2011 ESTIMATES OF ANTHROPOGENIC MERCURY AIR EMISSIONS IN MICHIGAN

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Executive Summary

This report is a compilation of estimates from the 2011 triennial inventory of anthropogenic mercury emissions prepared by the Michigan Department of Environment, Great Lakes, and Energy (EGLE), Air Quality Division (AQD).

The estimates for many point sources were obtained from the Michigan Air Emissions Reporting System (MAERS). Estimated emissions are reported annually to MAERS by approximately 1700 facilities and are subject to limited quality assurance efforts by EGLE to identify, verify, and correct outlier data. Values were also obtained from United States Environmental Protection Agency's (USEPA) Toxics Release Inventory (TRI) and the 2011 National Emissions Inventory (NEI). Where facility-reported values were not available, estimates were calculated by the AQD through application of emission factors or stack test emission rates to facility-reported throughput data.

In addition to point source estimates of mercury, values are included for area sources. Mercury calculations were prepared by the AQD for the stationary nonpoint sector based on county employment, population data, and other inputs. Values for some categories and the mobile source sector were obtained from the USEPA.

The triennial mercury inventory was prepared using the best available estimates at the time of the inventory's development. Due to the use of stack test-based calculations and emission factors obtained from published reports, the augmented inventory is considered more likely to represent the emissions from individual sources than values based on default emission factors. It should be noted that the enhanced estimates are not quality-assured by the facilities themselves.

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Introduction

Table 1 presents the estimated values of mercury for different sectors and the statewide totals. For some categories more than one estimate was arrived at, based on different methodologies and information sources. In these instances, a range of values is presented.

Speciation profiles were applied to the mercury estimates in order to quantify the different forms of the pollutant for each sector. These forms are particulate mercury or Hg(P), Reactive Gaseous Mercury or RGM, and elemental mercury or Hg(0).

Table 1. 2011 ESTIMATES OF ANTHROPOGENIC MERCURY

Emission Source	Hg (lbs/yr) in 2011	2011, low range	2011, high range	Hg(p)	RGM	Hg(0)
FUEL COMBUSTION						
COAL COMBUSTION						
Electric Utilities	2,634.67	2,634.67	2,634.67	406.17	766.48	1462.03
Residential	8.82	8.82	8.82	1.76	2.65	4.41
Industrial/Commercial	263.19	263.19	263.19	52.64	78.96	131.60
OIL COMBUSTION						
Electric Utilities, Boilers	4.17	4.17	4.17	0.83	1.25	2.08
Electric Utilities, ICE	0.15	0.15	0.15	0.03	0.04	0.07
Residential	17.40	17.40	17.40	3.48	5.22	8.70
Industrial/Commercial Boilers	3.36E-04	3.36E-04	3.36E-04	6.72E-05	1.01E-04	1.68E-04
Industrial/Commercial, ICE	0.14	0.14	0.14	0.03	0.04	0.07
NATURAL GAS COMBUSTION						
Electric Utilities	7.02E-06	7.02E-06	7.02E-06	1.40E-06	2.11E-06	3.51E-06
Residential	2.53E-04	2.53E-04	2.53E-04	5.06E-05	7.59E-05	1.27E-04
Industrial/Commercial Boilers	5.34E-05	5.34E-05	5.34E-05	1.07E-05	1.60E-05	2.67E-05
Stationary Internal Combustion Engines	1.20E-05	1.20E-05	1.20E-05	2.40E-06	3.60E-06	6.00E-06
WOOD COMBUSTION						
Electric Utilities	38.78	38.78	38.78	7.76	11.63	19.39
Residential	11.94	11.94	11.94	2.39	3.58	5.97
Industrial/Commercial	35.29	35.29	35.29	7.058	10.587	17.645
Refuse-derived fuel	276.19	276.19	276.19	55.24	82.86	138.10
PETROLEUM REFINING	7.66	7.66	7.66	1.532	2.298	3.83
RESIDENTIAL LPG PROPANE COMBUSTION	4.61	4.61	4.61	0.922	1.383	2.305
TOTAL FUEL COMBUSTION	**3303.00**	**3303.00**	**3303.00**	**539.83**	**966.98**	**1796.19**
INCINERATION						
Sewage Sludge Incineration	154.63	154.63	154.63	30.93	89.69	34.02
Municipal Waste	72.82	72.82	72.82	14.56	42.24	16.02
Hazardous Waste Incineration	1.39	1.39	1.39	0.28	0.81	0.31
Hospital Medical Infectious Waste Incineration	NA	NA	NA	0	0	0

Emission Source	Hg (lbs/yr) in 2011	2011, low range	2011, high range	Hg(p)	RGM	Hg(0)
Human and Animal Cremation (point source)	4.56E-05	4.56E-05	4.56E-05	9.12E-06	2.64E-05	1.00E-05
Pathological Waste Incineration	9.53E-03	9.53E-03	9.53E-03	1.91E-03	7.15E-03	4.76E-04
INCINERATION TOTALS	228.85	228.85	228.85	45.77	132.73	50.35
INDUSTRIAL SOURCES						
Cement Manufacturing	184.09	184.09	184.09	2.20	159.88	22.01
Taconite processing	67.55	67.55	67.55	6.76	6.76	54.04
Lime Manufacturing	58.12	58.12	58.12	5.81	5.81	46.50
Dental Amalgam Manufacturing	4	4	4	0	0	4
Brick Manufacturing	0.34	0.34	0.34	0.03	0.03	0.27
Coke Production	52.56	52.56	52.56	5.26	5.26	42.05
Thermometer Manufacturing				0	0	0
Medical Waste Autoclave	NA	NA	NA	0	0	0
Auto Switches-shredding of autos (point source)	16.54	16.54	16.54	1.65	1.65	13.23
Relay/Switch Manufacturing	80.5	80.5	80.5	0	0	80.5
PRODUCTION OF METALS						
Primary metal production (Blast/BOF Steel Manufacturing)	58.06	58.06	58.06	5.81	5.81	46.45
EAFs in primary metal production (Steel Manufacturing)	261.48	261.48	261.48	26.15	26.15	209.18
EAFs & EIFs in secondary metal production (Steel Foundries)	39.72	39.72	39.72	3.97	3.97	31.78
Secondary metal production (Grey Iron), excluding EAFs	74.31 - 97.60	74.31	97.6	9.8 - 13.1	9.8 - 13.1	78.4 - 104.8
EAFs & EIFs in Secondary metal production (Grey Iron)	22.21 - 82.83	22.21	82.83	2.2 - 8.3	2.2 - 8.3	17.8 - 66.3
INDUSTRIAL SOURCE TOTALS	**914 - 998**	**919.48**	**1003.39**	**67 - 75**	**224 - 233**	**623 - 690**
AREA SOURCES						
MERCURY CONTAINING PRODUCTS						
Dental Amalgam	132.37	132.37	132.37	0	0	132.37
Auto Switches-shredding of autos (area source)	59.53	59.53	59.53	5.95	5.95	47.62
Switches and Relays	64.44	64.44	64.44	0	0	64.44
Measurement and Control Devices	29.50	29.50	29.50	0	0	29.50
Consumer Use of Bulk Mercury	8.82	8.82	8.82	0	0	8.82
Thermostats	8.90	8.90	8.90	0	0	8.90
Fluorescent and Non-Fluorescent Lamp	6.64	6.64	6.64	0	0	6.64

Emission Source	Hg (lbs/yr) in 2011	2011, low range	2011, high range	Hg(p)	RGM	Hg(0)
Breakage						
Drum-top Crushing	0.07 - 0.16	0.07	0.16	0	0	0.07 - 0.16
Thermometers	0	0	0	0	0	0
WASTE DISPOSAL						
Volatilization during solid waste collection & processing	514.95	514.95	514.95	51.495	51.495	411.96
Fluorescent and Non-Fluorescent Lamps	*62.59*	*62.59*	*62.59*	*0*	*0*	*62.59*
Switches and Relays	*15.28*	*15.28*	*15.28*	*0*	*0*	*15.28*
Measurement and Control Devices	*0.60*	*0.60*	*0.60*	*0*	*0*	*0.60*
Thermometers	*0*	*0*	*0*	*0*	*0*	*0*
Thermostats	*12.85*	*12.85*	*12.85*	*0*	*0*	*12.85*
Bulk Mercury	*3.15*	*3.15*	*3.15*	*0*	*0*	*3.15*
Dental Amalgam	*0.31*	*0.31*	*0.31*	*0*	*0*	*0.31*
Landfill volatilization	39.43	39.43	39.43	3.943	3.943	31.544
Switches and Relays	*7.05*	*7.05*	*7.05*	*0*	*0*	*7.05*
Measurement and Control Devices	*0.29*	*0.29*	*0.29*	*0*	*0*	*0.29*
Fluorescent and Non-Fluorescent Lamps	*4.43*	*4.43*	*4.43*	*0*	*0*	*4.43*
Thermostats	*7.23*	*7.23*	*7.23*	*0*	*0*	*7.23*
Dental Amalgam	*1.87*	*1.87*	*1.87*	*0*	*0*	*1.87*
Thermometers	*0*	*0*	*0*	*0*	*0*	*0*
Disposal of products in burn barrels	106 - 841	106	841	21 - 168	32 - 252	53 - 421
Switches and Relays	*30.38*	*30.38*	*30.38*	*0*	*0*	*30.38*
Measurement and Control Devices	*1.19*	*1.19*	*1.19*	*0*	*0*	*1.19*
Thermostats	*23.77*	*23.77*	*23.77*	*0*	*0*	*23.77*
Fluorescent and Non-Fluorescent Lamps	*8.53*	*8.53*	*8.53*	*0*	*0*	*8.53*
Thermometers	*0*	*0*	*0*	*0*	*0*	*0*
RECYCLING						
Volatilization during collection for recycling						
Switches and Relays	20.37	20.37	20.37	0	0	20.37
Measurement and Control Devices	0.31	0.31	0.31	0	0	0.31
Thermostats	0.37	0.37	0.37	0	0	0.37
Fluorescent and Non-Fluorescent Lamps	1.76	1.76	1.76	0	0	1.76
Release during recycling						
Switches and Relays	19.95	19.95	19.95	0	0	19.95
Measurement and Control Devices	0.31	0.31	0.31	0	0	0.31
Thermostats	0.18	0.18	0.18	0	0	0.18
Fluorescent and Non-Fluorescent Lamps	3.5	3.5	3.5	0	0	3.5
OTHER						
Cremation	223.40	223.40	223.40	44.68	129.57	49.15
Disposal of Bulk Hg to Clean Sweep Sites	3.15	3.15	3.15	0	0	3.15
Volatilization: land application of sludge	2.9	2.9	2.9	0.29	0.29	2.32
Contaminated Site Remediation	0	0	0	0	0	0
AREA SOURCE TOTALS	1200 - 1935	1246.85	1981.94	128 - 275	143 - 363	929 - 1298

Emission Source	Hg (lbs/yr) in 2011	2011, low range	2011, high range	Hg(p)	RGM	Hg(0)
MOBILE SOURCES						
On Road	0.18 - 23.53	0.18	23.53	0 - 0.09	0.02 - 2.02	0.16 - 21.41
Non-Road Rail and Commercial Marine	11.00	11.00	11.00	1.65	3.19	6.16
Non-Road Coal-fired Car Ferry	0.24 - 10.80	0.24	10.80	0.04	0.07	0.13
Nonroad Equipment and Vehicles - diesel	0.20	0.20	0.20	0.03	0.06	0.11
Nonroad Equipment and Vehicles - gasoline	1.16	1.16	1.16	0.00	0.10	1.06
MOBILE SOURCE TOTALS	11.42 - 45.33	11.42	45.33	1.69 - 3.36	3.28 - 8.35	6.46 - 33.62
TOTAL Hg AIR EMISSIONS	5710-6563	5709.60	6562.51	782-939	1551-1785	3376-3838

Fuel combustion

Coal Combustion

Electric Utilities

The amount of mercury released from coal-fired electric utilities was extracted from the Michigan Air Emissions Reporting System (MAERS) 2011 emissions inventory data, the United States Environmental Protection Agency's (USEPA) 2011 Toxics Release Inventory (TRI), and the USEPA's Mercury and Air Toxics Standards (MATS) rule. Highest preference was given to facility-estimated process level mercury emissions reported to MAERS. Calculations by the Michigan Department of Environment, Great Lakes, and Energy[1] (EGLE), Air Quality Division (AQD), utilizing emission factors from the MATS rule were given second preference. Facility-wide TRI values for mercury were used in instances where neither MAERS "reported by owner" estimates or MATS values were available. Default MAERS "emission estimator" values, which are based on facility-reported activity data and standard USEPA WebFIRE emission factors, were selected as the final option.

[1] Formerly the Michigan Department of Environmental Quality (MDEQ).

Table 2.

SRN	Facility Name	SCC*	Coal tons	Final MAERS Mercury Value lbs	Facility-wide TRI Values lbs	MATS Values by Process lbs	Best Estimate**
B1573	Escanaba Power Plant	10100205	53,304.20	22.17		7.5	7.5
B1833	Marquette Board of Light & Power	10100204	6,667.00	2.77	18	0.01	0.01
B1833	Marquette Board of Light & Power	10100226	192,151.00	79.93		16.88	16.88
B1976	J.B. Sims Generating Station	10100202	158,770.50	66.05	2.384	5.14	5.14
B1966	White Pine Power, LCC	10200202	2,417.30	0.54		0.10	0.10
B1966	White Pine Power, LCC	10200204	0.00	0.00	0	0	0.00
B2132	Wyandotte Dept. Muni. Power Plant	10100202	54,201.84	22.55		13.91	13.91
B2132	Wyandotte Dept. Muni. Power Plant	10100218	35,662.68	2.96		0.04	0.04
B2357	Holland BPW, Generating Station & WWTP	10100202	141,863.00	3.30	3.651	17.3889	3.30
B2647	LBWL, Eckert, Moores Park & REO Cogen	10100222	912,044.00	379.41	110.44	53.11	53.11
B2796	St. Clair / Belle River Power Plant	10100202	0.00	0.00	891.51	0	0.00
B2796	St. Clair / Belle River Power Plant	10100212	0.00	0.00		0	0.00
B2796	St. Clair / Belle River Power Plant	10100222	6,011,719.00	547.30		362.23	547.30
B2796	St. Clair / Belle River Power Plant	10100226	1,909,663.00	137.20		211.53	137.20
B2810	DTE Electric Company, River Rouge	10100202	0.00	0.00	150.57	0	0.00
B2810	DTE Electric Company, River Rouge	10100212	0.00	0.00		0	0.00
B2810	DTE Electric Company, River Rouge	10100222	638,170.30	72.40		70.58	72.40
B2810	DTE Electric Company, River Rouge	10100226	689,837.50	78.20		42.77	78.20
B2811	DTE Electric Company, Trenton Channel	10100202	0.00	0.00	229.63	0	0.00
B2811	DTE Electric Company, Trenton Channel	10100222	1,820,618.00	150.30		159.96	150.30
B2815	DTE Electric Company, Harbor Beach Power Plant	10100202	85,922.00	8.40	8.52	11.84	8.40
B2815	DTE Electric Company, Harbor Beach Power Plant	10100222	0.00	0.00		0	0.00
B2816	DTE Electric Company, Monroe Power	10100202	0.00	0.00	1103.83	0	0.00
B2816	DTE Electric Company, Monroe Power	10100222	8,504,819.00	707.20		597.816	707.20
B2835	J.H. Campbell Plant	10100202	737,075.00	71.26	553.62	10.87	71.26
B2835	J.H. Campbell Plant	10100222	3,916,230.00	374.13		48.39	374.13
B2836	B.C. Cobb Plant	10100212	822,616.00	70.26	72.53	49.99	70.26
B2840	Consumers Energy Karn-Weadock Facility	10100212	2,372,101.00	196.88	166.94	146.72	146.72
B2846	J.R. Whiting Co.	10100202	942,725.00	88.52	115.19	56.06	88.52
B4001	LBWL, Erickson Station	10100222	491,630.00	204.52	54.55	21.15	21.15
B4261	Wisconsin Electric Power Company	10100202	360,914.00	150.14	51.6	0.34	0.34
B4261	Wisconsin Electric Power Company	10100222	1,041,478.00	433.25		57.06	57.06
B6611	MI SO Central Power Agency	10100202	123,661.45	51.44	10.26	3.75	3.75
N1685	TES Filer City Station	10100204	200,598.70	83.45	1.76	0.49	0.49
N7786	DTE Pontiac North, LLC	10100204	0.00	0.00		0	0.00
	TOTAL			4,004.55		1,965.63	2,634.67

*SCC = Source Classification Codes
** Values reported by owner to MAERS are given highest preference.
In the absence of a reported by owner value, the MATS values for a process are generally given preference after weighing them against the facility-reported, facility wide TRI values.
All the MATS factors were selected by the USEPA from bins with the exception of B2835 for which unit / facility factors were available.
MAERS owner-reported values are displayed in green, TRI values are in purple, and values based on MATS factors are in blue.

Residential

Residential fuel combustion estimates were generated as part of EGLE's submittal to the USEPA's 2011 National Emissions Inventory (NEI). For residential coal combustion, an emission factor of 0.00042 lbs/ton was used, along with year 2010 Census data on household heating and 2010 statewide fuel consumption data from the Energy Information Administration (EIA) of the United States Department of Energy (USDoE) to generate estimated emissions of mercury (MDEQ, 2014).

Table 3.

Category	Throughput tons	Emission Factor	Lbs Emitted
Residential Coal Combustion	21,000.00	4.20E-04	8.82

Industrial/Commercial

Point source estimates, such as those for industrial and commercial combustion of coal, were collected from MAERS. These point source estimates were generated as part of Michigan's submittal to USEPA's 2011 NEI (MDEQ, 2014).

The following industrial and commercial sources of coal combustion were included in the estimate:

Table 4.

SRN	Facility Name	SCC	Coal tons	Emission Factor lb / ton	Emissions lbs
A0884	Escanaba Paper Company	10200212	105,745.00	4.16E-04	8.80
A6175	Nexteer Automotive Corporation	10100204	0.00	4.16E-04	0.00
A6175	Nexteer Automotive Corporation	10200204	31,246.00	4.16E-04	13.00
A6240	Cargill Salt, Inc.	10100204	27,579.00	4.16E-04	11.47
A6380	Abbott Nutrition	10200205	1,280.60	4.16E-04	0.53
A6475	MPI Acquisition, LLC	10200204	37,811.00	4.16E-04	15.73
B1470	Neenah Paper – Michigan, Inc.	10200204	47,758.00	4.16E-04	19.87
B1476	Decorative Panels International, Inc.	10200204	33,568.00	4.16E-04	13.96
B1563	Great Lakes Tissue	10200205	0.00	4.16E-04	0.00
B1824	Morton Salt, Inc.	10100205	43,840.00	4.16E-04	3.20
B1855	Clearwater Paper, Menominee	10200204	17,647.00	4.16E-04	7.34
B2873	Michigan Sugar Company, Sebewaing Factory	10100204	21,482.00	4.16E-04	8.94
B2875	Michigan Sugar Company, Caro Factory	10100204	22,480.00	4.16E-04	9.35
B2876	Michigan Sugar Company, Croswell Factory	10100204	16,216.00	4.16E-04	6.75
B3610	Pharmacia & Upjohn Co., a subsidiary of Pfizer	10200204	46,575.74	4.16E-04	19.38
B3692	Packaging Corp. of America, Filer City Mill	10100202	62,148.00	4.16E-04	25.85
B6420	E.B. Eddy Paper, Inc.	10200202	55,941.00	4.16E-04	23.27
B7192	Verso Paper - Quinnesec	10200204	507.00	4.16E-04	0.21
B7227	General Motors, Orion Assembly	10200204	0.00	4.16E-04	0.00
K3249	Michigan State University	10300206	100,727.70	4.16E-04	41.90
K3249	Michigan State University	10300218	61,753.90	4.16E-04	25.69
N0677	Steelcase Inc.- Kentwood Complex	10100204	19,099.30	4.16E-04	7.95
	TOTAL				263.19

Oil Combustion

Electric Utilities, External Combustion Boilers

Mercury emissions from oil-fired electric utilities were estimated using data from MAERS as part of Michigan's submittal to the USEPA's 2011 NEI (MDEQ, 2014). The oil combustion, or throughput, is expressed in thousands of gallons (E3GAL). The following sources were included in the estimate, for oil-fired boilers:

Table 5.

SRN	Facility Name	SCC	Factor lb / E3GAL	Oil E3GAL	Lbs Emitted
B4252	AEP Cook Nuclear Plant	10100501	4.20E-04	12.80	0.0054
B2840	Consumers Energy Karn-Weadock Facility	10100401	1.13E-04	1,020.85	0.1154
B2840	Consumers Energy Karn-Weadock Facility	10100501	4.20E-04	1,928.79	0.8101
M4148	Detroit Renewable Power, LLC	10100501	4.20E-04	298.80	0.1255
B6145	DTE Electric Company, Greenwood Energy Center	10100401	1.13E-04	600.00	0.0678
B6145	DTE Electric Company, Greenwood Energy Center	10100501	4.20E-04	76.34	0.0321
B2815	DTE Electric Company, Harbor Beach Power Plant	10100501	4.20E-04	157.08	0.0660
B2816	DTE Electric Company, Monroe Power	10100501	4.20E-04	1,443.35	0.6062
B2811	DTE Electric Company, Trenton Channel	10100501	4.20E-04	503.76	0.2116
B2835	J.H. Campbell Plant	10100501	4.20E-04	774.44	0.3253
B2846	J.R. Whiting Company	10100501	4.20E-04	814.79	0.3422
B2647	LBWL, Eckert, Moores Park & REO Cogeneration	10100501	4.20E-04	402.81	0.1692
B4001	LBWL, Erickson Station	10100501	4.20E-04	164.78	0.0692
B1833	Marquette Board of Light & Power	10100501	4.20E-04	18.00	0.0076
B6611	MI SO Central Power Agency	10100501	4.20E-04	91.39	0.0384
B2796	St. Clair / Belle River Power Plant	10100401	1.13E-04	0.00	0.0000
B2796	St. Clair / Belle River Power Plant	10100501	4.20E-04	2,102.35	0.8830
B2838	Veolia Energy Grand Rapids, LLC	10100401	1.13E-04	0.00	0.0000
B4261	Wisconsin Electric Power Company	10100501	4.20E-04	692.00	0.2906
	TOTAL			11,102.31	4.1654

Electric Utilities, Stationary Internal Combustion Engines

Oil-fired, stationary internal combustion engines were separated from oil-fired, external combustion boilers in the report to provide greater clarity. Throughput and emissions from facilities with electric-generating units (EGU) are presented below for 2011, based on data from MAERS and standard USEPA emission factors. Mercury in the amount of 0.15 lbs was estimated for this sector.

Table 6.

SRN	Facility Name	SCC	Emission Factor lb / E3GAL	Diesel Fuel, E3GAL	Lbs Emitted
B2942	Consumers Energy Gaylord Combustion Turbine Plant	20200102	4.129E-05	0.16	0.0000
B2840	Consumers Energy Karn-Weadock Facility	20200102	4.129E-05	0.23	0.0000
N6252	Consumers Energy Morrow Combustion Turbine Plant	20200102	4.129E-05	0.22	0.0000
B2918	Consumers Energy Thetford Combustion Turbine Plant	20200102	4.129E-05	0.23	0.0000
B2185	Detroit Public Lighting Dept.	20100101	1.644E-04	9.78	0.0016
B2808	DTE - Electric Company Northeast Station	20100101	1.644E-04	100.81	0.0166
B2806	DTE - Electric Company Superior	20100101	1.644E-04	37.69	0.0062
B4321	DTE Electric Company - Fermi Energy Center	20100101	1.644E-04	579.08	0.0952
B1573	Escanaba Power Plant	20100101	1.644E-04	78.34	0.0129
N6000	Holland Board of Public Works	20100101	1.644E-04	16.42	0.0027
N2586	Holland Board of Public Works, 48th St. Peaking Station	20100101	1.644E-04	20.17	0.0033
B2835	J.H. Campbell Plant	20100101	1.644E-04	7.73	0.0013

SRN	Facility Name	SCC	Emission Factor lb / E3GAL	Diesel Fuel, E3GAL	Lbs Emitted
B2846	J.R. Whiting Company	20100101	1.644E-04	0.00	0.0000
B6553	UPPCO Portage Station	20100101	1.644E-04	0.00	0.0000
N6171	Wolverine Power, Tower Power Plant	20100101	1.644E-04	31.69	0.0052
N6249	Wolverine Power, Vestaburg Power Plant	20100101	1.644E-04	0.00	0.0000
	TOTAL			882.53	0.1450

Residential

Residential fuel combustion estimates were generated as part of Michigan's submittal to the USEPA's 2011 NEI. For residential oil combustion, an emission factor of 0.00042 lbs/1,000 gallons was used along with year 2010 Census data on household heating and 2010 statewide fuel consumption data from the EIA, USDoE to generate estimated emissions of mercury (MDEQ, 2014).

Table 7.

Category	Throughput E3GAL	Emission Factor	Lbs Emitted
Residential Oil Combustion	41,432.00	4.200E-04	17.40

Industrial/Commercial (External Combustion Boilers)

Point source estimates such as those for industrial and commercial combustion of oil were collected from MAERS (MDEQ, 2011). These point source estimates were generated as part of Michigan's submittal to USEPA's 2011 NEI. The following industrial and commercial oil-fired, external combustion boilers were included in the estimate:

Table 8.

SRN	Facility Name	SCC	Factor lb / E3GAL	Oil, E3GAL	Lbs Emitted
A2402	Access Business Group, LLC	10100501	4.20E-04	0.8	0.000336
B1548	Post Foods	10100501	4.20E-04	0	0
B1677	Allnex USA, Inc.	10100401	1.13E-04	0	0
N5930	Delta College	10100501	4.20E-04	0	0
N5930	Delta College	10100501	4.20E-04	0	0
N5930	Delta College	10100501	4.20E-04	0	0
	TOTAL			0.8	0.000336

Stationary Internal Combustion Engines (Oil-Fired, Industrial / Commercial)

Oil-fired, stationary internal combustion engines were separated from oil-fired, external combustion boilers in the report to provide greater clarity. Throughput and emissions from commercial/industrial facilities are presented below for 2011, based on data from MAERS and standard USEPA emission factors. Mercury in the amount of 0.14 lbs was estimated for this sector.

Table 9.

SRN	Facility Name	SCC	Emission Factor lb / E3GAL	Diesel Fuel E3GAL	Lbs Emitted
N3396	A & E Agg., Inc. (Plant 1)	20200102	4.13E-05	24.4	0.0010075
N6439	Ace-Saginaw Paving Co. (Plant 10)	20200102	4.13E-05	1.79	0.0000738
N5816	Aggregate & Developing, LLC	20200102	4.13E-05	39	0.0016103
N7981	Aggregate & Developing, LLC, Superior Pit	20200102	4.13E-05	14.98	0.0006186
N6197	Aggregate Industries, AC3 Portable Plant	20200102	4.13E-05	6.41	0.0002647
N3177	Aggregate Industries, AC3 Portable Plant	20200102	4.13E-05	25.73	0.0010624
N6283	Aggregate Industries, Day Road	20200102	4.13E-05	33.52	0.001384
N5998	Aggregate Industries, NB1 Portable Plant	20200102	4.13E-05	26.07	0.0010764
M4731	Ajax Paving Industries, Inc.	20200102	4.13E-05	28	0.0011561
N1917	Ajax Paving Industries, Inc.	20200102	4.13E-05	1.5	0.0000619
N1656	Albrecht Sand and Gravel	20200102	4.13E-05	15.9	0.0006565
N7259	Alpena Aggregate, Inc.	20200102	4.13E-05	49.28	0.0020348
N3152	American Aggregates of Michigan, Inc. Eljay 54	20200102	4.13E-05	2.35	0.0000972
N7601	American Aggregates of Michigan, Inc., Metso Plant	20200102	4.13E-05	21.11	0.0008715
N7375	American Aggregates of Michigan, Inc., Sandvik Cone	20200102	4.13E-05	11.42	0.0004715
N7390	Balkema Excavating, Plant 104	20200102	4.13E-05	0	0
N6589	Balkema Excavating, Portable Plant 101	20200102	4.13E-05	0	0
N3435	Balkema Excavating/Agg. Resources, Plant 102	20200102	4.13E-05	12.14	0.0005012
N5131	Balkema Excavating/Agg. Resources, Plant 103	20200102	4.13E-05	6.53	0.0002694
N8252	Barber Creek Sand and Gravel, Inc.	20200102	4.13E-05	15.36	0.0006342
N7407	Barber Creek Sand and Gravel, Inc.	20200102	4.13E-05	20.9	0.000863
P0197	Bierlein Companies, Inc.	20200102	4.13E-05	1.82	0.0000751
N5488	Bierlein Demolition Contract	20200102	4.13E-05	0	0
B4164	Bolen Asphalt Paving, Inc.	20200102	4.13E-05	9.8	0.0004046
N1905	Bolen Asphalt Paving, Inc.	20200102	4.13E-05	13.3	0.0005492
N7232	Carl Schlegel, Inc.	20200102	4.13E-05	9.46	0.0003906
N6533	Carlo Construction	20200102	4.13E-05	0	0
N6883	Carr Brothers & Sons Inc., Plant 1	20200102	4.13E-05	11.38	0.0004699
N6880	Carr Brothers & Sons Inc., Plant 2	20200102	4.13E-05	11.6	0.000479
N6749	Carrick Gravel and Crushing	20200102	4.13E-05	12.12	0.0005004
N8162	Clayton Unit	20200102	4.13E-05	0.68	0.000028
B6508	Clinton, Village of	20200102	4.13E-05	0.27	0.0000109
N7659	Crystal Aggregates, LLC	20200102	4.13E-05	0	0
N6664	Custom Crushing & Recycle, Inc.	20200102	4.13E-05	66.1	0.0027293
N6861	Custom Crushing Lakeshore	20200102	4.13E-05	35.2	0.0014534
N6631	Dearborn Industrial Generation	20200102	4.13E-05	2.78	0.0001149
M4164	Delta Air Lines, Inc.	20200102	4.13E-05	0	0
M4174	Detroit Metropolitan Wayne County Airport	20100101	1.64E-04	1.62	0.0002655
B2816	DTE Electric Company, Monroe Power	20200102	4.13E-05	0.23	0.0000095
N6762	Dykema Excavators, Inc.	20200102	4.13E-05	10.45	0.0004314
B2209	Eaton Corporation - Galesburg Campus	20200102	4.13E-05	98.11	0.0040508
B3534	Edw. C. Levy Co., Plant 2 Portable Crusher	20200102	4.13E-05	3.61	0.0001491
N5748	Elmer's Crane and Dozer, Inc.	20200102	4.13E-05	3.02	0.0001245

SRN	Facility Name	SCC	Emission Factor lb / E3GAL	Diesel Fuel E3GAL	Lbs Emitted
N6453	Elmer's Crane and Dozer, Inc.	20200102	4.13E-05	1.49	0.0000615
N6750	Elmer's Crane and Dozer, Inc.	20200102	4.13E-05	1.01	0.0000416
N7052	Elmer's Crane and Dozer, Inc.	20200102	4.13E-05	0.87	0.000036
N7837	Elmer's Crane and Dozer, Inc.	20200102	4.13E-05	0.52	0.0000216
B2063	Faurecia Interior Systems Saline, LLC	20200102	4.13E-05	1.61	0.0000664
N6600	Florence Cement Co., Inc.	20200102	4.13E-05	1.58	0.0000651
N6599	Florence Cement Co., Inc.	20200102	4.13E-05	2.87	0.0001186
N7996	Florence Cement, Plant 741	20200102	4.13E-05	5.19	0.0002143
A8648	Ford Motor Co., Rouge Complex	20200102	4.13E-05	0.54	0.0000223
A8645	Ford Motor Co., Livonia Transmission	20200102	4.13E-05	0.51	0.0000211
B2064	Ford Motor Co., Rawsonville Plant	20200102	4.13E-05	1.2	0.0000495
B2869	Ford Motor Co., Romeo Engine Plant	20200102	4.13E-05	0.52	0.0000215
A3567	Ford Motor Co., Sterling Plant	20200102	4.13E-05	0.22	0.0000089
B1771	Ford Motor Co., Van Dyke Plant	20200102	4.13E-05	0.56	0.000023
B4032	General Motors, LLC - Pontiac North Campus	20200102	4.13E-05	1.4	0.0000578
N6834	Gerken Materials, Inc.	20200102	4.13E-05	0	0
G7126	Grand Valley State University	20200102	4.13E-05	0.81	0.0000336
N2627	Great Lakes Aggregates, HAZMAG Plant	20200102	4.13E-05	40.28	0.001663
N5241	Great Lakes Aggregates, Sylvania Minerals	20200102	4.13E-05	0	0
N7383	Green Plains Holdings II, LLC	20200102	4.13E-05	2.69	0.0001111
N7011	Grosso Trucking and Supply Company	20200102	4.13E-05	4.2	0.0001734
N3631	GS Materials, LLC	20200102	4.13E-05	11.66	0.0004814
B7205	Guardian Fiberglass, Inc.	20200102	4.13E-05	5.31	0.000219
N6429	Halliday Sand & Gravel, 945 Cone	20200102	4.13E-05	10	0.0004129
N5841	Halliday Sand & Gravel, Plant 2	20200102	4.13E-05	20	0.0008258
N5842	Halliday Sand & Gravel, Plant 3	20200102	4.13E-05	15	0.0006193
N6307	Halliday Sand & Gravel, Plant 1 225-97A	20200102	4.13E-05	13	0.0005368
N6430	Halliday Sand & Gravel	20200102	4.13E-05	1	0.0000413
N6957	Halliday Sand & Gravel, 6000 Cone Plant	20200102	4.13E-05	3	0.0001239
N6306	Hanlee Equipment, LLC	20200102	4.13E-05	7.88	0.0003253
N7730	Heritage Resources, Inc.	20200102	4.13E-05	1.53	0.0000633
N7518	Heritage Resources, Inc.	20200102	4.13E-05	4.96	0.0002049
N6704	Hubscher & Son, Inc., Pioneer 50VE Portable	20200102	4.13E-05	4	0.000165
N6705	Hubscher & Son, Inc., Cedarapids 443	20200102	4.13E-05	4.97	0.0002052
B7013	Huron Casting, Inc. & Blue Diamond Steel Casting	20300102	1.64E-04	0	0
B2835	J.H. Campbell Plant	20200102	4.13E-05	1.6	0.0000662
N7385	K & K Crushing and Leasing	20200102	4.13E-05	5	0.0002065
B4383	Kasson Sand and Gravel	20200102	4.13E-05	9.45	0.0003902
P0244	KGL Associates, Inc.	20200102	4.13E-05	26.23	0.001083
N6804	Klett Recycle, Inc.	20200102	4.13E-05	10.23	0.0004224
N6488	LC Redi Mix, Inc.	20200102	4.13E-05	19.1	0.0007886
N7361	Les Miller & Sons Aggregates, Inc.	20200102	4.13E-05	0	0
P0068	Ludington Pumped Storage Facility	20200102	4.13E-05	0.09	0.0000037
N0503	Lyon Sand & Gravel, RAP Plant	20200102	4.13E-05	24.4	0.0010076
N6448	Manthei Development Corp., MDC Contracting	20200102	4.13E-05	2.36	0.0000974
A5858	Mead Johnson & Company, LLC	20200102	4.13E-05	0.67	0.0000276
B7090	Michigan Milk Producers Association	20100101	1.64E-04	4.2	0.0006905
N6385	Mid Michigan Materials, Inc.	20200102	4.13E-05	1.16	0.0000479
B6527	Midland Cogeneration Venture	20200102	4.13E-05	1.35	0.0000559
N6767	New Covert Generating Company, LLC	20200102	4.13E-05	0.37	0.0000151
N6548	Ottawa Aggregates, Inc.	20200102	4.13E-05	0	0
N7618	Pamar Enterprise, Inc.	20200102	4.13E-05	7.64	0.0003153
N6849	Parker Excavating Gravel & Recycle, Inc.	20200102	4.13E-05	0.15	0.0000061
N6850	Parker Excavating Gravel & Recycle, Inc.	20200102	4.13E-05	1.69	0.0000698

SRN	Facility Name	SCC	Emission Factor lb / E3GAL	Diesel Fuel E3GAL	Lbs Emitted
N6851	Parker Excavating Gravel & Recycle, Inc.	20200102	4.13E-05	5.15	0.0002124
N6848	Parker Excavating Gravel & Recycle, Inc.	20200102	4.13E-05	3.14	0.0001296
N7151	Paul Bechtel Sand and Gravel, LLC	20200102	4.13E-05	10.35	0.0004274
P0030	Posen Construction, Inc.	20200102	4.13E-05	7.3	0.0003014
N7271	Pyramid Paving & Contracting	20200102	4.13E-05	0	0
N5476	R.E. Glancy, Inc.	20200102	4.13E-05	0	0
N5477	R.E. Glancy, Inc.	20200102	4.13E-05	2.38	0.0000983
N5478	R.E. Glancy, Inc.	20200102	4.13E-05	0	0
N5480	R.E. Glancy, Inc.	20200102	4.13E-05	0	0
N5963	R.E. Glancy, Inc.	20200102	4.13E-05	11.38	0.0004699
N6901	R. Smith & Sons, Inc., Plant 1	20200102	4.13E-05	14	0.0005781
N7595	R. Smith & Sons, Inc.	20200102	4.13E-05	2.2	0.0000908
N6355	R.E. Glancy, Inc.	20200102	4.13E-05	0.73	0.0000301
N6634	R.E. Glancy, Inc.	20200102	4.13E-05	0	0
B4147	Rieth Riley Construction Co., Inc.	20200102	4.13E-05	19.42	0.0008019
N2184	Rieth Riley Construction Co., Inc.	20200102	4.13E-05	30.52	0.0012602
N1594	Rieth Riley Construction Co., Inc.	20200102	4.13E-05	0	0
B4058	Rieth Riley Construction Co., Inc.	20200102	4.13E-05	13.5	0.0005574
N6022	Rieth Riley Construction Co., Inc.	20200102	4.13E-05	13.04	0.0005384
N6413	Rieth Riley Construction Co., Inc.	20200102	4.13E-05	18.02	0.000744
N1357	Rieth Riley Construction Co., Inc.	20200102	4.13E-05	4.5	0.0001858
N6608	Rieth Riley Construction Co., Inc.	20200102	4.13E-05	13.04	0.0005384
N6837	Rock Recyclers	20200102	4.13E-05	27.21	0.0011234
N1588	Searles Construction, 36 Plant	20200102	4.13E-05	5.67	0.000234
N6913	Searles Construction, 45 Plant	20200102	4.13E-05	8.74	0.0003608
N6910	Searles Construction, Extec Plant	20200102	4.13E-05	0.25	0.0000101
N6914	Searles Construction, Wash Plant	20200102	4.13E-05	6.87	0.0002835
F3254	Selfridge Air National Guard Base	20300102	1.64E-04	5.3	0.0008713
M4722	Sora Limestone Quarry	20200102	4.13E-05	0	0
N0677	Steelcase, Inc., Kentwood Complex	20100101	1.64E-04	0.07	0.0000118
N3203	Stoneco, Inc., 100th Street, Division 84	20200102	4.13E-05	40	0.0016516
P0121	Sungard Availability Services, LP	20300102	1.64E-04	282	0.0463608
N7168	TelSmith 52G Portable Crusher.	20200102	4.13E-05	4.93	0.0002037
N6338	Tri City Aggregates	20200102	4.13E-05	2.44	0.0001007
N6341	Tri City Aggregates	20200102	4.13E-05	1.92	0.0000791
N6432	Tri City Aggregates	20200102	4.13E-05	6.67	0.0002752
B7748	Tuscola Minerals Co	20200102	4.13E-05	32	0.0013213
B4102	U.S. Gypsum Co.	20200102	4.13E-05	3.74	0.0001544
M0675	University of Michigan	20200103	1.67E-04	231.31	0.038583
B2328	University of Michigan, former Pfizer Global R&D	20200102	4.13E-05	2.63	0.0001084
B2328	University of Michigan, former Pfizer Global R&D	20200103	1.67E-04	0	0
B5421	Vandyke Generating Plant	20200102	4.13E-05	0.08	0.0000033
N7288	Weber Sand & Gravel, Inc., Cedar Rapids	20200102	4.13E-05	10.44	0.0004309
B7302	Weyerhaeuser N.R. Company	20200102	4.13E-05	1.22	0.0000506
N7391	Wiegand's Crushing, Inc.	20200102	4.13E-05	8.57	0.0003539
N6833	Wolverine Power, Gaylord Generating Station	20200102	4.13E-05	0.45	0.0000184
N3519	Zoetis P&U LLC	20200102	4.13E-05	0	0
	TOTAL			1,785.13	0.1388341

Natural Gas Combustion

Electric Utilities

Mercury emissions from natural gas-fired electric utilities were estimated using an emission factor published by the Electric Power Research Institute (EPRI 1996) for natural gas combustion. Throughput, or natural gas consumption, is expressed in millions of cubic feet (MMCF). The EPRI factor of 8.00E-10 lb/MMCF is several orders of magnitude lower than the USEPA emission factor used in MAERS, which is 2.6E-04 lb/MMCF. The result is that the estimated mercury emissions for this category drop to 7.02E-06 lbs statewide, compared to the MAERS estimate of 2.28 lbs for 2011.

Sources included in the estimate for emissions from natural gas-fired electric utilities:

Table 10.

SRN	Facility Name	SCC	EPRI Emission Factor lb / MMCF	Throughput MMCF	Lbs Emitted per EPRI Factor
N1784	Ada Cogeneration, LP	10100602	8.00E-10	243.38	1.95E-07
B2836	B.C. Cobb Plant	10100604	8.00E-10	147.98	1.18E-07
B2840	Consumers Energy Karn-Weadock Facility	10100601	8.00E-10	1768.19	1.41E-06
B2840	Consumers Energy Karn-Weadock Facility	10100604	8.00E-10	144.19	1.15E-07
B2812	DTE Electric Company Conners Creek	10100601	8.00E-10	0.00	0.00E+00
B6145	DTE Electric Company Greenwood Energy Center	10100601	8.00E-10	4012.57	3.21E-06
B2813	DTE Electric Company Marysville Power Plant	10100604	8.00E-10	0.00	0.00E+00
B2810	DTE Electric Company River Rouge	10100601	8.00E-10	504.72	4.04E-07
B2810	DTE Electric Company River Rouge	10100604	8.00E-10	164.06	1.31E-07
N2388	Grayling Generating Station Ltd Partnership	10100601	8.00E-10	1.04	8.32E-10
N1266	Hillman Power Company	10100602	8.00E-10	1.24	9.92E-10
B2357	Holland BPW, Generating Station & WWTP	10100601	8.00E-10	9.76	7.81E-09
B1976	J.B. Sims Generating Station	10100601	8.00E-10	21.32	1.71E-08
B4260	L'Anse Warden Electric Company	10100601	8.00E-10	3.05	2.44E-09
B2796	St. Clair / Belle River Power Plant	10100601	8.00E-10	53.72	4.30E-08
B2796	St. Clair / Belle River Power Plant	10100604	8.00E-10	263.14	2.11E-07
N1160	Viking Energy of McBain	10100601	8.00E-10	1264.00	1.01E-06
B2132	Wyandotte Dept. Muni. Power Plant	10100601	8.00E-10	169.93	1.36E-07
	TOTAL			8,772.29	7.02E-06

Residential

For residential natural gas combustion, the EPRI emission factor of 8.0E-10 lb/MMCF was used along with year 2010 Census data on household heating and 2011 statewide fuel consumption data from the EIA, USDoE to generate estimated emissions of mercury (MDEQ, 2014). This resulted in statewide total emissions from this category of 2.53E-04 lbs, compared to the estimate of 82.18 lbs, which is based on the WebFIRE natural gas combustion factor of 2.60E-04 lb/MMCF.

Table 11.

Category	Throughput MMCF	Emission Factor	Lbs Emitted
Residential Natural Gas Combustion	316,069.00	8.00E-10	0.000253

Industrial/Commercial Boilers

For natural gas combustion from Industrial and Commercial boilers, the EPRI emission factor of 8.0E-10 lb/MMCF was utilized, along with 2011 activity data from MAERS. The statewide total mercury emissions estimated for this category were 5.34E-05 lbs. The MAERS estimate, based on the standard USEPA factor, was 17.30 lbs for this category.

The following industrial and commercial sources of natural gas combustion were included in the estimate:

Table 12.

SRN	Facility Name	SCC	EPRI Emission Factor lb/MMCF)	Throughput MMCF	Lbs Emitted per EPRI Factor
N2432	A.G. SIMPSON (USA), INC.	10100602	8.00E-10	22.94	1.84E-08
P0024	A123 SYSTEMS	10200602	8.00E-10	0.12	9.68E-11
A6380	ABBOTT NUTRITION	10200602	8.00E-10	354.13	2.83E-07
A2402	ACCESS BUSINESS GROUP, LLC	10100602	8.00E-10	8.00	6.40E-09
A2402	ACCESS BUSINESS GROUP, LLC	10200602	8.00E-10	87.58	7.01E-08
N7809	ADEPT PLASTIC FINISHING	10200602	8.00E-10	31.70	2.54E-08
B4311	ADM GRAIN COMPANY	10200602	8.00E-10	43.02	3.44E-08
B8863	ADM GRAIN COMPANY	10200602	8.00E-10	25.60	2.05E-08
M3912	ADM GRAIN COMPANY	10200602	8.00E-10	38.33	3.07E-08
B5830	AJAX METAL PROCESSING, INC.	10200602	8.00E-10	144.00	1.15E-07
B6519	ALBEMARLE CORP.	10200602	8.00E-10	33.28	2.66E-08
B1677	ALLNEX USA, INC.	10100602	8.00E-10	354.30	2.83E-07
M4732	AMCANE SUGAR, LLC	10200602	8.00E-10	189.28	1.51E-07
B6633	AMERICAN AXLE & MANUFACTURING, INC.	10200602	8.00E-10	48.91	3.91E-08
B1713	AMERICAN SEATING COMPANY	10200602	8.00E-10	24.10	1.93E-08
M4268	AMERICAN SOY PRODUCTS	10200602	8.00E-10	0.06	4.88E-11
C5728	ANDREWS UNIVERSITY	10300602	8.00E-10	145.98	1.17E-07
E4569	ARKEMA, INC.	10200602	8.00E-10	50.27	4.02E-08
N1794	ATLAS EPS, A DIVISION OF ATLAS ROOFING CORP.	10200602	8.00E-10	6.03	4.82E-09
A3569	AXALTA COATING SYSTEMS, LLC, MT CLEMENS PLANT	10200602	8.00E-10	16.66	1.33E-08
B2836	B.C. COBB PLANT	10200602	8.00E-10	7.71	6.17E-09
K2688	BOP FEDERAL CORRECTIONAL INSTITUTE	10300602	8.00E-10	94.80	7.58E-08
B4359	BASF CORP.	10200602	8.00E-10	0.00	0.00E+00
N1336	BASF CORP.	10200602	8.00E-10	36.82	2.95E-08
B6643	BAYER CROPSCIENCE, LP	10200602	8.00E-10	244.66	1.96E-07
P0243	BEAUMONT INFORMATION TECHNOLOGY CENTER	10300603	8.00E-10	1.05	8.40E-10
B2359	BIRDS EYE FOODS, LLC	10200602	8.00E-10	66.63	5.33E-08
N7303	BLUEWATER GAS STORAGE FACILITY	10200602	8.00E-10	1.72	1.38E-09
N5797	BOAR'S HEAD PROVISIONS CO., INC.	10300602	8.00E-10	143.23	1.15E-07
K2729	BOTSFORD HOSPITAL	10300602	8.00E-10	89.63	7.17E-08
N3655	BRONSON BATTLE CREEK	10300602	8.00E-10	0.09	6.88E-11
B2158	BUCKEYE TERMINALS, LLC, WOODHAVEN TERMINAL	10300602	8.00E-10	0.00	0.00E+00
L0550	CALVIN COLLEGE	10300602	8.00E-10	91.50	7.32E-08
A6240	CARGILL SALT, INC.	10200601	8.00E-10	952.40	7.62E-07
K2460	CENTRAL MICHIGAN UNIVERSITY	10300601	8.00E-10	0.00	0.00E+00
K2460	CENTRAL MICHIGAN UNIVERSITY	10300602	8.00E-10	149.44	1.20E-07
B1801	CHRYSLER GROUP, LLC, STERLING STAMPING PLANT	10100602	8.00E-10	238.66	1.91E-07
N2155	CHRYSLER JEFFERSON NORTH ASSEMBLY PLANT	10200602	8.00E-10	316.48	2.53E-07
N2155	CHRYSLER JEFFERSON NORTH ASSEMBLY PLANT	10300602	8.00E-10	447.06	3.58E-07
B2767	CHRYSLER WARREN TRUCK ASSEMBLY PLANT	10200601	8.00E-10	484.88	3.88E-07
B2767	CHRYSLER WARREN TRUCK ASSEMBLY PLANT	10200602	8.00E-10	2.27	1.82E-09

SRN	Facility Name	SCC	EPRI Emission Factor lb/MMCF)	Throughput MMCF	Lbs Emitted per EPRI Factor
B7248	CHRYSLER STERLING HEIGHTS ASSEMBLY PLANT	10200602	8.00E-10	667.74	5.34E-07
B7248	CHRYSLER STERLING HEIGHTS ASSEMBLY PLANT	10300602	8.00E-10	115.24	9.22E-08
N1436	CHRYSLER TECHNOLOGY CENTER	10200602	8.00E-10	415.60	3.32E-07
B3350	CHRYSLER TRENTON ENGINE	10200601	8.00E-10	24.23	1.94E-08
B3350	CHRYSLER TRENTON ENGINE	10200602	8.00E-10	102.20	8.18E-08
B1855	CLEARWATER PAPER, MENOMINEE	10200602	8.00E-10	26.33	2.11E-08
B5453	COASTAL CONTAINER CORP.	10200602	8.00E-10	0.00	0.00E+00
N5573	CONSUMERS ENERGY, WHITE PIGEON	10300603	8.00E-10	1.53	1.22E-09
N1099	CONSUMERS ENERGY, NORTHVILLE	10300603	8.00E-10	3.14	2.51E-09
N6013	CONTINENTAL ALUMINUM	10200602	8.00E-10	73.30	5.86E-08
M1954	COVENANT HEALTH CARE	10300602	8.00E-10	300.00	2.40E-07
A6902	DARLING INTERNATIONAL, INC.	10200602	8.00E-10	77.70	6.22E-08
B1526	DARLING INTERNATIONAL, INC.	10200602	8.00E-10	359.72	2.88E-07
D8065	DART CONTAINER CORPORATION OF MICHIGAN	10200602	8.00E-10	211.89	1.70E-07
B2014	DAY INTERNATIONAL, INC. A FLINT GROUP COMPANY	10200602	8.00E-10	81.09	6.49E-08
N6631	DEARBORN INDUSTRIAL GENERATION	10200601	8.00E-10	59.12	4.73E-08
B1476	DECORATIVE PANELS INTERNATIONAL, INC.	10200602	8.00E-10	1,839.00	1.47E-06
A1177	DELPHI FLINT EAST	10200602	8.00E-10	0.00	0.00E+00
N5930	DELTA COLLEGE	10300602	8.00E-10	67.47	5.40E-08
N5930	DELTA COLLEGE	10300603	8.00E-10	0.00	0.00E+00
A1640	DEMMER CORP.	10200602	8.00E-10	0.09	7.04E-11
N1192	DENSO MANUFACTURING MICHIGAN, INC.	10200602	8.00E-10	99.43	7.95E-08
A8638	DETROIT DIESEL CORP.	10200602	8.00E-10	309.80	2.48E-07
B5853	DETROIT MEDIA PARTNERSHIP	10100602	8.00E-10	59.19	4.74E-08
M4174	DETROIT METROPOLITAN WAYNE COUNTY AIRPORT	10300602	8.00E-10	322.23	2.58E-07
B2116	DETROIT STEEL CO., TRENTON	10200601	8.00E-10	0.00	0.00E+00
B2814	DETROIT THERMAL, BEACON HEATING PLANT	10300601	8.00E-10	1,451.28	1.16E-06
B3012	DETROIT THERMAL, BLVD. HEATING PLANT	10300602	8.00E-10	2.80	2.24E-09
N6358	DETROIT THERMAL, HENRY HEATING PLANT	10300602	8.00E-10	3.50	2.80E-09
B2103	DETROIT WASTEWATER TREATMENT PLANT	10300602	8.00E-10	41.13	3.29E-08
B1925	DIVERSIFIED MACHINE MONTAGUE, INC.	10200602	8.00E-10	18.40	1.47E-08
B4942	DOW AGROSCIENCES, LLC	10200602	8.00E-10	135.00	1.08E-07
A4043	DOW CORNING, MIDLAND PLANT	10200601	8.00E-10	1,541.30	1.23E-06
A4043	DOW CORNING, MIDLAND PLANT	10200602	8.00E-10	265.70	2.13E-07
B2810	DTE ELECTRIC COMPANY, RIVER ROUGE	10200601	8.00E-10	0.46	3.65E-10
B7221	DTE GAS CO., MILFORD COMPRESSOR STATION	10200601	8.00E-10	0.00	2.24E-12
N7786	DTE PONTIAC NORTH, LLC	10300601	8.00E-10	17.63	1.41E-08
A6218	DUNN PAPER, INC.	10200602	8.00E-10	418.16	3.35E-07
A8448	DURR SYSTEMS, INC.	10100602	8.00E-10	21.37	1.71E-08
B5417	DW-NATIONAL STANDARD-NILES, LLC	10200602	8.00E-10	105.59	8.45E-08
B6420	E.B. EDDY PAPER, INC.	10200602	8.00E-10	37.37	2.99E-08
B6420	E.B. EDDY PAPER, INC.	10300603	8.00E-10	4.04	3.23E-09
H5877	EASTERN MICHIGAN UNIVERSITY	10300601	8.00E-10	191.29	1.53E-07
H5877	EASTERN MICHIGAN UNIVERSITY	10300602	8.00E-10	54.80	4.38E-08
B2217	EATON RESEARCH CENTER	10300603	8.00E-10	16.40	1.31E-08
H5265	EDWARD BROTHERS, INC.	10300603	8.00E-10	23.80	1.90E-08
B1827	EMPIRE IRON MINING PARTNERSHIP	10200602	8.00E-10	20.04	1.60E-08
B9080	ENVIROSOLIDS, LLC	10300603	8.00E-10	5.16	4.13E-09
A0884	ESCANABA PAPER COMPANY	10200601	8.00E-10	790.47	6.32E-07
A0884	ESCANABA PAPER COMPANY	10200602	8.00E-10	145.05	1.16E-07
B4302	ESCO COMPANY, LLC	10200602	8.00E-10	73.70	5.90E-08
B8574	EVERGREEN PACKAGING, INC.	10100602	8.00E-10	8.63	6.90E-09
B2429	FAURECIA INTERIOR SYSTEMS	10200602	8.00E-10	32.38	2.59E-08
B2063	FAURECIA INTERIOR SYSTEMS SALINE, LLC	10200602	8.00E-10	75.27	6.02E-08
K2155	FERRIS STATE UNIVERSITY	10300602	8.00E-10	413.90	3.31E-07
B3037	FITZGERALD FINISHING, LLC	10300603	8.00E-10	106.00	8.48E-08
M4768	FLAT ROCK METAL, INC.	10200602	8.00E-10	64.18	5.13E-08
N1280	FLINT HILLS RESOURCES POLYMERS, LLC	10300602	8.00E-10	23.65	1.89E-08
B1598	FLINT WATER POLLUTION CONTROL FACILITY	10300602	8.00E-10	103.72	8.30E-08

SRN	Facility Name	SCC	EPRI Emission Factor lb/MMCF)	Throughput MMCF	Lbs Emitted per EPRI Factor
M4175	FORD MOTOR CO.	10300602	8.00E-10	154.70	1.24E-07
B3241	FORD MOTOR CO., BROWNSTOWN	10200602	8.00E-10	37.29	2.98E-08
M4764	FORD MOTOR CO., ELM STREET BOILERHOUSE	10200601	8.00E-10	602.87	4.82E-07
M4764	FORD MOTOR CO., ELM STREET BOILERHOUSE	10200602	8.00E-10	630.57	5.04E-07
A8648	FORD MOTOR CO., ROUGE COMPLEX	10200602	8.00E-10	52.98	4.24E-08
A8645	FORD MOTOR CO., LIVONIA TRANSMISSION	10200601	8.00E-10	145.62	1.16E-07
A8645	FORD MOTOR CO., LIVONIA TRANSMISSION	10200602	8.00E-10	195.25	1.56E-07
A8650	FORD MOTOR CO., WAYNE COMPLEX	10100602	8.00E-10	148.19	1.19E-07
B2064	FORD MOTOR CO., RAWSONVILLE PLANT	10200602	8.00E-10	135.25	1.08E-07
N7081	FORD MOTOR CO., DRIVEABILITY TEST FACILITY	10300602	8.00E-10	44.84	3.59E-08
A3567	FORD MOTOR CO., STERLING PLANT	10200601	8.00E-10	127.10	1.02E-07
A3567	FORD MOTOR CO., STERLING PLANT	10200602	8.00E-10	183.89	1.47E-07
A5260	FORD MOTOR CO., WIXOM ASSEMBLY PLANT	10200602	8.00E-10	1.99	1.59E-09
A8651	FORD MOTOR CO., WOODHAVEN STAMPING PLANT	10200602	8.00E-10	2.17	1.73E-09
B1771	FORD MOTOR CO., VAN DYKE PLANT	10200601	8.00E-10	22.96	1.84E-08
B1771	FORD MOTOR CO., VAN DYKE PLANT	10200602	8.00E-10	96.56	7.73E-08
B4238	FRENCH PAPER COMPANY	10200602	8.00E-10	151.56	1.21E-07
M4547	FRITZ PRODUCTS	10200602	8.00E-10	77.00	6.16E-08
N0842	GAGE PRODUCTS COMPANY	10200602	8.00E-10	51.00	4.08E-08
M4199	GENERAL MOTORS, HAMTRAMCK	10200602	8.00E-10	80.35	6.43E-08
B2460	GENERAL MOTORS, BAY CITY	10200602	8.00E-10	189.52	1.52E-07
A5262	GENERAL MOTORS, MILFORD PROVING GROUND	10300602	8.00E-10	330.95	2.65E-07
B7227	GENERAL MOTORS, ORION ASSEMBLY	10200601	8.00E-10	507.83	4.06E-07
B7227	GENERAL MOTORS, ORION ASSEMBLY	10200602	8.00E-10	38.34	3.07E-08
B4032	GENERAL MOTORS, PONTIAC NORTH CAMPUS	10200602	8.00E-10	300.89	2.41E-07
B1606	GENERAL MOTORS, FLINT ASSEMBLY	10200601	8.00E-10	381.96	3.06E-07
B1798	GENERAL MOTORS, WARREN TRANSMISSION PLANT	10200602	8.00E-10	104.07	8.33E-08
N6950	GENERAL MOTORS, LANSING DELTA TOWNSHIP	10200602	8.00E-10	62.96	5.04E-08
N6016	GENESYS REGIONAL MEDICAL CENTER	10300602	8.00E-10	139.49	1.12E-07
N1237	GEORGIA PACIFIC CHEMICALS, LLC	10200602	8.00E-10	14.61	1.17E-08
N6866	GEORGIA PACIFIC CORRUGATED, III, LLC	10200602	8.00E-10	69.51	5.56E-08
A6714	GEORGIA-PACIFIC CORRUGATED II, LLC	10200602	8.00E-10	58.56	4.68E-08
A4338	GERBER PRODUCTS CO.	10200601	8.00E-10	222.75	1.78E-07
A4338	GERBER PRODUCTS CO.	10200602	8.00E-10	290.03	2.32E-07
B7061	GERDAU MACSTEEL MONROE	10200602	8.00E-10	153.01	1.22E-07
B4306	GERDAU SPECIAL STEEL NORTH AMERICA, JACKSON MILL	10200602	8.00E-10	105.79	8.46E-08
B3291	GIBRALTER NATIONAL / QUIKRETE, DETROIT	10100602	8.00E-10	16.16	1.29E-08
A2620	GM COMPONENTS HOLDINGS, LLC	10200601	8.00E-10	5.72	4.58E-09
A2620	GM COMPONENTS HOLDINGS, LLC	10200602	8.00E-10	148.96	1.19E-07
B1604	GM CUSTOMER CARE & AFTERSALES, SWARTZ CREEK	10200602	8.00E-10	144.90	1.16E-07
B1991	GM POWERTRAIN GROUP, SAGINAW METAL CASTING	10200602	8.00E-10	216.41	1.73E-07
B4049	GM TECHNICAL CENTER	10200601	8.00E-10	716.26	5.73E-07
B4049	GM TECHNICAL CENTER	10200602	8.00E-10	12.15	9.72E-09
K2528	GRAND RAPIDS COMMUNITY COLLEGE	10300602	8.00E-10	83.03	6.64E-08
G7126	GRAND VALLEY STATE UNIVERSITY	10300602	8.00E-10	120.62	9.65E-08
B1534	GRAPHIC PACKAGING INTERNATIONAL, INC.	10200601	8.00E-10	1,162.37	9.30E-07
B1678	GRAPHIC PACKAGING INTERNATIONAL, INC.	10200601	8.00E-10	2,336.74	1.87E-06
B1563	GREAT LAKES TISSUE	10200602	8.00E-10	189.33	1.51E-07
B4752	GREAT LAKES PETROLEUM TERMINAL, LLC	10200601	8.00E-10	62.89	5.03E-08
N0888	GREEN BAY PACKAGING, KALAMAZOO CONTAINER DIV.	10200602	8.00E-10	34.13	2.73E-08
N0888	GREEN BAY PACKAGING, KALAMAZOO CONTAINER DIV.	10300603	8.00E-10	7.11	5.69E-09
N7383	GREEN PLAINS HOLDINGS II LLC	10200602	8.00E-10	1,090.10	8.72E-07
B4045	H.J. HEINZ COMPANY, LP	10200602	8.00E-10	9.20	7.36E-09
A0171	HASTINGS MANUFACTURING CO.	10200602	8.00E-10	50.21	4.02E-08
N8270	HEARTHSIDE FOOD SOLUTIONS	10300603	8.00E-10	14.76	1.18E-08

SRN	Facility Name	SCC	EPRI Emission Factor lb/MMCF)	Throughput MMCF	Lbs Emitted per EPRI Factor
N8265	HEARTHSIDE FOOD SOLUTIONS LLC	10300603	8.00E-10	23.98	1.92E-08
N6726	HEAT TREATING SERVICES CORP., PLANT 3	10200602	8.00E-10	166.39	1.33E-07
N7096	HEAT TREATING SERVICES CORP. OF AMERICA, PLANT 1	10200602	8.00E-10	82.94	6.64E-08
B2644	HEMLOCK SEMICONDUCTOR CORP.	10200602	8.00E-10	1,375.87	1.10E-06
A6237	HENKEL CORP.	10300603	8.00E-10	30.70	2.46E-08
B6569	HENKEL CORP.	10200602	8.00E-10	23.54	1.88E-08
K1271	HENRY FORD HOSPITAL	10300602	8.00E-10	345.10	2.76E-07
P0336	HENRY FORD WEST BLOOMFIELD HOSPITAL	10300602	8.00E-10	155.00	1.24E-07
N6734	HERITAGE-CRYSTAL CLEAN, LLC	10200602	8.00E-10	7.49	5.99E-09
A5806	HILLSHIRE BRANDS COMPANY	10200602	8.00E-10	153.41	1.23E-07
M4153	HOPE COLLEGE	10300602	8.00E-10	135.78	1.09E-07
N6976	HUNTINGTON FOAM, LLC	10200602	8.00E-10	63.56	5.08E-08
D3598	HURLEY MEDICAL CENTER	10300602	8.00E-10	200.01	1.60E-07
M4232	HURON VALLEY, SINAI HOSPITAL	10200602	8.00E-10	57.50	4.60E-08
B6178	HURON VALLEY STEEL CORP.	10200602	8.00E-10	11.93	9.54E-09
A1864	INDUSTRIAL STEEL TREAT CO.	10300603	8.00E-10	194.80	1.56E-07
B7985	INTERNATIONAL PAPER	10200602	8.00E-10	56.23	4.50E-08
B4004	INTERNATIONAL PAPER	10200602	8.00E-10	52.57	4.21E-08
B6027	INTEVA PRODUCTS, ADRIAN OPERATIONS	10200602	8.00E-10	51.02	4.08E-08
B1976	J.B. SIMS GENERATING STATION	10200602	8.00E-10	1.33	1.06E-09
B7244	JBS PLAINWELL, INC.	10200602	8.00E-10	179.60	1.44E-07
M4752	JOHN D. DINGELL VA MEDICAL CENTER	10300602	8.00E-10	197.70	1.58E-07
A1991	KALSEC, INC.	10200602	8.00E-10	47.32	3.79E-08
B4395	KEEBLER CO.	10200602	8.00E-10	44.29	3.54E-08
A0563	KELLOGG USA, INC.	10200602	8.00E-10	402.24	3.22E-07
N3225	KENT CAREER TECHNICAL CENTER	10300602	8.00E-10	20.06	1.60E-08
N1604	KENT COUNTY WASTE TO ENERGY FACILITY	10300602	8.00E-10	14.20	1.14E-08
N0547	KRUGER COMMODITIES	10200602	8.00E-10	282.21	2.26E-07
B7276	L. PERRIGO CO.	10200602	8.00E-10	54.53	4.36E-08
B1912	L-3 COMMUNICATIONS CORP., COMBAT PROPULSION SYS.	10200602	8.00E-10	70.09	5.61E-08
K2087	LAKELAND CORRECTIONAL FACILITY	10300602	8.00E-10	116.02	9.28E-08
C5704	LAKELAND MEDICAL CENTER (FORMERLY MEMORIAL HOSPITAL)	10300602	8.00E-10	30.00	2.40E-08
A2396	LEON PLASTICS	10300603	8.00E-10	0.10	8.00E-11
P0087	LG CHEM MICHIGAN, INC.	10200602	8.00E-10	35.93	2.87E-08
B6179	LOCKHART CHEMICAL COMPANY	10200602	8.00E-10	49.46	3.96E-08
A4285	LORIN INDUSTRIES	10200602	8.00E-10	37.20	2.98E-08
N3417	LYMTAL INTERNATIONAL, INC.	10200601	8.00E-10	4.78	3.82E-09
B2751	MAGNA MIRRORS CORP.	10300603	8.00E-10	31.32	2.51E-08
N1781	MAGNA MIRRORS CORP.	10300603	8.00E-10	84.48	6.76E-08
N5056	MAGNA MIRRORS CORP., NEWAYGO	10300603	8.00E-10	15.55	1.24E-08
A9831	MARATHON PETROLEUM COMPANY, LP	10200601	8.00E-10	2,938.96	2.35E-06
A9831	MARATHON PETROLEUM COMPANY, LP	10200602	8.00E-10	933.64	7.47E-07
N7493	MARYSVILLE ETHANOL, LLC	10200601	8.00E-10	1,426.00	1.14E-06
B2032	MARYSVILLE NPDC	10200602	8.00E-10	8.99	7.19E-09
A5858	MEAD JOHNSON & COMPANY, LLC	10200602	8.00E-10	145.35	1.16E-07
A0402	MENASHA PACKAGING CO., LLC, COLOMA PLANT	10200602	8.00E-10	43.40	3.47E-08
M0037	MERCY GENERAL HEALTH PARTNERS	10300602	8.00E-10	63.34	5.07E-08
N5866	METAL TECHNOLOGIES, INC., RAVENNA DUCTILE IRON	10200602	8.00E-10	66.77	5.34E-08
N7349	METRO HEALTH HOSPITAL	10300602	8.00E-10	87.15	6.97E-08
N1966	MICHIGAN AUTOMOTIVE COMPRESSOR INC.	10300603	8.00E-10	157.00	1.26E-07
N6996	MICHIGAN ETHANOL DBA POET BIOREFINING, CARO	10200602	8.00E-10	1,477.00	1.18E-06
B7090	MICHIGAN MILK PRODUCERS ASSOCIATION	10200602	8.00E-10	253.02	2.02E-07
N4975	MICHIGAN POWER LP	10200601	8.00E-10	148.91	1.19E-07
A4741	MICHIGAN SEAMLESS TUBE, LLC	10200602	8.00E-10	103.57	8.29E-08
K3249	MICHIGAN STATE UNIVERSITY	10200602	8.00E-10	8.24	6.59E-09
K3249	MICHIGAN STATE UNIVERSITY	10300601	8.00E-10	1,974.40	1.58E-06
K3249	MICHIGAN STATE UNIVERSITY	10300603	8.00E-10	22.73	1.82E-08
B2331	MICHIGAN STATE UNIVERSITY, BIOECONOMY	10200602	8.00E-10	23.40	1.87E-08

SRN	Facility Name	SCC	EPRI Emission Factor lb/MMCF)	Throughput MMCF	Lbs Emitted per EPRI Factor
	INSTITUTE				
B1929	MICHIGAN STEEL, INC.	10300603	8.00E-10	2.31	1.85E-09
B2873	MICHIGAN SUGAR CO., SEBEWAING FACTORY	10200602	8.00E-10	250.00	2.00E-07
B1493	MICHIGAN SUGAR CO., BAY CITY	10200601	8.00E-10	1,863.00	1.49E-06
B2875	MICHIGAN SUGAR CO., CARO FACTORY	10200602	8.00E-10	133.04	1.06E-07
B2876	MICHIGAN SUGAR CO., CROSWELL FACTORY	10200602	8.00E-10	167.00	1.34E-07
B4131	MNP CORP.	10300602	8.00E-10	130.81	1.05E-07
N1701	MORBARK, INC.	10200602	8.00E-10	45.40	3.63E-08
B1824	MORTON SALT, INC.	10100604	8.00E-10	5.08	4.06E-09
B1824	MORTON SALT, INC.	10200602	8.00E-10	0.00	0.00E+00
N2954	MOSAIC POTASH HERSEY, LLC	10200602	8.00E-10	194.40	1.56E-07
A6475	MPI ACQUISITION, LLC	10200602	8.00E-10	0.00	0.00E+00
B2050	MPI RESEARCH	10300602	8.00E-10	163.52	1.31E-07
B2050	MPI RESEARCH	10300603	8.00E-10	84.68	6.77E-08
N2614	NBHX TRIM USA CORP.	10200602	8.00E-10	22.21	1.78E-08
N6577	ND INDUSTRIES, INC.	10300603	8.00E-10	6.24	4.99E-09
B1470	NEENAH PAPER – MICHIGAN, INC.	10200601	8.00E-10	5.40	4.32E-09
N6767	NEW COVERT GENERATING CO., LLC	10200602	8.00E-10	24.23	1.94E-08
A6175	NEXTEER AUTOMOTIVE CORP.	10200602	8.00E-10	9.03	7.22E-09
M3792	NORTHERN MICHIGAN UNIVERSITY	10300602	8.00E-10	343.56	2.75E-07
E4437	NORTHWEST HARDWOODS	10200602	8.00E-10	27.10	2.17E-08
N0731	NORTRU, LLC	10300603	8.00E-10	5.63	4.50E-09
G5252	OAKLAND COUNTY SERVICE CENTER, CENTRAL STEAM PLANT	10300602	8.00E-10	154.40	1.24E-07
N3422	OAKLAND UNIVERSITY	10300602	8.00E-10	235.50	1.88E-07
K1260	OAKWOOD HEALTHCARE, ANNAPOLIS	10100602	8.00E-10	72.00	5.76E-08
J4912	OAKWOOD HOSPITAL	10300602	8.00E-10	203.00	1.62E-07
B4925	O-N MINERALS (MI) CO. DBA CARMEUSE LIME	10200602	8.00E-10	44.33	3.55E-08
A0023	OTSEGO PAPER, INC.	10200601	8.00E-10	21.28	1.70E-08
B2013	OX PAPERBOARD OF MICHIGAN, LLC	10200602	8.00E-10	219.00	1.75E-07
B2561	PACKAGING CORPORATION OF AMERICA	10300602	8.00E-10	60.49	4.84E-08
B3692	PACKAGING CORPORATION OF AMERICA, FILER CITY MILL	10200601	8.00E-10	1,636.55	1.31E-06
B2329	PAR STERILE PRODUCTS, LLC	10200602	8.00E-10	32.58	2.61E-08
E5094	PAULSTRA CRC CORP.	10200602	8.00E-10	35.66	2.85E-08
N5688	PERRIGO HOLLAND, INC.	10200602	8.00E-10	51.64	4.13E-08
B3610	PHARMACIA & UPJOHN CO., LLC, A SUBSIDIARY OF PFIZER	10200601	8.00E-10	309.80	2.48E-07
B4977	PINNACLE FOODS GROUP, LLC	10200602	8.00E-10	117.02	9.36E-08
N6388	PIONEER METAL FINISHING, STEPHENS ROAD	10200602	8.00E-10	36.65	2.93E-08
N5747	PIONEER METAL FINISHING, INDUSTRIAL HWY.	10300603	8.00E-10	68.40	5.47E-08
N1622	POLLARD (US), LTD.	10200602	8.00E-10	37.57	3.01E-08
B1548	POST FOODS	10200601	8.00E-10	360.38	2.88E-07
M4347	PRAXAIR, INC.	10200602	8.00E-10	107.70	8.62E-08
N8273	PROVIDENCE PARK HOSPITAL	10300602	8.00E-10	66.00	5.28E-08
B0785	QUAKER CHEMICAL CORP.	10200602	8.00E-10	66.55	5.32E-08
B1945	QUIKRETE, FLINT	10200602	8.00E-10	10.34	8.27E-09
N5226	QUINCY STREET, INC.	10200602	8.00E-10	55.00	4.40E-08
N1294	RACER PONTIAC CENTERPOINT CAMPUS CENTRAL & WEST	10200602	8.00E-10	5.39	4.31E-09
B4031	RACER TRUST, PONTIAC CENTRAL AND WEST	10200602	8.00E-10	76.04	6.08E-08
B2052	RACER TRUST, WILLOW RUN PLANT INDUSTRIAL LAND	10200601	8.00E-10	259.83	2.08E-07
B2052	RACER TRUST, WILLOW RUN PLANT INDUSTRIAL LAND	10200602	8.00E-10	139.44	1.12E-07
N7543	RALCORP FROZEN BAKERY PRODUCTS	10100602	8.00E-10	79.56	6.36E-08
B1537	RALSTON FOODS	10200602	8.00E-10	140.38	1.12E-07
B6636	RAY COMPRESSOR STATION	10300603	8.00E-10	29.71	2.38E-08
N8192	REQUEST FOODS, INC.	10100602	8.00E-10	119.34	9.55E-08
N8192	REQUEST FOODS, INC.	10200602	8.00E-10	115.82	9.27E-08
N3929	RESOLUTE FOREST PRODUCTS, MENOMINEE	10200601	8.00E-10	703.56	5.63E-07
B4072	ROCK-TENN CO.	10200601	8.00E-10	875.50	7.00E-07
N3391	ROMEO GAS PROCESSING PLANT	10200602	8.00E-10	52.78	4.22E-08

SRN	Facility Name	SCC	EPRI Emission Factor lb/MMCF)	Throughput MMCF	Lbs Emitted per EPRI Factor
F3254	SELFRIDGE AIR NATIONAL GUARD BASE	10300603	8.00E-10	152.85	1.22E-07
B2952	SILBOND CORP.	10200602	8.00E-10	33.26	2.66E-08
M2032	SPECTRUM HEALTH, BUTTERWORTH CAMPUS	10300602	8.00E-10	258.00	2.06E-07
B8707	SPRINGS WINDOW FASHIONS, LLC	10200602	8.00E-10	0.44	3.54E-10
M1812	ST. JOHN HOSPITAL & MEDICAL CENTER	10300602	8.00E-10	106.43	8.51E-08
G5066	ST. JOSEPH MERCY HOSPITAL	10300602	8.00E-10	103.78	8.30E-08
M3431	ST. JOSEPH MERCY HOSPITAL	10300602	8.00E-10	230.60	1.84E-07
M1952	ST. MARY'S OF MICHIGAN	10300602	8.00E-10	88.01	7.04E-08
M1967	ST. JOHN PROVIDENCE HOSPITAL	10300602	8.00E-10	136.42	1.09E-07
N0677	STEELCASE, INC., KENTWOOD COMPLEX	10200602	8.00E-10	13.30	1.06E-08
N0677	STEELCASE, INC., KENTWOOD COMPLEX	10300602	8.00E-10	76.80	6.14E-08
B5966	SUN CHEMICAL CORP.	10200602	8.00E-10	141.35	1.13E-07
N7132	SUN GRO HORTICULTURE	10100602	8.00E-10	62.40	4.99E-08
B2926	SUNOCO PARTNERS M & T, LP, RIVER ROUGE TERMINAL	10300603	8.00E-10	2.00	1.60E-09
N7289	TEGRANT DIVERSIFIED BRANDS, INC.	10200602	8.00E-10	177.31	1.42E-07
A4033	THE DOW CHEMICAL COMPANY USA, MIDLAND	10200601	8.00E-10	49.20	3.94E-08
A4033	THE DOW CHEMICAL COMPANY USA, MIDLAND	10200602	8.00E-10	163.90	1.31E-07
B6619	TIARA YACHTS DIVISION OF S2 YACHTS	10300603	8.00E-10	31.08	2.49E-08
B4885	TILDEN MINING COMPANY LC	10200601	8.00E-10	1,636.00	1.31E-06
N2915	TOYOTA MOTOR ENGINEERING AND MANUFACTURING	10300603	8.00E-10	69.80	5.58E-08
M4086	TOYOTA TECHNICAL CENTER, USA	10300603	8.00E-10	2.67	2.14E-09
N5767	TWEDDLE GROUP	10300602	8.00E-10	21.24	1.70E-08
A7757	US SILICA CO.	10200602	8.00E-10	55.70	4.46E-08
A7809	US STEEL GREAT LAKES WORKS	10200601	8.00E-10	0.00	0.00E+00
A7809	US STEEL GREAT LAKES WORKS	10200602	8.00E-10	1,433.00	1.15E-06
B2763	US ARMY GARRISON, DETROIT ARSENAL	10300603	8.00E-10	195.00	1.56E-07
N7248	US MANUFACTURING CORP.	10200602	8.00E-10	35.33	2.83E-08
K5375	UNIVERSITY OF MICHIGAN, DEARBORN	10300602	8.00E-10	82.50	6.60E-08
K5375	UNIVERSITY OF MICHIGAN, DEARBORN	10300603	8.00E-10	47.80	3.82E-08
M0675	UNIVERSITY OF MICHIGAN	10300601	8.00E-10	2,323.17	1.86E-06
M0675	UNIVERSITY OF MICHIGAN	10300602	8.00E-10	131.53	1.05E-07
M0675	UNIVERSITY OF MICHIGAN	10300603	8.00E-10	452.31	3.62E-07
M3641	UNIVERSITY OF MICHIGAN, FLINT	10300603	8.00E-10	114.92	9.19E-08
B2328	UNIVERSITY OF MICHIGAN, FORMER PFIZER GLOBAL R & D	10200602	8.00E-10	351.20	2.81E-07
N5040	USEPA NATIONAL VEHICLE & FUEL EMISSION	10300602	8.00E-10	52.56	4.20E-08
M3653	VA MEDICAL CENTER	10300602	8.00E-10	134.81	1.08E-07
B2337	VCF FILMS, INC.	10200602	8.00E-10	28.72	2.30E-08
N0923	VENTRA IONIA MAIN, LLC	10200602	8.00E-10	90.31	7.22E-08
B2838	VEOLIA ENERGY GRAND RAPIDS, LLC	10300601	8.00E-10	639.65	5.12E-07
B2838	VEOLIA ENERGY GRAND RAPIDS, LLC	10300602	8.00E-10	173.41	1.39E-07
B7192	VERSO PAPER, QUINNESEC	10200601	8.00E-10	174.10	1.39E-07
B7192	VERSO PAPER, QUINNESEC	10200602	8.00E-10	100.70	8.06E-08
B2817	VERTELLUS HEALTH & SPECIALTY PRODUCTS, LLC	10200602	8.00E-10	67.27	5.38E-08
A2849	WACKER CHEMICAL CORP	10200602	8.00E-10	18.88	1.51E-08
M4773	WAYNE COUNTY COM. COLLEGE, DOWNRIVER	10300603	8.00E-10	23.10	1.85E-08
M4774	WAYNE COUNTY COM. COLLEGE, EASTERN	10300603	8.00E-10	13.80	1.10E-08
M4833	WAYNE COUNTY COM. COLLEGE, NORTHWEST	10300603	8.00E-10	10.00	8.00E-09
M4772	WAYNE COUNTY COM. COLLEGE, WESTERN	10300603	8.00E-10	10.10	8.08E-09
M0239	WAYNE STATE UNIVERSITY	10300602	8.00E-10	838.46	6.71E-07
M0239	WAYNE STATE UNIVERSITY	10300603	8.00E-10	33.63	2.69E-08
N1461	WELCH FOODS, INC.	10200602	8.00E-10	223.08	1.78E-07
K2131	WESTERN MICHIGAN UNIVERSITY	10300602	8.00E-10	313.69	2.51E-07
B2024	WHITE PIGEON PAPER COMPANY	10200601	8.00E-10	62.03	4.96E-08
B2024	WHITE PIGEON PAPER COMPANY	10200602	8.00E-10	340.36	2.72E-07
B1966	WHITE PINE ELECTRIC POWER, LLC	10200602	8.00E-10	3.31	2.65E-09
G5067	WILLIAM BEAUMONT HOSPITAL	10300602	8.00E-10	454.66	3.64E-07
G5067	WILLIAM BEAUMONT HOSPITAL	10300603	8.00E-10	22.49	1.80E-08
N3987	WILLIAM BEAUMONT HOSPITAL	10300602	8.00E-10	149.98	1.20E-07
N6980	WMU ENERGY RESOURCE CENTER	10300602	8.00E-10	47.63	3.81E-08

SRN	Facility Name	SCC	EPRI Emission Factor lb/MMCF)	Throughput MMCF	Lbs Emitted per EPRI Factor
B5162	XCEL STEEL PICKLING	10200602	8.00E-10	33.70	2.70E-08
B4288	ZOETIS P & U, LLC	10200601	8.00E-10	37.99	3.04E-08
B4288	ZOETIS P & U, LLC	10200602	8.00E-10	149.72	1.20E-07
N3519	ZOETIS P & U, LLC	10200602	8.00E-10	0.00	0.00E+00
N3519	ZOETIS P & U, LLC	10300602	8.00E-10	39.78	3.18E-08
	TOTAL			66,692.07	5.34E-05

Stationary Internal Combustion Engines

Stationary internal combustion engine emissions were calculated similarly to industrial/ commercial boilers that combust natural gas. The EPRI factor produced a statewide estimate of 1.20E-05 lbs, compared to the MAERS estimate, which produced an estimate of 126.01 lbs using the USEPA factor.

The following sources of natural gas combustion were included in the estimate:

Table 13.

SRN	Facility Name	SCC	Emission Factor lb / MMCF	Throughput MMCF	Lbs Emitted	EI Year
B7197	ANR Pipeline Co., Rapid River Compressor Station	20200202	8.000E-10	97.11	7.77E-08	2011
B7390	ANR Pipeline Co., Central Charlton Compressor Station	20200202	8.000E-10	89.38	7.15E-08	2011
B7198	ANR Pipeline Co., Cold Springs / Blue Lake	20200202	8.000E-10	597.86	4.78E-07	2011
B3721	ANR Pipeline Co., Reed City Compressor Station	20200202	8.000E-10	139.64	1.12E-07	2011
B7220	ANR Pipeline Co., Woolfolk Compressor Station	20200202	8.000E-10	558.22	4.47E-07	2011
N5578	ANR Pipeline Co., Winfield Compressor Station	20200202	8.000E-10	41.27	3.30E-08	2011
N5576	ANR Pipeline Co., Goodwell Compressor Station	20200201	8.000E-10	42.39	3.39E-08	2011
B7219	ANR Pipeline Co., South Chester Compressor Station	20200202	8.000E-10	92.35	7.39E-08	2011
N5575	ANR Pipeline Co., Bridgman Compressor Station	20200201	8.000E-10	82.71	6.62E-08	2011
N5575	ANR Pipeline Co., Bridgman Compressor Station	20200202	8.000E-10	616.15	4.93E-07	2011
N5574	ANR Pipeline Co., Hamilton Compressor Station	20200201	8.000E-10	835.64	6.69E-07	2011
N5574	ANR Pipeline Co., Hamilton Compressor Station	20200202	8.000E-10	2.29	1.83E-09	2011
N5586	ANR Pipeline Co., Lincoln Compressor Station	20200202	8.000E-10	527.85	4.22E-07	2011
B7196	ANR Storage Co., Excelsior Compressor Station	20200202	8.000E-10	62.95	5.04E-08	2011
M4085	Chrysler, Mack Avenue	20200202	8.000E-10	0.08	6.40E-11	2011
B3350	Chrysler, Trenton Engine	20200202	8.000E-10	0.39	3.09E-10	2011
N5724	City of St. Louis	20200202	8.000E-10	0.00	2.16E-12	2011
B6508	Clinton, Village of	20200202	8.000E-10	0.15	1.23E-10	2011
N2901	Consumers Energy, Muskegon River Compressor Stat	20200201	8.000E-10	34.29	2.74E-08	2011
N5798	Core Energy, LLC, Chester 10 CO2 Recovery	20200202	8.000E-10	202.00	1.62E-07	2011
A8638	Detroit Diesel Corp.	20200202	8.000E-10	0.00	0.00E+00	2011
B4942	Dow Agrosciences, LLC	20200201	8.000E-10	738.00	5.90E-07	2011
N3392	DTE Gas Co., Taggart Compressor Station	20200202	8.000E-10	285.13	2.28E-07	2011
N3022	Eaton Rapids Gas Storage System	20200202	8.000E-10	132.34	1.06E-07	2011
N6266	Federal Mogul Powertrain, Inc.	20200202	8.000E-10	0.00	0.00E+00	2011
B5815	General Motors, Romulus Engine Plant	20200201	8.000E-10	0.00	0.00E+00	2011
B4049	GM Technical Center	20200202	8.000E-10	0.00	0.00E+00	2011
N5581	Great Lakes Gas, Farwell Compressor Station 12	20200201	8.000E-10	26.78	2.14E-08	2011
N5581	Great Lakes Gas, Farwell Compressor Station 12	20200202	8.000E-10	473.06	3.78E-07	2011
B8573	Great Lakes Gas, Transmission Station 11 (TransCanada 11)	20200201	8.000E-10	323.88	2.59E-07	2011
N3758	Great Lakes Gas, Transmission Station 10	20200201	8.000E-10	1,106.93	8.86E-07	2011
N3818	Great Lakes Gas, Transmission Station 13	20200201	8.000E-10	991.16	7.93E-07	2011
N2168	Great Lakes Gas, Transmission Station 7	20200201	8.000E-10	276.59	2.21E-07	2011
N3760	Great Lakes Gas, Transmission Station 8	20200201	8.000E-10	1,258.97	1.01E-06	2011
N3759	Great Lakes Gas, Transmission Station 9	20200201	8.000E-10	89.36	7.15E-08	2011

SRN	Facility Name	SCC	Emission Factor lb / MMCF	Throughput MMCF	Lbs Emitted	EI Year
A9831	Marathon Petroleum Co., LP	20200202	8.000E-10	91.23	7.30E-08	2011
B4282	Marysville Hydrocarbons, LLC	20200201	8.000E-10	2.65	2.12E-09	2011
A5858	Mead Johnson & Company, LLC	20200202	8.000E-10	0.00	2.20E-13	2011
B4292	Merit Energy Co., Kalkaska Gas Plant	20200201	8.000E-10	28.38	2.27E-08	2011
B6481	Mid Michigan Gas Storage Co., Capac	20200202	8.000E-10	0.04	3.20E-11	2011
N2954	Mosaic Potash Hersey LLC	20200201	8.000E-10	529.80	4.24E-07	2011
B8337	Muttonville Compressor Station	20200202	8.000E-10	31.09	2.49E-08	2011
B6636	Ray Compressor Station	20200201	8.000E-10	177.06	1.42E-07	2011
N3391	Romeo Gas Processing Plant	20200202	8.000E-10	584.32	4.67E-07	2011
M4780	Roush Industries	20200202	8.000E-10	0.93	7.44E-10	2011
B6637	St. Clair Compressor Station	20200201	8.000E-10	87.33	6.99E-08	2011
N1685	TES Filer City Station	20200202	8.000E-10	0.05	4.00E-11	2011
B5421	Van Dyke Generating Plant	20200201	8.000E-10	24.38	1.95E-08	2011
N7624	Vector Pipeline, LP	20200201	8.000E-10	1,286.69	1.03E-06	2011
N8151	Vector Pipeline, LP, Athens Compressor Station	20200201	8.000E-10	906.89	7.26E-07	2011
N6838	Vector Pipeline LP, Highland Compressor Station	20200201	8.000E-10	1,407.88	1.13E-06	2011
N6512	Westside Gas Producers, LLC	20200202	8.000E-10	63.35	5.07E-08	2011
N1652	Whiting Petroleum West Branch Gas Plant	20200202	8.000E-10	58.16	4.65E-08	2011
	TOTAL			15,005.14	1.20E-05	

Wood Combustion

Electric Utilities

Mercury emissions from wood-fired electric utilities were estimated using data from MAERS as part of Michigan's submittal to the USEPA's 2011 NEI (MDEQ, 2014). Wood consumption, or throughput, is expressed in tons.

A mercury emission factor was not available for the source classification code (SCC) selected by Genesee Power for reporting of wood and wood waste combusted in their boiler. Accordingly, an emission rate factor obtained from their May 2010 stack testing was used by the AQD with hourly activity data from MAERS to create an estimate.

Wood-fired electric utilities included in the estimate:

Table 14.

SRN	Facility Name	SCC	Emission Factor lb / ton	Throughput tons	Lbs Emitted	EI Year
N1395	Cadillac Renewable Energy Facility	10100902	3.64E-05	344374.00	12.53521	2011
N3570	Genesee Power	10100911	3.0E-04 hrs / yr	8160 hrs / yr	2.45	2011
N2388	Grayling Generating Station	10100902	3.64E-05	329372.00	11.98914	2011
N1266	Hillman Power Company	10100902	3.64E-05	217966.00	7.93396	2011
B4260	L'Anse Warden Electric Company	10100901	5.15E-06	40.00	0.00021	2011
B4260	L'Anse Warden Electric Company	10100903	3.64E-05	105684.00	3.84690	2011
N0890	Viking Energy of Lincoln, LLC	10100902	3.64E-05	0.00	0.00000	2011
B1966	White Pine Electric Power, LLC	10200905	5.15E-06	0.00	0.00000	2011
N2454	Wolverine Hardwoods, Inc.	10100903	3.64E-05	773.00	0.02814	2011
	TOTAL				38.78356	

Industrial/Commercial

Point source estimates such as those for industrial and commercial combustion of wood were collected from MAERS (MDEQ, 2014). These point source estimates were generated as part of Michigan's submittal to USEPA's 2011 NEI.

Facilities included in the estimate:

Table 15.

SRN	Facility Name	SCC	Emission Factor	Throughput tons	Lbs Emitted	EI Year
A0749	Ameriwood Industries	10300903	3.64E-05	2,018.00	0.07346	2011
N2206	Banks Hardwoods, Inc.	10200906	5.15E-06	7,595.00	0.03911	2011
N7799	Bordine Nursery	10100903	3.64E-05	3219.00	0.11717	2011
K2460	Central Michigan University	10300903	3.64E-05	34,078.00	1.24044	2011
B7099	Connor AGA Sports Flooring, LLC	10200905	5.15E-06	3,214.59	0.01656	2011
B1476	Decorative Panels International, Inc.	10200901	3.15E-05	55,363.00	1.74393	2011
B1476	Decorative Panels International, Inc.	10200902	3.395E-05	9,863.00	0.33485	2011
A0884	Escanaba Paper Company	10200902	3.395E-05	588,524.00	19.98039	2011
B6001	Herman Miller, Inc.	10200907	5.15E-06	10,409.00	0.05361	2011
A5937	Howard Miller Company	10200906	5.15E-06	790.00	0.00407	2011
B8603	JELD-WEN Interior Door - Grand Rapids	10300903	3.64E-05	0.00	0.00000	2011
N0780	Louisiana-Pacific Corp. Newberry Plant	10200905	5.15E-06	10,448.00	0.05381	2011
N1315	Louisiana-Pacific Corp. Sagola Plant	10200904	5.15E-06	18,255.00	0.09401	2011
A0999	Michigan Maple Block Company	10200906	5.15E-06	2,184.00	0.01125	2011
N7729	Michigan Wood Fuels, LLC	10300903	3.64E-05	2,740.00	0.09974	2011
B1470	Neenah Paper – Michigan, Inc.	10200902	3.395E-05	0.00	0.00000	2011
E4437	Northwest Hardwoods	10200906	5.15E-06	3,000.00	0.01545	2011
N5940	Potlatch Land and Lumber, LLC	10200905	5.15E-06	39,220.00	0.20198	2011
B8707	Springs Window Fashions, LLC	10200905	5.15E-06	1,139.27	0.00587	2011
B7192	Verso Paper - Quinnesec	10200902	3.395E-05	303,546.00	10.30539	2011
N1160	Viking Energy of McBain	10300902	5.15E-06	174,830.00	0.90037	2011
	TOTAL				35.29145	

Residential

For residential wood combustion, the USEPA's estimate of mercury emissions from the 2011 NEI version 1 was utilized. The USEPA calculated that 11.94 lbs of mercury was emitted from residential wood burning in Michigan. This estimate is based on inputs and emission factors included in USEPA's Residential Wood Combustion Tool, an Access database designed for estimating pollutants from the residential wood sector.

Tire-Derived Fuel Combustion

Several facilities utilized tire-derived fuel (TDF) to fire their boilers. Viking Energy of Lincoln, LLC (N0890) is the only facility to have reported a mercury value to MAERS based on their stack testing in 2010. The other values are default MAERS estimates based on a USEPA emission factor.

Table 16.

EI Year	SRN	Facility Name	SCC	TDF tons	Mercury lbs	Source of Estimate
2011	B2132	Wyandotte Dept. Muni Power Plant	10101201	25,882.00	100.01	Default MAERS Estimate
2011	N0890	Viking Energy of Lincoln, LLC	10101201	11,538.00	0.00	2010 Stack Test
2011	N1160	Viking Energy of McBain	10101201	14,453.00	55.85	Default MAERS Estimate
2011	N1685	TES Filer City Station	10101201	26,029.60	100.58	Default MAERS Estimate
2011	N2388	Grayling Generating Station	10101201	4,839.00	18.70	Default MAERS Estimate
2011	N3570	Genesee Power Station	10101201	273.00	1.05	Default MAERS Estimate
		TOTAL		83,014.60	276.19	

Petroleum Refining

Marathon Ashland Petroleum (A9831), the only petroleum refinery in the state, emitted 7.66 lbs of mercury in 2011 according to data gathered from MAERS as part of Michigan's submittal to USEPA's 2011 NEI (MDEQ, 2014).

Table 17.

SRN	Facility	Throughput MMCF	Emission Factor	Lbs Emitted	EI Year
A9831	Marathon Petroleum Refining	1185.88	4.23E-04	0.50	2011
A9831	Marathon Petroleum Refining	2624.06	2.73E-03	7.16	2011
	TOTAL			7.66	

Residential LPG (Propane) Combustion

Residential fuel combustion estimates were generated as part of Michigan's submittal to the USEPA's 2011 NEI. For residential Liquefied Petroleum Gas (LPG) or propane combustion, an emission factor of 0.000012 lbs/1,000 gallons was selected. This factor was used along with year 2010 Census data on household heating and 2010 statewide fuel consumption data from the EIA, USDoE to generate estimated emissions of mercury for 2011 (MDEQ, 2014). LPG consumption, or throughput, is expressed in thousands of gallons.

Table 18.

Category	Throughput E3GAL	Emission Factor lb / E3GAL	Lbs Emitted	Year
Residential LPG Propane	384,510.00	1.20E-05	4.61	2011

INCINERATION

Sewage Sludge Incineration

When possible, specific facility information was collected and used to compute emissions. The Battle Creek Wastewater Treatment Plant (WWTP) has two multiple hearth sewage sludge incinerators, which have venturi scrubber, impingement scrubber, quencher, and afterburner controls. Both incinerators had stack testing conducted on them in 2001. More recent testing data was not available. According to facility reported MAERS data, the Battle Creek WWTP emitted 0.00 lbs of mercury in 2005 due to incineration (MDEQ, 2009). The facility did not report a mercury value for 2011. The 2011 emission estimator value is 9.23 lbs.

According to MAERS, 97,717.60 tons of biosolids (sewage sludge) were incinerated at the Detroit Wastewater Treatment Plant in 2011 (McGeen, 2014). Using an emission factor derived from a 2012 stack test at the facility, 105.54 lbs of Hg were likely released to the air in 2011.

The Flint Water Pollution Control Plant has an afterburner, venturi and impingement tray scrubber and mist eliminator controls. Recent stack testing data was not available; therefore, stack tests from 2001, and 2011 MAERS operating data, were used to compute emissions (McGeen, 2014).

Emissions in 2011 from the Ypsilanti Community Utilities Authority (YCUA) were reported at 0.35 lbs / yr in the annual MAERS reporting (MDEQ, 2014). This was based on stack testing conducted at the facility on December 6, 2011. The new incinerator is a fluidized bed incinerator with venturi and impingement scrubbers, wet electrostatic precipitator, and carbon adsorption. The East Lansing POTW shut down their incinerator in 2002; therefore, it was not included in this inventory. The Trenton WWTP removed their incinerator in 2003 and it was also not accounted for in this inventory. The Ann Arbor WWTP incinerator ceased operations and the permit was voided in 2006.

MAERS was used to determine SCCs and control technologies for the other incinerators (MDEQ, 2014). An emission factor from WebFIRE was then applied to these facilities' throughput information (USEPA, 2014).

The following sewage sludge incinerators were included in the calculation:

Table 19.

SRN	Facility Name	Throughput tons	EM Factor lb/ton	MAERS EE Value lbs	Final Estimate, includes Alternate Calculation where Available
B1598	Flint Water Pollution Control	annual hrs / unit	various	11.65	7.78
B1950	Pontiac WWTP	3205.3	1.90E-03	14.74	6.09
B2103	Detroit WWTP	97,717.60	1.08E-03	NA	105.54
L0058	Port Huron WWTP	1277	1.40E-03	NA	1.79
B1792	Warren WWTP	5185		23.851	23.851
B6237	Ypsilanti Community Utilities Authority	5842.513		0.35	0.35
B6307	City of Battle Creek WWTP	2006.87		9.2316	9.231602
	TOTALS			59.83	154.63
	B2060, Ann Arbor WWTP, voided incinerator permit in 2006				

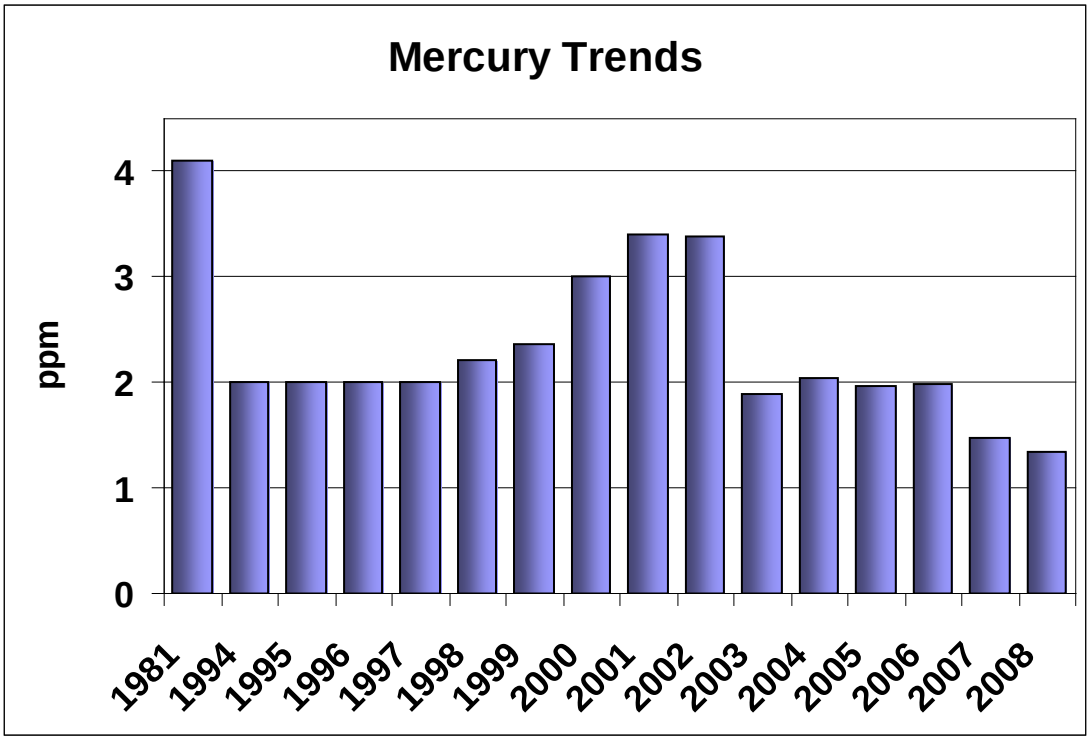
Trends for Mercury in Michigan Biosolids (MDEQ, Water Bureau, 2012), per an email from Michael Person, MDEQ, to Joy Taylor Morgan:

Table 20.

Year	Hg Concentrations in Biosolids mg/kg
2009	1.63
2010	1.83
2011	2.01
2012	1.61

In an email on February 19, 2014, Michael Person indicated "… please note that this is the average concentration in land applied biosolids not sewage sludge that is incinerated. It is probably fairly close, but I do not have the Hg concentration of incineration only facilities."

Pre-2008 trends in biosolids are shown below, as documented by the MDEQ's Water Bureau (2014).
Table 21.



Municipal Waste Incineration

Three municipal waste combustors were operating in Michigan in 2011.

Kent County Waste-to-Energy submitted facility-verified estimates of 2.89 lbs of mercury to MAERS for the 2011 operating year based on stack testing (MAERS, 2014).

An emission factor for the Jackson County Waste to Energy facility was obtained from the facility's 2010 stack test data (MDEQ, 2014). When applied to hourly operating data from the 2011 MAERS report, this factor yielded an emission estimate of 0.46 lbs for 2011 (McGeen, 2014).

Detroit Renewable Power, LLC (formerly Greater Detroit Resource Recovery Facility) conducted stack testing on all three of its municipal solid waste combustors in 2011 (TESTAR, Inc.). The combustors at the Greater Detroit facility had combined emissions of 69.47 lbs of Hg based on the lb/hr rate from 2011 stack tests for EUBOILER011, EUBOILER012 and EUBOILER013.

The following municipal waste incinerators were included in the calculations:

Table 22.

SRN	Facility Name	Throughput tons MSW	Emission Factor lb / ton	Emissions lbs	EI Year	Comments
N1125	Jackson County Waste to Energy	54,152	2.63E-05	0.46	2011	EM Factor from 2010 stack test
N1604	Kent County Waste to Energy	93,417		1.82	2011	Reported by owner
N1604	Kent County Waste to Energy	92,582		1.07	2011	Reported by owner
M4148	Greater Detroit Resource Recovery	132,956	7.10E-04 LB/HR	6.22	2011	Reported by owner, based on stack tests for each boiler
M4148	Greater Detroit Resource Recovery	284,115	1.08E-03 LB/HR	9.46	2011	Reported by owner, based on stack tests for each boiler
M4148	Greater Detroit Resource Recovery	277,687	6.14E-03 LB/HR	53.79	2011	Reported by owner, based on stack tests for each boiler
	TOTAL			72.82		

Hazardous Waste Incineration

One facility operates a hazardous waste incinerator in Michigan: Dow Chemical (A4033). In 2003, Dow began operating a new incinerator, the 32 Incinerator, to replace the existing 830 Building and 703 Building Incinerators. The most recent stack testing was conducted on the 32 Incinerator in 2009. Per Dow's 32 Incinerator HWC MACT Notification of Compliance and Comprehensive Performance Test Report, less than 1.59E-04 pounds of mercury per hour were emitted from this facility under test conditions designed to simulate extreme operating parameters. Based on the continuous year-round operating schedule reported to MAERS in 2011, this extrapolates to annual emissions of 1.39 lbs of mercury. Actual emissions were likely less as the performance test simulates adverse rather than routine operating conditions (McGeen, 2014).

Pharmacia & Upjohn operated a hazardous waste incinerator, which was included in the MDEQ's 2002 and 2005 reports of anthropogenic mercury emissions. However, the incinerator was reported as removed on December 31, 2006 (MAERS, 2014).

Table 23.

SRN	Facility Name	Emission Factor lb / hr	Lbs Emitted	EI Year	Comments
A4033	Dow Chemical	1.55E-03	1.39	2011	Based on 2009 stack test
B3610	Pharmacia & Upjohn	NA	NA	2011	B3610 removed incinerator on or prior to 12/31/2006.
	TOTAL		1.39		

Hospital Medical Infectious Waste Incineration

There is not currently any medical waste incineration facility operating in Michigan. City Medical Waste (M4139) in Hamtramck was a hospital medical infectious waste incinerator, which stopped operating on July 28, 2008. This was per the date of a court order, which required the company to cease operation of the facility (McLemore, 2010). The ROP was voided on December 15, 2008 (Foy, 2010).

Human and Animal Cremation (Point Source)

Two universities and three animal/veterinary cremation facilities reported the combustion of animal and / or human remains in 2011. If the emission factor from the Takoaka study of crematories is utilized, a total of 4.56E-05 lbs of emissions are estimated from the point source human and animal cremation category.

Table 24.

SRN	Facility Name	Throughput tons	Emission Factor lb / ton*	ERAU Value	MAERS EE Value	EI Year	Comments
K3249	Michigan State Univ.	442.803	1.38E-08	6.11E-06	0.33	2011	
M0239	Wayne State Univ.	19	1.38E-08	2.62E-07	0.01	2011	
N6494	Union Lake Veterinary Hospital (fka Veterinarian Cremation Service)	27	1.38E-08	3.73E-07		2011	No longer a MAERS source; therefore, 2005 throughput is used as a surrogate.
N6543	Monroe County Animal Control	2814	1.38E-08	3.88E-05	2.07	2011	
N7158	TLC Acres (fka Rainbow Bridge)	2.5	1.38E-08	3.45E-08		2011	No longer a MAERS source; therefore, 2005 throughput is used as a surrogate.
	TOTALS			4.56E-05	2.40		

* 0.94 mg Hg / body (without fillings) used for human and/or animal remains; assumes 100 lbs / body per study "Mercury emission from crematories in Japan" (Takaoka, Oshita, Takeda and Morisawa, 2010).

Pathological Waste Incineration

Pharmacia & Upjohn Company, LLC (N3519), a medical research and development facility, is estimated to have emitted 0.00953 lbs of mercury in 2011 from the disposal of pathological waste in their pathological waste incinerator. This is based on the use of a WebFIRE emission factor by the MAERS emission estimator.

Table 25.

SRN	Facility Name	Throughput tons	Emission Factor lb / ton	Source of Factor	Lbs Emitted	EI Year	Comments
N3519	Pharmacia & Upjohn	12.98	7.34E-04	MAERS	0.00953	2011	EE Value

INDUSTRIAL SOURCES

Cement Manufacturing

There are three cement manufacturing facilities in Michigan: Holcim, Lafarge, and St. Marys Cement. Throughput values for all of the facilities were obtained from EI Toolkit. According to MAERS, Holcim estimated their facility's 2005 emissions of mercury to be 53.00 lbs through stack testing. Holcim ceased operating the cement kilns in 2009 and voided the kiln permits in 2010. The facility continues operations only as a cement terminal with bagging operation (Maillard, 2009). Lafarge's own 2011 estimate of mercury from their cement manufacturing facility was 180.94 lbs, as reported to MAERS. Speciation data was obtained from a 2007 report prepared for the company (Advanced Environmental Management Group, 2007).

Table 26.

B1477 (Lafarge) processes, for 2011	Hg in lbs	Particulate Divalent Speciation Factor	Gaseous Divalent Speciation Factor	Elemental Gaseous Speciation Factor	Hg(p) in lbs	RGM in lbs	Hg(0) in lbs
Kiln 19	20.28	0.01	0.85	0.14	0.2028	17.238	2.8392
Kiln 20	28.87	0.01	0.85	0.14	0.2887	24.5395	4.0418
Kiln 21	36.51	0.01	0.85	0.14	0.3651	31.0335	5.1114
Kiln 22	51.05	0.01	0.91	0.08	0.5105	46.4555	4.084
Kiln 23	44.14	0.01	0.91	0.08	0.4414	40.1674	3.5312
Raw Material Grinding and Drying	0.09	0.17	0.38	0.45	0.0153	0.0342	0.0405
TOTAL	180.94				1.8238	159.468	19.648

A facility-submitted MAERS value was not available for St. Marys Cement. Accordingly, 2010 stack testing data and 2011 hourly operating data was used by the AQD's Emissions Reporting and Assessment Unit (ERAU), to estimate emissions of mercury at 3.15 lbs (McGeen, 2014). For comparison, the 2011 TRI value of 26.88 lbs has also been included in the report. A total of 184.09 lbs of mercury was estimated from cement manufacturing in Michigan in 2011.

The following cement manufacturing facilities were included in the inventory:

Table 27.

SRN	Facility	Throughput tons	Source for Best Estimate	Lbs Hg Emitted, Best Estimate	TRI Data lbs	MAERS Estimate
B1743	Holcim	NA	Kiln permits voided in 2010	NA	NA	NA
B1477	Lafarge	5,323,511	Owner reported value in MAERS, 2011	180.94	219.00	180.94
B1559	St. Marys Cement	915,212	2010 stack test	3.15	26.88	201.35
TOTAL				184.09	245.88	382.29

Taconite Processing

Michigan has two taconite processing plants, Empire and Tilden, located in the Marquette Range of the Upper Peninsula. Cleveland-Cliffs is the owner of both Tilden and Empire.

Tilden processes both hematite and magnetite. A 2002 stack test for Tilden (B4885) found it emitted 71.83 lbs/yr of mercury, based on reported continuous operation of 8,760 hours. More recent stack testing is not available for mercury. Based on the 2002 factor and the 2011 operating schedule for coal-fired pellet production from MAERS (7,296 hours for the Unit 1 kiln and 6,396 hours for the Unit 2 kiln), an estimate of 58.35 lbs was created for 2011.

Empire (B1827) only produces taconite from magnetite. Based on an emission factor of 3.54E-06 lb of mercury per long ton of coal-fired pellets made (3.161E-06 lb/ton) from Jiang (1999), and the 2011 production value of 2.91 million tons from coal firing, 9.20 lbs of mercury was likely emitted from Empire for 2011. Total mercury emissions from taconite processing amount to 67.55 lbs.

Dental Amalgam Manufacturing

In 2011 there was one dental amalgam manufacturer in Michigan, Kerr Industries (B2658). Based on the average mercury concentration inside the building and the ventilation rate of the building, one can estimate that less than four pounds of mercury are emitted from this facility every year. Lumex RA915+ monitoring inside the building yielded an estimated average mercury concentration of approximately 500 ng/m^3 for the entire building. The building has a volume of 44,309 m^3 and has nine air exchanges per hour (MDEQ, 2009).

Lime Manufacturing

Throughput values for facilities with lime kilns were obtained using MAERS. These throughputs were then multiplied by an emission factor to estimate mercury emissions. The emission factor of 1.2 x 10^{-4} lbs of mercury per ton of lime produced corresponds to facilities that manufacture lime (Pilgrim, 1998). The emission factor from WebFIRE for lime kilns used by the paper manufacturing industry (2.90 x 10^{-7} lbs of mercury per ton of lime produced) was used to estimate emissions from Escanaba Paper Company and Verso Paper – Quinnesec. Using the WebFIRE and Pilgrim emission factors, and 2011 TRI data, where available, it is estimated that 58.12 lbs of mercury was emitted to the air in 2011 from lime manufacturing kilns (McGeen, 2014).

Western Lime Corporation began operations on May 14, 2007, and therefore was not included in earlier mercury inventories. A trial burn with refuse-derived fuel in August 2009 yielded a rate of 2.50E-04 lb/hr. When applied to the 2011 operating schedule this produced an estimate of 2.11 lbs of mercury annually. However, this value has not been included in the table below since the kiln is typically fired with coal rather than refuse-derived fuel. The Pilgrim factor was used as the basis for an estimate instead (McGeen, 2014).

The following lime kilns were included in the calculation:

Table 28.

SRN	Facility	Throughput tons	WebFIRE and Pilgrim Emission Factors*	ERAU Estimate of Mercury in lbs	2011 TRI Data	Best Estimate	EI Year
A0884	Escanaba Paper Co.	104,655.00	2.90E-07	0.03	35.32	35.32	2011
A3900	Martin Marietta Magnesia Specialties, LLC	153,333.00	1.20E-04	18.40		18.40	2011
B2169	Carmeuse Lime, Inc., River Rouge	266,876.00	1.20E-04	32.03	2.02	2.02	2011
B7192	Verso Paper - Quinnesec	496,606.00	2.90E-07	0.14		0.14	2011
N7362	Graymont Western Lime, Inc.	240,424.98	1.20E-04	28.85	2.24	2.24	2011
	TOTAL	1,261,894.98		79.45	39.58	58.12	

* 1.2E-04 lb / ton from Pilgrim, 1998; 2.9E-07 lb / ton from WebFIRE
Harbison Walker Refractories Co. (A3933) was closed and demolished in 2007.
Occidental Chemical Corporation, fka The Dow Chemical Company, Calcium Chloride Products (B1846), reported zero activity in 2011 for its calcium chloride production line.

Phosphate Mills

Michigan does not have any phosphate mills. Based on a query of the SCCs involving phosphates, superphosphates, and ammonium phosphates, the only facility in MAERS associated with the use of phosphates is B1989, Agrium Advanced Technologies (US) Inc. (MDEQ, 2014). This facility's NAICS code of 325314 indicates "Fertilizer (Mixing Only) Manufacturing."

Brick Manufacturing

Hanson Brick (A6497) in Corunna, emitted 0.34 lbs from its two gas-fired kilns in 2011, based on the facility reported throughput and the application of a standard USEPA emission factor by the MAERS emission estimator (MDEQ, 2014).

Table 29.

SRN	Facility	Throughput tons	Emission Factor	Lbs Emitted	Year
A6497	Hanson Brick	0	7.50E-06	0	2011
A6497	Hanson Brick	45688	7.50E-06	0.34266	2011
	TOTAL			0.34266	2011

Coke Production

Michigan has one coke battery, the EES Coke Battery, LLC (P0408). This facility was formerly part of US Steel (A7809) on Zug Island, River Rouge, until it was permitted as a separate stationary source (P0408). In a permit application submitted in June 2014, EES Coke estimated a maximum emission rate for mercury of 0.006 lb/hr (Brunner, 2014). Accordingly, a maximum annual estimate of 52.56 lbs has been estimated by the AQD (McGeen, 2014).

Medical Waste Autoclave

There were no medical waste autoclaves operating in Michigan in 2011. There were two medical waste autoclaves referenced in the 2005 mercury report. One was Michigan Waste Services (M4139) in Grand Blanc. This facility, which utilized a medical waste incinerator as well as the autoclave, is no longer operating. This source ceased operations on July 28, 2008, per the date of the court order, which required the company to cease operation of the facility (McLemore, 2010). The other medical waste autoclave was Agility (N7568), in Kentwood. This facility was later known as Stericycle, Inc. This source started operation on October 7, 2004, and closed in 2010 (Charley, 2010).

PRODUCTION OF METALS

Primary Metal production refers to metal created from ore, whereas secondary metal production refers to the production of alloys from ingots and to the recovery of metal from scrap and salvage (USEPA, 1986). Metal production that uses scrap is of more concern for mercury emissions, because of the wide application of mercury-containing convenience light switches and antilock brake switches used in vehicles until 2003 (End-of Life Vehicles Solutions Corporation, 2014).

BOFs in Primary Metal Production (Steel Manufacturing)

Basic Oxygen Furnaces (BOFs) are used to make steel from molten metal and scrap. The input material is typically 70 percent molten pig iron and 30 percent scrap (Grinstern, 2010). The input material is refined by injecting high-purity oxygen into the furnace; the oxygen reacts with carbon and other impurities in the metal to remove them from the metal. Basic oxygen process steelmaking is executed in large, refractory-lined, pear-shaped furnaces (USEPA,1986).

There are two facilities in Michigan that make steel using the basic oxygen process, Severstal (formerly Rouge Steel) (A8640) and US Steel (A7809). For 2011 operations, Severstal reported 54.00 lbs of mercury emissions to the USEPA's TRI (MDEQ, 2014). TRI data from 2011 indicates that US Steel emitted 4.06 lbs of mercury in that year. In total, it is estimated that facilities engaged in steelmaking via the Blast/BOF process emitted 58.06 lbs of mercury to the atmosphere in 2011.

Table 30.

SRN	Facility	Emissions lbs	EI Year	Comments
A8640	Severstal (formerly River Rouge)	54.00	2011	2011 TRI
A7809	US Steel	4.06	2011	2011 TRI
	TOTAL	58.06		

EAFs in Primary Metal Production (Steel Manufacturing)

Electric arc furnaces are the most common type of furnace used for the electric production of steel. EAFs are capable of melting small amounts of iron scrap, pig iron, and direct reduced iron, but primarily melt scrap (Energy International, 2005). According to the AP-42 Compilation of Emission Factors, about 57% of total steel produced in the United States comes from EAFs in operations called minimills (USEPA, 2010). Minimills use 100% scrap charge (Metals Advisor).

Gerdau MacSteel Jackson (B4306) in Jackson, MI conducted stack testing in December 2006. More recent stack testing for mercury was not available. Based on the stack test emission factor of 1.70E-02 lb/hr, and the 2011 operating schedule of 7,200 hours reported to MAERS, 122.40 lbs are estimated for this facility (McGeen, 2014).

Gerdau MacSteel Monroe (B7061) estimated in their 2011 MAERS report that their mercury emissions for the year were 123.12 lbs. This is based on facility stack test data. The ERAU also added a value of 0.03 lbs for emissions of particle bound mercury from the baghouse, based on baghouse dust analysis performed by the facility in 2005. Accordingly, a total estimate of 123.15 lbs of mercury was estimated for Gerdau MacSteel Monroe. These emissions are comprised of elemental and gaseous reactive mercy (McGeen, 2014).

Ervin Amasteel (B1754) conducted stack testing in 2008 on their EAF baghouse exhaust. The emission rate of 7.86E-07 gr/dscf was utilized by the ERAU to estimate annual emissions of 15.93 lbs of mercury from the facility (McGeen, 2014).

Table 31.

EI Year	SRN	Facility Name	SCC	Throughput tons steel	Emission Factor	Hrs / yr	Estimated Emissions
2011	B7061	Gerdau MacSteel Monroe	30300908	590490	1.60E-02 lb / hr	7695	123.15
2011	B4306	Gerdau Special Steel North America, Jackson Mill	30300904	283576.91	1.70E-02 lb / hr		122.40
2011	B1754	Ervin Amasteel Division	30400701	85646	7.86E-07 gr/dscf		15.93
TOTAL							261.48

EAFs and EIFs in Secondary Metal Production (Steel Foundries)

EAFs and EIFs are used by the steel industry to melt and formulate steel. EAFs are large, welded steel cylindrical vessels with removable roofs through which three retractable carbon electrodes are lowered; metal charge is melted by the resistive heating generated from electrical current flowing among the electrodes and through the charge. EAFs are used to produce carbon and alloy steels. The input material to an EAF is typically 100% scrap (USEPA, 1986).

EIFs are cylindrical or cup-shaped vessels that are surrounded by electrical coils. The coils are energized with an alternating current to produce a fluctuating magnetic field that heats the metal charge (USEPA, 1986).

Throughput information for secondary metal production (steel foundries) was obtained using the EI toolkit. An emission factor from *"Toxics in Vehicles: Mercury"* was then applied since WebFIRE was lacking an emission factor for this category (Ecology Center & Great Lakes United, 2001). EAFs and EIFs engaged in Secondary Metal Production (steel foundries) emitted approximately 39.72 lbs of mercury in 2011 (McGeen, 2014).

The following EAFs and EIFs in steel foundries were included in the calculation:

Table 32.

EI Year	SRN	Facility Name	Throughput tons	Emission Factor lb/ton*	ERAU Mercury Estimate
2011	B1929	Michigan Steel, Inc.	5590	6.90E-04	3.86
2011	B2178	Cadillac Casting, Inc.	137592	3.90E-05	5.37
2011	B7013	Huron Castings, Inc. & Blue Diamond Steel Casting	18901	6.90E-04	13.04
2011	B7357	Temperform Corp.	590	6.90E-04	0.41
2011	B7870	Eagle Alloy, Inc.	22957.56	6.90E-04	15.84
2011	N2631	Barron Cast, Inc.	910	6.90E-04	0.63
2011	N7276	Ancast, Inc.	835	6.90E-04	0.58
TOTAL					39.72

* Factor for B2178 based on facility stack testing

Cannon Muskegon Corp. (A4315) was not included for mercury estimates since they do not melt any automotive or common white goods scrap. They only use high quality/purity metals due to the products they produce; therefore, any mercury emitted would have to come from the metal itself as opposed to contamination from mercury switches (Grinstern, 2010).

Table 33. Supporting Data from *Toxics in Vehicles: Mercury*
(Ecology Center & Great Lakes United, 2001)

Table 16: Mercury Emission Factors for EAFs (1997-2000 test data)

Company	State	Production[a] Capacity Short Tons/year	Estimated Hg Emissions Low Lbs/yr	Estimated Hg Emissions High Lbs/yr	Average Estimated Hg Emissions Lbs/yr	Average Emission Factor	
						Lbs Hg/ton	Kg Hg/metric ton
Marion Steel	OH	365,000	371	572	514	0.0014	0.0007
Co-Steel Sayreville	NJ	750,000	24	4730	597	0.00080	0.00040
North Star Steel	MN	465,000[b]	136	136	136	0.00029	0.00011
Co-Steel Raritan	NJ	800,000	129	323	224	0.00028	0.00014
Overall average emission factor						0.00069	0.00035

Note: Except for NSS, estimated mercury emissions are based on actual stack-test data for pounds of mercury emitted per hour times the allowable operating hours per year. NSS mercury emissions are based on actual stack-test data times the annual hours the EAF is under power.

[a] Except for NSS, production capacity data from Iron & Steel Maker, EAF Roundup, May 2000.

[b] Based on estimated 1998 production instead of capacity.

Secondary Metal Production (Grey Iron)

Grey iron is a type of cast iron with 3.5% carbon and is used in industry. Much of the carbon in this type of cast iron separates out as graphite giving grey iron its grey appearance (Dictionary.com). This broad grouping includes the following two categories, cupolas in secondary metal production (grey iron) and EAFs and EIFs in secondary metal production (grey iron).

Cupolas in Secondary Metal Production (Grey Iron)

The cupola is a type of furnace used in the iron foundry industry. It uses coke as a fuel and is typically composed of a cylindrical steel shell with a refractory-lined or water-cooled inner wall (USEPA, 1986).

For Grede LLC (B1577), CWC Textron (B1909) and Metavation Vassar LLC (B2043), recent stack test data was available and was deemed applicable for use in estimating 2011 emissions based on lack of process equipment changes preceding or following the years in which the testing occurred. Accordingly, ERAU staff created mercury estimates for these sources using the emission rates in lbs per ton. Emission rates in lbs per hour were also utilized, where available. The resulting values were several times lower than the MAERS default estimates and the estimates based on the New Jersey or WebFIRE emission factors (McGeen, 2014).

Stack testing data from other cupolas engaged in secondary metal production of grey iron was not available. Throughput data was gathered using the EI Toolkit. This throughput data was then multiplied by an emission factor. For facilities where control information was unknown, the uncontrolled emission factor from WebFIRE was utilized. The emission factor from WebFIRE is based on compliance testing for one baghouse from December 1990. Where knowledge was available on control information, a controlled factor from WebFIRE was selected. The “New Jersey” emission factor was generated based on stack tests from three facilities between 1993

and 1999 (Ecology Center & Great Lakes United, 2001). When using the stack-test based emission estimates, and the WebFIRE and New Jersey factors for facilities where stack testing was not available, between 74.31 lbs and 97.60 lbs of mercury emissions were emitted from cupolas in 2011.

The following cupolas engaged in the production of grey iron were included in the inventory:

Table 34.

SRN	Facility Name	2011 EE Value from MAERS	WebFIRE Factor lb / ton[1]	New Jersey Factor lb / ton[2]	Facility Stack Emission Rates lb / hr[3]	Facility Stack Emission Rates lb / ton[3]	Lbs Emitted per WebFIRE Factor, and Stack Test Results, as Available	Lbs Emitted per New Jersey Factor, and Stack Test Results, as Available
A0767	East Jordan Iron Works, dba EJUSA, Inc.	62.14	1.59E-04	2.50E-04			28.39	44.64
A3934	Great Lakes Castings, LLC	19.44	3.48E-04	2.50E-04			19.44	13.96
B1577	Grede, LLC, Iron Mountain	26.49	1.59E-04	2.50E-04		2.70E-05	2.05	2.05
B1909	CWC Textron	16.08	1.59E-04	2.50E-04	2.90E-06	1.49E-07	6.89E-03	6.89E-03
B2043[4]	Metavation Vassar, LLC	9.76	3.48E-04	2.50E-04	7.09E-04	1.03E-04	2.54	2.54
B2178	Cadillac Casting, Inc.	47.88	1.59E-04	2.50E-04			21.88	34.40
TOTALS		181.79					74.31	97.60

[1] 1.59e-04 lb / ton is controlled factor from WebFIRE reflecting application of a baghouse; 3.48e-04 lb / ton is an uncontrolled factor from WebFIRE.
[2] The "New Jersey" emission factor was generated based on stack tests from three facilities between 1993 and 1999 (Ecology Center and Great Lakes United, 2001). B2043, now known as Metavation Vassar, LLC ceased operations in November 2013 and entered Chapter 11 bankruptcy in January 2014. By 2010, B1961 (Barber Steel Foundry Corporation) was bankrupt. It did not operate in 2011 and therefore is not included in the report. The facility began operating again as of 2013.
[3] For CWC Textron (B1909), mercury emissions were beneath the Method Detection Limit (MDL) during stack testing of 6/20/2010; therefore, the MDL is used to approximate a worst case scenario. For Grede/Metavation Vassar (B2043), stack testing on 7/24/2013 was used to estimate per ton and per hour emission rates. For Grede LLC/Iron Mountain (B1577), stack testing on 5/8/2012 was used to estimate a per ton emission rate.
[4] B2043, now known as Metavation Vassar, LLC, ceased operations in November 2013 and entered Chapter 11 bankruptcy in January 2014.

Table 35. Supporting data from *Toxics in Vehicles: Mercury* (Ecology Center & Great Lakes United, 2001)

Table 20: Mercury Emissions from New Jersey Foundries

Facility	Permitted Production Capacity (short tons/yr)	Mercury Permit Limit (lbs/yr)	Stack Test Date	Mercury Emissions (lbs/yr)	Average Mercury Emission Factor	
					(lbs/short ton)	(kg/metric ton)
Atlantic States Iron Pipe Co.	234,000	137	Nov. 1993	40	0.00032	0.000016
			Nov. 1999	108		
Griffin Pipe Products	182,000	312	Sept. 1997	10	0.000055	0.000027
U.S. Pipe and Foundry, Inc.	262,964	80	Sept. 1997	96	0.00037	0.00018
Average Emission Factor					0.00025	0.00012

Source: Agrawal, Sunila, NJ DEP, October 30, 2000.

EAFs and EIFs in Secondary Metal Production (Grey Iron)

An EAF is a large, welded steel cylindrical vessel with a removable roof through which three retractable carbon electrodes are lowered and energized, creating arcs that melt metallic charge with their heat. EIFs are cylindrical or cup-shaped vessels that are surrounded by electrical coils, which are energized to produce an electromagnetic field that heats the metal charge (USEPA, 1986).

Stack testing was not available for EAFs and EIFs involved in the secondary metal production of grey iron. Throughput information was obtained from the EI Toolkit. The emission factor was obtained from the Indiana Department of Environmental Management's "Summary of Mercury Emissions from Non-Electric Generating Units (IDEM, 2004)." This emission factor was then compared to the emission factors corresponding to grey iron production from WebFIRE to generate a range (USEPA, 2009).

The following EAFs and EIFs engaged in the production of grey iron in 2011 were included in the calculations:

Table 36.

EI Year	SRN	Facility Name	Throughput tons	Emission Factor from WebFIRE	Emission Factor from IDEM	Stack Test Emission Rate Lb/hr	Lbs Emitted per WebFIRE, and Stack Test-based Est. B1716 and N5814	Lbs Emitted per IDEM, and Stack Test-based Est. B1716 and N5815
2011	A0095	ATI Casting Service, LLC	0.00	7.20E-05	2.70E-04		0.00	0.00
2011	A0171	Hastings Manufacturing Co., LLC.	1,961.40	7.20E-05	2.70E-04		0.14	0.53
2011	B1577	Grede LLC, Iron Mountain	2,295.00	7.20E-05	2.70E-04		0.17	0.62
2011	B1661	Pioneer Foundry Co., Inc.	1,024.00	7.20E-05	2.70E-04		0.07	0.28
2011	B1709	Federal-Mogul Powertrain Systems	15,254.00	7.20E-05	2.70E-04		1.10	4.12
2011	B1716	Betz Industries, Inc.	33,727.00	7.20E-05	2.70E-04	< 4.969E-05	0.11	0.11
2011	B1737	Kent Foundry Co.	6,175.40	7.20E-05	2.70E-04		0.44	1.67
2011	B2015	Metal Technologies, Inc., Three Rivers Gray Iron	159,011.00	7.20E-05	2.70E-04		11.45	42.93
2011	B4538	Blackmer	2,884.50	7.20E-05	2.70E-04		0.21	0.78
2011	M4387	Process Prototype, Inc.	246.06	7.20E-05	2.70E-04		0.02	0.07
2011	N5814	Asama Coldwater Manufacturing, Inc.	72,969.00	7.20E-05	2.70E-04	6.11E-06	0.06	0.06
2011	N5866	Metal Technologies, Inc., Ravenna Ductile Iron	117,313.00	7.20E-05	2.70E-04		8.45	31.67
TOTALS							22.21	82.83

A6177, Eaton Corp. did not operate its three EAFs in 2005 and has since closed.
B1547, Hayes Albion Corp. closed in 2002.
B1786, Schwarb Foundry closed in 2003.

EAFs and EIFs engaged in the production of grey iron produced between 22.21 and 82.83 lbs of mercury emissions in 2011 (McGeen, 2014).

Auto Switches – Shredding of Autos (Point Source)

Mercury emissions from the shredding of automobiles have a point source component (from permitted facilities) as well as an area source component from unpermitted facilities.

Table 37.

Category	2011 Mercury Emissions in lbs
Point source auto shredding	16.54
Area source auto shredding	59.53
Statewide totals: auto shredding	76.07

Using Michigan data about scrapped vehicles, an estimated total of 34.51 kg (76.07 lbs) of mercury were emitted statewide to the atmosphere from shredding (McGeen, 2014). It was estimated that 16.54 lbs were emitted by point sources, per the table below. Estimates were based on stack test data and Lumex monitoring.

In the area source section, the methodology for estimating the area source component of auto shredding emissions (59.53 lbs) will be presented.

Table 38.

SRN	Company	Emission Control Equipment	Emissions lbs/yr	Source
A2457	Louis Padnos Iron & Metal Co., 2001 Turner Ave NW, Grand Rapids	Shredder has "water only" spray in the hammer mill.	11.44	2008 stack test
A4750	SLC Recycling, Inc. (Ferrous Processing and Trading)	Baghouse	0.4	2001 stack test
B3240	Fritz Enterprises 23550 Pennsylvania Rd, Taylor	Water spray and cyclone on shredder.	1	2003 Lumex Monitoring (assuming 8 hour workday/ 365 days/yr)
B6178	Huron Valley Steel Corp. 41000 Huron River Dr., Belleville	Two cyclones	NA	No stack test, TRI, permit or MAERS data available for mercury emissions
N0844	Rifkin Scrap Iron & Metal 1445 N. Niagara Street, Saginaw	Shredder enclosed by a metal hood and ducted to a cyclone followed by a wet venturi scrubber.	2.7	2004 stack test at baghouse (assuming operating 24 hr / d, 365 d / yr)
N3753	E. Kingsford Iron and Metal 100 Superior Avenue, Kingsford	NA	NA	No stack test, TRI, permit or MAERS data available for mercury emissions
N6293	Strong Steel Products 6464 Strong, Detroit	Shredder has water added to control emissions.	1	2005 Lumex Monitoring (5008 max. operating hours)
	TOTAL		16.54	

Relay Manufacturers

MDI (Mercury Displacement Industry, SRN # N5886) operates in Edwardsburg, MI. According to the facility's TRI report, it emitted 80.5 lbs of mercury in 2011. According to the 2005 NATA, the mercury emissions are elemental mercury.

AREA SOURCES

MERCURY IN PRODUCTS

Incineration of wastes contaminated with mercury-containing products have been known for some time to release mercury to the air, but other pathways for atmospheric mercury emissions from products have received little attention. Emissions from products in this inventory were calculated using the flow model approach. The flow pathway technique was pioneered by the Swedish Nation Chemicals Inspectorate (KEMI), which estimated releases from batteries, fluorescent lamps and sewage sludge. Barr Engineering Company (Barr) and Minnesota Pollution Control Agency (MPCA) used the KEMI approach to estimate the quantity of mercury releases from products in Minnesota. The Minnesota study expanded the KEMI technique to include additional release pathways and additional products. The Minnesota study looked at releases to air, water, and land. The flow model developed during the Minnesota study has since been used to estimate emissions in studies conducted by the Wisconsin Department of Natural Resources and USEPA Region 5 with assistance from Barr (WDNR, 2006). The estimates for emissions from products in this inventory used the most recent model that was updated by USEPA Region 5. Michigan specific data was incorporated into the model when possible. Since the purpose of this inventory is to quantify air emissions, releases to land and water were not included. The methodology used for each specific product is described below.

Dental Amalgam

Substituting Michigan data for national data in the USEPA Mercury Flow Diagram, emissions from dental amalgam were calculated (McGeen, 2014). Emissions in this category can be further subdivided into four categories: emissions from the dental office, emissions from the consumer “in use,” emissions from recycling, and emissions from dental amalgam in the solid waste stream.

Emissions from dental offices are based on the Interstate Mercury Education & Reduction Clearinghouse Fact Sheet: Mercury Use in Dental Amalgam (IMERC, 2014). According to the January 2014 version of the fact sheet, there were 34,163 total lbs of mercury sold nationally in dental amalgam in 2010. The 2011 calculation assumes that 2011 sales were identical to 2010. Michigan’s proportion of the national sales was determined by population (3.2% of the national value). Furthermore, it was assumed that all amalgam sold within the year was placed. Accordingly, 1093.23 lbs was assumed for placement of dental amalgam in Michigan in 2011.

This corresponds to 33.96 kg (74.87 lbs) of mercury emissions, assuming that 7% of the mercury in an amalgam volatilizes to the air during placement of the amalgam.

Additionally, it was estimated that 276.04 kg of mercury returned to the dental office in the form of mercury amalgams which were replaced with new amalgam. Seven percent of the replaced amalgam or 18.90 kg (41.67 lbs) of mercury was emitted from the dental office in the form of air emissions. This source of emissions was inadvertently omitted from the AQD’s 2002 and 2005 mercury reports.

Consumer “in use” emissions were estimated to be 7.18 kg (15.83 lbs). This estimate was based on the assumption that 76 percent of the mercury input to dental offices goes to the consumer. A release factor of 0.02% was used to estimate the amount of mercury that would be exhaled to the air.

Mercury from storage, transit and transfer en route to MSW landfills was estimated at 0.14 kg (0.31 lbs). Mercury from disposal as MSW was estimated at 0.85 kg (1.87 lbs).

Mercury in the amount of 3.20 kg from mass burn and refuse derived fuel (RDF) was estimated by the USEPA model, but since this category is already accounted for in the point source inventory, this estimate was not included in the Michigan 2011 mercury inventory.

Mercury in the amount of 132.37 lbs was estimated in total for the category of dental amalgams in 2011, for the placement of dental amalgams and consumer "in use" emissions. Mercury in the amount of 2.18 lbs was estimated for the waste steam as noted above. These values do not include the emission estimates from cremation which is a separate area source category.

Table 39.

Dental Amalgam			
Year	**kg**	**lb**	**Subset**
2011	33.96	74.87	Emissions from replacement (removal) of dental amalgam
2011	18.90	41.67	Emissions from placement of dental amalgam
2011	7.18	15.83	Consumer "in use" emissions
2011	0.14	0.31	Storage, transit and transfer (MSW)
2011	0.85	1.87	Landfills
2011	NA	NA	Recycling
2011	NA	NA	Mass burning and RDF
2011	NA	NA	Burn barrels
TOTALS		134.55	
Assignment in Table 1			
Table 1		132.37	MERCURY CONTAINING PRODUCTS
Table 1		2.18	All other values (storage, transfer and transit) are included under subsets of Waste Disposal category

Fluorescent and Non-fluorescent Lamps

Substituting Michigan data for national data in the USEPA Mercury Flow Diagram, an emissions estimate for fluorescent lamp breakage was calculated (McGeen, 2014). 8.40 tons of mercury was present in lamp sales in 2010, based on data from IMERC's Mercury Use in Products factsheet (IMERC, 2014). This represents a 22% decline since 2001. The IMERC data was presented for lamp manufacturing as a whole and did not apportion the number into values for fluorescent and non-fluorescent lighting. Accordingly, the two categories have been grouped together for the 2011 mercury report.

For the estimation of Michigan's 2011 emissions, it was assumed that 2011 lamp sales in the United States were the same as in 2010. Using Michigan and national population data for 2011, it was assumed that Michigan received a proportionate percentage of the lamps containing mercury (3.2%, or 30,468,707 lamps). This number was increased to account for an additional 0.5% broken at retail locations (for 30,621,050 lamps), and an additional 5.0% broken prior to delivery to retail locations (production total of 32,152,103 lamps). The quantity of lamps in retail and the quantity of lamps purchased by consumers were then multiplied by release factors to estimate the amount of mercury emitted when a fraction of these lamps were broken. The release factor for breakage during retail was 0.002%, and the release factor for consumer breakage was 0.01%. It was assumed that each lamp manufactured in 2011 contained 0.008 g of mercury (NEMA, 2000). This method yielded an emissions estimate of 2.93 kg (6.46 lbs) of mercury emitted from lamp breakage by retailers and consumers, plus an additional 0.08 kg

(0.18 lbs) of mercury from lamps broken at production facilities for a total of 3.01 kg (6.64 lbs) directly from lamp breakage.

The USEPA Flow Diagram was also used to estimate emissions from the disposal of lamps in the MSW stream. Of the total number of disposed fluorescent lamps (364 kg/yr in Michigan based on the estimate of lamps being discarded in 2011), 78% or 283.92 kg likely ended up in the solid waste stream. Assuming 10% of the mercury in each lamp was released while in transit, 28.39 kg (62.59 lbs) of mercury emissions would be attributable to the collection and processing of lamp-containing MSW.

Assuming 84% of lamps in MSW end up in landfills, and 1% of the mercury is released, 2.01 kg (4.43 lbs) of mercury emissions can be attributed to landfill emissions from disposed lamps. Another 3.87 kg (8.53 lbs) of emissions were likely due to the 2% of lamps in MSW that are burned in burn barrels, assuming a 90% release factor. Emissions in the amount of 16.80 kg (37.04 lbs) were estimated from lamps incinerated in mass burn/RDF combustion. However, Michigan's 2011 mercury inventory already accounts for solid waste incineration under point sources, so the 37.04 lbs of area source mercury emissions estimated by the USEPA Mercury Flow Diagram for mass burn/RDF has been omitted from the Michigan 2011 inventory.

Using the USEPA Mercury Flow Diagram and assuming that Michigan recycles fluorescent lamps at the same rate as the national average, 22%, about 5.1 million lamps should have been recycled in Michigan in 2005 (U.S. Census Bureau). Approximately 0.80 kilogram (1.76 lbs) of mercury was likely released during the transport of lamps to the recycling facility based on a 1% release factor.

It can be estimated that the four companies in Michigan with fluorescent lamp recyclers emit 3.5 lbs of mercury per year, assuming that they are emitting the maximum amount allowed by their permit conditions. These six facilities are not required to report to the Michigan Air Emissions Reporting System. Therefore, it was not known how many hours they operated or, in the case of the portable sources, where they operated and emitted in 2011.

Table 40.

SRN	Facility	Portable or Stationary	Permit Limit	Max. Emitted lbs
N5941, N5942, N5614	Valley City	Each facility is portable.	0.004 g / hr for each portable lamp recycler	0.231
N5948	Greenlites (Cleanlites)	Stationary	0.08 g / hr	1.5
N6821	Reliable Relamping	Facility is permitted as both a portable and a stationary source.	0.01 g / hr	0.19
N5549	Greenlite Lamp Recycling	Stationary	0.08 g / hr	1.55
	Total			3.5

Hence, fluorescent and non-fluorescent lamp breakage, recycling and the solid waste stream are estimated to have released 39.67 kg (87.45 lbs) of mercury to the atmosphere in 2011. Lamp breakage is estimated to have released 6.64 lbs of mercury by itself, and fluorescent lamp recycling is estimated to have released 5.26 lbs.

Table 41.

Fluorescent and Non-fluorescent Lamps			
Year	**kg**	**lb**	**Subset**
2011	0.08	0.18	Production breakage
2011	0.49	1.08	Retail breakage
2011	2.44	5.38	Consumer breakage
2011	28.39	62.59	Storage, transit and transfer (MSW)
2011	0.80	1.76	Storage, transit and transfer (recycling)
2011	2.01	4.43	Landfills
2011	1.59	3.50	Recycling
2011	NA	NA	Mass burning and RDF
2011	3.87	8.53	Burn barrels
TOTAL		87.45	
Assignment in TABLE 1			
TABLE 1		6.64	MERCURY CONTAINING PRODUCTS
TABLE 1		80.81	All other values (storage, transfer, transit and recycling) are included under subsets of Waste Disposal category

Drum-Top Crushers

As of 2014, eight permits have been issued by EGLE for drum-top crushers (DTCs). One permit was voided in 2006 and another in 2011 when that DTC was included under the facility's Renewable operating permit. Accordingly, there were seven permitted DTCs operating in 2011. A new DTC was permitted in 2014. The information available for these sources is summarized below. Based on the maximum allowed number of lamps to be crushed each year (5,000 per facility with 90% control for carbon filters, per Joy Taylor Morgan, EGLE), the amount emitted from this category in 2011 can be estimated at a minimum of 0.07 lbs and a maximum of 0.16 lbs (McGeen, 2014).

Table 42.

SRN	Applicant	Site City	Permit No.	Received	Approved	Voided	Rolled into ROP
N7614	Shaheen Chevrolet	Lansing	138-06	4/11/2006	7/13/2006		
N7728	Blue Star, Inc.	Dearborn	351-06	11/17/2006	11/17/2006	12/11/2006	
E8510	Adrian College	Adrian	23-10	12/11/2009	2/3/2010		
P0063	McPhee Electric	Potterville	40-10	2/4/2010	3/8/2010		
N5245	Marquette County Waste	Marquette	117-10	4/19/2010	7/19/2010		
N0929	Auto Alliance International	Flat Rock	112-10	5/26/2010	6/9/2010	5/19/2011	X
P0231	Hybra Recycling, LLC	Traverse City	49-11	3/29/2011	5/4/2011		
P0500	Sebewaing Light and Power	Sebewaing	16-14	2/11/2014			

Auto Switches – Shredding of Autos (Area Source)

Area source mercury emissions from the shredding of automobiles were calculated by substituting Michigan data for national data in the USEPA Flow Diagram (McGeen, 2014).

Using Michigan data about scrapped vehicles, an estimated 34.51 kg (76.07 lbs) of mercury was emitted to the atmosphere from shredding, in total. It was estimated that 238.76 kg (526.37 lbs) of mercury was present in switches in end-of-life vehicles in Michigan in 2011, based on the estimated number of vehicles scrapped in Michigan (5.62% or 442,142 vehicles) and assuming an average of 0.54 switches per vehicle with an average of 1 gram of mercury

per switch. Ninety-nine percent of these vehicles were assumed to be sent to scrap yards / dismantlers, with the remaining 1% being disposed of in some other manner. Based on a 2006 report (End-of-Life-Vehicle Solutions, 2006) which estimated that 100.96 lbs of mercury was recovered from end of life vehicles, a similar amount (18.69% or 101.96 lbs of the 2011 end of life vehicles sent to scrap yards) was estimated to have been recovered during 2011, since Michigan's mercury switch recovery program has been in place since 2004 (MDEQ, 2010). Sixty-six percent of the vehicles sent to scrap yards/dismantlers were assumed to be shredded. Per the USEPA Flow Diagram, it was estimated that 22% or 27.61 kg (60.86 lbs) of mercury in these vehicles will be released during the shredding process. This release factor was based on the *North Star Steel Mercury Mass Balance Report*, prepared by Barr in 1999. Another 6.90 kg (15.21 lbs) of mercury should be released from auto fluff, assuming a 25% release factor per the Barr report.

This results in a total of 34.51 kg (76.07 lbs) from the auto shredding sector. Following the deduction of 16.54 lbs of mercury estimated for the point source component of auto shredding, the area source component is estimated to be 59.53 lbs in 2011.

Table 43.

Auto Switches			
Year	**kg**	**lb**	**Subset**
2011	27.61	60.86	Shredding
2011	6.90	15.21	Auto fluff
2011	NA	NA	Storage, transit and transfer (MSW)
2011	NA	NA	Storage, transit and transfer (recycling)
2011	NA	NA	Landfills
2011	NA	NA	Recycling
2011	NA	NA	Mass burning and RDF
2011	NA	NA	Burn barrels
TOTAL		76.07	Area source and point source totals
		16.54	Point source total
		59.53	Area source total
Assignment in TABLE 1			
TABLE 1		59.53	MERCURY CONTAINING PRODUCTS
TABLE 1		16.54	Point source deduction entry

Switches and Relays

Using national data in the USEPA Flow Diagram, emissions from switches and relays were estimated as a proportion of national emissions (McGeen, 2014). Michigan accounted for 3.2% of the United States population in 2011 so national values were scaled down to reflect Michigan's proportion of the national population.

Approximately 0.54 kg (1.19 lbs) of mercury was emitted from the retail of switches and relays, assuming 0.1% of mercury in switches and relays is released during retail in 2011. The quantity of mercury sold annually in switches and relays nationally was based on the 2010 figure from the IMERC Fact Sheet: Mercury Use in Switches & Relays (IMERC, 2014). The 2010 value was adjusted for an annual 4% decline by 2011.

For consumer breakage of switches and relays a 0.05% release factor was used. It is estimated that 28.69 kg (63.25 lbs) of mercury was emitted from consumer breakage in 2011, for a total of 64.44 lbs from the consumer and retail category.

During the storage, transit, and transfer of MSW, 6.93 kg (15.28 lbs) of mercury was likely released assuming a 1.5% release factor. Another 9.24 kg (20.37 lbs) of mercury was released in 2011 during the storage and transfer of switches and relays bound for recycling. Approximately 40% of the mercury in discarded switches and relays is sent on for recycling.

The switches and relays in MSW which reach landfills contributed 3.20 kg (7.05 lbs) of mercury emissions under the assumption that 1% of the mercury is released. Another 9.05 kg (19.95 lbs) of mercury was likely released due to recycling switches and relays, assuming a 1% release factor and is reported under recycling. The mercury model projected that 44.92 kg more would be lost due to mass burning and RDF combustion, but this was not included in the switch and relay area source estimate as the incineration category has already been accounted for under point sources. Three percent of switches and relays in MSW were likely burned in burn barrels releasing 90% of the mercury contained in them, or 13.78 kg (30.38 lbs).

In total, 157.47 lbs of mercury was likely released from activities associated with mercury-containing switches and relays in 2011. This includes the solid waste stream.

Mercury in the amount of 64.44 lbs is listed in Table 1 for the Switches & Relays component of the mercury-containing products category. This includes only the emissions from retail and consumer breakage. The remaining emissions from activities such as storage, transfer, transit and recycling are reported in Table 1 under the Waste Disposal category.

Table 44.

Switches and Relays			
Year	**kg**	**lb**	**Subset**
2011	0.54	1.19	Retail breakage
2011	28.69	63.25	Consumer breakage
2011	6.93	15.28	Storage, transit and transfer (MSW)
2011	9.24	20.37	Storage, transit and transfer (recycling)
2011	3.20	7.05	Landfills
2011	NA	NA	Compost
2011	9.05	19.95	Recycling
2011	NA	NA	Mass burning and RDF
2011	13.78	30.38	Burn barrels
TOTAL	71.43	157.47	
Assignment in TABLE 1			
TABLE 1		64.44	MERCURY CONTAINING PRODUCTS
TABLE 1		93.03	All other values (storage, transfer, transit and recycling) are included under subsets of Waste Disposal category

Thermostats

Emissions from thermostats were estimated by substituting Michigan data for national data in the USEPA Flow Diagram (McGeen, 2014). Emissions were estimated from production, retail, and consumers.

The fact sheet Mercury Use in Thermostats provided an estimate of total mercury sold nationally in electro-mechanical thermostats (IMERC, 2014). The fact sheet indicated that 340 lbs of mercury was sold in thermostats in 2010. This represents a decline of almost 99% in mercury use in thermostats since 2001. According to Clean Water Action, this decline was in large part due to state laws which banned the sale of thermostats containing mercury (Clean Water Action, 2010).

Assuming that mercury use in 2011 thermostats sold is equal to 2010 levels, and using Michigan's 2011 population data to apportion the United States total sales to Michigan, 1,345 thermostats containing mercury was estimated to be sold in Michigan in 2011. This includes sales for new construction, and sales for the replacement of older units. This estimate assumes that Michigan received an even percentage of the national number of thermostats produced, that thermostats contain an average of 3.67 g mercury per unit.

It was assumed that 0.2% of the mercury in new electro-mechanical thermostats was emitted during production, resulting in 0.01 kg (0.02 lbs) of mercury emissions. Another 0.2% of the mercury in thermostats was emitted from breakage during retail. This likely contributed 0.01 kg (0.02 lbs) of mercury emissions in 2011.

Based on state and national population data, and national estimates for the number of thermostats replaced, an estimated 112,000 mercury-containing thermostats were replaced (discarded by consumers) in Michigan in 2011. This estimate assumes that Michigan accounted for an even percentage of the national number of thermostats replaced, that thermostats contain an average of 3.67 g mercury per unit, and that 70% of the thermostats removed contained mercury (an increasing share of replaced thermostats is expected to be non-mercury, based on the gradual increase since the 1990s in the sale of non-mercury thermostats). An estimated 4.02 kg (8.86 lbs) of mercury was emitted from consumer breakage of the replaced thermostats. During consumer use, 1% percent of the mercury in thermostats was expected to have volatilized due to breakage. The total emission estimate from retail and consumer breakage is 8.90 lbs.

Based on the estimated 112,000 mercury-containing thermostats discarded by consumers in 2011, 8.67 kg was contained in the 2% of thermostats which were recycled.

Per the USEPA Mercury Flow Diagram, 0.17 kg (0.37 lbs) of mercury of mercury was estimated to be emitted during storage, transit and transfer on the way to recycling. Mercury in the amount of 0.08 kg (0.18 lbs) was estimated to be emitted during recycling.

Mercury in the amount of 361.26 kg in thermostats entered the solid waste stream. During the storage, transit and transfer of MSW, thermostats contributed 5.42 kg (11.95 lbs) of emissions. Three percent of thermostats in MSW were likely burned in burn barrels emitting 90% or 10.78 kg (23.77 lbs) of the mercury they contained. Mercury in the amount of 2.51 kg (5.53 lbs) was likely released due to the 75% of the thermostats in the MSW stream that were landfilled, assuming 1% of the mercury would volatilize.

An additional 41 kg of mercury was present in the 10% of thermostats which ended up under demolition debris disposal. Mercury in the amount of 0.41 kg (0.90 lbs) was emitted during the storage, transit, and transfer to demolition debris landfills. Additional mercury in the amount of 0.77 kg (1.70 lbs) was emitted after disposal in the demolition debris landfills.

There are also wastewater treatment and sludge disposal emission components for thermostats which enter the MSW stream. 0.55 kg (0.90 lbs) of mercury emissions were estimated from wastewater treatment. Another 0.28 kg (0.62 lbs) was estimated from land application air emissions, but this category has been estimated as a separate area source. Mercury in the amount of 0.56 kg, estimated by the USEPA Mercury Flow Diagram for WWTP incineration was not included, since this category is addressed under point sources.

Not including the emissions from wastewater treatment and land application, 53.30 lbs of mercury was likely emitted due to thermostats in 2011. Of this, 8.90 lbs was emitted directly from retail and consumer breakage.

Table 45.

Thermostats			
Year	**kg**	**lb**	**Subset**
2011		0.02	Production losses
2011		8.86	Consumer breakage
2011		0.02	Retail breakage
2011	5.42	11.95	Storage, transit and transfer (MSW)
2011	0.41	0.90	Storage, transit and transfer (demolition debris landfills)
2011	0.17	0.37	Storage, transit and transfer (recycling)
2011	2.51	5.53	Landfills
2011	0.77	1.70	Landfills (demolition debris)
2011	0.08	0.18	Recycling
2011	NA	NA	Mass burning and RDF
2011	10.78	23.77	Burn barrels
TOTAL		53.30	
Assignment in TABLE 1			
TABLE 1		8.90	MERCURY CONTAINING PRODUCTS
TABLE 1		12.85	Storage, transit and transfer (includes both MSW and demolition debris landfills)
TABLE 1		7.23	Emissions from landfills (includes both MSW and demoliton debris landfills)
TABLE 1		24.32	All other values (storage, transfer, transit and recycling) are included under subsets of Waste Disposal category

Measurement and Control Devices

Emissions from measurement and control devices were estimated as a proportion of national emissions using the USEPA Flow Diagram (McGeen, 2014). According to the IMERC fact sheet Mercury Use in Measuring Devices, 0.77 tons of mercury was contained in measuring devices sold nationally in 2010 (IMERC, 2014). This represents an 85% decline since 2001 when measuring devices sold contained 5.12 tons of mercury. Much of the decline comes from the discontinuation of mercury in barometers and dairy manometers, and the reduction of mercury used in thermometers. Based on USEPA's assessment that mercury thermometers have an average life span of five years, the same assumption will be made for mercury manometers until data can be found indicating. Michigan accounted for 3.2% of the United States population in 2011 so national values were adjusted accordingly to generate Michigan-specific values.

Approximately 0.02 kg (0.40 lbs) of mercury was emitted from the retail of measurement and control devices assuming 0.1% of mercury in measurement and control devices is released during retail. For consumer breakage of measurement and control devices a 0.2% release factor was used. 13.2 kg (29.10 lbs) of mercury was emitted from consumer breakage in 2011, for a total of 29.50 lbs from retail and consumer breakage.

During the storage, transit, and transfer of measurement and control devices as MSW, 0.27 kg (0.60 lbs) of mercury was likely released assuming a 1.5% release factor. Approximately 40% of the mercury in discarded measurement and control devices is sent on for recycling. Mercury in the amount of 0.14 kg (0.31 lbs) was release during storage and transfer of measurement and control devices bound for recycling. Another 0.14 kg (0.31 lbs) of mercury was likely released due to recycling assuming a 1% release factor and will be grouped with retail and consumer losses.

Three percent of measurement and control devices in MSW were likely burned in a burn barrel releasing 90% of the mercury contained in them. Accordingly, 0.54 kg (1.19 lbs) of mercury was released due to measurement and control devices being burned in burn barrels. Seventy-five percent of measurement and control devices in MSW are sent to landfills. Measurement and control devices in landfills contribute 0.13 kg (0.29 lbs) of mercury emissions assuming 1% of the mercury is released.

In total, 14.61 kg (32.20) lbs of mercury was likely released from all activities associated with mercury-containing measurement and control devices in 2011.

Table 46.

Measurement & Control Devices			
Year	**kg**	**lb**	**Subset**
2011	0.02	0.40	Retail breakage
2011	13.20	29.10	Consumer breakage
2011	0.27	0.60	Storage, transit and transfer (MSW)
2011	0.14	0.31	Storage, transit and transfer (recycling)
2011	0.13	0.29	Landfills
2011	0.14	0.31	Recycling
2011	NA	NA	Mass burning and RDF
2011	0.54	1.19	Burn barrels
TOTAL	14.44	32.20	
Assignment in TABLE 1			
TABLE 1		29.50	MERCURY CONTAINING PRODUCTS
TABLE 1		2.70	All other values (storage, transfer, transit and recycling) are included under subsets of Waste Disposal category

Thermometers

In 2003, Michigan PA 578 banned the sale of mercury thermometers in Michigan, or for use in the state of Michigan. The only exceptions are if a mercury thermometer is sold or offered for one of the following:

a) A use for which a mercury thermometer is required by state or federal statute, regulation or administrative rule;
b) Pharmaceutical research purposes; or
c) By prescription.

Mercury thermometers in household use are assumed to have a 5-year lifespan prior to breakage and disposal. Therefore, it is assumed that household use and breakage of mercury thermometers in 2011 is negligible, based on the ban on sales since 2003. Mercury thermometers used in hospitals were assumed to have a 1-year life span prior to breakage and disposal; therefore, it was assumed no hospital mercury thermometers were in use in 2011. Accordingly, mercury emissions from breakage and disposal of mercury thermometers is assumed to be minimal in 2011 and zero emissions have been calculated (McGeen, 2014).

Bulk Mercury

Clean Sweep Household Hazardous Waste collection sites collected 142.97 kg (315.2 lbs) of elemental free-flowing mercury in 2011. The USEPA Flow Model estimates that 1% or 1.43 kg (3.15 lbs) of this mercury was released to the air. A total of 142.97 kg (315.2 lbs) of bulk mercury was also transported as waste in 2011. One percent or 1.43 kg (3.15 lbs) of this mercury was expected to be released during waste transport. Approximately 1,906.23 kg (4,202.51 lbs) of mercury was calculated as the total consumer input by extrapolating from the total waste estimates. It was assumed that bulk mercury disposed of as waste comprised 7.5% of total consumer input. Mercury from consumers had an expected release factor of 0.2%, resulting in emissions of approximately 4 kg (8.82 lbs) of elemental mercury in 2011. Therefore, approximately 15.12 lbs of mercury was likely released from all aspects of the bulk mercury category in 2011 (McGeen, 2014).

Table 47.

Consumer Use of Bulk Mercury			
Year	**kg**	**lb**	**Subset**
2011	1.43	3.15	Released from collection of bulk mercury emissions (Clean Sweep sites)
2011	4.00	8.82	Consumer and retail
2011	1.43	3.15	Storage, transit and transfer (MSW)
2011	NA	NA	Landfills
2011	NA	NA	Recycling
2011	NA	NA	Mass burning and RDF
2011	NA	NA	Burn barrels
TOTAL	6.86	15.12	
Assignment in TABLE 1			
TABLE 1		8.82	MERCURY CONTAINING PRODUCTS
TABLE 1		3.15	See CLEAN SWEEP SITES entry
TABLE 1		3.15	All other values (storage, transfer, transit and recycling) are included under subsets of Waste Disposal category

Volatilization During Solid Waste Collection and Processing

The estimate for volatilization during solid waste collection and processing was based on the assumption that 1.5% of the mercury in solid waste is volatilized during collection, transportation, and mechanical processing (MPCA, 2001). To estimate the quantity of MSW composted in Michigan, a Michigan specific figure from the MDEQ Waste and Hazardous Materials Division (WHMD) was utilized (Fletcher, 2009). 2008 is the only year for which MSW compost data was available. The quantity of solid waste combusted was calculated using EI Toolkit throughput values (see Municipal Waste Incineration). Landfill data from 2011 was obtained from the WHMD (MDEQ, 2014). For this estimate, only Type II in-state waste (municipal solid waste) was considered. The value was 21,764,732 cubic yards and a weight of 0.333 tons per yard was assumed. Since out-of-state waste is not likely to be transported to a transfer station in Michigan, it was not included in this estimate. It is assumed that the mercury concentration of MSW is approximately 0.004 lbs of mercury per ton of solid waste (van Veizen, 2002). Mercury in the amount of 514.95 lbs was likely emitted due to volatilization during the collection and processing of MSW in 2011 (McGeen, 2014).

Table 48.

Fate of Municipal Solid Waste (MSW)	Amount	Reference
MSW Compost (tons)	400,000.00	Fletcher, DEQ (2008 value)
Resource Recovery (tons)	934,909.00	From 2011 MSW incineration sector
Landfill Type II In-State Waste (tons)	7,247,655.76	MDEQ, WHMD, for 2011
Total landfill, combusted, composted	8,582,564.76	
Calculated Mercury Content (lb/ton)	0.004	van Veizen (2002)
Mercury content (lb) of solid waste (excluding recycling)	34,330.26	
Volatilization during handling and transport, in lbs (equals 1.5% of mercury content from landfill, combustion, composting)	514.95	

Landfill Volatilization

The estimate for volatilization during from solid waste in landfills was based on the assumption that 0.1% of the mercury in landfilled solid waste is volatilized per year based on studies of MSW emissions in Florida (Lindberg and Price, 1999).

To estimate the quantity of MSW landfilled in Michigan in 2011, a Michigan specific figure from the MDEQ's WHMD was utilized (MDEQ, WHMD, 2014). For this estimate, total landfilled Type II (in-state and out-of-state) waste (29,600,348 cubic yards) was considered and a weight of 0.333 tons per yard was assumed. It is assumed that the mercury concentration of MSW is approximately 0.004 lbs of mercury per ton of solid waste (van Veizen, 2002). Approximately 39.43 lbs of mercury was likely emitted due to volatilization from landfilled MSW in 2011 (McGeen, 2014).

Table 49.

Fate of Municipal Solid Waste	Amount	Reference
Total landfilled in-state and out-state Type II Waste (municipal solid & commercial waste) in cubic yards, 2011	29,600,348	MDEQ, WHMD
Total landfilled Type II Waste (municipal solid waste) in tons (assumes 0.333 tons/yd), 2011	9,856,916	MDEQ, WHMD
Calculated mercury content (lb/ton)	0.0040	van Veizen (2002)
Mercury content in lb of solid waste (excluding recycling)	39,428	
Volatilization from landfilled MSW in lb (0.1% of mercury in MSW volatilizes)	39.43	Lindberg and Price (1999)

Burn Barrels

For the category of burn barrels (open burning of MSW), the methodology from the 2005 report was utilized to estimate 105.60 lbs of mercury from the open burning of MSW in 2011. The USEPA's methodology was from Appendix A of *Documentation for the Final 2002 Nonpoint Sector (Feb 06 Version) National Emissions inventory for Criteria and Hazardous Air Pollutants*. The ratio of urban to rural population was obtained from 2000 U.S. Census data, and then multiplied by a 2011 U.S. Census Bureau estimate of the county population in Michigan to obtain an estimate of rural population in 2011. The USEPA's estimate of 3.37 lbs of solid waste per person per day was used to calculate total solid waste generated. It was assumed that MSW has a mercury content of 0.0040 lb / ton (van Veizen, 2002). Per an estimate by Minnesota Pollution Control Agency (MPCA, 20008), 2% of MSW was assumed to be disposed of in burn barrels, resulting in the estimate of 105.60 lbs (McGeen, 2014).

Per the USEPA's open burning estimates in the 2011 NEI v1, an estimated 210,174.93 tons of MSW were burned using 2010 data as a surrogate for 2011. From this source, burn barrel emissions of mercury for 2011 are estimated at 840.70 lbs utilizing the van Veizen emission factor and the throughput from the 2011 NEI (McGeen, 2014). This value is substantially higher due to the assumption of a larger quantity of available waste being burned.

Human Cremation

According to Michael Beebe, Michigan Department of Community Health (MDCH), there were 44,058 bodies cremated in Michigan in 2011 (MDCH, 2014). Estimates of the amount of mercury released per body cremated vary greatly. One literature review concludes that a release of 2 to 3 grams of mercury per body cremated seems most well-supported (Reindl, 2005). This yields a total emissions estimate between 194.26 and 291.39 lbs of mercury from this category in Michigan. However, a more recent study in Japan estimated that the average mercury amalgam in place contains 51.6 mg (Takaoka, Oshita, Takeda and Morisawa, 2010). This estimate, with an assumption of four fillings per body, yields a total estimate of 20.05 lbs of mercury emitted in 2011 from the human cremation category. Using the study's conservative estimate of a maximum of 231 mg of mercury per filling, a high range emissions estimate of 89.75 lbs is obtained.

A research project was conducted to quantify the emissions of mercury from dental amalgam in human cremations in Minnesota. The report *Quantifying Mercury Emissions Resulting from the Cremation of Dental Amalgam in Minnesota: Final Results* was presented to MPCA on September 15, 2015. A factor of 2.3 grams of mercury emissions per body from cremation was calculated for the project. This value was applied to the number of 2011 cremations in Michigan, resulting in a statewide estimate of 223.40 lbs of mercury emissions. The factor from the MPCA study is considered to be more representative of the U.S. population than the Takaoka study. Therefore, 223.40 lbs of mercury was likely emitted to the atmosphere from human cremations in Michigan in 2011 (McGeen, 2016).

Volatilization: Land Application of Sewage Sludge

Sewage sludge in the amount of 72,048 dry English tons was land applied in Michigan in 2011 according to estimates from the Sewage Sludge Program of the Water Bureau, MDEQ (Water Bureau, 2014). According to Water Bureau staff, sewage sludge had an average concentration of 2.01 ppm of mercury in 2011. Assuming 1% of mercury applied to the surface of the land volatilized within one year (MPCA, 2004), but not taking into account any carryover from previous years, 2.90 lbs of mercury was likely emitted via volatilization from surface-applied sewage sludge in 2011 (McGeen, 2014).

Contaminated Site Remediation

The only known source of atmospheric mercury emissions from the clean-up of a contaminated site in Michigan was the dredging of the BASF Riverview site in Detroit. The dredging of this site began in late 2006 and was completed in the second week of 2007 (MDEQ, 2014). Therefore in 2011 there are no known air emissions of mercury from contaminated site remediation.

Mobile Sources

ON-ROAD

The USEPA and the University of Michigan (U of M) Air Quality Laboratory collaborated on a pilot project in 2002 to investigate motor vehicle mercury emissions (Hoyer et al., 2004). This pilot project produced significantly different emission factors than those previously used to estimate mobile source mercury emissions from on-road vehicles. Michigan's 1999 mercury emissions inventory estimated on-road mobile source emissions using emission factors that were the detection limit cut in half from Coordinating Research Council (CRC) data. The emission factors produced by the USEPA/U of M pilot project were several orders of magnitude lower than the estimate based on the CRC factor.

Table 50.

Year	Total On-road Emissions, lbs (1999 CRC factor)	Total On-road Low Range Emissions, lbs (USEPA / U of M 2002 factor)	Total On-road High Range Emissions, lbs (USEPA / U of M 2002 factor)	USEPA NEI Estimate for On-road lbs
2011	1767.49	0.18	0.49	23.53

Table 51. Comparison of 1999 (CRC) and 2002 (USEPA/U of M) Emission Factors

Vehicle Type	1999 Emission Factor	2002 Emission Factor
Light-duty Diesel	6,579 ng / mi	6.4-11.1 ng / mi
Heavy-duty Diesel	86,577 ng / mi	6.4-11.1 ng / mi
Light-duty Gasoline	875 ng / mi	0.3-1.4 ng / mi
Heavy-duty Gasoline	839 ng / mi	0.3-1.4 ng / mi

Table 52. 2011 Michigan Statewide Vehicle Miles Traveled (VMT) (in millions)

LDG	HDG	LDD	HDD	Total VMT
85937.6193	3363.4001	332.8592	8333.7632	97967.6419

The Light Duty Gasoline Vehicles emission factor from USEPA/U of M was applied to all gasoline vehicles for 2011 and the Heavy Duty Diesel Vehicles emission factor from USEPA/ U of M was applied to all diesel vehicles. Based on data from MDEQ and the Michigan Department of Transportation (MDOT, 2014) 89,301,019,446 miles were driven by various gasoline vehicles in 2011. The estimated number of miles to be driven by diesel vehicles was 8,666,622,451. The 2011 estimate based on the USEPA/U of M 2002 factor suggests that <1 lbs of mercury was emitted from on-road vehicles (0.18 to 0.49 lbs). The estimate from the USEPA's 2011 NEI version 1 suggests that 23.53 lbs of mercury was emitted from on-road vehicles.

It should be noted that the USEPA/U of M pilot project did not measure reactive gaseous mercury and since this was a pilot project, few vehicles were studied. Further research is needed to estimate emissions from mobile sources with the desired degree of certainty. This pilot study tested light-duty gasoline vehicles and heavy-duty diesel vehicles. These estimates only include mercury from tailpipe emissions and do not address other potential mercury sources from on-road vehicles such as mercury in brake pads. Brake wear was identified as a

potentially significant source of mercury emissions from mobile sources during the pilot study (Hoyer et al., 2004).

NON-ROAD

The 2011 mercury inventory includes several non-road categories, which were not present in the 2002 and 2005 reports. These categories are: off-road vehicles and equipment (diesel and gasoline-powered); commercial marine vessels; and railroads.

The estimate from the USEPA's 2011 Mobile dataset estimates that 1.36 lbs of mercury was emitted from off-road vehicles and equipment. This includes snowmobiles, ATVs, agricultural, construction, mining, and lawn and garden equipment. Mercury in the amount of 0.20 lbs was from diesel equipment and vehicles, and 1.16 lbs of mercury was from gasoline-powered vehicles and equipment (USEPA, 2014).

The USEPA's 2011 NEI version 1 estimates that 11.00 lbs of mercury was emitted from commercial marine vessels and 12.11 lbs from came from railroads (USEPA, 2014). This includes port and underway emissions for the marine vessels. It also includes emissions from line-haul locomotives for Class I, II and III railroads (large carriers, regional railroads, and shortlines, respectively).

A preliminary estimate of between 0.24 and 10.80 lbs of mercury emitted per year was generated for Michigan's only coal-burning ferry, the *S.S. Badger,* owned by Lake Michigan Carferry Service. The *Badger* burns12,000 tons of bituminous coal per year on average, according to USEPA (EPA, 2013). Using the range of mercury concentration in bituminous coal of 0.01-0.45 ppm (MMEUW, 2005), the preliminary range of emissions was created (McGeen, 2014). Efforts to estimate other emissions from this source sector and other non-road mobile sources have not been conducted to date.

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Prepared by Dennis McGeen, Air Quality Division, EGLE, September 2019. This inventory represents the best information available at the time of the last update. The inventory will continue to be updated as better information becomes available.