.13	82.1%
Total of all sources	**13.02**	**7.01**	**27.77**	**25.83**	**23.74**	**18.42**	**100.0%**

Source:
U. S. Environmental Protection Agency, National Emission Inventory Air Pollutant Emission Trends website www.epa.gov/ttn/chief/trends (Additional resources: www.epa.gov/oar/oaqps)

Note: Because PM-10 is fine particle matter less than 10 microns, it also includes PM-2.5. Specific data for PM-2.5 are shown on Tables 12.10 and 12.11.

[a] Fine particle matter less than 10 microns. The sums of subcategories may not equal total due to rounding.
[b] Data are not available.

Since the mid-1980's, diesel-powered vehicles have been responsible for more than half of highway vehicle emissions of particulate matter (PM-10). Heavy vehicles are clearly the main source.

Table 12.9
Emissions of Particulate Matter (PM-10) from Highway Vehicles, 1970–2005[a]
(thousand short tons)

Source category	1970	1980	1990	1995	2000	2005	Percent of total, 2005
Gasoline powered							
Light vehicles & motorcycles	249	141	57	53	51	46	25.1%
Light trucks[b]	74	49	31	32	32	35	19.1%
Heavy vehicles	44	30	17	13	10	8	4.4%
Total	367	220	104	98	93	89	48.6%
Diesel powered							
Light vehicles	2	9	11	4	1	1	0.5%
Light trucks[b]	19	12	5	3	1	1	0.5%
Heavy vehicles	92	191	268	199	135	92	50.3%
Total	113	212	284	206	137	94	51.4%
Total							
Highway vehicle total	**480**	**432**	**389**	**304**	**230**	**183**	**100.0%**
Percent diesel	23.5%	49.1%	73.0%	67.7%	59.5%	51.4%	

Source:
U. S. Environmental Protection Agency, National Emission Inventory Air Pollutant Emission Trends website www.epa.gov/ttn/chief/trends (Additional resources: www.epa.gov/oar/oaqps)

Note: Because PM-10 is fine particle matter less than 10 microns, it also includes PM-2.5. Specific data for PM-2.5 are shown on Tables 12.10 and 12.11.

[a] The sums of subcategories may not equal total due to rounding.
[b] Less than 8,500 pounds.

The transportation sector accounted for only 3% of the nation's particulate matter (PM-2.5) emissions in 2006. For details on the highway emissions of PM-2.5, see Table 12.11.

Table 12.10
Total National Emissions of Particulate Matter (PM-2.5), 1990–2006
(million short tons)

Source category	1990	1995	2000	2002	2004	2006	Percent of total, 2006
Highway vehicles	0.32	0.25	0.17	0.15	0.14	0.13	2.8%
Off-highway	0.30	0.31	0.30	0.30	0.29	0.28	6.1%
Transportation total	0.62	0.56	0.47	0.45	0.43	0.41	9.0%
Stationary fuel combustion total	0.91	0.90	1.29	1.05	1.05	1.05	22.9%
Industrial processes total	0.56	0.50	0.50	0.48	0.50	0.52	11.4%
Waste disposal and recycling total	0.23	0.25	0.33	0.27	0.28	0.29	6.3%
Miscellaneous total	5.23	4.73	4.69	2.23	2.27	2.31	50.4%
Total of all sources	**7.55**	**6.94**	**7.28**	**4.48**	**4.53**	**4.58**	**100.0%**

Source:
U. S. Environmental Protection Agency, National Emission Inventory Air Pollutant Emission Trends website www.epa.gov/ttn/chief/trends (Additional resources: www.epa.gov/oar/oaqps)

Diesel vehicles are responsible for the majority of highway vehicle PM-2.5 emissions. Nearly two-thirds of the highway vehicles' PM-2.5 emissions are from heavy diesel trucks.

Table 12.11
Emissions of Particulate Matter (PM-2.5) from Highway Vehicles, 1990–2005[a]
(thousand short tons)

Source category	1990	1995	2000	2005	Percent of total, 2005
Gasoline powered					
Light vehicles & motorcycles	35	30	27	23	18.0%
Light trucks[b]	21	20	18	18	14.1%
Heavy vehicles	11	9	7	6	4.7%
Total	67	59	52	47	36.7%
Diesel powered					
Light vehicles	9	4	1	1	0.8%
Light trucks[b]	4	2	1	1	0.8%
Heavy vehicles	243	179	119	79	61.7%
Total	256	185	121	81	63.3%
Total					
Highway vehicle total	**323**	**245**	**173**	**128**	**100.0%**
Percent diesel	79.3%	75.5%	69.9%	63.3%	

Source:
U. S. Environmental Protection Agency, National Emission Inventory Air Pollutant Emission Trends website www.epa.gov/ttn/chief/trends (Additional resources: www.epa.gov/oar/oaqps)

[a] The sums of subcategories may not equal total due to rounding.
[b] Less than 8,500 pounds.

Table 12.12
U.S. Tier 2 Emission Standards for Cars and Light Trucks
Effective for 2004–2009 Model Years[a]
(grams/mile)

Bin	NMOG	CO	NOx	PM	HCHO
		50,000 miles			
10[b]	0.125	3.4	0.4	[c]	0.015
9[b]	0.075	3.4	0.2	[c]	0.015
8	0.100	3.4	0.14	[c]	0.015
7	0.075	3.4	0.11	[c]	0.015
6	0.075	3.4	0.08	[c]	0.015
5	0.075	3.4	0.05	[c]	0.015
		120,000 miles			
MDPV[b]	0.280	7.3	0.9	0.12	0.032
10[b]	0.156	4.2	0.6	0.08	0.018
9[b]	0.090	4.2	0.3	0.06	0.018
8	0.125	4.2	0.2	0.02	0.018
7	0.090	4.2	0.15	0.02	0.018
6	0.090	4.2	0.10	0.01	0.018
5	0.090	4.2	0.07	0.01	0.018
4	0.070	2.1	0.04	0.01	0.011
3	0.055	2.1	0.03	0.01	0.011
2	0.010	2.1	0.02	0.01	0.004
1	0.000	0.0	0.00	0.00	0.000

Source:
Federal Register, Vol. 65, No. 28, Thursday, February 10, 2000, pp. 6822–6870.

Acronyms Used on Tables 12.12 and 12.13

CO	Carbon monoxide
GVW	Gross vehicle weight
HC	Hydrocarbons
HCHO	Formaldehyde
LDT	Light-duty truck
LEV	Low-emission vehicle
LVW	Loaded vehicle weight
MDPV	Medium-duty passenger vehicle (8,500–10,000 lbs. GVWR)
NMOG	Non-methane organic gases
NOx	Nitrogen oxides
PM	Particulate matter
SULEV	Super-ultra-low-emission vehicle
ULEV	Ultra-low-emission vehicle
ZEV	Zero-emission vehicle

[a] Some temporary standards are not shown.
[b] Bin expires after 2008.
[c] No Standard.

Table 12.13
Light Vehicle Exhaust Emission Standards in Effect in 2009
when U.S. Tier 2 Standards are Final
(grams/mile)

Vehicle fuels: Gasoline AND diesel unless noted otherwise

Vehicle size: Up to 8,500 lbs. GVW unless noted otherwise

Useful life:		120,000 miles				
	Bins, category, size	NMOG	CO	NOx	PM	HCHO
U.S.	Bins					
emission	8	0.125	4.2	0.20	0.02	0.018
standards	7	0.090	4.2	0.15	0.02	0.018
	6	0.090	4.2	0.10	0.01	0.018
	5	0.090	4.2	0.07	0.01	0.018
	4	0.070	2.1	0.04	0.01	0.011
	3	0.055	2.1	0.03	0.01	0.011
	2	0.010	2.1	0.02	0.01	0.004
	1	0.000	0.0	0.00	0.00	0.000
	Average[a]	–	–	0.07	–	–
California	Category			(Diesel only)		
LEV II	LEV[b]	0.090	4.2	0.07	0.01	0.018
emission	ULEV	0.055	2.1	0.07	0.01	0.011
standards	SULEV	0.010	1.0	0.02	0.01	0.004
	ZEV[c]	0.000	0.0	0.00	0.00	0.000

Source:
U.S.: *Federal Register*, Vol. 65, No. 28, Thursday, February 10, 2000, pp. 6822–6870.
California Exhaust Emission Standards and Test Procedures for 2001 and Subsequent Model Passenger Cars, Light-Duty Trucks and Medium-Duty Vehicles, as of December 1, 1999 (adopted August 5, 1999), incorporated by reference in section 1961(d), title 13, CCR.

Note: See acronym list on previous page.

[a] Includes medium-duty passenger vehicles which are also required to meet bin standards.
[b] A LEV Option 1 with higher NOx levels also exists for up to 4% of LDTs above 3,750 lbs.
[c] Only apply to cars and LDTs 0-3750 lbs LVW.

Table 12.14
California Cars and Light Trucks Emission Certification Standards
for Model years 2001–2006
(grams/mile)

Vehicle Type	Emission Category	Vehicle Useful Life: 10 Years / 100,000 Miles						
		THC[a]	NMHC[b]	NMOG[c]	CO	NO_X	PM	HCHO
Car	Tier 1	–	0.31	–	4.2	0.6	–	–
	TLEV	–	–	0.156	4.2	0.6	0.08[d]	0.018
	LEV	–	–	0.090	4.2	0.3	0.08[d]	0.018
	ULEV	–	–	0.055	2.1	0.3	0.04[d]	0.011
	ZEV	0.00	0.00	0.000	0.0	0.0	0.00	0.000
LDT1	Tier 1	–	0.31	–	4.2	0.6	–	–
	TLEV	–	–	0.156	4.2	0.6	0.08[d]	0.018
	LEV	–	–	0.090	4.2	0.3	0.08[d]	0.018
	ULEV	–	–	0.055	2.1	0.3	0.04[d]	0.011
	ZEV	0.00	0.00	0.000	0.0	0.0	0.00	0.000
LDT2	Tier 1	–	0.40	–	5.5	0.97	–	–
	TLEV	–	–	0.200	5.5	0.9	0.10[d]	0.023
	LEV	–	–	0.130	5.5	0.5	0.10[d]	0.023
	ULEV	–	–	0.070	2.8	0.5	0.05[d]	0.013

Source:
U.S. Environmental Protection Agency, Office of Transportation and Air Quality, EPA 420-B-00-001. (Additional resources: www.epa.gov/otag)

Note: After 2003, Tier 1 and TLEV standards will be eliminated. LDT1 = light truck (6,000 lbs. or less GVWR) up through 3,750 lbs. loaded vehicle weight; LDT2 = light truck (6,000 lbs. or less GVWR) greater than 3,750 lbs. loaded vehicle weight.

[a] THCE for methanol vehicles. Does not apply to CNG vehicles.
[b] THCE for Tier 0 methanol vehicles. NMHCE for other alcohol vehicles.
[c] NMHC for diesel-fueled vehicles.
[d] Diesel-fueled vehicles only.