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Date: April 6, 2015
To: Rodney LeBlance
From: Rick Buckley
Subject: Waterford 3 Air Emission Calculations
Criteria Pollutants, Hazardous Air Pollutants and Greenhouse Gases

CEO 2015-00017

To support the evaluation of air quality impacts associated with license renewal, this calculation package contains the criteria air pollutant emissions associated with the permitted sources listed in Attachment 1 for the years 2010 through 2014. In addition, this package also contains the calculated direct (combustion sources) and indirect (workforce commuting) greenhouse gas emissions associated with Waterford 3's plant operation for these same years.

Attachment 2 to this calculation package contains an annual emission summary of criteria air pollutant emissions for the years 2010 through 2014 of the permitted sources listed in Attachment 1. Attachment 2 also lists a criteria air pollutant emission summary for each the categorical sources listed below which was utilized to develop the overall annual emission summary.

- ≤600 Horsepower Stationary Generators
- >600 Horsepower Stationary Generators
- <100 MMBTU Portable Diesel Boiler
- ≤600 Horsepower Portable Diesel Generators

- Portable Gasoline Engines
- Diesel Fuel/Lube Oil/Gasoline Tanks

Criteria air pollutant emission calculations for combustion sources shown in Attachment 1 were based on calculated annual fuel usage (Attachment 3) utilizing the Environmental Protection Agency's emission factors published in AP-42, Compilation of Air Pollutant Emission Factors. Volatile organic compounds for the diesel fuel oil, lube oil and gasoline tanks listed in Attachment 1 were based on permitted tons per year (0.35) shown on pages 5 and 6 in Waterford 3 Air Permit 2520-00091-00.

Attachment 4 contains an annual greenhouse gas (GHG) emission summary of the combustion sources listed in Attachment 1, and from workforce commuting for the years 2010 through 2014. GHG emissions for combustion sources were calculated based on annual fuel usage from all combustion sources. GHG emissions from workforce commuting were calculated based on data furnished by the United States Census Bureau and the Environmental Protection Agency. Attachment 5 contains the supporting calculations for these sources of GHG emissions.

If you have any questions, please contact me at 601-368-5823.



Rick Buckley
Sr. Project Manager, Environmental

Attachment 1
Permitted Air Emission Sources

<u>Emission Point</u>	<u>Description</u>
3-79	Emergency Diesel Generator A
4-79	Emergency Diesel Generator B
5-79	Fire Water Diesel Pump A
6-79	Fire Water Diesel Pump B
7-79	Security Emergency Diesel Generator
8-83	Emergency Operations Facility Emergency Diesel Generator
9-99	Dry Cooling Tower Diesel Pump A
10-99	Dry Cooling Tower Diesel Pump B
11-00	IT Emergency Diesel Generator
19-79	Portable Diesel Generator
20-00	ACCW Wet Cooling Tower A
21-00	ACCW Wet Cooling Tower B
12-79	Diesel Fuel Oil Storage Tank (100,000 gallons)
13-79	Emergency Diesel Generator Fuel Oil Storage Tank A (142,500 gallons)
14-79	Emergency Diesel Generator Fuel Oil Storage Tank B (142,500 gallons)
15-79	Lube Oil Batch Tank A (21,200 gallons)
16-79	Lube Oil Batch Tank B (21,200 gallons)
17-79	Main Turbine Lube Oil Reservoir (20,900 gallons)
18-79	Gasoline Fuel Storage Tank (900 gallons)
22-02	Portable Outage/Maintenance Diesel Engines
23-02	Portable Outage/Maintenance Gasoline Engines
24-03	Portable Auxiliary Boiler

Attachment 2

Annual Air Emissions Inventory Summary, 2010–2014

Year	Annual Emissions (tons/year)					
	SO_x	NO_x	CO	PM₁₀	VOCs	HAPs
2010	0.4	15.0	3.9	0.7	1.0	0.01
2011	0.5	20.5	5.3	1.0	1.2	0.02
2012	1.8	38.5	9.1	2.2	2.7	0.04
2013	0.6	18.1	4.7	0.8	1.0	0.03
2014	0.6	22.2	5.5	1.2	1.5	0.02

Attachment 2 (Continued)
Annual Air Emissions Inventory Summary, 2010–2014

2010 Annual Emissions (tons/year)						
Emission Source	SO_x	NO_x	CO	PM₁₀	VOCs	HAPs
≤600 Horsepower Stationary Generators	0.1	0.8	0.2	0.1	0.1	0.001
>600 Horsepower Stationary Generators	0.1	11.9	3.2	0.4	0.3	0.01
<100 MMBTU Portable Diesel Boiler	0	0	0	0	0	0
≤600 Horsepower Portable Diesel Generators	0.2	2.3	0.5	0.2	0.2	0.002
Portable Gasoline Engines	0.001	0.01	0.01	0.02	0.001	0.00003
Diesel Fuel/Lube Oil/Gasoline Tanks ^(a)	0	0	0	0	0.35	0
Total	0.4	15.0	3.9	0.7	1.0	0.01
2011 Annual Emissions (tons/year)						
Emission Source	SO_x	NO_x	CO	PM₁₀	VOCs	HAPs
≤600 Horsepower Stationary Generators	0.1	0.8	0.2	0.1	0.1	0.001
>600 Horsepower Stationary Generators	0.1	15.4	4.1	0.5	0.4	0.01
<100 MMBTU Portable Diesel Boiler	0.1	0.6	0.2	0.1	0.01	0.005
≤600 Horsepower Portable Diesel Generators	0.2	3.7	0.8	0.3	0.3	0.003
Portable Gasoline Engines	0.001	0.01	0.01	0.02	0.001	0.00003
Diesel Fuel/Lube Oil/Gasoline Tanks ^(a)	0	0	0	0	0.35	0
Total	0.5	20.5	5.3	1.0	1.2	0.02

a. VOC annual emissions based on the permitted tons per year from all tanks shown on Pages 5 and 6 in WF3 Air Permit 2520-00091-00.

Attachment 2 (Continued)
Annual Air Emissions Inventory Summary, 2010–2014

2012 Annual Emissions (tons/year)						
Emission Source	SO_x	NO_x	CO	PM₁₀	VOCs	HAPs
≤600 Horsepower Stationary Generators	0.1	1.0	0.2	0.1	0.1	0.001
>600 Horsepower Stationary Generators	0.1	13.8	3.7	0.4	0.4	0.01
<100 MMBTU Portable Diesel Boiler	0.1	0.7	0.2	0.1	0.01	0.005
≤600 Horsepower Portable Diesel Generators	1.5	23.0	5.0	1.6	1.8	0.02
Portable Gasoline Engines	0	0	0	0	0	0
Diesel Fuel/Lube Oil/Gasoline Tanks ^(a)	0	0	0	0	0.35	0
Total	1.8	38.5	9.1	2.2	2.7	0.04
2013 Annual Emissions (tons/year)						
Emission Source	SO_x	NO_x	CO	PM₁₀	VOCs	HAPs
≤600 Horsepower Stationary Generators	0.1	0.8	0.2	0.1	0.1	0.001
>600 Horsepower Stationary Generators	0.1	13.9	3.7	0.4	0.4	0.01
<100 MMBTU Portable Diesel Boiler	0.3	2.0	0.5	0.2	0.03	0.015
≤600 Horsepower Portable Diesel Generators	0.1	1.4	0.3	0.1	0.1	0.001
Portable Gasoline Engines	0	0	0	0	0	0
Diesel Fuel/Lube Oil/Gasoline Tanks ^(a)	0	0	0	0	0.35	0
Total	0.6	18.1	4.7	0.8	1.0	0.03

a. VOC annual emissions based on the permitted tons per year from all tanks shown on Pages 5 and 6 in WF3 Air Permit 2520-00091-00.

Attachment 2 (Continued)
Annual Air Emissions Inventory Summary, 2010–2014

2014 Annual Emissions (tons/year)						
Emission Source	SO_x	NO_x	CO	PM₁₀	VOCs	HAPs
≤600 Horsepower Stationary Generators	0.1	2.2	0.5	0.2	0.2	0.002
>600 Horsepower Stationary Generators	0.1	12.7	3.4	0.4	0.4	0.01
<100 MMBTU Portable Diesel Boiler	0.003	0.8	0.2	0.1	0.01	0.006
≤600 Horsepower Portable Diesel Generators	0.4	6.5	1.4	0.5	0.5	0.006
Portable Gasoline Engines	0	0	0	0	0	0
Diesel Fuel/Lube Oil/Gasoline Tanks ^(a)	0	0	0	0	0.35	0
Total	0.6	22.2	5.5	1.2	1.5	0.02

a. VOC annual emissions based on the permitted tons per year from all tanks shown on Pages 5 and 6 in WF3 Air Permit 2520-00091-00.

Attachment 3

Annual Air Emissions Inventory Summary, Supporting Calculations

1. Emission calculations for the stationary emission points below were based on annual calculated fuel usage (annual operational run hours × maximum gallons per hour fuel consumption).
 - Emission Point 3-79: Emergency Diesel Generator A (339 gph)
 - Emission Point 4-79: Emergency Diesel Generator B (339 gph)
 - Emission Point 5-79: Fire Water Diesel Pump A (12 gph)
 - Emission Point 6-79: Fire Water Diesel Pump B (12 gph)
 - Emission Point 7-79: Security Emergency Diesel Generator (16 gph)
 - Emission Point 8-83: EOF Emergency Diesel Generator (18 gph)
 - Emission Point 9-99: Dry Cooling Tower Diesel Pump A (1.2 gph)
 - Emission Point 10-99: Dry Cooling Tower Diesel Pump B (1.2 gph)
 - Emission Point 11-00: IT Emergency Diesel Generator (9.4 gph)

Although stationary combustion sources at Waterford 3 are limited as it relates to annual operational hours based on the operating schedule shown in Air Permit 2520-00091-00, the permit does not impose recordkeeping requirements to track the hours. In 2004, Waterford 3 began tracking the operational hours to verify that the values specified in the operating schedule of the air permit were not exceeded. However based on review of the operational run times recorded from 2004 through 2014, this practice did not continue on a consistent basis after 2008. Therefore with the exception of Emission Points 3-79 (Emergency Diesel Generator A) and 4-79 (Emergency Diesel Generator B), calculated criteria air pollutant emissions based on annual operational run hours and associated calculated fuel usage for the remaining stationary combustion sources (Emission Points 4-79, 5-79, 6-79, 8-83, 9-99, 10-99 and 11-00) should be considered projected annual estimates for certain years. Table A-1 provides additional details regarding the basis for determining annual operational hours.

2. With the exceptions noted in Table A-2, emission calculations for the emission points below were based on annual fuel usage reports submitted to the LDEQ.
 - Emission Point 22-02: Portable Outage/Maintenance Diesel Engines
 - Emission Point 23-02: Portable Outage/Maintenance Gasoline Engines
 - Emission Point 24-03: Portable Auxiliary Boiler

3. PM_{10} emissions from the auxiliary component cooling water wet cooling towers were not included in the emissions inventory since water flowing through the towers is filtered water; therefore, PM_{10} emissions, if any, would be insignificant.

Table A-1 lists operational hours for the emission sources in Item 1 above, while Table A-2 lists calculated fuel usage for these emission sources. Table A-2 also lists fuel usage reported to the LDEQ for the emission sources in Item 2 above. Emission calculations for emission sources listed in Items 1 and 2 above are included in this attachment.

Table A-1						
Operational Hours, 2010 – 2014						
Emission Point	Description	2010	2011	2012	2013	2014
3-79	EDG A	69.9	98.7	88.8	91.4	91.9
4-79	EDG B	86.4	103.8	92.8	91.9	74.7
5-79 ^(a)	Fire Water Diesel Pump A	19.5	19.5	19.5	19.5	12.0
6-79 ^(b)	Fire Water Diesel Pump B	13.5	13.5	13.5	13.5	11.0
7-79 ^(c)	Security EDG	76.0	76.0	76.0	76.0	386.0
8-83 ^(d)	EOF EDG	43.6	43.6	75.8	44.65	44.65
9-99 ^(e)	DCT Diesel Pump A	0.15	0.15	0.15	0.15	0.15
10-99 ^(f)	DCT Diesel Pump B	0.16	0.16	0.16	0.16	0.16
11-00 ^(g)	IT EDG	22.1	22.1	22.1	22.1	1.5

- a. 2010 -2013 based on 4-year average. December 2013 reading (217.0) minus December 2009 reading (139.0).
- b. 2010 – 2013 based on 2-year historical average. December 2009 reading (35.0) minus December 2007 reading (8.0).
- c. 2010 -2013 based on 4-year average. December 2013 reading (1542.6) minus December 2009 reading (1238.5).
- d. 2010 and 2011 based on 3-year average. December 2011 reading (1032.2) minus December 2008 reading (901.3).
2013 -2014 based on 2-year average. December 2014 reading (1197.3) minus December 2012 reading (1108.0).
- e. 2010 – 2014 based on 4-year historical average, December 2008 reading (0.7) minus December 2004 reading (0.09).
- f. 2010 – 2014 based on 4-year historical average, December 2008 reading (0.74) minus December 2004 reading (0.09).
- g. 2010 – 2013 based on 5-year average, December 2013 reading (516.6) minus December 2008 reading (406.0).

Table A-2					
Fuel Usage, 2010 - 2014					
Emission Source	2010	2011	2012	2013	2014
Stationary Diesels (>600 HP)	52,986	68,648	61,562	62,139	56,477
Stationary Diesels (≤600 HP)	2,605	2,605	3,185	2,624	7,270
Portable Diesel Boiler (<100 MMBTU)	0	64,467	65,280	200,940	79,815
Portable Diesels (≤600 HP)	7,468	11,974	74,529	4,500	20,902 ^(a)
Gasoline Engines	110	110	0	0	0 ^(b)
<p>a. Assumed that fuel usage was all fuel deliveries made by Jackie Bee in 2014.</p> <p>b. Value of 7,317 gallons reported in the Annual Air Emissions Report was not associated with Emission Point 23-02 (Portable Outage/Maintenance Gasoline Engines).</p>					

4. For the emission points listed below, permitted volatile organic carbon tons per year from all tanks listed on pages 5 and 6 of Waterford 3 Air Permit 2520-00091-00 was utilized as the default value (0.35).

- Emission Point 12-79: Diesel Fuel Oil Storage Tank (100,000 gallons)
- Emission Point 13-79: EDG Fuel Oil Storage Tank A (142,500 gallons)
- Emission Point 14-79: EDG Fuel Oil Storage Tank B (142,500 gallons)
- Emission Point 15-79: Lube Oil Batch Tank A (21,200 gallons)
- Emission Point 16-79: Lube Oil Batch Tank B (21,200 gallons)
- Emission Point 17-79: Main Turbine Lube Oil Reservoir (20,900 gallons)
- Emission Point 18-79: Gasoline Fuel Storage Tank (900 gallons)

Stationary Diesels

Air Emission Calculations

(Emission Points 5-79, 6-79, 7-79, 8-83, 9-99, 10-99 and 11-00: ≤ 600 Horsepower)

(Emission Points 3-79 and 4-79: > 600 Horsepower)

2010 Stationary Combustion Sources (≤ 600 HP) ^a

<i>Enter Fuel Use (gal/yr) ^b</i>	2,605			
Criteria Pollutants	AP-42 Factor (lb/MMBtu) ^c	MMBtu/yr ^d	lbs/yr ^e	tons/yr
SO ₂	0.29	365	106	0.1
NO _x	4.41	365	1,608	0.8
CO	0.95	365	346	0.2
VOC ^f	0.35	365	128	0.1
PM ₁₀	0.31	365	113	0.1
Hazardous Air Pollutants				
Benzene	0.000933	365	0.3	0.0002
Toluene	0.000409	365	0.1	0.0001
Xylenes	0.000285	365	0.1	0.0001
1,3-Butadiene	0.0000391	365	0.01	0.00001
Formaldehyde	0.00118	365	0.4	0.0002
Acetaldehyde	0.000767	365	0.3	0.0001
Acrolein	0.0000925	365	0.03	0.00002
Napthalene	0.0000848	365	0.0	0.00002
Criteria Pollutants (Tons/Year)				1.2
Hazardous Air Pollutants (Tons/Year)				0.001

a. Includes Emission Points 5-79, 6-79, 7-79, 8-83, 9-99, 10-99, and 11-00.

b. Total combined fuel usage for emission points listed in note a above.

c. Factors obtained from AP-42 Tables 3.3-1 and 3.3-2.

d. Yearly fuel usage \times 140,000 Btu/gal \div 1,000,000

e. AP-42 Factor \times MMBtu/yr

f. Utilized AP-42 exhaust emission factor.

2010 Stationary Combustion Sources (>600 HP) ^a

Enter Fuel Use (gal/yr) ^b	52,986
Enter Fuel Sulfur Content (%)	0.02

Criteria Pollutants	AP-42 Factor (lb/MMBtu) ^c	MMBtu/yr ^d	lbs/yr ^e	tons/yr
SO ₂	1.01	7,418	150	0.1
NO _x	3.2	7,418	23,738	11.9
CO	0.85	7,418	6,305	3.2
VOC ^f	0.09	7,418	668	0.3
PM ₁₀	0.1	7,418	742	0.4
Hazardous Air Pollutants				
Benzene	0.000776	7,418	5.8	0.003
Toluene	0.000281	7,418	2.1	0.001
Xylenes	0.000193	7,418	1.4	0.001
Formaldehyde	0.0000789	7,418	0.6	0.0003
Acetaldehyde	0.0000252	7,418	0.2	0.0001
Acrolein	0.00000788	7,418	0.1	0.00003
Napthalene	0.000130	7,418	1.0	0.0005

Criteria Pollutants (Tons/Year)			15.8
Hazardous Air Pollutants (Tons/Year)			0.01

- a. Includes Emission Points 3-79 (EDG A) and 4-79 (EDG B).
- b. Total combined fuel usage for Emission Points 3-79 and 4-79.
- c. Factors obtained from AP-42 Tables 3.4-1, 3.4-3 and 3.4-4.
- d. Yearly fuel usage × 140,000 Btu/gal ÷ 1,000,000
- e. AP-42 Factor × MMBtu/yr (For SO₂, fuel sulfur content of 0.02 was also included in the formula).
- f. Emission factor includes methane and nonmethane emissions (see AP-42 ,Table 3.4-1, footnote f).

2011 Stationary Combustion Sources (≤ 600 HP) ^a

<i>Enter Fuel Use (gal/yr) ^b</i>	2,605			
Criteria Pollutants	AP-42 Factor (lb/MMBtu) ^c	MMBtu/yr ^d	lbs/yr ^e	tons/yr
SO ₂	0.29	365	106	0.1
NO _x	4.41	365	1,608	0.8
CO	0.95	365	346	0.2
VOC ^f	0.35	365	128	0.1
PM ₁₀	0.31	365	113	0.1
Hazardous Air Pollutants				
Benzene	0.000933	365	0.3	0.0002
Toluene	0.000409	365	0.1	0.0001
Xylenes	0.000285	365	0.1	0.0001
1,3-Butadiene	0.0000391	365	0.01	0.00001
Formaldehyde	0.00118	365	0.4	0.0002
Acetaldehyde	0.000767	365	0.3	0.0001
Acrolein	0.0000925	365	0.03	0.00002
Napthalene	0.0000848	365	0.03	0.00002
Criteria Pollutants (Tons/Year)				1.2
Hazardous Air Pollutants (Tons/Year)				0.001

- a. Includes Emission Points 5-79, 6-79, 7-79, 8-83, 9-99, 10-99, and 11-00.
- b. Total combined fuel usage for emission points listed in note a above.
- c. Factors obtained from AP-42 Tables 3.3-1 and 3.3-2.
- d. Yearly fuel usage × 140,000 Btu/gal ÷ 1,000,000
- e. AP-42 Factor × MMBtu/yr.
- f. Utilized AP-42 exhaust emission factor.

2011 Stationary Combustion Sources (>600 HP) ^a

Enter Fuel Use (gal/yr) ^b	68,648
Enter Fuel Sulfur Content (%)	0.02

Criteria Pollutants	AP-42 Factor (lb/MMBtu) ^c	MMBtu/yr ^d	lbs/yr ^e	tons/yr
SO ₂	1.01	9,611	194	0.1
NO _x	3.2	9,611	30,754	15.4
CO	0.85	9,611	8,169	4.1
VOC ^f	0.09	9,611	865	0.4
PM ₁₀	0.1	9,611	961	0.5
Hazardous Air Pollutants				
Benzene	0.000776	9,611	7.5	0.004
Toluene	0.000281	9,611	2.7	0.001
Xylenes	0.000193	9,611	1.9	0.001
Formaldehyde	0.0000789	9,611	0.8	0.0004
Acetaldehyde	0.0000252	9,611	0.2	0.0001
Acrolein	0.00000788	9,611	0.1	0.00004
Napthalene	0.00013	9,611	1.2	0.001

Criteria Pollutants (Tons/Year)	20.5
Hazardous Air Pollutants (Tons/Year)	0.01

- a. Includes Emission Points 3-79 (EDG A) and 4-79 (EDG B).
- b. Total combined fuel usage for Emission Points 3-79 and 4-79.
- c. Factors obtained from AP-42 Tables 3.4-1, 3.4-3 and 3.4-4.
- d. Yearly fuel usage × 140,000 Btu/gal ÷ 1,000,000
- e. AP-42 Factor × MMBtu/yr (For SO₂, fuel sulfur content of 0.02 was also included in the formula).
- f. Emission factor includes methane and nonmethane emissions (see AP-42 ,Table 3.4-1, footnote f).

2012 Stationary Combustion Sources (≤ 600 HP) ^a

<i>Enter Fuel Use (gal/yr) ^b</i>	3,185			
Criteria Pollutants	AP-42 Factor (lb/MMBtu) ^c	MMBtu/yr ^d	lbs/yr ^e	tons/yr
SO ₂	0.29	446	129	0.1
NO _x	4.41	446	1,966	1.0
CO	0.95	446	424	0.2
VOC ^f	0.35	446	156	0.1
PM ₁₀	0.31	446	138	0.1
Hazardous Air Pollutants				
Benzene	0.000933	446	0.4	0.0002
Toluene	0.000409	446	0.2	0.0001
Xylenes	0.000285	446	0.1	0.0001
1,3-Butadiene	0.0000391	446	0.02	0.00001
Formaldehyde	0.00118	446	0.5	0.0003
Acetaldehyde	0.000767	446	0.3	0.0002
Acrolein	0.0000925	446	0.04	0.00002
Napthalene	0.0000848	446	0.04	0.00002
Criteria Pollutants (Tons/Year)				1.4
Hazardous Air Pollutants (Tons/Year)				0.001

a. Includes Emission Points 5-79, 6-79, 7-79, 8-83, 9-99, 10-99, and 11-00.

b. Total combined fuel usage for emission points listed in note a above.

c. Factors obtained from AP-42 Tables 3.3-1 and 3.3-2.

d. Yearly fuel usage \times 140,000 Btu/gal \div 1,000,000

e. AP-42 Factor \times MMBtu/yr.

f. Utilized AP-42 exhaust emission factor.

2012 Stationary Combustion Sources (>600 HP) ^a

Enter Fuel Use (gal/yr) ^b	61,562
Enter Fuel Sulfur Content (%)	0.02

Criteria Pollutants	AP-42 Factor (lb/MMBtu) ^c	MMBtu/yr ^d	lbs/yr ^e	tons/yr
SO ₂	1.01	8,619	174	0.1
NO _x	3.2	8,619	27,580	13.8
CO	0.85	8,619	7,326	3.7
VOC ^f	0.09	8,619	776	0.4
PM ₁₀	0.1	8,619	862	0.4
Hazardous Air Pollutants				
Benzene	0.000776	8,619	6.7	0.003
Toluene	0.000281	8,619	2.4	0.001
Xylenes	0.000193	8,619	1.7	0.001
Formaldehyde	0.0000789	8,619	0.7	0.0003
Acetaldehyde	0.0000252	8,619	0.2	0.0001
Acrolein	0.00000788	8,619	0.1	0.00003
Napthalene	0.00013	8,619	1.1	0.001

Criteria Pollutants (Tons/Year)	18.4
Hazardous Air Pollutants (Tons/Year)	0.01

- a. Includes Emission Points 3-79 (EDG A) and 4-79 (EDG B).
- b. Total combined fuel usage for Emission Points 3-79 and 4-79.
- c. Factors obtained from AP-42 Tables 3.4-1, 3.4-3 and 3.4-4.
- d. Yearly fuel usage × 140,000 Btu/gal ÷ 1,000,000
- e. AP-42 Factor × MMBtu/yr (For SO₂, fuel sulfur content of 0.02 was also included in the formula).
- f. Emission factor includes methane and nonmethane emissions (see AP-42 ,Table 3.4-1, footnote f).

2013 Stationary Combustion Sources (≤ 600 HP) ^a

<i>Enter Fuel Use (gal/yr) ^b</i>	2,624			
Criteria Pollutants	AP-42 Factor (lb/MMBtu) ^c	MMBtu/yr ^d	lbs/yr ^e	tons/yr
SO ₂	0.29	367	107	0.1
NO _x	4.41	367	1,620	0.8
CO	0.95	367	349	0.2
VOC ^f	0.35	367	129	0.1
PM ₁₀	0.31	367	114	0.1
Hazardous Air Pollutants				
Benzene	0.000933	367	0.3	0.0002
Toluene	0.000409	367	0.2	0.0001
Xylenes	0.000285	367	0.1	0.0001
1,3-Butadiene	0.0000391	367	0.01	0.00001
Formaldehyde	0.00118	367	0.4	0.0002
Acetaldehyde	0.000767	367	0.3	0.0001
Acrolein	0.0000925	367	0.03	0.00002
Napthalene	0.0000848	367	0.03	0.00002
Criteria Pollutants (Tons/Year)				1.2
Hazardous Air Pollutants (Tons/Year)				0.001

a. Includes Emission Points 5-79, 6-79, 7-79, 8-83, 9-99, 10-99, and 11-00.

b. Total combined fuel usage for emission points listed in note a above.

c. Factors obtained from AP-42 Tables 3.3-1 and 3.3-2.

d. Yearly fuel usage \times 140,000 Btu/gal \div 1,000,000

e. AP-42 Factor \times MMBtu/yr.

f. Utilized AP-42 exhaust emission factor.

2013 Stationary Combustion Sources (>600 HP) ^a

Enter Fuel Use (gal/yr) ^b	62,139
Enter Fuel Sulfur Content (%)	0.02

Criteria Pollutants	AP-42 Factor (lb/MMBtu) ^c	MMBtu/yr ^d	lbs/yr ^e	tons/yr
SO ₂	1.01	8,699	176	0.1
NO _x	3.2	8,699	27,838	13.9
CO	0.85	8,699	7,395	3.7
VOC ^f	0.09	8,699	783	0.4
PM ₁₀	0.1	8,699	870	0.4
Hazardous Air Pollutants				
Benzene	0.000776	8,699	6.8	0.003
Toluene	0.000281	8,699	2.4	0.001
Xylenes	0.000193	8,699	1.7	0.001
Formaldehyde	0.0000789	8,699	0.7	0.0003
Acetaldehyde	0.0000252	8,699	0.2	0.0001
Acrolein	0.00000788	8,699	0.1	0.00003
Napthalene	0.00013	8,699	1.1	0.001

Criteria Pollutants (Tons/Year)				18.5
Hazardous Air Pollutants (Tons/Year)				0.01

- a. Includes Emission Points 3-79 (EDG A) and 4-79 (EDG B).
- b. Total combined fuel usage for Emission Points 3-79 and 4-79.
- c. Factors obtained from AP-42 Tables 3.4-1, 3.4-3 and 3.4-4.
- d. Yearly fuel usage × 140,000 Btu/gal ÷ 1,000,000
- e. AP-42 Factor × MMBtu/yr (For SO₂, fuel sulfur content of 0.02 was also included in the formula).
- f. Emission factor includes methane and nonmethane emissions (see AP-42 ,Table 3.4-1, footnote f).

2014 Stationary Combustion Sources (≤ 600 HP) ^a

<i>Enter Fuel Use (gal/yr) ^b</i>	7,270			
Criteria Pollutants	AP-42 Factor (lb/MMBtu) ^c	MMBtu/yr ^d	lbs/yr ^e	tons/yr
SO ₂	0.29	1,018	295	0.1
NO _x	4.41	1,018	4,488	2.2
CO	0.95	1,018	967	0.5
VOC ^f	0.35	1,018	356	0.2
PM ₁₀	0.31	1,018	316	0.2
Hazardous Air Pollutants				
Benzene	0.000933	1,018	0.9	0.0005
Toluene	0.000409	1,018	0.4	0.0002
Xylenes	0.000285	1,018	0.3	0.0001
1,3-Butadiene	0.0000391	1,018	0.04	0.00002
Formaldehyde	0.00118	1,018	1.2	0.001
Acetaldehyde	0.000767	1,018	0.8	0.0004
Acrolein	0.0000925	1,018	0.1	0.00005
Napthalene	0.0000848	1,018	0.1	0.00004
Criteria Pollutants (Tons/Year)				3.2
Hazardous Air Pollutants (Tons/Year)				0.002

a. Includes Emission Points 5-79, 6-79, 7-79, 8-83, 9-99, 10-99, and 11-00.

b. Total combined fuel usage for emission points listed in note a above.

c. Factors obtained from AP-42 Tables 3.3-1 and 3.3-2.

d. Yearly fuel usage \times 140,000 Btu/gal \div 1,000,000

e. AP-42 Factor \times MMBtu/yr.

f. Utilized AP-42 exhaust emission factor.

2014 Stationary Combustion Sources (>600 HP) ^a

Enter Fuel Use (gal/yr) ^b	56,477
Enter Fuel Sulfur Content (%)	0.02

Criteria Pollutants	AP-42 Factor (lb/MMBtu) ^c	MMBtu/yr ^d	lbs/yr ^e	tons/yr
SO ₂	1.01	7,907	160	0.1
NO _x	3.2	7,907	25,302	12.7
CO	0.85	7,907	6,721	3.4
VOC ^f	0.09	7,907	712	0.4
PM ₁₀	0.1	7,907	791	0.4
Hazardous Air Pollutants				
Benzene	0.000776	7,907	6.1	0.003
Toluene	0.000281	7,907	2.2	0.001
Xylenes	0.000193	7,907	1.5	0.0008
Formaldehyde	0.0000789	7,907	0.6	0.0003
Acetaldehyde	0.0000252	7,907	0.2	0.0001
Acrolein	0.00000788	7,907	0.1	0.00003
Napthalene	0.00013	7,907	1.0	0.0005

Criteria Pollutants (Tons/Year)			16.8
Hazardous Air Pollutants (Tons/Year)			0.01

- a. Includes Emission Points 3-79 (EDG A) and 4-79 (EDG B).
- b. Total combined fuel usage for Emission Points 3-79 and 4-79.
- c. Factors obtained from AP-42 Tables 3.4-1, 3.4-3 and 3.4-4.
- d. Yearly fuel usage × 140,000 Btu/gal ÷ 1,000,000
- e. AP-42 Factor × MMBtu/yr (For SO₂, fuel sulfur content of 0.02 was also included in the formula).
- f. Emission factor includes methane and nonmethane emissions (see AP-42 ,Table 3.4-1, footnote f).

Portable Diesel Boiler

Air Emission Calculations

(Portable Diesel Boiler: <100 MMBTU)

2011 Portable Auxiliary Boiler (Emission Point 2-95)

Enter Fuel Use (gals/yr)	64,467
Enter Fuel Sulfur Content (%)	0.02

Criteria Pollutants	AP-42 Factor (lb/1000 gal) ^a	lbs/yr ^b	tons/yr
SO ₂	142	183	0.1
NO _x	20	1,289	0.6
CO	5	322	0.2
PM ₁₀	2	129	0.1
VOC ^c	0.252	16	0.01

Hazardous Air Pollutants			
Benzene	0.000214	0.01	0.00001
Ethylbenzene	0.0000636	0.004	0.000002
Formaldehyde	0.0330	2.1	0.001
Napthalene	0.00113	0.1	0.00004
1,1,1-Trichloroethane	0.000236	0.02	0.00001
Toluene	0.00620	0.4	0.0002
o-Xylene	0.000109	0.01	0.000004
Antimony	0.00525	0.3	0.0002
Arsenic	0.00132	0.1	0.00004
Beryllium	0.0000278	0.002	0.000001
Cadmium	0.000398	0.03	0.00001
Chromium	0.000845	0.1	0.00003
Cobalt	0.00602	0.4	0.0002
Lead	0.00151	0.1	0.00005
Manganese	0.00300	0.2	0.0001
Mercury	0.000113	0.01	0.000004
Nickel	0.0845	5.4	0.003
Selenium	0.000683	0.04	0.00002

Criteria Pollutants (Tons/Year)		1.0
Hazardous Air Pollutants (Tons/Year)		0.005

a. Factors obtained from AP-42 Tables 1.3-1, 1.3-3, 1.3-9 and 1.3-11

b. Yearly fuel usage × AP-42 emission factor × 0.001 (For SO₂, the fuel sulfur content of 0.02 was also included in the formula).

c. Emission factor includes methane and nonmethane emissions.

2012 Portable Auxiliary Boiler (Emission Point 2-95)

Enter Fuel Use (gals/yr)	65,280
Enter Fuel Sulfur Content (%)	0.02

Criteria Pollutants	AP-42 Factor (lb/1000 gal) ^a	lbs/yr ^b	tons/yr
SO ₂	142	185	0.1
NO _x	20	1,306	0.7
CO	5	326	0.2
PM ₁₀	2	131	0.1
VOC ^c	0.252	16	0.01

Hazardous Air Pollutants			
Benzene	0.000214	0.01	0.00001
Ethylbenzene	0.0000636	0.004	0.000002
Formaldehyde	0.0330	2.2	0.001
Napthalene	0.00113	0.1	0.00004
1,1,1-Trichloroethane	0.000236	0.02	0.00001
Toluene	0.00620	0.4	0.0002
o-Xylene	0.000109	0.0	0.000004
Antimony	0.00525	0.3	0.0002
Arsenic	0.00132	0.1	0.00004
Beryllium	0.0000278	0.002	0.000001
Cadmium	0.000398	0.03	0.00001
Chromium	0.000845	0.1	0.00003
Cobalt	0.00602	0.4	0.0002
Lead	0.00151	0.1	0.00005
Manganese	0.00300	0.2	0.0001
Mercury	0.000113	0.01	0.000004
Nickel	0.0845	5.5	0.003
Selenium	0.000683	0.04	0.00002

Criteria Pollutants (Tons/Year)		1.0
Hazardous Air Pollutants (Tons/Year)		0.005

a. Factors obtained from AP-42 Tables 1.3-1, 1.3-3, 1.3-9 and 1.3-11

b. Yearly fuel usage × AP-42 emission factor × 0.001 (For SO₂, the fuel sulfur content of 0.02 was also included in the formula).

c. Emission factor includes methane and nonmethane emissions.

2013 Portable Auxiliary Boiler (Emission Point 2-95)

Enter Fuel Use (gals/yr)	200,940		
Enter Fuel Sulfur Content (%)	0.02		
Criteria Pollutants	AP-42 Factor (lb/1000 gal) ^a	lbs/yr ^b	tons/yr
SO ₂	142	571	0.3
NO _x	20	4,019	2.0
CO	5	1,005	0.5
PM ₁₀	2	402	0.2
VOC ^c	0.252	51	0.03
Hazardous Air Pollutants			
Benzene	0.000214	0.04	0.00002
Ethylbenzene	0.0000636	0.01	0.00001
Formaldehyde	0.0330	6.6	0.003
Napthalene	0.00113	0.2	0.0001
1,1,1-Trichloroethane	0.000236	0.05	0.00002
Toluene	0.00620	1.2	0.001
o-Xylene	0.000109	0.02	0.00001
Antimony	0.00525	1.1	0.001
Arsenic	0.00132	0.3	0.0001
Beryllium	0.0000278	0.01	0.000003
Cadmium	0.000398	0.1	0.00004
Chromium	0.000845	0.2	0.0001
Cobalt	0.00602	1.2	0.001
Lead	0.00151	0.3	0.0002
Manganese	0.00300	0.6	0.0003
Mercury	0.000113	0.02	0.00001
Nickel	0.0845	17.0	0.01
Selenium	0.000683	0.1	0.0001
Criteria Pollutants (Tons/Year)			3.0
Hazardous Air Pollutants (Tons/Year)			0.015

a. Factors obtained from AP-42 Tables 1.3-1, 1.3-3, 1.3-9 and 1.3-11

b. Yearly fuel usage × AP-42 emission factor × 0.001 (For SO₂, the fuel sulfur content of 0.02 was also included in the formula).

c. Emission factor includes methane and nonmethane emissions.

2014 Portable Auxiliary Boiler (Emission Point 2-95)

Enter Fuel Use (gals/yr)	79,815
Enter Fuel Sulfur Content (%)	0.0005

Criteria Pollutants	AP-42 Factor (lb/1000 gal) ^a	lbs/yr ^b	tons/yr
SO ₂	142	6	0.003
NO _x	20	1,596	0.8
CO	5	399	0.2
PM ₁₀	2	160	0.1
VOC ^c	0.252	20	0.01

Hazardous Air Pollutants			
Benzene	0.000214	0.02	0.00001
Ethylbenzene	0.0000636	0.01	0.000003
Formaldehyde	0.0330	2.6	0.001
Napthalene	0.00113	0.1	0.00005
1,1,1-Trichloroethane	0.000236	0.02	0.00001
Toluene	0.00620	0.5	0.0002
o-Xylene	0.000109	0.01	0.000004
Antimony	0.00525	0.4	0.0002
Arsenic	0.00132	0.1	0.0001
Beryllium	0.0000278	0.002	0.000001
Cadmium	0.000398	0.03	0.00002
Chromium	0.000845	0.1	0.00003
Cobalt	0.00602	0.5	0.0002
Lead	0.00151	0.1	0.0001
Manganese	0.00300	0.2	0.0001
Mercury	0.000113	0.01	0.000005
Nickel	0.0845	6.7	0.003
Selenium	0.000683	0.1	0.00003

Criteria Pollutants (Tons/Year)		1.1
Hazardous Air Pollutants (Tons/Year)		0.006

a. Factors obtained from AP-42 Tables 1.3-1, 1.3-3, 1.3-9 and 1.3-11

b. Yearly fuel usage × AP-42 emission factor × 0.001 (For SO₂, the fuel sulfur content of 0.0005 was also included in the formula).

c. Emission factor includes methane and nonmethane emissions.

Portable Diesels

Air Emission Calculations

(Portable Diesels: ≤ 600 Horsepower)

2010 Portable Diesel Engines (Emission Points 19-79 and 22-02)

<i>Enter Fuel Use (gal/yr)</i>	7,468
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Criteria Pollutants	AP-42 Factor (lb/MMBtu) ^a	MMBtu/yr ^b	lbs/yr ^c	tons/yr
SO ₂	0.29	1,046	303	0.2
NO _x	4.41	1,046	4,611	2.3
CO	0.95	1,046	993	0.5
VOC ^d	0.35	1,046	366	0.2
PM ₁₀	0.31	1,046	324	0.2

Hazardous Air Pollutants				
Benzene	0.000933	1,046	1.0	0.0005
Toluene	0.000409	1,046	0.4	0.0002
Xylenes	0.000285	1,046	0.3	0.0001
1,3-Butadiene	0.0000391	1,046	0.04	0.00002
Formaldehyde	0.00118	1,046	1.2	0.001
Acetaldehyde	0.000767	1,046	0.8	0.0004
Acrolein	0.0000925	1,046	0.1	0.00005
Napthalene	0.0000848	1,046	0.1	0.00004

Criteria Pollutants (Tons/Year)				3.3
Hazardous Air Pollutants (Tons/Year)				0.002

- a. Factors obtained from AP-42 Tables 3.3-1 and 3.3-2.
- b. Yearly fuel usage × 140,000 Btu/gal ÷ 1,000,000
- c. AP-42 Factor × MMBtu/yr
- d. Utilized AP-42 exhaust emission factor.

2011 Portable Diesel Engines (Emission Points 19-79 and 22-02)

<i>Enter Fuel Use (gal/yr)</i>	11,974
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Criteria Pollutants	AP-42 Factor (lb/MMBtu) ^a	MMBtu/yr ^b	lbs/yr ^c	tons/yr
SO ₂	0.29	1,676	486	0.2
NO _x	4.41	1,676	7,393	3.7
CO	0.95	1,676	1,593	0.8
VOC ^d	0.35	1,676	587	0.3
PM ₁₀	0.31	1,676	520	0.3
Hazardous Air Pollutants				
Benzene	0.000933	1,676	1.6	0.001
Toluene	0.000409	1,676	0.7	0.0003
Xylenes	0.000285	1,676	0.5	0.0002
1,3-Butadiene	0.0000391	1,676	0.1	0.00003
Formaldehyde	0.00118	1,676	2.0	0.001
Acetaldehyde	0.000767	1,676	1.3	0.001
Acrolein	0.0000925	1,676	0.2	0.0001
Napthalene	0.0000848	1,676	0.1	0.0001

Criteria Pollutants (Tons/Year)			5.3
Hazardous Air Pollutants (Tons/Year)			0.003

- a. Factors obtained from AP-42 Tables 3.3-1 and 3.3-2.
- b. Yearly fuel usage × 140,000 Btu/gal ÷ 1,000,000
- c. AP-42 Factor × MMBtu/yr
- d. Utilized AP-42 exhaust emission factor.

2012 Portable Diesel Engines (Emission Points 19-79 and 22-02)

<i>Enter Fuel Use (gal/yr)</i>	74,529
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Criteria Pollutants	AP-42 Factor (lb/MMBtu) ^a	MMBtu/yr ^b	lbs/yr ^c	tons/yr
SO ₂	0.29	10,434	3,026	1.5
NO _x	4.41	10,434	46,014	23.0
CO	0.95	10,434	9,912	5.0
VOC ^d	0.35	10,434	3,652	1.8
PM ₁₀	0.31	10,434	3,235	1.6
Hazardous Air Pollutants				
Benzene	0.000933	10,434	9.7	0.005
Toluene	0.000409	10,434	4.3	0.002
Xylenes	0.000285	10,434	3.0	0.001
1,3-Butadiene	0.0000391	10,434	0.4	0.000
Formaldehyde	0.00118	10,434	12.3	0.01
Acetaldehyde	0.000767	10,434	8.0	0.004
Acrolein	0.0000925	10,434	1.0	0.0005
Napthalene	0.0000848	10,434	0.9	0.000

Criteria Pollutants (Tons/Year)				32.9
Hazardous Air Pollutants (Tons/Year)				0.02

- a. Factors obtained from AP-42 Tables 3.3-1 and 3.3-2.
- b. Yearly fuel usage × 140,000 Btu/gal ÷ 1,000,000
- c. AP-42 Factor × MMBtu/yr
- d. Utilized AP-42 exhaust emission factor.

2013 Portable Diesel Engines (Emission Points 19-79 and 22-02)

<i>Enter Fuel Use (gal/yr)</i>	4,500
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Criteria Pollutants	AP-42 Factor (lb/MMBtu) ^a	MMBtu/yr ^b	lbs/yr ^c	tons/yr
SO ₂	0.29	630	183	0.1
NO _x	4.41	630	2,778	1.4
CO	0.95	630	599	0.3
VOC ^d	0.35	630	221	0.1
PM ₁₀	0.31	630	195	0.1
Hazardous Air Pollutants				
Benzene	0.000933	630	0.6	0.0003
Toluene	0.000409	630	0.3	0.0001
Xylenes	0.000285	630	0.2	0.0001
1,3-Butadiene	0.0000391	630	0.02	0.00001
Formaldehyde	0.00118	630	0.7	0.0004
Acetaldehyde	0.000767	630	0.5	0.0002
Acrolein	0.0000925	630	0.1	0.00003
Napthalene	0.0000848	630	0.1	0.00003

Criteria Pollutants (Tons/Year)				2.0
Hazardous Air Pollutants (Tons/Year)				0.001

- a. Factors obtained from AP-42 Tables 3.3-1 and 3.3-2.
- b. Yearly fuel usage × 140,000 Btu/gal ÷ 1,000,000
- c. AP-42 Factor × MMBtu/yr
- d. Utilized AP-42 exhaust emission factor.

2014 Portable Diesel Engines (Emission Points 19-79 and 22-02)

<i>Enter Fuel Use (gal/yr)</i>	20,902
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Criteria Pollutants	AP-42 Factor (lb/MMBtu) ^a	MMBtu/yr ^b	lbs/yr ^c	tons/yr
SO ₂	0.29	2,926	849	0.4
NO _x	4.41	2,926	12,905	6.5
CO	0.95	2,926	2,780	1.4
VOC ^d	0.35	2,926	1,024	0.5
PM ₁₀	0.31	2,926	907	0.5
Hazardous Air Pollutants				
Benzene	0.000933	2,926	2.7	0.001
Toluene	0.000409	2,926	1.2	0.001
Xylenes	0.000285	2,926	0.8	0.0004
1,3-Butadiene	0.0000391	2,926	0.1	0.0001
Formaldehyde	0.00118	2,926	3.5	0.002
Acetaldehyde	0.000767	2,926	2.2	0.001
Acrolein	0.0000925	2,926	0.3	0.0001
Napthalene	0.0000848	2,926	0.2	0.0001

Criteria Pollutants (Tons/Year)				9.2
Hazardous Air Pollutants (Tons/Year)				0.006

- a. Factors obtained from AP-42 Tables 3.3-1 and 3.3-2.
- b. Yearly fuel usage × 140,000 Btu/gal ÷ 1,000,000
- c. AP-42 Factor × MMBtu/yr
- d. Utilized AP-42 exhaust emission factor.

Portable Gasoline Engines

Air Emission Calculations

2010 Portable Outage/Maintenance Gasoline Engines (Emission Point 23-02)

Enter Fuel Use (gals/yr)	110			
Criteria Pollutants	AP-42 Factor (lb/MMBtu)^{a, b}	MMBtu/yr^c	lbs/yr^d	Tons/Year
SO ₂	0.084	14	1.2	0.001
NO _x	1.63	14	23	0.01
CO	0.99	14	14	0.01
VOC ^e	0.10	14	1.4	0.001
PM ₁₀	2.1	14	30.0	0.02
Hazardous Air Pollutants				
Benzene	0.000933	14	0.01	0.00001
Toluene	0.000409	14	0.01	0.000003
Xylenes	0.000285	14	0.004	0.000002
1,3-Butadiene	0.0000391	14	0.001	0.0000003
Formaldehyde	0.00118	14	0.02	0.00001
Acetaldehyde	0.000767	14	0.01	0.00001
Acrolein	0.0000925	14	0.001	0.000001
Naphthalene	0.0000848	14	0.001	0.000001
Criteria Pollutants (Tons/Year)				0.04
Hazardous Air Pollutants (Tons/Year)				0.00003

- a. Criteria pollutant emission factors obtained from AP-42 Table 3.3-1.
- b. HAP emission factors obtained from AP-42 Table 3.3-2 since these are the only ones related to gasoline engines based on AP-42 (Gasoline and Industrial Engines).
- c. Yearly fuel usage × 130,000 Btu/gal ÷ 1,000,000
- d. Emission Factor × MMBtu/yr
- e. Utilized AP-42 exhaust emission factor.

2011 Portable Outage/Maintenance Gasoline Engines (Emission Point 23-02)

Enter Fuel Use (gals/yr)	110			
Criteria Pollutants	AP-42 Factor (lb/MMBtu)^{a, b}	MMBtu/yr^c	lbs/yr^d	Tons/Year
SO ₂	0.084	14	1.2	0.001
NO _x	1.63	14	23	0.01
CO	0.99	14	14	0.01
PM ₁₀	0.10	14	1.4	0.001
VOC ^e	2.1	14	30	0.02
Hazardous Air Pollutants				
Benzene	0.000933	14	0.01	0.00001
Toluene	0.000409	14	0.01	0.000003
Xylenes	0.000285	14	0.004	0.000002
1,3-Butadiene	0.0000391	14	0.001	0.0000003
Formaldehyde	0.00118	14	0.02	0.00001
Acetaldehyde	0.000767	14	0.01	0.00001
Acrolein	0.0000925	14	0.001	0.000001
Naphthalene	0.0000848	14	0.001	0.000001
Criteria Pollutants (Tons/Year)				0.04
Hazardous Air Pollutants (Tons/Year)				0.00003

- a. Criteria pollutant emission factors obtained from AP-42 Table 3.3-1.
- b. HAP emission factors obtained from AP-42 Table 3.3-2 since these are the only ones related to gasoline engines based on AP-42 (Gasoline and Industrial Engines).
- c. Yearly fuel usage × 130,000 Btu/gal ÷ 1,000,000
- d. Emission Factor × MMBtu/yr

AP-42 Emission Factors

- <100 MMBTU Portable Diesel Boiler (Tables 1.3-1, 1.3-3, 1.3-9 and 1.3-11)
- ≤600 Horsepower Portable Diesel Generators (Tables 3.3-1 and 3.3-2)
- Portable Gasoline Engines (Table 3.3-1 and 3.3-2)
- >600 Horsepower Stationary Generators (Tables 3.4-1, 3.4-3 and 3.4-4)

Table 1.3-1. CRITERIA POLLUTANT EMISSION FACTORS FOR FUEL OIL COMBUSTION^a

Firing Configuration (SCC) ^a	SO ₂ ^b		SO ₃ ^c		NO _x ^d		CO ^e		Filterable PM ^f	
	Emission Factor (lb/10 ³ gal)	EMISSION FACTOR RATING	Emission Factor (lb/10 ³ gal)	EMISSION FACTOR RATING	Emission Factor (lb/10 ³ gal)	EMISSION N FACTOR RATING	Emission Factor (lb/10 ³ gal)	EMISSION FACTOR RATING	Emission Factor (lb/10 ³ gal)	EMISSION FACTOR RATING
Boilers > 100 Million Btu/hr										
No. 6 oil fired, normal firing (1-01-004-01), (1-02-004-01), (1-03-004-01)	157S	A	5.7S	C	47	A	5	A	9.19(S)+3.22	A
No. 6 oil fired, normal firing, low NO _x burner (1-01-004-01), (1-02-004-01)	157S	A	5.7S	C	40	B	5	A	9.19(S)+3.22	A
No. 6 oil fired, tangential firing, (1-01-004-04)	157S	A	5.7S	C	32	A	5	A	9.19(S)+3.22	A
No. 6 oil fired, tangential firing, low NO _x burner (1-01-004-04)	157S	A	5.7S	C	26	E	5	A	9.19(S)+3.22	A
No. 5 oil fired, normal firing (1-01-004-05), (1-02-004-04)	157S	A	5.7S	C	47	B	5	A	10	B
No. 5 oil fired, tangential firing (1-01-004-06)	157S	A	5.7S	C	32	B	5	A	10	B
No. 4 oil fired, normal firing (1-01-005-04), (1-02-005-04)	150S	A	5.7S	C	47	B	5	A	7	B
No. 4 oil fired, tangential firing (1-01-005-05)	150S	A	5.7S	C	32	B	5	A	7	B
No. 2 oil fired (1-01-005-01), (1-02-005-01), (1-03-005-01)	142S ^h	A	5.7S	C	24	D	5	A	2	A
No.2 oil fired, LNB/FGR, (1-01-005-01), (1-02-005-01), (1-03-005-01)	142S ^h	A	5.7S	A	10	D	5	A	2	A

External Combustion Sources

Table 1.3-1. (cont.)

Firing Configuration (SCC) ^a	SO ₂ ^b		SO ₃ ^c		NO _x ^d		CO ^e		Filterable PM ^f	
	Emission Factor (lb/10 ³ gal)	EMISSION FACTOR RATING	Emission Factor (lb/10 ³ gal)	EMISSION FACTOR RATING	Emission Factor (lb/10 ³ gal)	EMISSION FACTOR RATING	Emission Factor (lb/10 ³ gal)	EMISSION FACTOR RATING	Emission Factor (lb/10 ³ gal)	EMISSION FACTOR RATING
Boilers < 100 Million Btu/hr										
No. 6 oil fired (1-02-004-02/03) (1-03-004-02/03)	157S	A	2S	A	55	A	5	A	9.19(S)+3.22 ⁱ	B
No. 5 oil fired (1-03-004-04)	157S	A	2S	A	55	A	5	A	10 ⁱ	A
No. 4 oil fired (1-03-005-04)	150S	A	2S	A	20	A	5	A	7	B
Distillate oil fired (1-02-005-02/03) (1-03-005-02/03)	142S	A	2S	A	20	A	5	A	2	A
Residential furnace (A2104004/A2104011)	142S	A	2S	A	18	A	5	A	0.4 ^g	B

- a To convert from lb/103 gal to kg/103 L, multiply by 0.120. SCC = Source Classification Code.
- b References 1-2,6-9,14,56-60. S indicates that the weight % of sulfur in the oil should be multiplied by the value given. For example, if the fuel is 1% sulfur, then S = 1.
- c References 1-2,6-8,16,57-60. S indicates that the weight % of sulfur in the oil should be multiplied by the value given. For example, if the fuel is 1% sulfur, then S = 1.
- d References 6-7,15,19,22,56-62. Expressed as NO₂. Test results indicate that at least 95% by weight of NO_x is NO for all boiler types except residential furnaces, where about 75% is NO. For utility vertical fired boilers use 105 lb/103 gal at full load and normal (>15%) excess air. Nitrogen oxides emissions from residual oil combustion in industrial and commercial boilers are related to fuel nitrogen content, estimated by the following empirical relationship: lb NO₂ /103 gal = 20.54 + 104.39(N), where N is the weight % of nitrogen in the oil. For example, if the fuel is 1% nitrogen, then N = 1.
- e References 6-8,14,17-19,56-61. CO emissions may increase by factors of 10 to 100 if the unit is improperly operated or not well maintained.
- f References 6-8,10,13-15,56-60,62-63. Filterable PM is that particulate collected on or prior to the filter of an EPA Method 5 (or equivalent) sampling train. Particulate emission factors for residual oil combustion are, on average, a function of fuel oil sulfur content where S is the weight % of sulfur in oil. For example, if fuel oil is 1% sulfur, then S = 1.
- g Based on data from new burner designs. Pre-1970's burner designs may emit filterable PM as high as 3.0 lb/103 gal.
- h The SO₂ emission factor for both no. 2 oil fired and for no. 2 oil fired with LNB/FGR, is 142S, not 157S. Errata dated April 28, 2000. Section corrected May 2010.
- i The PM factors for No.6 and No. 5 fuel were reversed. Errata dated April 28, 2000. Section corrected May 2010.

Table 1.3-3. EMISSION FACTORS FOR TOTAL ORGANIC COMPOUNDS (TOC), METHANE, AND NONMETHANE TOC (NMTOC) FROM UNCONTROLLED FUEL OIL COMBUSTION^a

EMISSION FACTOR RATING: A

Firing Configuration (SCC)	TOC ^b Emission Factor (lb/10 ³ gal)	Methane ^b Emission Factor (lb/10 ³ gal)	NMTOC ^b Emission Factor (lb/10 ³ gal)
Utility boilers			
No. 6 oil fired, normal firing (1-01-004-01)	1.04	0.28	0.76
No. 6 oil fired, tangential firing (1-01-004-04)	1.04	0.28	0.76
No. 5 oil fired, normal firing (1-01-004-05)	1.04	0.28	0.76
No. 5 oil fired, tangential firing (1-01-004-06)	1.04	0.28	0.76
No. 4 oil fired, normal firing (1-01-005-04)	1.04	0.28	0.76
No. 4 oil fired, tangential firing (1-01-005-05)	1.04	0.28	0.76
Industrial boilers			
No. 6 oil fired (1-02-004-01/02/03)	1.28	1.00	0.28
No. 5 oil fired (1-02-004-04)	1.28	1.00	0.28
Distillate oil fired (1-02-005-01/02/03)	0.252	0.052	0.2
No. 4 oil fired (1-02-005-04)	0.252	0.052	0.2
Commercial/institutional/residential combustors			
No. 6 oil fired (1-03-004-01/02/03)	1.605	0.475	1.13
No. 5 oil fired (1-03-004-04)	1.605	0.475	1.13
Distillate oil fired (1-03-005-01/02/03)	0.556	0.216	0.34
No. 4 oil fired (1-03-005-04)	0.556	0.216	0.34
Residential furnace (A2104004/A2104011)	2.493	1.78	0.713

a To convert from lb/103 gal to kg/103 L, multiply by 0.12. SCC = Source Classification Code.

b References 29-32. Volatile organic compound emissions can increase by several orders of magnitude if the boiler is improperly operated or is not well maintained.

Table 1.3-9. EMISSION FACTORS FOR SPECIATED ORGANIC COMPOUNDS
FROM FUEL OIL COMBUSTION^a

Organic Compound	Average Emission Factor ^b (lb/10 ³ Gal)	EMISSION FACTOR RATING
Benzene	2.14E-04	C
Ethylbenzene	6.36E-05 ^c	E
Formaldehyde ^d	3.30E-02	C
Naphthalene	1.13E-03	C
1,1,1-Trichloroethane	2.36E-04 ^c	E
Toluene	6.20E-03	D
o-Xylene	1.09E-04 ^c	E
Acenaphthene	2.11E-05	C
Acenaphthylene	2.53E-07	D
Anthracene	1.22E-06	C
Benz(a)anthracene	4.01E-06	C
Benzo(b,k)fluoranthene	1.48E-06	C
Benzo(g,h,i)perylene	2.26E-06	C
Chrysene	2.38E-06	C
Dibenzo(a,h) anthracene	1.67E-06	D
Fluoranthene	4.84E-06	C
Fluorene	4.47E-06	C
Indo(1,2,3-cd)pyrene	2.14E-06	C
Phenanthrene	1.05E-05	C
Pyrene	4.25E-06	C
OCDD	3.10E-09 ^c	E

^a Data are for residual oil fired boilers, Source Classification Codes (SCCs) 1-01-004-01/04.

^b References 64-72. To convert from lb/10³ gal to kg/10³ L, multiply by 0.12.

^c Based on data from one source test (Reference 67).

^d The formaldehyde number presented here is based only on data from utilities using No. 6 oil. The number presented in Table 1.3-7 is based on utility, commercial, and industrial boilers.

Table 1.3-11. EMISSION FACTORS FOR METALS FROM UNCONTROLLED NO. 6 FUEL OIL COMBUSTION^a

Metal	Average Emission Factor ^{b, d} (lb/10 ³ Gal)	EMISSION FACTOR RATING
Antimony	5.25E-03 ^c	E
Arsenic	1.32E-03	C
Barium	2.57E-03	D
Beryllium	2.78E-05	C
Cadmium	3.98E-04	C
Chloride	3.47E-01	D
Chromium	8.45E-04	C
Chromium VI	2.48E-04	C
Cobalt	6.02E-03	D
Copper	1.76E-03	C
Fluoride	3.73E-02	D
Lead	1.51E-03	C
Manganese	3.00E-03	C
Mercury	1.13E-04	C
Molybdenum	7.87E-04	D
Nickel	8.45E-02	C
Phosphorous	9.46E-03	D
Selenium	6.83E-04	C
Vanadium	3.18E-02	D
Zinc	2.91E-02	D

^a Data are for residual oil fired boilers, Source Classification Codes (SCCs) 1-01-004-01/04.

^b References 64-72. 18 of 19 sources were uncontrolled and 1 source was controlled with low efficiency ESP. To convert from lb/10³ gal to kg/10³ L, multiply by 0.12.

^c References 29-32,40-44.

^d For oil/water mixture, reduce factors in proportion to water content of the fuel (due to dilution). To adjust the listed values for water content, multiply the listed value by 1-decimal fraction of water (ex: For fuel with 9 percent water by volume, multiply by 1-0.9=.91).

Table 3.3-1. EMISSION FACTORS FOR UNCONTROLLED GASOLINE AND DIESEL INDUSTRIAL ENGINES^a

Pollutant	Gasoline Fuel (SCC 2-02-003-01, 2-03-003-01)		Diesel Fuel (SCC 2-02-001-02, 2-03-001-01)		EMISSION FACTOR RATING
	Emission Factor (lb/hp-hr) (power output)	Emission Factor (lb/MMBtu) (fuel input)	Emission Factor (lb/hp-hr) (power output)	Emission Factor (lb/MMBtu) (fuel input)	
NO _x	0.011	1.63	0.031	4.41	D
CO	6.96 E-03 ^d	0.99 ^d	6.68 E-03	0.95	D
SO _x	5.91 E-04	0.084	2.05 E-03	0.29	D
PM-10 ^b	7.21 E-04	0.10	2.20 E-03	0.31	D
CO ₂ ^c	1.08	154	1.15	164	B
Aldehydes	4.85 E-04	0.07	4.63 E-04	0.07	D
TOC					
Exhaust	0.015	2.10	2.47 E-03	0.35	D
Evaporative	6.61 E-04	0.09	0.00	0.00	E
Crankcase	4.85 E-03	0.69	4.41 E-05	0.01	E
Refueling	1.08 E-03	0.15	0.00	0.00	E

^a References 2,5-6,9-14. When necessary, an average brake-specific fuel consumption (BSFC) of 7,000 Btu/hp-hr was used to convert from lb/MMBtu to lb/hp-hr. To convert from lb/hp-hr to kg/kw-hr, multiply by 0.608. To convert from lb/MMBtu to ng/J, multiply by 430. SCC = Source Classification Code. TOC = total organic compounds.

^b PM-10 = particulate matter less than or equal to 10 µm aerodynamic diameter. All particulate is assumed to be ≤ 1 µm in size.

^c Assumes 99% conversion of carbon in fuel to CO₂ with 87 weight % carbon in diesel, 86 weight % carbon in gasoline, average BSFC of 7,000 Btu/hp-hr, diesel heating value of 19,300 Btu/lb, and gasoline heating value of 20,300 Btu/lb.

^d Instead of 0.439 lb/hp-hr (power output) and 62.7 lb/mmBtu (fuel input), the correct emissions factors values are 6.96 E-03 lb/hp-hr (power output) and 0.99 lb/mmBtu (fuel input), respectively. This is an editorial correction. March 24, 2009

Table 3.3-2. SPECIATED ORGANIC COMPOUND EMISSION FACTORS FOR UNCONTROLLED DIESEL ENGINES^a

EMISSION FACTOR RATING: E

Pollutant	Emission Factor (Fuel Input) (lb/MMBtu)
Benzene ^b	9.33 E-04
Toluene ^b	4.09 E-04
Xylenes ^b	2.85 E-04
Propylene	2.58 E-03
1,3-Butadiene ^{b,c}	<3.91 E-05
Formaldehyde ^b	1.18 E-03
Acetaldehyde ^b	7.67 E-04
Acrolein ^b	<9.25 E-05
Polycyclic aromatic hydrocarbons (PAH)	
Naphthalene ^b	8.48 E-05
Acenaphthylene	<5.06 E-06
Acenaphthene	<1.42 E-06
Fluorene	2.92 E-05
Phenanthrene	2.94 E-05
Anthracene	1.87 E-06
Fluoranthene	7.61 E-06
Pyrene	4.78 E-06
Benzo(a)anthracene	1.68 E-06
Chrysene	3.53 E-07
Benzo(b)fluoranthene	<9.91 E-08
Benzo(k)fluoranthene	<1.55 E-07
Benzo(a)pyrene	<1.88 E-07
Indeno(1,2,3-cd)pyrene	<3.75 E-07
Dibenz(a,h)anthracene	<5.83 E-07
Benzo(g,h,l)perylene	<4.89 E-07
TOTAL PAH	1.68 E-04

^a Based on the uncontrolled levels of 2 diesel engines from References 6-7. Source Classification Codes 2-02-001-02, 2-03-001-01. To convert from lb/MMBtu to ng/J, multiply by 430.

^b Hazardous air pollutant listed in the *Clean Air Act*.

^c Based on data from 1 engine.

Table 3.4-1. GASEOUS EMISSION FACTORS FOR LARGE STATIONARY DIESEL AND ALL STATIONARY DUAL-FUEL ENGINES^a

Pollutant	Diesel Fuel (SCC 2-02-004-01)			Dual Fuel ^b (SCC 2-02-004-02)		
	Emission Factor (lb/hp-hr) (power output)	Emission Factor (lb/MMBtu) (fuel input)	EMISSION FACTOR RATING	Emission Factor (lb/hp-hr) (power output)	Emission Factor (lb/MMBtu) (fuel input)	EMISSION FACTOR RATING
NO _x						
Uncontrolled	0.024	3.2	B	0.018	2.7	D
Controlled	0.013 ^c	1.9 ^c	B	ND	ND	NA
CO	5.5 E-03	0.85	C	7.5 E-03	1.16	D
SO _x ^d	8.09 E-03S ₁	1.01S ₁	B	4.06 E-04S ₁ + 9.57 E-03S ₂	0.05S ₁ + 0.895S ₂	B
CO ₂ ^e	1.16	165	B	0.772	110	B
PM	0.0007 ^c	0.1 ^c	B	ND	ND	NA
TOC (as CH ₄)	7.05 E-04	0.09	C	5.29 E-03	0.8	D
Methane	f	f	E	3.97 E-03	0.6	E
Nonmethane	f	f	E	1.32 E-03	0.2 ^g	E

^a Based on uncontrolled levels for each fuel, from References 2,6-7. When necessary, the average heating value of diesel was assumed to be 19,300 Btu/lb with a density of 7.1 lb/gallon. The power output and fuel input values were averaged independently from each other, because of the use of actual brake-specific fuel consumption (BSFC) values for each data point and of the use of data possibly sufficient to calculate only 1 of the 2 emission factors (e. g., enough information to calculate lb/MMBtu, but not lb/hp-hr). Factors are based on averages across all manufacturers and duty cycles. The actual emissions from a particular engine or manufacturer could vary considerably from these levels. To convert from lb/hp-hr to kg/kw-hr, multiply by 0.608. To convert from lb/MMBtu to ng/J, multiply by 430. SCC = Source Classification Code.

^b Dual fuel assumes 95% natural gas and 5% diesel fuel.

^c References 8-26. Controlled NO_x is by ignition timing retard.

^d Assumes that all sulfur in the fuel is converted to SO₂. S₁ = % sulfur in fuel oil; S₂ = % sulfur in natural gas. For example, if sulfur content is 1.5%, then S = 1.5.

^e Assumes 100% conversion of carbon in fuel to CO₂ with 87 weight % carbon in diesel, 70 weight % carbon in natural gas, dual-fuel mixture of 5% diesel with 95% natural gas, average BSFC of 7,000 Btu/hp-hr, diesel heating value of 19,300 Btu/lb, and natural gas heating value of 1050 Btu/scf.

^f Based on data from 1 engine, TOC is by weight 9% methane and 91% nonmethane.

^g Assumes that nonmethane organic compounds are 25% of TOC emissions from dual-fuel engines. Molecular weight of nonmethane gas stream is assumed to be that of methane.

Table 3.4-3. SPECIATED ORGANIC COMPOUND EMISSION FACTORS FOR LARGE UNCONTROLLED STATIONARY DIESEL ENGINES^a

EMISSION FACTOR RATING: E

Pollutant	Emission Factor (lb/MMBtu) (fuel input)
Benzene ^b	7.76 E-04
Toluene ^b	2.81 E-04
Xylenes ^b	1.93 E-04
Propylene	2.79 E-03
Formaldehyde ^b	7.89 E-05
Acetaldehyde ^b	2.52 E-05
Acrolein ^b	7.88 E-06

^aBased on 1 uncontrolled diesel engine from Reference 7. Source Classification Code 2-02-004-01. Not enough information to calculate the output-specific emission factors of lb/hp-hr. To convert from lb/MMBtu to ng/J, multiply by 430.

^bHazardous air pollutant listed in the *Clean Air Act*.

Table 3.4-4. PAH EMISSION FACTORS FOR LARGE UNCONTROLLED STATIONARY DIESEL ENGINES^a

EMISSION FACTOR RATING: E

PAH	Emission Factor (lb/MMBtu) (fuel input)
Naphthalene ^b	1.30 E-04
Acenaphthylene	9.23 E-06
Acenaphthene	4.68 E-06
Fluorene	1.28 E-05
Phenanthrene	4.08 E-05
Anthracene	1.23 E-06
Fluoranthene	4.03 E-06
Pyrene	3.71 E-06
Benz(a)anthracene	6.22 E-07
Chrysene	1.53 E-06
Benzo(b)fluoranthene	1.11 E-06
Benzo(k)fluoranthene	<2.18 E-07
Benzo(a)pyrene	<2.57 E-07
Indeno(1,2,3-cd)pyrene	<4.14 E-07
Dibenz(a,h)anthracene	<3.46 E-07
Benzo(g,h,l)perylene	<5.56 E-07
TOTAL PAH	<2.12 E-04

^a Based on 1 uncontrolled diesel engine from Reference 7. Source Classification Code 2-02-004-01. Not enough information to calculate the output-specific emission factors of lb/hp-hr. To convert from lb/MMBtu to ng/J, multiply by 430.

^b Hazardous air pollutant listed in the *Clean Air Act*.

Attachment 4

Annual Greenhouse Gas Emissions Inventory Summary, 2010 - 2014

Metric Tons of Carbon Dioxide Equivalent Emissions, 2010 – 2014			
Year	Combustion Sources	Workforce Commuting	Total
2010	647	2,722	3,369
2011	1,513	2,722	4,235
2012	2,094	2,722	4,816
2013	2,766	2,722	5,488
2014	1,684	2,722	4,406

Attachment 5

Annual Greenhouse Gas Inventory Summary, Supporting Calculations

A. Permitted Stationary and Portable Combustion Sources

Carbon dioxide equivalent emissions for the stationary and portable diesels, and portable diesel-fired boiler were calculated annually based on total fuel usage of all emission sources within these categories (see Table A-3). For the portable gasoline engines, carbon dioxide equivalent emissions were calculated based on total fuel usage (see Table A-3). Calculations are included in this attachment.

Table A-3					
Total Fuel Usage, 2010 - 2014					
Emission Source	2010	2011	2012	2013	2014
Stationary Diesels (>600 HP)	52,986	68,648	61,562	62,139	56,477
Stationary Diesels (≤600 HP)	2,605	2,605	3,185	2,624	7,270
Portable Diesel Boiler	0	64,467	65,280	200,940	79,815
Portable Diesels (≤600 HP)	7,468	11,974	74,529	4,500	20,902 ^(a)
Total	63,059	147,694	204,556	270,203	164,464
Gasoline Engines	110	110	0	0	0 ^(b)
Total	110	110	0	0	0

a. Assumed that fuel usage was all fuel deliveries made by Jackie Bee in 2014.

b. Value of 7,317 gallons reported in the Annual Air Emissions Report was not associated with Emission Point 23-02 (Portable Outage/Maintenance Gasoline Engines).

B. Workforce Transport

Based on statistical information obtained from the U. S. Census Bureau (USCB), 10.5 percent of U.S. residents carpool to work (USCB 2014). As of February 2014, there were 640 full-time employees employed at the Waterford 3 (Table 2.5-1 of WF3 Environmental Report), and is being assumed that this employment number remained consistent over previous years. Utilizing the USCB 10.5 percent statistic, it is assumed that approximately "67" of these employees would car pool (640 x 10.5%) to work every day. Therefore, a value of "573" passenger vehicles per day was utilized, which would be considered conservative since the number of employees traveling to the site on weekends would be less than that during the normal work week of Monday - Friday.

Based on information obtained from the Environmental Protection Agency's Greenhouse Gas Equivalencies Calculator, the CO₂e/vehicle/year was estimated to be 4.75 metric tons based on the 2011 average vehicle miles of 11,318 miles per year, and the weighted average combined fuel economy of cars and light trucks at 21.4 miles per gallon (EPA 2014a). Based

on Table A-1 to Subpart A of 40 CFR Part 98, carbon dioxide has a global warming potential (100-year time horizon) of "1" (EPA 2014a). Therefore, the metric tons of carbon dioxide equivalent (CO_{2e}) emissions that would have been generated during the years of 2010 through 2014 as a result of Waterford 3 employees commuting to and from work would be as follows:

<u>Year</u>	<u>CO_{2e} metric tons</u> ^(a)
2010	2,722
2011	2,722
2012	2,722
2013	2,722
2014	2,722

a. 573 vehicles × 4.75 metric tons CO_{2e}/vehicle/year × 1 (GWP)

REFERENCES

EPA (U.S. Environmental Protection Agency). 2014a. Greenhouse Gas Equivalencies Calculator, Calculations and Reference Page. Retrieved from <<http://www.epa.gov/cleanenergy/energy-resources/refs.html>> (accessed April 24, 2014).

EPA. 2014b. Table A-1 to Subpart A of 40 CFR Part 98. April 22, 2014.

USCB (U.S. Census Bureau). 2014. Random Samplings, Green Stats. Retrieved from <<http://blogs.census.gov/2011/04/20/green-stats/>> (accessed April 24, 2014).

**Stationary and Portable Diesels, and Portable Diesel Boiler
Carbon Dioxide Equivalent Emission Calculations**

2010 Stationary Diesels, Portable Diesel Boiler and Portable Diesels

<i>Enter Fuel Use (gal/yr)</i>	63,059				
Pollutants	Global Warming Potential a	Emission Factor (lb/MMBtu) b	MMBtu/yr^c	lbs/yr^d	CO₂e metric tons/yr^e
Carbon Dioxide	1	163.1	8,702	1,419,319	644
Nitrous Oxide	298	0.001	8,702	9	1.2
Methane	25	0.007	8,702	61	0.7
				TOTAL	646

a. Based on Table A-1 to Subpart A of 40 CFR Part 98.

b. Based on Table 1 of EPA's 2014 GHG Emission Factor Hub for Number 2 diesel fuel oil (<http://www.epa.gov/climateleadership/documents/emission-factors.pdf>). Emission factors were converted to lb/MMBtu (see below).

GHG Gas	Emission Factor	lb/MMBtu Conversion
Carbon Dioxide	73.96 kg/MMBtu	163.1
Nitrous Oxide	0.6 g/MMBtu	0.001
Methane	3 g/MMBtu	0.007

c. Yearly fuel usage × 138,000 Btu/gal ÷ 1,000,000. Btu value based on Table 1 of EPA's 2014 GHG Emission Factor Hub (<http://www.epa.gov/climateleadership/documents/emission-factors.pdf>).

d. Emission factor × MMBtu/yr.

e. Pounds per year ÷ 2.205 pounds × Global Warming Potential.

2011 Stationary Diesels, Portable Diesel Boiler and Portable Diesels

<i>Enter Fuel Use (gal/yr)</i>	147,694				
Pollutants	Global Warming Potential a	Emission Factor (lb/MMBtu) b	MMBtu/yr^c	lbs/yr^d	CO₂e metric tons/yr^e
Carbon Dioxide	1	163.1	20,382	3,324,267	1,508
Nitrous Oxide	298	0.001	20,382	20	2.8
Methane	25	0.007	20,382	143	1.6
				TOTAL	1,512

a. Based on Table A-1 to Subpart A of 40 CFR Part 98.

b. Based on Table 1 of EPA's 2014 GHG Emission Factor Hub for Number 2 diesel fuel oil (<http://www.epa.gov/climateleadership/documents/emission-factors.pdf>). Emission factors were converted to lb/MMBtu (see below).

<u>GHG Gas</u>	<u>Emission Factor</u>	<u>lb/MMBtu Conversion</u>
Carbon Dioxide	73.96 kg/MMBtu	163.1
Nitrous Oxide	0.6 g/MMBtu	0.001
Methane	3 g/MMBtu	0.007

c. Yearly fuel usage × 138,000 Btu/gal ÷ 1,000,000. Btu value based on Table 1 of EPA's 2014 GHG Emission Factor Hub (<http://www.epa.gov/climateleadership/documents/emission-factors.pdf>).

d. Emission factor × MMBtu/yr.

e. Pounds per year ÷ 2.205 pounds × Global Warming Potential.

2012 Stationary Diesels, Portable Diesel Boiler and Portable Diesels

<i>Enter Fuel Use (gal/yr)</i>	204,556				
Pollutants	Global Warming Potential a	Emission Factor (lb/MMBtu) b	MMBtu/yr^c	lbs/yr^d	CO₂e metric tons/yr^e
Carbon Dioxide	1	163.1	28,229	4,604,106	2,088
Nitrous Oxide	298	0.001	28,229	28	3.8
Methane	25	0.007	28,229	198	2.2
				TOTAL	2,094

a. Based on Table A-1 to Subpart A of 40 CFR Part 98.

b. Based on Table 1 of EPA's 2014 GHG Emission Factor Hub for Number 2 diesel fuel oil (<http://www.epa.gov/climateleadership/documents/emission-factors.pdf>). Emission factors were converted to lb/MMBtu (see below).

<u>GHG Gas</u>	<u>Emission Factor</u>	<u>lb/MMBtu Conversion</u>
Carbon Dioxide	73.96 kg/MMBtu	163.1
Nitrous Oxide	0.6 g/MMBtu	0.001
Methane	3 g/MMBtu	0.007

c. Yearly fuel usage × 138,000 Btu/gal ÷ 1,000,000. Btu value based on Table 1 of EPA's 2014 GHG Emission Factor Hub (<http://www.epa.gov/climateleadership/documents/emission-factors.pdf>).

d. Emission factor × MMBtu/yr.

e. Pounds per year ÷ 2.205 pounds × Global Warming Potential.

2013 Stationary Diesels, Portable Diesel Boiler and Portable Diesels

<i>Enter Fuel Use (gal/yr)</i>	270,203				
Pollutants	Global Warming Potential a	Emission Factor (lb/MMBtu) b	MMBtu/yr^c	lbs/yr^d	CO₂e metric tons/yr^e
Carbon Dioxide	1	163.1	37,288	6,081,675	2,758
Nitrous Oxide	298	0.001	37,288	37	5.0
Methane	25	0.007	37,288	261	3.0
				TOTAL	2,766

a. Based on Table A-1 to Subpart A of 40 CFR Part 98.

b. Based on Table 1 of EPA's 2014 GHG Emission Factor Hub for Number 2 diesel fuel oil (<http://www.epa.gov/climateleadership/documents/emission-factors.pdf>). Emission factors were converted to lb/MMBtu (see below).

<u>GHG Gas</u>	<u>Emission Factor</u>	<u>lb/MMBtu Conversion</u>
Carbon Dioxide	73.96 kg/MMBtu	163.1
Nitrous Oxide	0.6 g/MMBtu	0.001
Methane	3 g/MMBtu	0.007

c. Yearly fuel usage × 138,000 Btu/gal ÷ 1,000,000. Btu value based on Table 1 of EPA's 2014 GHG Emission Factor Hub (<http://www.epa.gov/climateleadership/documents/emission-factors.pdf>).

d. Emission factor × MMBtu/yr.

e. Pounds per year ÷ 2.205 pounds × Global Warming Potential.

2014 Stationary Diesels, Portable Diesel Boiler and Portable Diesels

<i>Enter Fuel Use (gal/yr)</i>	164,464				
Pollutants	Global Warming Potential a	Emission Factor (lb/MMBtu) b	MMBtu/yr^c	lbs/yr^d	CO₂e metric tons/yr^e
Carbon Dioxide	1	163.1	22,696	3,701,723	1,679
Nitrous Oxide	298	0.001	22,696	23	3.1
Methane	25	0.007	22,696	159	1.8
				TOTAL	1,684

a. Based on Table A-1 to Subpart A of 40 CFR Part 98.

b. Based on Table 1 of EPA's 2014 GHG Emission Factor Hub for Number 2 diesel fuel oil (<http://www.epa.gov/climateleadership/documents/emission-factors.pdf>). Emission factors were converted to lb/MMBtu (see below).

<u>GHG Gas</u>	<u>Emission Factor</u>	<u>lb/MMBtu Conversion</u>
Carbon Dioxide	73.96 kg/MMBtu	163.1
Nitrous Oxide	0.6 g/MMBtu	0.001
Methane	3 g/MMBtu	0.007

c. Yearly fuel usage × 138,000 Btu/gal ÷ 1,000,000. Btu value based on Table 1 of EPA's 2014 GHG Emission Factor Hub (<http://www.epa.gov/climateleadership/documents/emission-factors.pdf>).

d. Emission factor × MMBtu/yr.

e. Pounds per year ÷ 2.205 pounds × Global Warming Potential.

Portable Gasoline Engines
Carbon Dioxide Equivalent Emission Calculations

2010 Portable Outage/Maintenance Gasoline Engines (Emission Point 23-02)

<i>Enter Fuel Use (gal/yr)</i>	110				
Pollutants	Global Warming Potential ^a	Emission Factor (lb/MMBtu) ^b	MMBtu/yr ^c	lbs/yr ^d	CO₂e metric tons/yr ^e
Carbon Dioxide	1	154.8	14	2,129	1.0
Nitrous Oxide	298	0.001	14	0.01	0.002
Methane	25	0.007	14	0.10	0.001
				TOTAL	1

a. Based on Table A-1 to Subpart A of 40 CFR Part 98.

b. Based on Table 1 of EPA's 2014 GHG Emission Factor Hub (<http://www.epa.gov/climateleadership/documents/emission-factors.pdf>). Emission factors were converted to lb/MMBtu (see below).

GHG Gas	Emission Factor	lb/MMBtu Conversion
Carbon Dioxide	70.22 kg/MMBtu	154.8
Nitrous Oxide	0.6 g/MMBtu	0.001
Methane	3 g/MMBtu	0.007

c. Yearly fuel usage × 125,000 Btu/gal ÷ 1,000,000. Btu value based on Table 1 of EPA's 2014 GHG Emission Factor Hub (<http://www.epa.gov/climateleadership/documents/emission-factors.pdf>).

d. Emission factor × MMBtu/yr.

e. Pounds per year ÷ 2.205 pounds × Global Warming Potential.

2011 Portable Outage/Maintenance Gasoline Engines (Emission Point 23-02)

<i>Enter Fuel Use (gal/yr)</i>	110				
Pollutants	Global Warming Potential ^a	Emission Factor (lb/MMBtu) ^b	MMBtu/yr ^c	lbs/yr ^d	CO₂e metric tons/yr ^e
Carbon Dioxide	1	154.8	14	2,129	1.0
Nitrous Oxide	298	0.001	14	0.01	0.002
Methane	25	0.007	14	0.10	0.001
				TOTAL	1

a. Based on Table A-1 to Subpart A of 40 CFR Part 98.

b. Based on Table 1 of EPA's 2014 GHG Emission Factor Hub (<http://www.epa.gov/climateleadership/documents/emission-factors.pdf>). Emission factors were converted to lb/MMBtu (see below).

<u>GHG Gas</u>	<u>Emission Factor</u>	<u>lb/MMBtu Conversion</u>
Carbon Dioxide	70.22 kg/MMBtu	154.8
Nitrous Oxide	0.6 g/MMBtu	0.001
Methane	3 g/MMBtu	0.007

c. Yearly fuel usage × 125,000 Btu/gal ÷ 1,000,000. Btu value based on Table 1 of EPA's 2014 GHG Emission Factor Hub (<http://www.epa.gov/climateleadership/documents/emission-factors.pdf>).

d. Emission factor × MMBtu/yr.

e. Pounds per year ÷ 2.205 pounds × Global Warming Potential.

EPA's Greenhouse Gas Emission Factor Hub

<http://www.epa.gov/climateleadership/documents/emission-factors.pdf>

Emission Factors for Greenhouse Gas Inventories

Last Modified: 4 April 2014

Red text indicates an update from the 2011 version of this document.

Typically, greenhouse gas emissions are reported in units of carbon dioxide equivalent (CO₂e). Gases are converted to CO₂e by multiplying by their global warming potential (GWP). The emission factors listed in this document have not been converted to CO₂e. To do so, multiply the emissions by the corresponding GWP listed in the table below.

Gas	100-year GWP
CH ₄	25
N ₂ O	298

Source: Intergovernmental Panel on Climate Change (IPCC), Fourth Assessment Report (AR4), 2007. See the source note to Table 9 for further explanation.

Table 1 Stationary Combustion Emission Factors

Fuel Type	Heating Value mmBtu per short ton	CO ₂ Factor kg CO ₂ per mmBtu	CH ₄ Factor g CH ₄ per mmBtu	N ₂ O Factor g N ₂ O per mmBtu	CO ₂ Factor kg CO ₂ per short ton	CH ₄ Factor g CH ₄ per short ton	N ₂ O Factor g N ₂ O per short ton	Unit
Coal and Coke								
Anthracite Coal	25.09	103.69	11	1.6	2,602	276	40	short tons
Bituminous Coal	24.93	93.28	11	1.6	2,325	274	40	short tons
Sub-bituminous Coal	17.25	97.17	11	1.6	1,676	190	28	short tons
Lignite Coal	14.21	97.72	11	1.6	1,389	156	23	short tons
Mixed (Commercial Sector)	21.39	94.27	11	1.6	2,016	235	34	short tons
Mixed (Electric Power Sector)	19.73	95.52	11	1.6	1,885	217	32	short tons
Mixed (Industrial Coking)	26.28	93.90	11	1.6	2,468	289	42	short tons
Mixed (Industrial Sector)	22.35	94.67	11	1.6	2,116	246	36	short tons
Coal Coke	24.80	113.67	11	1.6	2,819	273	40	short tons
Fossil Fuel-derived Fuels (Solid)								
Municipal Solid Waste	9.95	90.70	32	4.2	902	318	42	short tons
Petroleum Coke (Solid)	30.00	102.41	32	4.2	3,072	960	126	short tons
Plastics	38.00	75.00	32	4.2	2,850	1,216	160	short tons
Tires	28.00	85.97	32	4.2	2,407	896	118	short tons
Biomass Fuels (Solid)								
Agricultural Byproducts	8.25	118.17	32	4.2	975	264	35	short tons
Peat	8.00	111.84	32	4.2	895	256	34	short tons
Solid Byproducts	10.39	105.51	32	4.2	1,096	332	44	short tons
Wood and Wood Residuals	17.48	93.80	7.2	3.6	1,640	126	63	short tons
	mmBtu per scf	kg CO ₂ per mmBtu	g CH ₄ per mmBtu	g N ₂ O per mmBtu	kg CO ₂ per scf	g CH ₄ per scf	g N ₂ O per scf	
Natural Gas								
Natural Gas (per scf)	0.001026	53.06	1.0	0.10	0.05444	0.00103	0.00010	scf
Fossil-derived Fuels (Gaseous)								
Blast Furnace Gas	0.000092	274.32	0.022	0.10	0.02524	0.000002	0.000009	scf
Coke Oven Gas	0.000599	46.85	0.48	0.10	0.02806	0.000288	0.000060	scf
Fuel Gas	0.001388	59.00	3.0	0.60	0.08189	0.004164	0.000833	scf
Propane Gas	0.002516	61.46	0.022	0.10	0.15463	0.000055	0.000252	scf
Biomass Fuels (Gaseous)								
Landfill Gas	0.000485	52.07	3.2	0.63	0.025254	0.001552	0.000306	scf
Other Biomass Gases	0.000655	52.07	3.2	0.63	0.034106	0.002096	0.000413	scf
	mmBtu per gallon	kg CO ₂ per mmBtu	g CH ₄ per mmBtu	g N ₂ O per mmBtu	kg CO ₂ per gallon	g CH ₄ per gallon	g N ₂ O per gallon	
Petroleum Products								
Asphalt and Road Oil	0.158	75.36	3.0	0.60	11.91	0.47	0.09	gallon
Aviation Gasoline	0.120	69.25	3.0	0.60	8.31	0.36	0.07	gallon
Butane	0.103	64.77	3.0	0.60	6.67	0.31	0.06	gallon
Butylene	0.105	68.72	3.0	0.60	7.22	0.32	0.06	gallon
Crude Oil	0.138	74.54	3.0	0.60	10.29	0.41	0.08	gallon
Distillate Fuel Oil No. 1	0.139	73.25	3.0	0.60	10.18	0.42	0.08	gallon
Distillate Fuel Oil No. 2	0.138	73.96	3.0	0.60	10.21	0.41	0.08	gallon
Distillate Fuel Oil No. 4	0.146	75.04	3.0	0.60	10.96	0.44	0.09	gallon
Ethane	0.068	59.60	3.0	0.60	4.05	0.20	0.04	gallon
Ethylene	0.058	65.96	3.0	0.60	3.83	0.17	0.03	gallon
Heavy Gas Oils	0.148	74.92	3.0	0.60	11.09	0.44	0.09	gallon
Isobutane	0.099	64.94	3.0	0.60	6.43	0.30	0.06	gallon
Isobutylene	0.103	68.86	3.0	0.60	7.09	0.31	0.06	gallon
Kerosene	0.135	75.20	3.0	0.60	10.15	0.41	0.08	gallon
Kerosene-type Jet Fuel	0.135	72.22	3.0	0.60	9.75	0.41	0.08	gallon
Liquefied Petroleum Gases (LPG)	0.092	61.71	3.0	0.60	5.68	0.28	0.06	gallon
Lubricants	0.144	74.27	3.0	0.60	10.69	0.43	0.09	gallon
Motor Gasoline	0.125	70.22	3.0	0.60	8.78	0.38	0.08	gallon
Naphtha (<401 deg F)	0.125	68.02	3.0	0.60	8.50	0.38	0.08	gallon
Natural Gasoline	0.110	66.88	3.0	0.60	7.36	0.33	0.07	gallon
Other Oil (>401 deg F)	0.139	76.22	3.0	0.60	10.59	0.42	0.08	gallon
Pentanes Plus	0.110	70.02	3.0	0.60	7.70	0.33	0.07	gallon
Petrochemical Feedstocks	0.125	71.02	3.0	0.60	8.88	0.38	0.08	gallon
Petroleum Coke	0.143	102.41	3.0	0.60	14.64	0.43	0.09	gallon
Propane	0.091	62.87	3.0	0.60	5.72	0.27	0.05	gallon
Propylene	0.091	65.95	3.0	0.60	6.00	0.27	0.05	gallon
Residual Fuel Oil No. 5	0.140	72.93	3.0	0.60	10.21	0.42	0.08	gallon
Residual Fuel Oil No. 6	0.150	75.10	3.0	0.60	11.27	0.45	0.09	gallon
Special Naphtha	0.125	72.34	3.0	0.60	9.04	0.38	0.08	gallon
Still Gas	0.143	66.72	3.0	0.60	9.54	0.43	0.09	gallon
Unfinished Oils	0.139	74.54	3.0	0.60	10.36	0.42	0.08	gallon
Used Oil	0.138	74.00	3.0	0.60	10.21	0.41	0.08	gallon
Biomass Fuels (Liquid)								
Biodiesel (100%)	0.128	73.84	1.1	0.11	9.45	0.14	0.01	gallon
Ethanol (100%)	0.084	68.44	1.1	0.11	5.75	0.09	0.01	gallon
Rendered Animal Fat	0.125	71.06	1.1	0.11	8.88	0.14	0.01	gallon
Vegetable Oil	0.120	81.55	1.1	0.11	9.79	0.13	0.01	gallon
	mmBtu per gallon	kg CO ₂ per mmBtu	g CH ₄ per mmBtu	g N ₂ O per mmBtu				
Steam and Hot Water								
Steam and Hot Water		66.33	1,250	0.125				mmBtu

Source:

Solid, gaseous, liquid and biomass fuels: Federal Register (2009) EPA; 40 CFR Parts 86, 87, 89 et al. Mandatory Reporting of Greenhouse Gases; Final Rule, 30Oct09, 261 pp. Tables C-1 and C-2 at FR pp. 56409-56410. Revised emission factors for selected fuels: Federal Register (2010) EPA; 40 CFR Part 98; Mandatory Reporting of Greenhouse Gases; Final Rule, 17Dec10, 81 pp. With Amendments from Memo: Table of 2013 Revisions to the Greenhouse Gas Reporting Rule (PDF) to 40 CFR part 98, subpart C. Table C-1 to Subpart C—Default CO₂ Emission Factors and High Heat Values for Various Types of Fuel and Table C-2 to Subpart C—Default CH₄ and N₂O Emission Factors for Various Types of Fuel.

Steam and Hot Water: EPA (2008) Climate Leaders Greenhouse Gas Inventory Protocol Core Module Guidance - Indirect Emissions from Purchases/Sales of Electricity and Steam. Assumption: 80% boiler efficiency and fuel type assumed natural gas. Factors are per mmBtu of steam or hot water purchased.

<http://www.epa.gov/ghgreporting/documents/pdf/2013/documents/memo-2013-technical-revisions.pdf>
<http://www.epa.gov/ghgreporting/reports/subpartc.html>