

# Appendix A

## **Emission Factors of Fuel Combustion**

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Emission factors of fuel combustion were primarily based on EPA's AP-42 document. They are used in GREET to calculate fuel combustion emissions for upstream activities.

Acronyms, initialisms, and abbreviations are defined on pages xv–xviii of Volume 1.



**Table A.1 Emission Factors of Fuel Combustion (g/10<sup>6</sup> Btu of fuel input)**

Technology	VOC	CO	NO <sub>x</sub>	PM <sub>10</sub>	SO <sub>x</sub>	CH <sub>4</sub>	N <sub>2</sub> O	CO <sub>2</sub>
<i>Natural-Gas-Fired Technologies</i>								
Utility/industrial boiler: current	2.700	41.100	92.900	3.700	0.309	1.100	1.100	59,863
Utility/industrial boiler: future	2.700	41.100	39.100	3.700	0.309	1.100	1.100	59,863
Small industrial boiler: current	2.700	41.100	48.900	3.700	0.309	1.100	1.100	59,863
Small industrial boiler: future	2.700	41.100	15.600	3.700	0.309	1.100	1.100	59,863
Large gas turbine: current	1.400	3.700	78.200	3.600	0.309	2.500	1.100	59,922
Large gas turbine: future	1.400	2.500	39.600	3.600	0.309	2.500	1.100	59,924
Combined-cycle gas turbine: current	1.400	3.700	78.200	3.600	0.309	2.500	1.100	59,922
Combined-cycle gas turbine: future	1.400	2.500	39.600	3.600	0.309	2.500	1.100	59,924
Pipeline turbine	0.908	77.180	154.360	11.607	0.309	23.154	2.000	59,751
Stationary reciprocating engine: current	560.690	379.847	1074.467	11.607	0.309	328.393	2.000	56,691
Stationary reciprocating engine: future	61.290	331.420	871.680	11.607	0.309	289.047	2.000	58,432
NG flaring in oil field	50.200	17.610	31.710	1.320	0.309	0.130	0.210	59,754
<i>LNG-Fired Technologies</i>								
Locomotive: current	175.000	140.000	300.000	0.824	0.000	20.000	2.000	58,322
HD truck	63.000	200.000	90.000	0.435	0.000	20.000	2.000	58,577
<i>Residual-Oil-Fired Technologies</i>								
Utility boiler: current	2.460	16.200	103.700	6.150	129.642	0.910	0.360	82,677
Utility boiler: future	2.460	16.200	84.200	6.150	51.857	0.910	0.360	82,677
Industrial boiler: current	0.910	16.200	178.200	6.150	129.642	3.240	0.360	82,675
Industrial boiler: future	0.910	16.200	144.691	6.150	51.857	3.240	0.360	82,675
Commercial boiler: current	1.103	16.214	19.457	14.083	129.643	0.700	0.357	82,681
Commercial boiler: future	1.103	16.214	13.620	14.083	51.857	0.700	0.357	82,681
Barge: current	162.143	324.286	908.000	14.083	129.643	0.700	0.357	81,695
Barge: future	1.103	16.214	19.457	14.083	51.857	0.700	0.357	82,681
<i>Diesel-Fired Technologies</i>								
Industrial boiler: current	0.710	17.700	84.700	3.530	12.607	0.180	0.390	80,402
Industrial boiler: future	0.710	17.700	35.300	3.530	12.607	0.180	0.390	80,402
Commercial boiler: current	1.200	17.700	70.600	3.810	12.607	0.760	0.390	80,399
Commercial boiler: future	1.200	17.700	35.300	3.810	12.607	0.760	0.390	80,399
Locomotive: current	250.000	350.000	1000.000	82.400	12.607	0.760	2.000	79,101
Stationary reciprocating engine: current	40.860	459.600	2133.600	150.000	12.607	4.540	2.000	79,715
Turbine controlled	1.335	8.714	131.660	16.989	12.607	0.844	2.000	80,413
HDE truck	90.000	500.000	300.000	43.520	12.607	4.410	2.000	79,354
Farming tractor	90.000	334.000	939.000	43.520	12.607	4.410	2.000	79,615

*Continued*



**Table A.1 Emission Factors of Fuel Combustion (g/10<sup>6</sup> Btu of fuel input) (Cont.)**

Technology	VOC	CO	NO <sub>x</sub>	PM <sub>10</sub>	SO <sub>x</sub>	CH <sub>4</sub>	N <sub>2</sub> O	CO <sub>2</sub>
<i>Gasoline-Fired Technologies</i>								
Stationary reciprocating engine: current	1169.050	30754.400	799.500	49.100	9.666	33.810	2.000	23,691
HDE trucks	210.000	1200.000	200.000	7.810	9.666	33.810	2.000	73,123
Farming tractor	210.000	1200.000	662.000	7.810	9.666	33.810	2.000	78,123
<i>Crude-Fired Technologies</i>								
Industrial boiler	0.820	23.740	181.600	29.712	393.846	0.360	2.000	76,677
<i>LPG-Fired Technologies</i>								
Industrial boiler: current	1.890	18.400	108.000	3.243	0.000	1.080	4.860	71,550
Commercial boiler: current	1.890	10.800	78.000	2.430	0.000	1.080	4.860	71,561
<i>Coal-Fired Technologies</i>								
Utility boiler: current	1.501	12.567	285.020	12.661	600.230	0.750	0.298	97,180
Utility boiler: future	1.436	12.617	209.360	12.617	228.650	0.943	0.347	97,180
Gasification/turbine	1.477	12.309	44.068	6.524	44.068	5.098	5.098	97,169
Industrial boiler: current	1.501	12.567	285.020	12.661	600.230	0.750	0.298	97,180
Industrial boiler: future	1.436	12.617	209.360	12.617	228.650	0.943	0.347	97,180
<i>Wood-Fired Technologies</i>								
FBC boiler	5.341	37.388	53.412	6.944	2.003	3.834	4.000	105,933

