2017 ESTIMATES OF ANTHROPOGENIC MERCURY AIR EMISSIONS IN MICHIGAN

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March 2022

EXECUTIVE SUMMARY

This report is a compilation of estimates from the 2017 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 traditional sources, referred to as point sources, were obtained from the Michigan Air Emissions Reporting System (MAERS). Estimated emissions are reported annually to MAERS by approximately 1,700 facilities and are subject to limited quality assurance efforts by EGLE to identify, verify, and correct outlier data. Values were also obtained from the United States Environmental Protection Agency (USEPA) Toxics Release Inventory (TRI) and the 2017 National Emissions Inventory (NEI). Where facility-reported values were not available, the USEPA created estimates for the purposes of gap-filling for some sectors. In some instances, estimates have also been calculated by the AQD for the mercury inventory 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 nonpoint sources. The nonpoint category includes small industrial, commercial, and institutional facilities which are not large enough to trigger air emissions reporting requirements but may collectively have significant emissions statewide. Mercury calculations were prepared by the AQD for the stationary nonpoint sector based on county employment, population data, and other inputs. Values for some nonpoint categories and the mobile source sector were obtained from the NEI.

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.

A range of values is presented for the estimated nonpoint mercury emissions from solid waste collection and processing (handling) and from burn barrels (open burning of household waste). Calculations originally developed based on a 2002 study have been used to estimate mercury emissions for these categories in Michigan's previous anthropogenic mercury inventories. However, between 2002 and 2017 there was a substantial decrease in the quantity of mercury within the solid and household waste stream. While the 2017 mercury report includes calculations made with the 2002 factor to present conservative values, the report also includes updated calculations scaled by the decline in mercury content for these sectors. This is to present values which may better reflect the mercury reductions achieved in the solid and household waste stream in Michigan by 2017. Additionally, the 2017 NEI included the USEPA's own calculation of mercury emissions from burn barrels in Michigan. This value is substantially lower than the highest of the estimates prepared by Michigan.

Where the USEPA prepared nonpoint mercury calculations as part of the 2017 NEI, for automobile shredding, burn barrels, dental amalgam placement, fluorescent lamp breakage and recycling, and thermostats, those values have been accepted for the statewide total emissions summary as the most defensible estimates in place of Michigan's alternate calculations for those same source categories and pathways. This is due to the USEPA values being calculated by the latest emission estimation methodologies and factors. For transparency, and to enable comparison, the AQD's calculations for those categories based on the alternate methodologies are presented within the text of the report.

Statewide total emissions from the 2017 mercury inventory range from a low of 1,901 lbs to a high of 2,345 lbs. This is substantially lower than the range of emissions from the 2014 mercury inventory (updated in February 2022) of 4,289 to 5,585 lbs. Contributing to the decline of mercury emissions in Michigan are: fuel switching and the retirement of coal-fired units at electric utilities and large industrial facilities; more accurate estimation of mercury emissions by facilities through stack-testing and other site-specific methodologies; the gradual phase-out of mercury-containing products; and estimation of nonpoint mercury emissions by the USEPA with the latest emission factors and emission estimation tools which, in some cases, produced lower values than previous calculation methodologies used by the AQD.

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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 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. 2017 Estimates of Anthropogenic Mercury

Emission Source	Hg (Lbs/Yr) in 2017	2017, Low Range	2017, High Range	Particulate Divalent Speciation Factor	Gaseous Divalent Speciation Factor	Elemental Gaseous Speciation Factor	Hg(p)	RGM	Hg(0)
FUEL COMBUSTION									
COAL COMBUSTION									
Electric Utilities	265.90	265.90	265.90	var	var	var	43.79	77.82	144.30
Residential	0.00	0.00	0.00	0.2	0.3	0.5	0.00	0.00	0.00
Industrial/commercial	45.33	45.33	45.33	0.2	0.3	0.5	9.07	13.60	22.66
Nonpoint Industrial, Institutional/Commercial	0.00	0.00	0.00	0.2	0.3	0.5	0.00	0.00	0.00
OIL COMBUSTION									0.00
Electric Utilities, Boiler	0.77	0.77	0.77	0.2	0.3	0.5	0.15	0.23	0.38
Electric Utilities, ICE	0.15	0.15	0.15	0.2	0.3	0.5	0.03	0.04	0.07
Residential	8.65	8.65	8.65	0.2	0.3	0.5	1.73	2.60	4.33
Industrial/Commercial Boilers	0.17	0.17	0.17	0.2	0.3	0.5	0.03	0.05	0.08
Industrial/Commercial, ICE	0.11	0.11	0.11	0.2	0.3	0.5	0.02	0.03	0.05
Nonpoint Industrial, Institutional/Commercial	0.37	0.37	0.37	0.2	0.3	0.5	0.07	0.11	0.18
NATURAL GAS COMBUSTION									
Electric Utilities	1.36E-04	1.36E-04	1.36E-04	0.2	0.3	0.5	0.00	0.00	0.00
Residential	2.39E-04	2.39E-04	2.39E-04	0.2	0.3	0.5	4.79E-05	7.18E-05	1.20E-04
Industrial/Commercial Boilers	5.88E-05	5.88E-05	5.88E-05	0.2	0.3	0.5	1.18E-05	1.76E-05	2.94E-05
Stationary Internal Combustion Engines	3.47E-05	3.47E-05	3.47E-05	0.2	0.3	0.5	6.94E-06	1.04E-05	1.74E-05
WOOD COMBUSTION									
Electric Utilities	12.34	12.34	12.34	0.2	0.3	0.5	2.47	3.70	6.17
Residential	44.54	44.54	44.54	0.2	0.3	0.5	8.91	13.36	22.27
Industrial/Commercial	3.40	3.40	3.40	0.2	0.3	0.5	0.68	1.02	1.70

Emission Source	Hg (Lbs/Yr) in 2017	2017, Low Range	2017, High Range	Particulate Divalent Speciation Factor	Gaseous Divalent Speciation Factor	Elemental Gaseous Speciation Factor	Hg(p)	RGM	Hg(0)
Refuse-derived fuel	22.75	22.75	22.75	0.2	0.3	0.5	4.55	6.83	11.38
PETROLEUM REFINING	33.35	33.35	33.35	0.2	0.3	0.5	6.67	10.00	16.67
RESIDENTIAL LPG PROPANE COMBUSTION	4.58	4.58	4.58	0.2	0.3	0.5	0.92	1.37	2.29
TOTAL FUEL COMBUSTION	442.39	442.39	442.39	0	0	0	79.09	130.77	232.55
INCINERATION									
Sewage Sludge Incineration	37.99	37.99	37.99	0.2	0.58	0.22	7.60	22.04	8.36
Municipal Waste Incineration	23.05	23.05	23.05	0.2	0.58	0.22	4.61	13.37	5.07
Hazardous Waste Incineration	0.53 - 1.39	0.53	1.39	0.2	0.58	0.22	0.11 - 0.28	0.31 - 0.81	0.12 - 0.31
Hospital Medical Infectious Waste Incineration	NA	NA	NA	0.2	0.75	0.05	0.00	0.00	0.00
Human Cremation (point source)	0.08	0.08	0.08	0.2	0.75	0.05	0.02	0.06	0.00
Animal Cremation (point source)	0.36	0.36	0.36	0.2	0.75	0.05	0.07	0.27	0.02
Pathological Waste Incineration	0.08	0.08	0.08	0.2	0.75	0.05	0.02	0.06	0.00
INCINERATION TOTALS	62.09 - 62.95	62.09	62.95				12.31	35.79	13.46
INDUSTRIAL SOURCES									
Cement Manufacturing	55.20	55.20	55.20	var	var	var	3.70	26.55	24.95
Taconite Processing	37.25	37.25	37.25	0.1	0.1	0.8	3.73	3.73	29.80
Lime Manufacturing	8.14	8.14	8.14	0.1	0.1	0.8	0.81	0.81	6.51
Dental Amalgam Manufacturing	4.00	4.00	4.00	0	0	1	0.00	0.00	4.00
Brick Manufacturing	0.37	0.37	0.37	0.1	0.1	0.8	0.04	0.04	0.30
Coke Production	0.02	0.02	0.02	0.1	0.1	0.8	0.00	0.00	0.02
Thermometer Manufacturing	0.00	0.00	0.00	0	0	1	0.00	0.00	0.00
Medical Waste Autoclave	0.45	0.45	0.45	0.2	0.75	0.05	0.09	0.34	0.02
Auto Switches - shredding of autos (point source)	18.61	18.61	18.61	0.1	0.1	0.8	1.86	1.86	14.89
Relay/Switch Manufacturing	1.00	1.00	1.00	0	0	1	0.00	0.00	1.00
PRODUCTION OF METALS									
Primary metal production (Blast/BOF Steel Manufacturing)	129.85	129.85	129.85	0.1	0.1	0.8	12.99	12.99	103.88
EAFs in primary metal production (Steel Manufacturing)	38.63	38.63	38.63	0.1	0.1	0.8	3.86	3.86	30.90

Emission Source	Hg (Lbs/Yr) in 2017	2017, Low Range	2017, High Range	Particulate Divalent Speciation Factor	Gaseous Divalent Speciation Factor	Elemental Gaseous Speciation Factor	Hg(p)	RGM	Hg(0)
EAFs & EIFs in secondary metal production (Steel Foundries)	33.62	33.62	33.62	0.1	0.1	0.8	3.36	3.36	26.89
Secondary metal production (Grey Iron), excluding EAFs	32.98 - 42.87	32.98	42.87	0.1	0.1	0.8	3.30 - 4.29	3.30 - 4.29	26.38 - 34.30
EAFs and EIFs in secondary metal production (grey iron)	33.90 - 95.86	33.90	95.86	0.1	0.1	0.8	3.39 - 9.59	3.39 - 9.59	27.12 - 76.69
INDUSTRIAL SOURCE TOTALS	394 - 466	394.02	465.87	0	0	0	37 - 44	60 - 67	297 - 354
NONPOINT (AREA) SOURCES									
MERCURY-CONTAINING PRODUCTS									
Dental Amalgam	27.40	27.40	27.40	0	0	1	0.00	0.00	27.40
Auto Switches - shredding of autos (nonpoint source)	132.83	132.83	132.83	0.1	0.1	0.8	0.27 - 13.28	0.27 - 13.28	2.19 - 106.26
Switches and Relays	59.92	59.92	59.92	0	0	1	0.00	0.00	59.92
Measurement and Control Devices	22.66	22.66	22.66	0	0	1	0.00	0.00	22.66
Consumer Use of Bulk Mercury	10.62	10.62	10.62	0	0	1	0.00	0.00	10.62
Thermostats	7.27	7.27	7.27	0	0	1	0.00	0.00	7.27
Fluorescent and Non-Fluorescent Lamp Breakage	55.88	55.88	55.88	0	0	1	0.00	0.00	55.88
Drum-top Crushing	0.09 - 0.18	0.09	0.18	0	0	1	0.00	0.00	0.09 - 0.18
Thermometers	0.00	0.00	0.00	0	0	1	0.00	0.00	0.00
Laboratory Activities	24.59	24.59	24.59	0	0	1	0.00	0.00	24.59
WASTE DISPOSAL									
Volatilization during solid waste collection & processing	173 - 509	173.11	509.14	0.1	0.1	0.8	14.77 - 50.91	14.77 - 50.91	118.12 - 407.31
Switches and Relays	14.20	14.20	14.20	0	0	1	0.00	0.00	14.20
Measurement and Control Devices	0.26	0.26	0.26	0	0	1	0.00	0.00	0.26
Thermometers	0.00	0.00	0.00	0	0	1	0.00	0.00	0.00
Bulk Mercury	3.98	3.98	3.98	0	0	1	0.00	0.00	3.98
	48.49	48.49	48.49	0.1	0.1	0.8	4.85	4.85	38.79
Switches and Relays	6.57	6.57	6.57	0	0	1	0.00	0.00	6.57
Measurement and Control Devices	0.13	0.13	0.13	0	0	1	0.00	0.00	0.13
Thermometers	0.00	0.00	0.00	0	0	1	0.00	0.00	0.00
Disposal of products in burn barrels	186.72	186.72	186.72	0.2	0.3	0.5	37.34	56.02	93.36

Emission Source	Hg (Lbs/Yr) in 2017	2017, Low Range	2017, High Range	Particulate Divalent Speciation Factor	Gaseous Divalent Speciation Factor	Elemental Gaseous Speciation Factor	Hg(p)	RGM	Hg(0)
Switches and Relays	28.22	28.22	28.22	0	0	1	0.00	0.00	28.22
Measurement and Control Devices	0.53	0.53	0.53	0	0	1	0.00	0.00	0.53
Thermometers	0.00	0.00	0.00	0	0	1	0.00	0.00	0.00
RECYCLING									
Volatilization during collection for recycling									
Switches and Relays	18.92	18.92	18.92	0	0	1	0.00	0.00	18.92
Measurement and Control Devices	0.13	0.13	0.13	0	0	1	0.00	0.00	0.13
Recycling									
Switches and Relays	18.54	18.54	18.54	0	0	1	0.00	0.00	18.54
Measurement and Control Devices	0.13	0.13	0.13	0	0	1	0.00	0.00	0.13
Fluorescent and Non-Fluorescent Lamp Breakage	0.00	0.00	0.00	0	0	1	0.00	0.00	0.00
OTHER	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00
Cremation	150.11	150.11	150.11	0.2	0.58	0.22	30.02	87.06	33.02
Disposal of Bulk Hg to Clean Sweep Sites	3.98	3.98	3.98	0	0	1	0.00	0.00	3.98
Volatilization: land application of sludge	2.04	2.04	2.04	0.1	0.1	0.8	0.20	0.20	1.63
Contaminated Site Remediation	0.00	0.00	0.00	0.2	0.58	0.22	0.00	0.00	0.00
Oil and Gas Exploration and Production	0.00	0.00	0.00	NA	NA	NA	NA	NA	NA
NONPOINT (AREA SOURCE) TOTALS	997 - 1333	997.34	1333.45	0	0	0	103 - 137	179 - 212	716 - 985
MOBILE SOURCES									
On-road	0.17 - 24.17	0.17	24.17	0.004	0.086	0.91	0.0 - 0.10	0.01 - 2.08	0.15 - 21.99
Non-road Rail and Commercial Marine	3.68	3.68	3.68	0.15	0.29	0.56	0.55	1.07	2.06
Non-road Coal-fired Car Ferry	0.24 - 10.80	0.24	10.80	0.15	0.29	0.56	0.04 - 1.62	0.07 - 3.13	0.13 - 6.05
Non-road Equipment and Vehicles - Diesel	0.12	0.12	0.12	0.15	0.29	0.56	0.02	0.04	0.07
Non-road Equipment and Vehicles - Gasoline	1.04	1.04	1.04	0.004	0.086	0.91	0.00	0.09	0.95
Non-road Equipment and Vehicles - Other Fuel Types	0.29	0.29	0.29	NA	NA	NA	NA	NA	NA
MOBILE SOURCE TOTALS	5.54 - 40.10	5.54	40.10	0	0	0	0.61 - 2.29	1.28 - 6.40	3.36 - 31.12
TOTAL Hg AIR EMISSIONS	1901 - 2345	1901.39	2344.77	0	0	0	232 - 275	407 - 454	1262 - 1616

FUEL COMBUSTION

Coal Combustion

Electric Utilities

The estimated mercury released from coal-fired electric utilities was extracted from the USEPA's 2017 NEI. The point source mercury estimates from the NEI were predominantly from the Michigan Air Emissions Reporting System (MAERS) 2017 emissions inventory data. Where the electric utilities did not report mercury to MAERS, the NEI was gap-filled by the USEPA. Gap-filled data utilized unit-specific and "bin" average emission factors collected in support of the Mercury and Air Toxics Standards (MATS) rule. Emission factors were applied against 2017 heat input data from the USEPA's Clean Air Markets Division Data.

Several of the 2017 NEI values are based on MAERS default emission estimates for mercury, in cases where a facility did not report a mercury value. For the 2017 AQD mercury report, staff of the AQD's Emissions Reporting and Assessment Unit (ERAU) created an alternate estimate by applying appropriate "bin" emission factors from the MATS rule to facility throughput values and heat input data from MAERS. The table below shows where those values were utilized for this report. Mercury estimates are presented alongside the eight-digit Source Classification Code (SCC) that indicates which processes at each facility were the source of the emissions.

The 2017 estimate of 265.90 lbs of mercury from coal-firing at electric utilities is much lower than the 2014 estimate of 1,832.87 lbs for the utilities. This is due to fuel switching and retirement of coal-fired units.

Table 2. Electric Utilities, Coal Combustion

SRN	Facility Name	Emission Unit ID	SCC	Estimated Mercury Emissions from 2017 NEI in Lbs	MATS Emission Factor-Based Estimate in Place of MAERS Default Estimate	Best Estimate in Lbs
B1833	Marquette Board of Light & Power	EU0003	10100226	1.73		1.73
B1833	Marquette Board of Light & Power	EU0012	10100204	4.99E-03	1.43E-05	1.43E-05
B1976	J.B. Sims Generating Station	EU0023	10100202	0.81		0.81
B2357	Holland BPW, Generating Station & WWTP	EU0012	10100202	0.00		0.00
B2357	Holland BPW, Generating Station & WWTP	EU0013	10100202	0.00		0.00
B2357	Holland BPW, Generating Station & WWTP	EU0014	10100202	0.00		0.00
B2647	LBWL - Eckert Station & REO Town Plant	RG0023	10100222	2.70		2.70
B2796	St. Clair / Belle River Power Plant	EU0105	10100222	5.79		5.79
B2796	St. Clair / Belle River Power Plant	EU0106	10100222	5.98		5.98
B2796	St. Clair / Belle River Power Plant	EU0107	10100222	6.36		6.36
B2796	St. Clair / Belle River Power Plant	EU0108	10100222	0.00		0.00
B2796	St. Clair / Belle River Power Plant	EU0110	10100226	9.01		9.01
B2796	St. Clair / Belle River Power Plant	EU0111	10100226	1.60		1.60
B2796	St. Clair / Belle River Power Plant	EU0119	10100222	32.38		32.38
B2796	St. Clair / Belle River Power Plant	EU0120	10100222	26.51		26.51
B2810	DTE Electric Company - River Rouge Power Plant	EU0040	10100226	4.09		4.09
B2811	DTE Electric Company - Trenton Channel Power Plant	EU0035	10100222	12.29		12.29
B2816	DTE Electric Company - Monroe Power Plant	EU0062	10100222	21.65		21.65

SRN	Facility Name	Emission Unit ID	SCC	Estimated Mercury Emissions from 2017 NEI in Lbs	MATS Emission Factor-Based Estimate in Place of MAERS Default Estimate	Best Estimate in Lbs
B2816	DTE Electric Company - Monroe Power Plant	EU0063	10100222	17.68		17.68
B2816	DTE Electric Company - Monroe Power Plant	EU0064	10100222	13.37		13.37
B2816	DTE Electric Company - Monroe Power Plant	EU0068	10100222	16.03		16.03
B2835	JH Campbell Plant	EU0059	10100222	5.12		5.12
B2835	JH Campbell Plant	EU0061	10100202	5.32		5.32
B2835	JH Campbell Plant	EU0062	10100222	24.00		24.00
B2840	Consumers Energy D.E. Karn Facility	RG0058	10100212	19.44		19.44
B4001	LBWL, Erickson Station	EU0007	10100222	8.89		8.89
B4261	Wisconsin Electric Power Company	EU0032	10100202	1.75		1.75
B4261	Wisconsin Electric Power Company	EU0033	10100202	3.22		3.22
B4261	Wisconsin Electric Power Company	EU0034	10100222	0.16		0.16
B4261	Wisconsin Electric Power Company	EU0035	10100222	6.54		6.54
B4261	Wisconsin Electric Power Company	EU0036	10100222	6.83		6.83
B6611	Michigan Hub LLC	EU0003	10100202	0.00	0	0.00
N1685	TES Filer City Station	RG0017	10100204	6.67		6.67
TOTAL						265.90

Residential

Residential fuel combustion estimates were generated as part of EGLE's submittal to the USEPA's 2017 NEI. For residential coal combustion, an emission factor of 0.00042 lbs/ton was used, along with 2017 statewide fuel consumption data from the United States Department of Energy (USDoE), Energy Information Administration (EIA). As zero tons of residential coal consumption were reported, mercury emissions are assumed to be zero (EGLE, 2021).

Table 3. Residential Coal Combustion

Data Source	Mercury Emissions in Lbs	Nonpoint Sector
2017 NEI	0	Fuel Comb. - Residential Coal

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 the USEPA's 2017 NEI (EGLE, 2021). The 2017 estimate of 45.33 lbs of mercury emissions from this fuel combustion sector is substantially lower than the 2014 estimate of 214.54 lbs. A number of the facilities from the 2014 inventory either reported zero coal-burning activity for the processes in 2017, or dismantled their equipment prior to 2017 (EGLE, 2021). The following industrial and commercial sources of coal combustion were included in the estimate:

Table 4. Industrial/Commercial Coal Combustion

SRN	Facility Name	SCC[1]	Coal in Tons	Emission Factor in Lb/Ton	Estimated Emissions in Lbs
A0884	Verso Escanaba, LLC	10200212	8619	4.16E-04	1.434
B1824	Morton Salt, Inc.	10100205	40438	4.16E-04	16.82
B1966	White Pine Electric Power, LLC	10200202	0	4.16E-04	0
B2873	Michigan Sugar Company - Sebewaing Factory	10100204	24165	4.16E-04	4.021
B3692	Packaging Corporation of America - Filer City Mill	10100202	0	4.16E-04	0
N0677	Steelcase Inc., Kentwood Complex	10100204	0	4.16E-04	0
A6475	Zellar MPI Equipment	10200204	0	4.16E-04	0.00
B1470	Neenah Paper – Michigan, Inc.	10200204	46889	4.16E-04	19.51
B1855	Menominee Acquisition Corporation	10200204	0	4.16E-04	0.00
B1966	White Pine Electric Power, LLC	10200204	0	4.16E-04	0.00
B3610	Pharmacia & Upjohn Co LLC, a subsidiary of Pfizer	10200204	8298.78	4.16E-04	3.45
B7192	Verso Quinnesec, LLC	10200204	224.8	4.16E-04	0.09
B7227	General Motors, LLC - Orion Assembly	10200204	0	4.16E-04	0.00
Total					45.33

[1] Michigan's state-specific mercury emission factor for SCC 10200204 was inactivated in MAERS prior to 2017 due to the unknown origin of the factor. However, review indicates it is the emission factor for a similar coal-fired process (10100202 - Boiler, Dry Bottom rather than 10200204 - Boiler, Spreader Stoker) after unit conversion from lb/MMBtu to lb/ton. It will therefore be utilized as a placeholder value for mercury emissions from the coal-fired processes identified by SCC 10200204.

Nonpoint Coal Combustion, Industrial and Commercial-Institutional

For the 2017 NEI, the USEPA estimated zero lbs of mercury emissions from nonpoint industrial and commercial-institutional sources that burned coal.

Table 5. Nonpoint Combustion of Coal from Industrial and Commercial-Institutional Sources

Data Source	Mercury Emissions in Lbs	Nonpoint Sector
2017 NEI	0	Fuel Comb. - Industrial & Comm/Institutional Coal

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 2017 NEI (EGLE, 2021). 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 6. Electric Utilities, External Combustion Boilers

SRN	Facility Name	SCC	Factor in LB/E3GAL	Oil in E3GAL	Estimated Emissions in Lbs
B2796	St. Clair / Belle River Power Plant	10200501	4.20E-04	153.54	0.06
B2816	DTE Electric Company - Monroe Power Plant	10200501	4.20E-04	19.22	0.01
B2835	JH Campbell Plant	10100501	4.20E-04	82.992	0.03
B2840	Consumers Energy D.E. Karn Facility	10100401	1.13E-04	1526.1	0.17
B4001	LBWL, Erickson Station	10100501	4.20E-04	17	0.01
B4252	AEP Cook Nuclear Plant	10100501	4.20E-04	12.226	0.01
B6145	DTE Electric Company - Greenwood Energy Center	10100401	1.13E-04	14.14	0.00
B6145	DTE Electric Company - Greenwood Energy Center	10100501	4.20E-04	21.89	0.01
B6145	DTE Electric Company - Greenwood Energy Center	10200501	4.20E-04	0	0.00
B6611	Michigan Hub LLC	10100501	4.20E-04	0	0.00
M4148	Detroit Renewable Power, LLC	10100501	4.20E-04	1182.8	0.47
Total					0.77

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 (EGUs) were presented below for 2017, based on data from MAERS and standard USEPA emission factors (EGLE, 2021). Mercury in the amount of 0.15 lbs was estimated for this sector.

Table 7. Electric Utilities, Stationary Internal Combustion Engines

SRN	Facility Name	SCC	Emission Factor in Lb/E3 GAL	Diesel Fuel in E3 GAL	Estimated Emissions in Lbs
B2357	Holland BPW, Generating Station & WWTP	20200102	4.13E-05	0.247	1.02E-05
B2806	DTE Electric Co. - Superior Peaking Facility	20100101	1.64E-04	8.886	1.46E-03
B2808	DTE Electric Co. - Northeast Peaking Facility	20100101	1.64E-04	58.89	9.68E-03
B2835	JH Campbell Plant	20100101	1.64E-04	35.534	5.84E-03
B2835	JH Campbell Plant	20200102	4.13E-05	4.768	1.97E-04
B2840	Consumers Energy D.E. Karn Facility	20200102	4.13E-05	1.317	5.44E-05
B4321	DTE Electric Company - Fermi Energy Center	20100101	1.64E-04	689.7	1.13E-01
B5421	Wolverine Power Supply Cooperative	20200102	4.13E-05	0.11	4.54E-06
B6553	Upper Peninsula Power Company - Portage	20100101	1.64E-04	50.8	8.35E-03
N1430	Upper Peninsula Power Company - Gladstone	20100101	1.64E-04	10.3248	1.70E-03
N2586	Holland BPW, 48th Street Peaking Station	20100101	1.64E-04	0	0.00E+00
N2586	Holland BPW, 48th Street Peaking Station	20200102	4.13E-05	0.234	9.66E-06
N5887	Marquette Board of Light & Power	20100101	1.64E-04	7.266	1.20E-03
N6000	Holland Board of Public Works	20100101	1.64E-04	3.511	5.77E-04
N6171	Wolverine Power, Tower Power Plant	20100101	1.64E-04	18.33	3.01E-03
N6249	Wolverine Power, Vestaburg Power Plant	20100101	1.64E-04	0	0.00E+00
N6833	Wolverine Power, Gaylord Generating Station	20200102	4.13E-05	0.431	1.78E-05
P0068	Consumers-Ludington Pump Storage Facility	20200102	4.13E-05	0.0256	1.06E-06
P0465	Holland Board of Public Works-Holland Energy Park	20200102	4.13E-05	0.139	5.74E-06
P0582	Wolverine Power Supply Co-Op - Alpine Power Plant	20200102	4.13E-05	0.41	1.69E-05
Total					0.15

Residential

For mercury emitted by residential oil combustion, the USEPA's 2017 NEI calculation was utilized.

Table 8. Residential Oil Combustion

Data Source	Mercury Emissions in Lbs	Nonpoint Sector
2017 NEI	8.65	Fuel Comb. - Residential Oil

Industrial/Commercial (External Combustion Boilers)

Point source estimates, such as those for industrial and commercial combustion of oil, were collected from MAERS (EGLE, 2021). These point source estimates were generated as part of Michigan's submittal to the USEPA's 2017 NEI. Mercury in the amount of 0.17 lbs was estimated for this sector. The following industrial and commercial oil-fired, external combustion boilers were included in the estimate:

Table 9. Industrial/Commercial (External Combustion Boilers)

SRN	Facility Name	SCC	Oil in E3 GAL	Emission Factor in Lb/E3 GAL	Estimated Emissions in Lbs
A0023	Otsego Paper, Inc.	10200501	0	4.20E-04	0.00
A2402	Access Business Group, LLC	10200501	0.32	4.20E-04	1.34E-04
A2849	Wacker Chemical Corp.	10200501	0	4.20E-04	0.00
A5858	Mead Johnson & Company, LLC	10200501	0	4.20E-04	0.00
A6218	Dunn Paper, Inc.	10200501	0	4.20E-04	0.00
A6475	UP Paper, LLC	10200501	0	4.20E-04	0.00
B1470	Neenah Paper – Michigan, Inc.	10200501	0	4.20E-04	0.00
B1479	Certainteed Ceilings Corp.	10200501	0	4.20E-04	0.00
B1606	General Motors, LLC Flint Assembly	10200501	0	4.20E-04	0.00
B1678	Graphic Packaging International, LLC	10200501	0	4.20E-04	0.00
B1827	Empire Iron Mining Partnership	10200501	0	4.20E-04	0.00
B2024	Ox Paperboard WP, LLC	10200501	0	4.20E-04	0.00
B2064	Ford Motor Co/Rawsonville Plant	10200501	0	4.20E-04	0.00
B2155	Solutia, Inc.	10200502	0	NA	0.00
B2814	Detroit Thermal Beacon Heating Plant	10300501	0	4.20E-04	0.00
B2934	Palisades Nuclear Plant	10200501	41.76	4.20E-04	1.75E-02
B3610	Pharmacia & Upjohn Co., LLC, A Subsidiary of Pfizer	10200501	0	4.20E-04	0.00
B9181	Sunoco Partners Marketing & Terminals LP - Owosso	10300504	0	NA	0.00
C5704	Lakeland Medical Center (Former Memorial Hospital)	10300501	0.243	4.20E-04	1.02E-04
D8065	Dart Container Corporation of Michigan	10300501	0.029	4.20E-04	1.22E-05
H5877	Eastern MI University	10300501	0	4.20E-04	0.00
K1271	Henry Ford Hospital	10300501	0.66	4.20E-04	2.77E-04
K1283	Beaumont Health Trenton Hospital	10300501	0	4.20E-04	0.00
K2087	Lakeland Correctional Facility	10300501	4.83	4.20E-04	2.03E-03
K2460	Central Michigan University	10300501	0.065	4.20E-04	2.73E-05
K2688	B.O.P. Federal Correctional Institute	10300501	2.425	4.20E-04	1.02E-03
M0675	University of Michigan	10300501	6.772	4.20E-04	2.84E-03
M1954	Covenant Health Care	10300501	330	4.20E-04	1.39E-01
M3431	St Joseph Mercy Hospital	10300501	7.3	4.20E-04	3.07E-03
M3641	University of Michigan Flint	10200501	0	4.20E-04	0.00
M3653	VA Medical Center	10300501	5.219	4.20E-04	2.19E-03

SRN	Facility Name	SCC	Oil in E3 GAL	Emission Factor in Lb/E3 GAL	Estimated Emissions in Lbs
M3792	Northern Michigan University	10300501	0	4.20E-04	0.00
M4132	Walter P. Reuther Psychiatric Hospital	10300501	0	4.20E-04	0.00
M4803	GSA - Federal Building	10500205	0.222	NA	9.19E-05
N0780	Louisiana-Pacific Corp. Newberry Plant	10200501	0.084	4.20E-04	3.53E-05
N5930	Delta College	10100501	0	4.20E-04	0.00
N6016	Ascension Genesys Hospital	10300501	0.237	4.20E-04	9.95E-05
N7864	Umicore Autocat USA, Inc.	10300503	0.61	NA	2.40E-04
Total					0.17

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 2017, based on data from MAERS and standard USEPA emission factors. Mercury in the amount of 0.107 lbs was estimated for this sector.

Table 10. Stationary Internal Combustion Engines (Oil-fired, Industrial/Commercial)

SRN	Facility Name	SCC	Diesel Fuel in E3 GAL	Emission Factor in Lb/E3 GAL	Estimated Emissions in Lbs
A0023	Otsego Paper, Inc.	20200102	0.13	4.129E-05	5.37E-06
A1641	General Motors Lansing Grand River Assembly	20200102	1.66	4.129E-05	6.85E-05
A3567	Ford Motor Company - Sterling Plant	20200102	0.987	4.129E-05	4.08E-05
A3569	Axalta Coating Systems, LLC- Mt Clemens Plant	20200102	1.548	4.129E-05	6.39E-05
A4043	Dow Silicones Corporation	20200102	2.119	4.129E-05	8.75E-05
A5262	General Motors, LLC - Milford Proving Ground	20200102	17.359	4.129E-05	7.17E-04
A5764	Ventra Evart, LLC	20200102	0.16	4.129E-05	6.61E-06
A5858	Mead Johnson & Company, LLC	20200102	0.703	4.129E-05	2.90E-05
A7809	US Steel Great Lakes Works	20200102	3.6	4.129E-05	1.49E-04
A8638	Detroit Diesel Corporation	20200102	1	4.129E-05	4.13E-05
A8640	AK Steel - Dearborn Works	20200102	10.48	4.129E-05	4.33E-04
A8645	Ford Motor Co. Livonia Transmission	20200102	0.8164	4.129E-05	3.37E-05
A8648	Ford Motor Co. Rouge Complex	20200102	1.9136	4.129E-05	7.90E-05
A8650	Ford Motor Co. Wayne Complex	20200102	2.31	4.129E-05	9.54E-05
B1476	Decorative Panels International/Alpena Biorefinery	20200102	0.166	4.129E-05	6.85E-06
B1548	Post Foods	20200102	0.0464	4.129E-05	1.92E-06
B1771	Ford Motor Company Van Dyke Plant	20200102	1.518	4.129E-05	6.27E-05
B1798	General Motors, LLC - Warren Transmission Plant	20200102	0.78	4.129E-05	3.22E-05
B1846	Occidental Chemical Corporation	20200102	0.21438	4.129E-05	8.85E-06
B1855	Dunn Paper, Inc.	20200102	170.24	4.129E-05	7.03E-03
B1991	GM LLC Saginaw Metal Casting Operations	20200102	1.18	4.129E-05	4.87E-05
B2013	Ox Engineered Products	20200102	0.22	4.129E-05	9.08E-06
B2063	Faurecia Interior Systems Saline, LLC	20200102	0.77	4.129E-05	3.18E-05
B2064	Ford Motor Co/Rawsonville Plant	20200102	0.53	4.129E-05	2.19E-05
B2132	Wyandotte Dept Muni Power Plant	20200102	0.092	4.129E-05	3.80E-06
B2209	Eaton Corporation - Galesburg Campus	20200102	105.82	4.129E-05	4.37E-03
B2357	Holland BPW, Generating Station & WWTP	20200102	0.247	4.129E-05	1.02E-05
B2644	Hemlock Semiconductor Operations, LLC	20200102	6.698	4.129E-05	2.77E-04
B2808	DTE Electric Company - Northeast Peaking Facility	20200102	0	4.129E-05	0.00E+00
B2816	DTE Electric Company - Monroe Power Plant	20200102	0.3867	4.129E-05	1.60E-05
B2835	JH Campbell Plant	20200102	4.768	4.129E-05	1.97E-04

SRN	Facility Name	SCC	Diesel Fuel in E3 GAL	Emission Factor in Lb/E3 GAL	Estimated Emissions in Lbs
B2840	Consumers Energy D.E. Karn Facility	20200102	1.317	4.129E-05	5.44E-05
B2869	Ford Motor Company - Romeo Engine Plant	20200102	0.5197	4.129E-05	2.15E-05
B2934	Palisades Nuclear Plant	20200102	0.427	4.129E-05	1.76E-05
B2942	Consumers Energy Gaylord Combustion Turbine Plant	20200102	0.24025	4.129E-05	9.92E-06
B2956	Ford Motor Co. New Model Program Ctr	20200102	0.389	4.129E-05	1.61E-05
B3241	Ford Motor Co. Brownstown	20200102	0.0449	4.129E-05	1.85E-06
B3350	FCA US, LLC Trenton Engine Complex	20200102	1.156	4.129E-05	4.77E-05
B3534	Edw. C. Levy Co. Plant 2 Portable Crusher	20200102	1.5	4.129E-05	6.19E-05
B3610	Pharmacia & Upjohn Co., LLC, A Subsidiary of Pfizer	20200102	2.64	4.129E-05	1.09E-04
B4001	LBWL, Erickson Station	20200102	0.256	4.129E-05	1.06E-05
B4032	General Motors, LLC Pontiac Engineering Center	20200102	2.47	4.129E-05	1.02E-04
B4058	Rieth Riley Construction Co., Inc.	20200102	6.209	4.129E-05	2.56E-04
B4072	Westrock California, LLC	20200102	0.0864	4.129E-05	3.57E-06
B4102	US Gypsum Co	20200102	2.2	4.129E-05	9.08E-05
B4147	Rieth Riley Construction Co., Inc.	20200102	4.6	4.129E-05	1.90E-04
B4164	Bolen Asphalt Paving, Inc.	20200102	17.6	4.129E-05	7.27E-04
B4288	Zoetis, LLC	20200102	0.155	4.129E-05	6.40E-06
B4383	Kasson Sand and Gravel	20200102	7.302	4.129E-05	3.02E-04
B5421	Wolverine Power Supply Cooperative	20200102	0.11	4.129E-05	4.54E-06
B6177	Wiegand's Crushing, Inc.	20200102	26.5563	4.129E-05	1.10E-03
B6230	Ford Motor Co. Research & Dev. Ctr.	20200102	1.9	4.129E-05	7.85E-05
B6508	Village of Clinton	20200102	0.238	4.129E-05	9.83E-06
B6527	Midland Cogeneration Venture	20200102	0	4.129E-05	0.00E+00
B7090	Michigan Milk Producers Association	20100101	1.01	1.644E-04	1.66E-04
B7302	Weyerhaeuser NR Company	20200102	1.17	4.129E-05	4.83E-05
B8570	The Andersons Marathon Holdings, LLC	20200102	1.744	4.129E-05	7.20E-05
D8065	Dart Container Corporation of Michigan	20200102	11.0261	4.129E-05	4.55E-04
F3254	Selfridge Air National Guard Base	20300102	2.2	1.644E-04	3.62E-04
G7126	Grand Valley State University	20200102	1.3188	4.129E-05	5.45E-05
K2460	Central Michigan University	20200102	1.3255	4.129E-05	5.47E-05
K3249	Michigan State University	20200102	36.96	4.129E-05	1.53E-03
M0675	University of Michigan	20200102	3.953	4.129E-05	1.63E-04
M0675	University of Michigan	20200103	0	1.668E-04	0.00E+00
M4174	Detroit Metropolitan Wayne County Airport	20100101	2.376	1.644E-04	3.91E-04
M4175	Ford Motor Co,	20200102	0.845	4.129E-05	3.49E-05
M4199	General Motors, LLC Detroit-Hamtramck Assembly	20200102	1.23	4.129E-05	5.08E-05
M4731	Ajax Paving Industries, Inc.	20200102	35	4.129E-05	1.45E-03
N0503	Lyon Sand & Gravel Co. - Rap Plant	20200102	25.116	4.129E-05	1.04E-03
N0929	Ford Motor Company - Flat Rock Assembly	20200102	1.5149	4.129E-05	6.26E-05
N1192	Denso Manufacturing Michigan, Inc.	20200102	0.2	4.129E-05	8.26E-06
N1316	NIT Enterprises, LLC (formerly MayCo. Plastics)	20200102	1.131	4.129E-05	4.67E-05
N1357	Rieth-Riley Construction Co., Inc.	20200102	0	4.129E-05	0.00E+00
N1436	FCA US Technology Center	20200102	0.4	4.129E-05	1.65E-05
N1656	Albrecht Sand and Gravel	20200102	17.43	4.129E-05	7.20E-04
N1685	TES Filer City Station	20200102	0.057	4.129E-05	2.35E-06
N1905	Bolen Asphalt Paving, Inc.	20200102	13.6	4.129E-05	5.62E-04
N1917	Ajax Paving Industries, Inc.	20200102	0	4.129E-05	0.00E+00
N2155	FCA US LLC - Jefferson North Assembly Plant	20200102	694	4.129E-05	2.87E-02
N2184	Rieth Riley Construction Co., Inc.	20200102	24.5	4.129E-05	1.01E-03
N2388	Grayling Generating Station Ltd. Partnership	20200102	1.048	4.129E-05	4.33E-05
N2586	Holland BPW, 48th Street Peaking Station	20200102	0.234	4.129E-05	9.66E-06
N2627	Great Lakes Aggregates, Hazmag Plant	20200102	47.594	4.129E-05	1.97E-03
N3152	American Aggregates of Michigan Eljay 54	20200102	2.059	4.129E-05	8.50E-05
N3177	Aggregate Industries - AC3 Portable Plant	20200102	0	4.129E-05	0.00E+00
N3396	A & E Agg. Inc. (Plant 1) - Brown Road, Orion Twp.	20200102	5.2	4.129E-05	2.15E-04

SRN	Facility Name	SCC	Diesel Fuel in E3 GAL	Emission Factor in Lb/E3 GAL	Estimated Emissions in Lbs
N3435	Balkema Excavating/Aggregate Resources Plant 102	20200102	7.726	4.129E-05	3.19E-04
N3570	Genesee Power Station Limited Partnership	20200102	0.064	4.129E-05	2.64E-06
N3631	GMI Clinton	20200102	30.507	4.129E-05	1.26E-03
N3920	Consumers Energy - Freedom Compressor Station	20200102	1.5855	4.129E-05	6.55E-05
N5131	Balkema Excavating/Aggregate Resources Plant 103	20200102	17.277	4.129E-05	7.13E-04
N5241	Great Lakes Aggregates, LLC - Sylvania Minerals	20200102	0	4.129E-05	0.00E+00
N5477	R E Glancy Inc.	20200102	10.29	4.129E-05	4.25E-04
N5748	Elmer's Crane and Dozer, Inc.	20200102	9.999	4.129E-05	4.13E-04
N5772	Mathy Construction Co. Plant 24	20200102	0	4.129E-05	0.00E+00
N5841	Halliday Sand & Gravel Inc. - Plant #2	20200102	24	4.129E-05	9.91E-04
N5842	Halliday Sand & Gravel Inc. - Plant #3	20200102	23.2	4.129E-05	9.58E-04
N5963	R E Glancy Inc.	20200102	21.15	4.129E-05	8.73E-04
N5998	Aggregate Industries - Nb1 Portable Plant	20200102	0	4.129E-05	0.00E+00
N6022	Rieth Riley Construction Co., Inc.	20200102	71.89	4.129E-05	2.97E-03
N6197	Aggregate Industries - AC2 Portable Plant	20200102	12.926	4.129E-05	5.34E-04
N6283	Aggregate Industries - Day Road	20200102	49.9	4.129E-05	2.06E-03
N6306	Hanlee Equipment LLC	20200102	13.768	4.129E-05	5.69E-04
N6307	Halliday Sand & Gravel, Plant #1 225-97A	20200102	14	4.129E-05	5.78E-04
N6338	Tri City Aggregates	20200102	4.4	4.129E-05	1.82E-04
N6355	R.E. Glancy, Inc.	20200102	12.78	4.129E-05	5.28E-04
N6385	AMC-Mid Michigan Materials, LLC	20200102	0.855	4.129E-05	3.53E-05
N6413	Rieth Riley Construction Co., Inc.	20200102	47.753	4.129E-05	1.97E-03
N6429	Halliday Sand & Gravel (945 Cone)	20200102	8.8	4.129E-05	3.63E-04
N6430	Halliday Sand & Gravel-Hazmag	20200102	0	4.129E-05	0.00E+00
N6432	Tri City Aggregates	20200102	11.83	4.129E-05	4.89E-04
N6448	Manthei Development Corp/ MDC Contracting, LLC	20200102	2.43	4.129E-05	1.00E-04
N6453	Elmer's Crane and Dozer, Inc.	20200102	3.1556	4.129E-05	1.30E-04
N6488	SRM Concrete LLC	20200102	26.8	4.129E-05	1.11E-03
N6521	Consumers Energy Co. - Zeeland Generating Station	20200102	0.31	4.129E-05	1.28E-05
N6589	Balkema Excavating, Inc. - Portable Plant 101	20200102	0	4.129E-05	0.00E+00
N6599	Florence Cement Company, Inc.	20200102	3.656	4.129E-05	1.51E-04
N6600	Florence Cement Co. Inc.	20200102	7.326	4.129E-05	3.03E-04
N6608	Rieth-Riley Construction Co., Inc.	20200102	71.89	4.129E-05	2.97E-03
N6626	Consumers Energy Co. - Jackson Generating Station	20200102	0.2652	4.129E-05	1.10E-05
N6631	Dearborn Industrial Generation	20200102	2.99	4.129E-05	1.23E-04
N6664	Custom Crushing & Recycle, Inc.	20200102	41.21	4.129E-05	1.70E-03
N6704	Hubscher & Son, Inc. - Pioneer 50Ve Portable	20200102	5.644	4.129E-05	2.33E-04
N6705	Hubscher & Son, Inc.- Cedar Rapids 443	20200102	3.858	4.129E-05	1.59E-04
N6749	Carrick Gravel and Crushing	20200102	8.235	4.129E-05	3.40E-04
N6750	Elmer's Crane and Dozer, Inc.	20200102	0.504	4.129E-05	2.08E-05
N6762	Dykema Excavators, Inc.	20200102	3.873	4.129E-05	1.60E-04
N6767	New Covert Generating Company, LLC	20200102	0.365	4.129E-05	1.51E-05
N6804	Klett Recycle, Inc.	20200102	36.51	4.129E-05	1.51E-03
N6833	Wolverine Power, Gaylord Generating Station	20200102	0.431	4.129E-05	1.78E-05
N6837	Rock Recyclers	20200102	55.713	4.129E-05	2.30E-03
N6849	Parker Excavating Gravel & Recycle, Inc.	20200102	4.472	4.129E-05	1.85E-04
N6850	Parker Excavating Gravel & Recycle, Inc.	20200102	2.61	4.129E-05	1.08E-04
N6851	Parker Excavating Gravel & Recycle, Inc.	20200102	6.438	4.129E-05	2.66E-04
N6861	Custom Crushing Lakeshore	20200102	36.82	4.129E-05	1.52E-03
N6880	Carr Brothers & Sons, Inc. - Plant 2	20200102	16.794	4.129E-05	6.93E-04
N6883	Carr Brothers & Sons, Inc. - Plant 1	20200102	13.002	4.129E-05	5.37E-04
N6901	R. Smith & Sons, Inc. - Plant #1	20200102	18.084	4.129E-05	7.47E-04
N6913	Searles Construction - 45 Plant	20200102	6.58	4.129E-05	2.72E-04

SRN	Facility Name	SCC	Diesel Fuel in E3 GAL	Emission Factor in Lb/E3 GAL	Estimated Emissions in Lbs
N6914	Searles Construction - Wash Plant	20200102	10.61	4.129E-05	4.38E-04
N6950	General Motors, LLC - Lansing Delta Township	20200102	1.188	4.129E-05	4.91E-05
N6957	Halliday Sand and Gravel, Inc. (6000 Cone Plant)	20200102	10.6	4.129E-05	4.38E-04
N7011	Grosso Trucking and Supply Company	20200102	6.1	4.129E-05	2.52E-04
N7151	Mid-Michigan Materials-Bechtel	20200102	10.35	4.129E-05	4.27E-04
N7168	American Aggregates-Telsmith 52G Portable Crusher	20200102	7.111	4.129E-05	2.94E-04
N7232	Carl Schlegel, Inc.	20200102	0	4.129E-05	0.00E+00
N7259	Alpena Aggregate, Inc.	20200102	22.438	4.129E-05	9.27E-04
N7288	Weber Sand and Gravel, Inc. - Cedar Rapids	20200102	22.521	4.129E-05	9.30E-04
N7375	American Aggregates of Michigan, Inc. Sandvik Cone	20200102	2.25	4.129E-05	9.29E-05
N7383	Valero Renewable Fuels Company, LLC	20200102	2.14	4.129E-05	8.84E-05
N7385	S&M Gravel, Inc.	20200102	1.39	4.129E-05	5.74E-05
N7390	Balkema Excavating, Inc. Plant 104	20200102	11.515	4.129E-05	4.76E-04
N7392	Mack Truck & Wiegand's Crushed Concrete	20200102	20.34	4.129E-05	8.40E-04
N7407	Barber Creek Sand and Gravel, Inc.	20200102	7.549	4.129E-05	3.12E-04
N7595	R. Smith and Sons, Inc.	20200102	10.032	4.129E-05	4.14E-04
N7618	Great Lakes Aggregates, LLC Terex Facility	20200102	37.774	4.129E-05	1.56E-03
N7688	Dicastal North America, Inc.	20200102	0.6	4.129E-05	2.48E-05
N7858	Tri City Aggregates	20200102	2.15	4.129E-05	8.88E-05
N7886	Hyundai America Technical Center, Inc. (HATCI)	20200102	0.154	4.129E-05	6.36E-06
N7996	Florence Cement Plant #741	20200102	2.364	4.129E-05	9.76E-05
N8066	Carl Schlegel, Inc.	20200102	0	4.129E-05	0.00E+00
N8078	Joy Construction & Leasing, Inc.	20200102	0	4.129E-05	0.00E+00
N8162	Clayton Unit CPF	20200102	0.794	4.129E-05	3.28E-05
N8252	Barber Creek Sand and Gravel	20200102	2.241	4.129E-05	9.25E-05
P0068	Consumers-Ludington Pump Storage Facility	20200102	0.0256	4.129E-05	1.06E-06
P0197	Bierlein Companies, Inc.	20200102	0.12	4.129E-05	4.96E-06
P0269	Bierlein Companies, Inc.	20200102	0	4.129E-05	0.00E+00
P0358	Kraken Crushed Concrete & Recycling - Northville	20200102	9.322	4.129E-05	3.85E-04
P0377	Florence Cement Company	20200102	2.368	4.129E-05	9.78E-05
P0411	Revolution Onsite Crushing	20200102	10.7	4.129E-05	4.42E-04
P0465	Holland Board of Public Works-Holland Energy Park	20200102	0.139	4.129E-05	5.74E-06
P0517	Maroa Farms, Inc. and Pepperco-USA, Inc.	20200102	10.03	4.129E-05	4.14E-04
P0526	Great Lakes Fusion, LLC	20200102	11.5	4.129E-05	4.75E-04
P0539	Weber Sand & Gravel Inc.-North Branch	20200102	13.983	4.129E-05	5.77E-04
P0582	Wolverine Power Supply Co-Op - Alpine Power Plant	20200102	0.41	4.129E-05	1.69E-05
P0594	Magna Closures Lighting Division	20200102	0.075	4.129E-05	3.10E-06
P0599	Toebe Construction, LLC - Brighton	20200102	8.176	4.129E-05	3.38E-04
P0627	James Peterson Sons, Inc.	20200102	0	4.129E-05	0.00E+00
P0668	Marquette Board of Light and Power	20200102	47.502	4.129E-05	1.96E-03
P0691	Dynamic Crushing, LLC	20200102	100	4.129E-05	4.13E-03
P0755	Weber Sand & Gravel, Inc. PTI 170-16	20200102	17.403	4.129E-05	7.19E-04
P0791	Melching, Inc.	20200102	2.109	4.129E-05	8.71E-05
P0798	Palmer Farms, Inc.	20200102	0.5	4.129E-05	2.06E-05
P0825	DCF Recycling, Inc.	20200102	0.36	4.129E-05	1.49E-05
P0828	Custom Crushing & Recycle, Inc.	20200102	29.868	4.129E-05	1.23E-03
Total					0.1073

Nonpoint Oil Combustion Industrial and Commercial-Institutional

Within the 2017 NEI, the USEPA estimated a total of 0.37 lbs of mercury emissions from nonpoint industrial and commercial-institutional sources that burned oil. This includes boilers and internal combustion engines. The value is lower than the 2014 NEI v2 estimate of 9.66 lbs. The 2017 estimate for industrial, commercial and institutional (ICI) boilers and engines was prepared by the USEPA with the latest version of their ICI Tool (v2.0) in March 2020.

Table 11. Nonpoint Combustion of Oil from Industrial and Commercial-Institutional Sources

Data Source	Mercury Emissions in Lbs	Nonpoint Sector
2017 NEI	0.37	Fuel Comb. - Industrial and Comm/Institutional Oil

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 of 2.6E-04 lb/MMCF used in previous inventory years in MAERS. The EPRI factor has since been added to MAERS as a state-specific emission factor, and the 2017 mercury values from MAERS were calculated accordingly. The estimated mercury emissions for this category were 1.36E-04 lbs statewide (EGLE, 2021).

The following sources are included in the estimate for emissions from natural gas-fired electric utilities:

Table 12. Electric Utilities, Natural Gas Combustion

SRN	Facility Name	SCC	Natural Gas in MMCF	MAERS Factor in Lb/MMCF	Estimated Emissions in Lbs from MAERS
B2132	Wyandotte Dept. Muni Power Plant	10100601	238.84	8.00E-10	1.91E-07
B2357	Holland BPW, Generating Station & WWTP	10100601	1.35	8.00E-10	4.32E-10
B2647	LBWL - Eckert Station & REO Town Plant	20100201	3958	8.00E-10	3.17E-06
B2796	St. Clair / Belle River Power Plant	10100601	0	8.00E-10	0.00E+00
B2796	St. Clair / Belle River Power Plant	20100201	4487.67	8.00E-10	3.59E-06
B2798	DTE Electric Company - Delray Power Plant	20100201	336.7	8.00E-10	2.69E-07
B2805	DTE Electric Company - Hancock Peaking Facility	20100201	114	8.00E-10	9.12E-08
B2808	DTE Electric Company - Northeast Peaking Facility	20100201	43.4	8.00E-10	3.47E-08
B2810	DTE Electric Company - River Rouge Power Plant	10100601	0	8.00E-10	0.00E+00
B2810	DTE Electric Company - River Rouge Power Plant	10200601	112.02	8.00E-10	8.96E-08
B2811	DTE Electric Company - Trenton Channel Power Plant	10200602	126.48	8.00E-10	1.01E-07
B2840	Consumers Energy D.E. Karn Facility	10100601	2112.256	8.00E-10	1.69E-06
B2918	Consumers Energy Thetford Combustion Turbine Plant	20100201	10.042	8.00E-10	8.03E-09

SRN	Facility Name	SCC	Natural Gas in MMCF	MAERS Factor in Lb/MMCF	Estimated Emissions in Lbs from MAERS
B2919	Consumers Energy Straits Combustion Turbine Plant	20100201	1.542	8.00E-10	1.23E-09
B2942	Consumers Energy Gaylord Combustion Turbine Plant	20100201	25.587	8.00E-10	2.05E-08
B4260	L'Anse Warden Electric Company LLC	10100601	2.595	8.00E-10	8.30E-10
B5421	Wolverine Power Supply Cooperative	20100201	100.11	8.00E-10	8.01E-08
B6145	DTE Electric Company - Greenwood Energy Center	10100601	4092	8.00E-10	3.27E-06
B6145	DTE Electric Company - Greenwood Energy Center	20100201	1530.8	8.00E-10	1.22E-06
B6527	Midland Cogeneration Venture	10100601	820.96	8.00E-10	6.57E-07
B6527	Midland Cogeneration Venture	20100201	54983.56	8.00E-10	4.40E-05
B6611	Michigan Hub LLC	10100601	0	8.00E-10	0.00E+00
B6611	Michigan Hub LLC	10100602	0	8.00E-10	0.00E+00
M4854	Sumpter Generating Plant	20100201	2187.928	8.00E-10	1.75E-06
N0890	Viking Energy of Lincoln, LLC	10100601	773	8.00E-10	0.00E+00
N1160	Viking Energy of McBain	10100601	5598	8.00E-10	1.79E-06
N1266	Hillman Power Co.	10100602	0.43	8.00E-10	1.38E-10
N2388	Grayling Generating Station Ltd. Partnership	10100601	1.272	8.00E-10	4.07E-10
N2586	Holland BPW, 48th Street Peaking Station	20100201	960.29	8.00E-10	7.68E-07
N3570	Genesee Power Station Limited Partnership	10100601	0.302	8.00E-10	9.66E-11
N5760	Wolverine Power Supply - Hersey	20100201	333.11	8.00E-10	2.67E-07
N6249	Wolverine Power, Vestaburg Power Plant	20100201	23.59	8.00E-10	1.89E-08
N6521	Consumers Energy Co. - Zeeland Generating Station	20100201	23669.1	8.00E-10	1.89E-05
N6526	CMS Generation, Livingston Generating Station	20100201	91.69	8.00E-10	7.34E-08
N6626	Consumers Energy Co. - Jackson Generating Station	20100201	14588.4	8.00E-10	1.17E-05
N6731	CMS Generation Kalamazoo River Generating Station	20100201	80.692	8.00E-10	6.46E-08
N6767	New Covert Generating Company, LLC	20100201	42101.79	8.00E-10	3.37E-05
N6833	Wolverine Power, Gaylord Generating Station	20100201	114.51	8.00E-10	9.16E-08
N6873	DTE Electric Company - Renaissance Power Plant	20100201	2999	8.00E-10	2.40E-06
N7113	Michigan Public Power Agency	20100201	187.539	8.00E-10	1.50E-07
P0375	Lowell Light & Power (Ll&P)	20100201	1.472	8.00E-10	1.18E-09
P0465	Holland Board of Public Works-Holland Energy Park	20100201	2457.21	8.00E-10	1.97E-06
P0582	Wolverine Power Supply Co-Op - Alpine Power Plant	20100201	4912.81	8.00E-10	3.93E-06
TOTALS					1.36E-04

Residential

For residential natural gas combustion, the EPRI emission factor of 8.0E-10 lb/MMCF was used along with the 2017 statewide fuel consumption data from the EIA, USDoE to generate estimated emissions of mercury (EGLE, 2021). This resulted in statewide total emissions from this category of 2.39E-04 lbs, compared to an estimate of 77.38 lbs, which was based on the WebFIRE natural gas combustion factor of 2.60E-04 lb/MMCF.

Table 13. Residential Natural Gas Combustion

Category	Throughput in MMCF	Emission Factor in LB/MMCF	Mercury Emissions in Lbs
Residential Natural Gas Combustion	299,158	8.00E-10	2.39E-04

Industrial/Commercial Boilers

For natural gas combustion from industrial and commercial boilers, the EPRI emission factor of 8.0E-10 lb/MMCF was incorporated into MAERS as a state-specific factor and applied to the facility-reported 2017 activity data. The statewide total mercury emissions estimated for this category were 5.88E-05 lbs.

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

Table 14: Industrial/Commercial Boilers, Natural Gas Combustion

SRN	Facility Name	SCC	Natural Gas in MMCF	MAERS Emission Factor in Lb/MMCF	MAERS Emission Estimates in Lbs
A0023	Otsego Paper Inc.	10200601	16.425	8.00E-10	1.314E-08
A0402	Menasha Packaging Company LLC - Coloma Plant	10200602	38.8	8.00E-10	3.104E-08
A0563	Kellogg USA Inc.	10200602	274.95	8.00E-10	0.00000022
A0884	Verso Escanaba LLC	10200601	2890.484	8.00E-10	2.28257E-06
A0884	Verso Escanaba LLC	10200602	3098.089	8.00E-10	9.9143E-07
A1640	Loc Performance Products	10200602	26.8	8.00E-10	2.144E-08
A1864	Industrial Steel Treat Co.	10300603	195.06	8.00E-10	1.56026E-07
A1932	Royal Adhesives & Sealants	10300603	184.4	8.00E-10	1.475E-07
A1991	Kalsec, Incorporated	10200602	50.36	8.00E-10	4.0286E-08
A2402	Access Business Group, LLC	10200602	56	8.00E-10	4.48E-08
A2620	GM Components Holdings, LLC	10200601	0	8.00E-10	0
A2620	GM Components Holdings, LLC	10200602	173.39	8.00E-10	1.387E-07
A2849	Wacker Chemical Corp	10200602	76.35	8.00E-10	6.108E-08
A3567	Ford Motor Company - Sterling Plant	10200601	0	8.00E-10	0
A3567	Ford Motor Company - Sterling Plant	10200602	0	8.00E-10	0
A3569	Axalta Coating Systems, LLC- Mt Clemens Plant	10200602	24	8.00E-10	1.92E-08
A4033	The Dow Chemical Company U.S.A., Midland	10200601	6.7	8.00E-10	5.36E-09
A4033	The Dow Chemical Company U.S.A., Midland	10200602	34	8.00E-10	2.72E-08
A4043	Dow Silicones Corporation	10200601	75.61	8.00E-10	6.049E-08
A4043	Dow Silicones Corporation	10200602	97.23	8.00E-10	7.778E-08
A4285	Lorin Industries	10200602	49.3	8.00E-10	3.944E-08
A4338	Gerber Products Co.	10200602	343.554	8.00E-10	2.7484E-07
A4741	Michigan Seamless Tube, LLC	10200602	116.09	8.00E-10	9.287E-08
A5262	General Motors LLC - Milford Proving Ground	10300602	425.3408	8.00E-10	3.403E-07
A5806	The Hillshire Brands Company	10200602	235	8.00E-10	0.000000188
A5858	Mead Johnson & Company, LLC	10200602	192.83	8.00E-10	1.5426E-07
A6175	Nexteer Automotive Corporation	10200601	616.66	8.00E-10	4.9327E-07
A6175	Nexteer Automotive Corporation	10200602	28.88	8.00E-10	2.31E-08
A6218	Dunn Paper, Inc.	10200602	410.479	8.00E-10	3.284E-07
A6220	Intertape Polymer Group	10200602	115.12	8.00E-10	9.21E-08
A6240	Cargill Salt - St. Clair	10200601	1283	8.00E-10	0.000001026
A6240	Cargill Salt - St. Clair	10200602	55.29	8.00E-10	4.158E-08
A6380	Abbott Nutrition	10200602	377.266	8.00E-10	3.018E-07
A6475	UP Paper LLC	10200602	983	8.00E-10	7.864E-07
A6714	Georgia-Pacific Corrugated LLC	10200602	52.313	8.00E-10	4.185E-08
A6902	Darling Ingredients Inc.	10200602	38.39	8.00E-10	3.071E-08
A7757	U S Silica Co.	10200602	86.96	8.00E-10	6.539E-08
A7809	U S Steel Great Lakes Works	10200602	1556.57	8.00E-10	1.2452E-06
A8638	Detroit Diesel Corporation	10200602	204.53	8.00E-10	1.6362E-07
A8648	Ford Motor Co Rouge Complex	10200602	55.838	8.00E-10	4.467E-08
A8650	Ford Motor Co/ Wayne Complex	10100602	208.99	8.00E-10	1.672E-07

SRN	Facility Name	SCC	Natural Gas in MMCF	MAERS Emission Factor in Lb/MMCF	MAERS Emission Estimates in Lbs
A8651	Ford Motor Company, Woodhaven Stamping Plant	10200602	18.33	8.00E-10	1.466E-08
A9365	Akwel Cadillac USA, Inc.	10200602	74.28	8.00E-10	5.942E-08
B0070	Georgia-Pacific Corrugated LLC-Owosso Facility	10200602	64	8.00E-10	5.12E-08
B0785	Quaker Chemical Corp.	10200602	37	8.00E-10	2.96E-08
B1470	Neenah Paper - Michigan Inc.	10200601	4.995	8.00E-10	3.996E-09
B1476	Decorative Panels International/Alpena Biorefinery	10200602	1190	8.00E-10	3.8084E-07
B1493	Michigan Sugar Company - Bay City	10200601	2220.716	8.00E-10	1.7766E-06
B1526	Darling Ingredients Inc.	10200602	361.722	8.00E-10	2.894E-07
B1534	Graphic Packaging International, LLC	10200601	1041.4	8.00E-10	8.331E-07
B1537	Treehouse Private Brands, Inc.	10200602	77.09	8.00E-10	6.1672E-08
B1548	Post Foods	10200601	313.319	8.00E-10	2.507E-07
B1604	GM LLC Customer Care & Aftersales - Swartz Creek	10200602	146.19	8.00E-10	0.000000117
B1606	General Motors LLC Flint Assembly	10200601	0	8.00E-10	0
B1633	Sensient Flavors, Inc.	10200602	136.72	8.00E-10	1.094E-07
B1677	Allnex USA Inc.	10100602	372.72	8.00E-10	2.982E-07
B1678	Graphic Packaging International LLC	10200601	2191.836	8.00E-10	1.75353E-06
B1678	Graphic Packaging International LLC	10200602	129.251	8.00E-10	9.72E-08
B1713	American Seating Company	10200602	44	8.00E-10	3.52E-08
B1771	Ford Motor Company-Van Dyke Plant	10200601	0	8.00E-10	0
B1771	Ford Motor Company-Van Dyke Plant	10200602	46.773	8.00E-10	3.742E-08
B1798	General Motors LLC - Warren Transmission Plant	10200602	0	8.00E-10	0
B1801	FCA US LLC, Sterling Stamping Plant	10100602	162.62	8.00E-10	1.301E-07
B1824	Morton Salt, Inc.	10100604	1.34	8.00E-10	5.113E-10
B1824	Morton Salt, Inc.	10200602	0	8.00E-10	0
B1827	Empire Iron Mining Partnership	10200602	0	8.00E-10	0
B1855	Dunn Paper, Inc.	10200602	370.990983	8.00E-10	2.968E-07
B1912	L3 Harris Combat Propulsion Systems	10200602	8.7	8.00E-10	6.96E-09
B1925	Aludyne Montague, LLC	10200602	25.8	8.00E-10	2.064E-08
B1945	Quikrete-Flint	10200602	18.297	8.00E-10	1.376E-08
B1966	White Pine Electric Power LLC	10200602	0	8.00E-10	0
B1976	J.B. Sims Generating Station	10200602	7.55	8.00E-10	6.04E-09
B2013	Ox Engineered Products	10200602	276.92	8.00E-10	2.215E-08
B2014	Day International, Inc. A Flint Group Company	10200602	84.21	8.00E-10	6.737E-08
B2024	Ox Paperboard WP, LLC	10200601	0	8.00E-10	0
B2024	Ox Paperboard WP, LLC	10200602	358.15	8.00E-10	2.865E-07
B2032	FCA US LLC	10200602	9.976	8.00E-10	7.981E-09
B2050	Charles River Laboratories (Formerly MPI Research)	10300602	188.7	8.00E-10	0.000000151
B2050	Charles River Laboratories (Formerly MPI Research)	10300603	88.7	8.00E-10	7.096E-08
B2063	Faurecia Interior Systems Saline, LLC	10200602	48	8.00E-10	3.84E-08
B2064	Ford Motor Co/Rawsonville Plant	10200602	127.27	8.00E-10	1.0182E-07
B2103	GLWA Water Resource Recovery Facility	10300602	32.78160994	8.00E-10	2.62233E-08
B2132	Wyandotte Dept Muni Power Plant	10200602	43.35	8.00E-10	3.468E-08
B2158	Buckeye Terminals, LLC - Woodhaven Terminal	10300602	0	8.00E-10	0
B2217	Eaton Research Center	10300603	17.764	8.00E-10	1.4211E-08
B2329	Par Sterile Products LLC	10200602	81.7563	8.00E-10	6.5397E-08
B2331	Michigan State University - Bioeconomy Institute	10200602	30.8	8.00E-10	2.464E-08
B2359	Conagra Foods Packaged Foods, LLC	10200602	40.094	8.00E-10	3.208E-08
B2429	Faurecia Interior Systems	10200602	2.155	8.00E-10	1.724E-09
B2460	General Motors LLC - Bay City	10200602	196.42	8.00E-10	1.5714E-07
B2561	Packaging Corporation of America	10300602	74.8	8.00E-10	5.984E-08
B2589	MDOC - Jackson Complex	10300602	263.09	8.00E-10	2.105E-07
B2644	Hemlock Semiconductor Operations LLC	10200602	698.668	8.00E-10	5.58976E-07
B2751	Magna Mirrors	10300603	6.22	8.00E-10	4.976E-09
B2763	U.S. Army Garrison-Detroit Arsenal	10200602	1.0881	8.00E-10	8.705E-10
B2763	U.S. Army Garrison-Detroit Arsenal	10300603	98.479	8.00E-10	7.878E-08
B2767	FCA US LLC Warren Truck Assembly Plant	10200601	407.68	8.00E-10	3.2609E-07

SRN	Facility Name	SCC	Natural Gas in MMCF	MAERS Emission Factor in Lb/MMCF	MAERS Emission Estimates in Lbs
B2767	FCA US LLC Warren Truck Assembly Plant	10200602	3.15	8.00E-10	2.52E-09
B2810	DTE Electric Company - River Rouge Power Plant	10200601	112.02	8.00E-10	8.962E-08
B2811	DTE Electric Company - Trenton Channel Power Plant	10200602	126.48	8.00E-10	1.0118E-07
B2814	Detroit Thermal Beacon Heating Plant	10300601	1481.097	8.00E-10	1.1849E-06
B2817	Vertellus Zeeland LLC	10200602	62.5	8.00E-10	0.00000005
B2838	Vicinity Energy Grand Rapids, LLC	10300601	277.9	8.00E-10	2.223E-07
B2838	Vicinity Energy Grand Rapids, LLC	10300602	568.556	8.00E-10	4.54845E-07
B2873	Michigan Sugar Company - Sebewaing Factory	10200602	342.001	8.00E-10	2.736E-07
B2875	Michigan Sugar Company, Caro Factory	10200601	383.201	8.00E-10	3.066E-07
B2875	Michigan Sugar Company, Caro Factory	10200602	291.495	8.00E-10	2.332E-07
B2876	Michigan Sugar Company, Croswell Factory	10200601	569.637	8.00E-10	4.557E-07
B2876	Michigan Sugar Company, Croswell Factory	10200602	147.01	8.00E-10	1.176E-07
B2952	Silbond Corp	10200602	32.108	8.00E-10	2.569E-08
B3012	Detroit Thermal Blvd Heating Plant	10300602	3.795	8.00E-10	3.036E-09
B3037	Fitzgerald Finishing LLC	10300603	139.1	8.00E-10	1.113E-07
B3241	Ford Motor Co Brownstown	10200602	48.367	8.00E-10	3.869E-08
B3291	Gibraltar National Corp / Quikrete Detroit	10100602	10.5644	8.00E-10	8.452E-09
B3350	FCA US LLC Trenton Engine Complex	10200601	55.67	8.00E-10	4.454E-08
B3350	FCA US LLC Trenton Engine Complex	10200602	54.48	8.00E-10	4.358E-08
B3472	Voss Industries-Voss Taylor Div.	10200602	75.24	8.00E-10	6.019E-08
B3610	Pharmacia & Upjohn Co LLC, A Subsidiary of Pfizer	10200601	1420.11	8.00E-10	0.000001136
B3692	Packaging Corporation of America - Filer City Mill	10200601	3695	8.00E-10	2.9562E-06
B3721	ANR Pipeline - Reed City Compressor Station	10200602	438.34	8.00E-10	3.507E-07
B3721	ANR Pipeline - Reed City Compressor Station	10300603	1.074	8.00E-10	8.592E-10
B4032	General Motors LLC Pontiac Engineering Center	10200602	152.33	8.00E-10	1.219E-07
B4045	Kraft Heinz Foods Company	10300602	126.01	8.00E-10	1.008E-07
B4049	GM Technical Center	10200601	645.34	8.00E-10	5.16276E-07
B4049	GM Technical Center	10200602	0.12	8.00E-10	9.6E-11
B4072	Westrock California, LLC	10200601	934.68	8.00E-10	7.477E-07
B4131	MNP Corp.	10300602	252.484	8.00E-10	0.000000202
B4197	AAR Mobility Systems	10200602	89.28	8.00E-10	7.142E-08
B4238	French Paper LLC	10200602	148.4286	8.00E-10	1.187E-07
B4288	Zoetis LLC	10200601	17.44	8.00E-10	1.395E-08
B4288	Zoetis LLC	10200602	180.59	8.00E-10	1.4447E-07
B4302	American Chemical Solutions, LLC	10200602	35.5	8.00E-10	2.84E-08
B4311	Adm Grain Co - Ottawa Lake	10200602	12.23	8.00E-10	9.784E-09
B4359	BASF Corp.	10200602	611.8	8.00E-10	4.894E-07
B4395	Keebler Co.	10200602	65.291	8.00E-10	5.223E-08
B4569	Awrey Bakeries, Inc.	10200602	5.07	8.00E-10	4.056E-09
B4569	Awrey Bakeries, Inc.	10300602	25.631	8.00E-10	2.05E-08
B4569	Awrey Bakeries, Inc.	10300603	6.49	8.00E-10	5.192E-09
B4752	Great Lakes Petroleum Terminal, LLC	10200601	90.4	8.00E-10	7.232E-08
B4885	Tilden Mining Company LC	10200601	1517	8.00E-10	1.2136E-06
B4885	Tilden Mining Company LC	10200602	6.99	8.00E-10	5.592E-09
B4925	O-N Minerals (Michigan) Company Dba Carmeuse Lime	10200602	54.9404	8.00E-10	4.395E-08
B4942	Corteva LLC	10200602	809.1559711	8.00E-10	6.47319E-07
B4977	Vlasic - Conagra Brands	10200602	217.74	8.00E-10	1.7419E-07
B5162	Maksteel Processing LLC a Union Partners Co.	10200602	21.32	8.00E-10	1.706E-08
B5417	DW-National Standard-Niles, LLC	10200602	84.07	8.00E-10	6.726E-08
B5453	Coastal Container Corp	10200602	0	8.00E-10	0
B5830	Ajax Metal Processing Inc.	10200602	149.18	8.00E-10	1.193E-07
B5853	Gannett Publishing Services	10100602	53.95	8.00E-10	4.316E-08
B5966	Sun Chemical Corp	10200602	76.86	8.00E-10	6.149E-08
B6027	Inteva Products Adrian Operations	10200602	43.43	8.00E-10	3.474E-08
B6145	DTE Electric Company - Greenwood Energy Center	10200602	16.06	8.00E-10	1.285E-08

SRN	Facility Name	SCC	Natural Gas in MMCF	MAERS Emission Factor in Lb/MMCF	MAERS Emission Estimates in Lbs
B6178	Huron Valley Steel Corp.	10200602	0	8.00E-10	0
B6179	Lockhart Chemical Company	10200602	59.357	8.00E-10	4.749E-08
B6237	Ypsilanti Comm. Utilities Authority	10200602	1.9044	8.00E-10	1.524E-09
B6420	E.B. Eddy Paper Inc.	10200601	1272.05	8.00E-10	0.000001018
B6420	E.B. Eddy Paper Inc.	10200602	98.09	8.00E-10	7.847E-08
B6519	Albemarle Corporation	10200602	18.613	8.00E-10	1.489E-08
B6569	Henkel Corporation	10200602	32.016	8.00E-10	2.561E-08
B6608	Thelamco Inc.	10200602	3.6289	8.00E-10	2.903E-09
B6619	Tiara Yachts Division of S2 Yachts	10300603	10.1	8.00E-10	8.08E-09
B6620	Coldwater Veneer, Inc.	10300603	0.2	8.00E-10	1.6E-10
B6633	American Axle & Manufacturing, Inc.	10200602	80.325	8.00E-10	6.426E-08
B6636	Consumers Energy - Ray Compressor Station	10200602	42.6204	8.00E-10	3.41E-08
B6636	Consumers Energy - Ray Compressor Station	10300602	28.753	8.00E-10	0.000000023
B6636	Consumers Energy - Ray Compressor Station	10300603	4.7356	8.00E-10	3.788E-09
B6637	Consumers Energy - St. Clair Compressor Station	10200602	2.44333	8.00E-10	1.955E-09
B6637	Consumers Energy - St. Clair Compressor Station	10300602	6.015229	8.00E-10	4.812E-09
B6637	Consumers Energy - St. Clair Compressor Station	10300603	0.10521696	8.00E-10	8.417E-11
B7038	Continental Dairy Facilities, LLC	10200602	442.46	8.00E-10	3.5396E-07
B7090	Michigan Milk Producers Association	10200602	309.18	8.00E-10	2.4739E-07
B7192	Verso Quinnesec, LLC	10200601	238.131	8.00E-10	1.905E-07
B7192	Verso Quinnesec, LLC	10200602	37.189	8.00E-10	1.19E-08
B7198	ANR Pipeline-Cold Sprngs12 /Blue Lk/ Cold Springs 1	10200602	128.82	8.00E-10	1.031E-07
B7198	ANR Pipeline-Cold Sprngs12 /Blue Lk/ Cold Springs 1	10300603	87.52	8.00E-10	7.002E-08
B7220	ANR Pipeline Co - Woolfolk Compressor Station	10300603	146.85	8.00E-10	1.1748E-07
B7227	General Motors LLC - Orion Assembly	10200601	84.69	8.00E-10	6.775E-08
B7227	General Motors LLC - Orion Assembly	10200602	53.74	8.00E-10	4.299E-08
B7244	JBS Plainwell, Inc.	10200602	173.5	8.00E-10	1.388E-07
B7248	FCA US LLC Sterling Heights Assembly Plant	10100602	366.42	8.00E-10	2.9313E-07
B7248	FCA US LLC Sterling Heights Assembly Plant	10200602	211.27	8.00E-10	1.6901E-07
B7248	FCA US LLC Sterling Heights Assembly Plant	10300602	5.21	8.00E-10	4.168E-09
B7248	FCA US LLC Sterling Heights Assembly Plant	10300603	16.09	8.00E-10	1.2872E-08
B7276	L Perrigo Co.	10200602	93.8	8.00E-10	7.504E-08
B7302	Weyerhaeuser NR Company	10200602	45.72	8.00E-10	3.658E-08
B8573	Great Lakes Gas Trans Station #11 (TransCanada #11	10300603	36.07	8.00E-10	2.886E-08
B8574	Evergreen Packaging Inc.	10100602	6.98	8.00E-10	5.584E-09
B8704	Michigan Turkey Producers Co-Op Inc.	10300603	106.8609	8.00E-10	8.549E-08
B8863	Adm Grain Company - Webberville	10200602	0.055483	8.00E-10	4.439E-11
B9080	Envirosolids, LLC	10300603	5.1591	8.00E-10	4.127E-09
C5704	Lakeland Medical Center (Former Memorial Hospital)	10300602	7.4944	8.00E-10	5.996E-09
C5728	Andrews University	10300602	130.643	8.00E-10	1.045E-07
D3598	Hurley Medical Center	10300602	158.7698	8.00E-10	1.2702E-07
D6394	Mid-Michigan Medical Center - Gratiot	10300603	58.28	8.00E-10	4.662E-08
D8065	Dart Container Corporation of Michigan	10200602	183.5068	8.00E-10	1.46809E-07
E4437	Northwest Hardwoods	10200602	23.2	8.00E-10	1.856E-08
E4569	Arkema, Inc.	10200602	46.45	8.00E-10	3.716E-08
E5094	Hutchinson Antivibration Systems, Inc.	10200602	34.612	8.00E-10	2.769E-08
E6807	Spectrum Health Blodgett Campus	10300603	127.93	8.00E-10	1.023E-07
F3254	Selfridge Air National Guard Base	10300603	116.8	8.00E-10	9.344E-08
G5066	St Joseph Mercy Hospital	10300602	198	8.00E-10	1.584E-07
G5067	William Beaumont Hospital	10300602	501.4	8.00E-10	4.011E-07
G5067	William Beaumont Hospital	10300603	17	8.00E-10	1.36E-08
G5252	Oakland Co. Service Center	10300602	141.2	8.00E-10	1.1296E-07
G7126	Grand Valley State University	10300602	151.29	8.00E-10	0.000000121
G7126	Grand Valley State University	10300603	85.84	8.00E-10	6.867E-08
H5877	Eastern MI University	10300601	325.642	8.00E-10	2.605E-07
H5877	Eastern MI University	10300602	0	8.00E-10	0

SRN	Facility Name	SCC	Natural Gas in MMCF	MAERS Emission Factor in Lb/MMCF	MAERS Emission Estimates in Lbs
J4912	Beaumont Hospital - Dearborn	10300602	184.4	8.00E-10	1.475E-07
K1260	Beaumont Hospital - Wayne	10300602	42.1	8.00E-10	3.368E-08
K1271	Henry Ford Hospital	10300602	411	8.00E-10	3.288E-07
K1276	DMC Sinai Grace Hospital	10200602	1.456	8.00E-10	1.165E-09
K1283	Beaumont Health Trenton Hospital	10300602	16	8.00E-10	1.28E-08
K2087	Lakeland Correctional Facility	10300602	95.6	8.00E-10	7.648E-08
K2120	MDOC Ionia Facilities	10300602	265.45	8.00E-10	2.124E-07
K2131	Western Michigan University	10300602	272.7	8.00E-10	2.1816E-07
K2153	Marquette Branch Prison	10300602	85.66	8.00E-10	6.853E-08
K2155	Ferris State University	10300602	346.2	8.00E-10	0.000000277
K2155	Ferris State University	10300603	0.0094	8.00E-10	7.52E-12
K2460	Central Michigan University	10300601	247.07	8.00E-10	1.977E-07
K2460	Central Michigan University	10300602	147.33	8.00E-10	1.1571E-07
K2688	B.O.P. Federal Correctional Institute	10300602	92.85	8.00E-10	7.428E-08
K2729	Beaumont Hospital Farmington Hills	10300602	99.717	8.00E-10	7.977E-08
K3249	Michigan State University	10200602	43.34	8.00E-10	3.467E-08
K3249	Michigan State University	10300601	5317.92	8.00E-10	3.8648E-06
K3249	Michigan State University	10300603	22.041	8.00E-10	1.7629E-08
K5375	University MI Dearborn	10300602	76	8.00E-10	6.08E-08
K5375	University MI Dearborn	10300603	36.2	8.00E-10	2.896E-08
M0037	Mercy Health	10300602	81.7723	8.00E-10	6.542E-08
M0239	Wayne State University	10300602	610.0417	8.00E-10	4.88094E-07
M0239	Wayne State University	10300603	25.963	8.00E-10	2.077E-08
M0675	University of Michigan	10200602	197.6574	8.00E-10	1.58123E-07
M0675	University of Michigan	10300601	1633.062	8.00E-10	1.30641E-06
M0675	University of Michigan	10300602	103.3252	8.00E-10	8.265E-08
M0675	University of Michigan	10300603	450.831	8.00E-10	3.607E-07
M1812	Ascension St. John Hospital	10300602	91.73	8.00E-10	7.338E-08
M1952	Ascension St. Marys Saginaw	10300602	87.857	8.00E-10	7.029E-08
M1954	Covenant Health Care	10300602	202	8.00E-10	1.616E-07
M1967	Ascension Providence Southfield Hospital	10300602	134.005	8.00E-10	1.072E-07
M1968	McLaren Oakland	10300602	59.234808	8.00E-10	4.739E-08
M2032	Spectrum Health-Butterworth Campus	10300602	241.37	8.00E-10	1.931E-07
M3431	St Joseph Mercy Hospital	10300602	215.9	8.00E-10	1.727E-07
M3546	Battle Creek VA Medical Center	10300602	149	8.00E-10	1.192E-07
M3641	University of Michigan Flint	10300602	91.8	8.00E-10	7.344E-08
M3641	University of Michigan Flint	10300603	14.9	8.00E-10	1.192E-08
M3653	V A Medical Center	10300602	185.0719	8.00E-10	1.481E-07
M3792	Northern Michigan University	10300602	330.658	8.00E-10	2.645E-07
M3912	Adm Grain Company - Grand Ledge	10200602	0.021154	8.00E-10	1.692E-11
M4086	Toyota Motor North America	10300603	1.69	8.00E-10	1.352E-09
M4153	Hope College	10300602	152.86	8.00E-10	1.223E-07
M4174	Detroit Metropolitan Wayne County Airport	10300602	323.418	8.00E-10	2.587E-07
M4175	Ford Motor Co	10300602	136.1561	8.00E-10	1.089E-07
M4199	General Motors LLC Detroit-Hamtramck Assembly	10200602	0.15	8.00E-10	1.2E-10
M4204	Zeeland Farm Services, Inc.	10300602	41.621	8.00E-10	3.3295E-08
M4204	Zeeland Farm Services, Inc.	10300603	15.476	8.00E-10	1.238E-08
M4210	Cayman Chemical Co.	10300603	12.7	8.00E-10	1.016E-08
M4232	Huron Valley - Sinai Hospital	10200602	55.1	8.00E-10	4.408E-08
M4347	Praxair, Inc.	10200602	104.39	8.00E-10	8.3506E-08
M4547	Fritz Products	10200602	71	8.00E-10	5.68E-08
M4732	Amcane Sugar LLC	10200602	210.5749	8.00E-10	1.685E-07
M4752	John D. Dingell VA Medical Center	10300602	204.72	8.00E-10	1.638E-07
M4764	Ford Motor Co. Elm Street Boilerhouse	10200601	480.989	8.00E-10	3.848E-07
M4764	Ford Motor Co. Elm Street Boilerhouse	10200602	643.217	8.00E-10	5.146E-07
M4768	Flat Rock Metal Inc.	10200602	96.3	8.00E-10	7.704E-08

SRN	Facility Name	SCC	Natural Gas in MMCF	MAERS Emission Factor in Lb/MMCF	MAERS Emission Estimates in Lbs
M4772	Wayne Co. Comm. College Western	10300603	12.5	8.00E-10	0.00000001
M4773	Wayne Co. Comm. College Western	10300603	10.5	8.00E-10	8.4E-09
M4774	Wayne Co. Comm. College Western	10300603	9.5	8.00E-10	7.6E-09
M4833	Wayne Co. Comm. College Western	10300603	13.2	8.00E-10	1.056E-08
N0547	Darling Ingredients Inc.	10200602	281	8.00E-10	2.248E-07
N0677	Steelcase Inc., Kentwood Complex	10200602	167.31	8.00E-10	1.3381E-07
N0677	Steelcase Inc., Kentwood Complex	10300602	90.8	8.00E-10	7.264E-08
N0731	Nortru, LLC	10300603	0	8.00E-10	0
N0842	Gage Products Company	10200602	47	8.00E-10	3.76E-08
N0923	Ventra Ionia Main, LLC	10200602	110.7	8.00E-10	8.856E-08
N1099	Consumers Energy - Northville Compressor Station	10300603	1.0497	8.00E-10	8.398E-10
N1192	Denso Manufacturing Michigan, Inc.	10200602	7.2664	8.00E-10	5.813E-09
N1237	Georgia Pacific Chemicals LLC	10200602	24.468	8.00E-10	1.957E-08
N1336	BASF Corporation	10200602	43.9	8.00E-10	3.512E-08
N1436	FCA US Technology Center	10200602	415.5	8.00E-10	3.3244E-07
N1461	Welch Foods Inc.	10200602	149.717	8.00E-10	1.198E-07
N1581	Tribar Technologies Inc. (Plant 1)	10300603	13.1	8.00E-10	1.048E-08
N1604	Kent County Waste To Energy Facility	10300602	11.55	8.00E-10	9.24E-09
N1622	Pollard (U.S.) Ltd	10200602	45.984	8.00E-10	3.679E-08
N1701	Morbark Holdings Group, LLC	10200602	4.64	8.00E-10	3.712E-09
N1757	Knoll Incorporated	10200602	84.76	8.00E-10	6.781E-08
N1781	Magna Mirrors Corporation	10300603	76.639	8.00E-10	6.132E-08
N1784	Ada Cogeneration Limited Partnership	10100602	187.328	8.00E-10	1.499E-07
N1794	Atlas EPS, A Division of Atlas Roofing Corp.	10200602	1.24	8.00E-10	9.92E-10
N1966	Michigan Automotive Compressor Inc.	10300603	241.25	8.00E-10	0.000000193
N2155	FCA US LLC - Jefferson North Assembly Plant	10200602	112.74	8.00E-10	9.019E-08
N2432	A G Simpson (USA), Inc.	10100602	19.48	8.00E-10	1.558E-08
N2614	NBHX Trim USA Corporation	10200602	29.979	8.00E-10	2.398E-08
N2915	Toyota Motor North America R&D	10300603	48.2	8.00E-10	3.856E-08
N2954	Cargill Salt - Hersey	10200602	74.8	8.00E-10	5.984E-08
N2955	Kinross Correctional Facility	10300602	19	8.00E-10	1.52E-08
N3022	Eaton Rapids Gas Storage System	10200602	85.88	8.00E-10	6.87E-08
N3225	Kent Career Technical Center	10300602	21.942	8.00E-10	1.755E-08
N3246	Ervin Technologies	10200602	24.94	8.00E-10	1.995E-08
N3391	DTE Gas Company - Washington 10 Compressor Station	10200602	73.003	8.00E-10	5.84E-08
N3417	Lymtal International, Inc.	10200601	4.371	8.00E-10	3.497E-09
N3422	Oakland University	10300602	30.053	8.00E-10	2.4042E-08
N3655	Bronson Battle Creek	10300602	66.484	8.00E-10	5.319E-08
N3929	Resolute Forest Products - Menominee	10200601	572.712	8.00E-10	4.582E-07
N3987	William Beaumont Hospital	10300602	213.1	8.00E-10	1.7048E-07
N4975	Michigan Power Limited Partnership	10200601	8.58	8.00E-10	6.864E-09
N5056	Magna Mirrors North America	10300603	18.03	8.00E-10	1.442E-08
N5226	Quincy Street, Inc.	10200602	30	8.00E-10	0.000000024
N5572	Howell Compressor Station	10200602	0.03	8.00E-10	2.4E-11
N5573	Consumers Energy - White Pigeon Compressor Station	10300603	4.5785	8.00E-10	3.663E-09
N5575	ANR Pipeline Company - Bridgman Compressor Station	10300603	43.12	8.00E-10	3.45E-08
N5688	Perrigo Holland, Inc.	10200602	94.2	8.00E-10	7.536E-08
N5747	Pioneer Metal Finishing Industrial Hwy	10300603	68.116	8.00E-10	5.449E-08
N5797	Boars Head Provisions Co., Inc.	10300602	106.3	8.00E-10	8.504E-08
N5866	Metal Technologies, Inc., Ravenna Ductile Iron	10200602	58.15	8.00E-10	4.652E-08
N5930	Delta College	10300602	53.059	8.00E-10	4.245E-08
N5930	Delta College	10300603	0	8.00E-10	0
N6013	Continental Aluminum	10200602	129.9	8.00E-10	1.0392E-07
N6016	Ascension Genesys Hospital	10300602	142.689	8.00E-10	1.142E-07

SRN	Facility Name	SCC	Natural Gas in MMCF	MAERS Emission Factor in Lb/MMCF	MAERS Emission Estimates in Lbs
N6226	Brembo North America, Inc.	10200602	68.59	8.00E-10	5.487E-08
N6358	Detroit Thermal Henry Heating Plant	10300602	2.883	8.00E-10	2.306E-09
N6388	Pioneer Metal Finishing - Stephens Road	10200602	28.722	8.00E-10	2.298E-08
N6577	ND Industries, Inc.	10300603	6.61	8.00E-10	5.288E-09
N6631	Dearborn Industrial Generation	10200601	100.2	8.00E-10	8.016E-08
N6726	Heat Treating Services Corp - Plant 3	10200602	158.27	8.00E-10	1.2661E-07
N6767	New Covert Generating Company, LLC	10200602	3.85	8.00E-10	3.08E-09
N6866	Georgia Pacific Corrugated LLC	10200602	53.614	8.00E-10	4.289E-08
N6950	General Motors LLC-Lansing Delta Township	10200602	119.7	8.00E-10	9.576E-08
N6976	Huntington Foam LLC	10200602	55.92	8.00E-10	4.474E-08
N6980	WMU Energy Resource Center	10300602	49.6	8.00E-10	3.968E-08
N6996	Poet Biorefining - Caro, LLC	10200602	1225.3	8.00E-10	9.802E-07
N7096	Heat Treating Services Corp of America - Plant 1	10200602	167.82	8.00E-10	1.3425E-07
N7132	Sun Gro Horticulture	10100602	63	8.00E-10	5.04E-08
N7202	Tribar Technologies Inc. (Plant 3)	10300603	34	8.00E-10	2.72E-08
N7289	Sonoco Protective Solutions, Inc.	10200602	240.49	8.00E-10	1.924E-07
N7303	Bluewater Gas Storage Facility	10200602	2.09	8.00E-10	1.672E-09
N7349	U of M Health / Metro Health Hospital	10300602	81.83	8.00E-10	6.546E-08
N7383	Valero Renewable Fuels Company, LLC	10200602	871.1	8.00E-10	6.969E-07
N7411	SMR Automotive Systems USA, Inc.	10300603	14.77	8.00E-10	1.182E-08
N7421	DTE Gas Company - Willow Run Compressor Station	10200602	19.954	8.00E-10	1.5963E-08
N7493	Marysville Ethanol, LLC	10200601	1510	8.00E-10	0.000001208
N7688	Dicastal North America, Inc.	10200602	243.78	8.00E-10	0.000000195
N7809	Tribar Technologies Inc. (Plant 4)	10200602	33.788	8.00E-10	2.703E-08
N8192	Request Foods, Inc.	10200602	164.357	8.00E-10	1.3148E-07
N8265	Hearthside Food Solutions LLC	10300603	15.8828	8.00E-10	1.271E-08
N8270	Hearthside Food Solutions	10300603	15.65	8.00E-10	1.252E-08
N8273	Ascension Providence Park Hospital	10300602	87	8.00E-10	6.96E-08
N8308	Alco Products, LLC	10300603	1.02516	8.00E-10	8.2008E-10
P0024	A123 Systems	10200602	59.73	8.00E-10	4.778E-08
P0087	LG Chem Michigan Inc.	10200602	77.74	8.00E-10	6.219E-08
P0152	Michigan Dept. of Technology, Management and Budget	10200602	0.379358	8.00E-10	3.0344E-10
P0243	Beaumont Information Technology Center	10300603	1.6	8.00E-10	1.28E-09
P0336	Henry Ford West Bloomfield Hospital	10300602	175	8.00E-10	0.00000014
P0445	Aramco Services Company	10300603	4.2382	8.00E-10	3.391E-09
P0448	Postle Aluminum	10200602	55.96	8.00E-10	4.477E-08
P0465	Holland Board of Public Works-Holland Energy Park	10200602	52.48	8.00E-10	4.198E-08
P0465	Holland Board of Public Works-Holland Energy Park	10300603	0.13	8.00E-10	1.04E-10
P0468	Newberry Correctional Facility	10300602	58.78	8.00E-10	4.702E-08
P0517	Maroa Farms, Inc. And Pepperco-USA, Inc.	10200602	660.12	8.00E-10	5.281E-07
P0585	Clemens Food Group	10200602	72.137	8.00E-10	5.771E-08
P0615	Toyota Motor North America R&D	10300603	0.0135	8.00E-10	1.08E-11
P0625	MDOC-Muskegon Complex	10300601	100.5	8.00E-10	8.04E-08
P0637	MDOC Women's Huron Valley Correctional Facility	10300602	127.95	8.00E-10	1.024E-07
P0640	MDOC Chippewa Complex	10300602	98.23	8.00E-10	7.858E-08
P0727	Tribar Technologies Inc. (Plant 5)	10200602	20.112	8.00E-10	1.609E-08
P0758	Unifirst Corporation	10200602	7.4	8.00E-10	5.92E-09
P0779	Standing Rock Farm	10300603	0.0791	8.00E-10	6.328E-11
TOTAL					5.87502E-05

Stationary Internal Combustion Engines

Stationary internal combustion engine emissions were calculated similarly to industrial/commercial boilers that combust natural gas. The EPRI factor was adopted in MAERS and produced a statewide estimate of 3.47E-05 lbs.

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

Table 15. Stationary Internal Combustion Engines, Natural Gas

SRN	Facility Name	SCC	Natural gas in MMCF	Emission factor in Lb/MMCF	MAERS Emission Estimates in Lbs
A1641	General Motors Lansing Grand River Assembly	20200202	0.042	8.00E-10	3.36E-11
A3567	Ford Motor Company - Sterling Plant	20200202	0.113	8.00E-10	9.04E-11
A3900	Martin Marietta Magnesia Specialties, LLC	20200202	0.596	8.00E-10	4.77E-10
A3934	Great Lakes Castings LLC	20200202	0.091	8.00E-10	7.28E-11
A5858	Mead Johnson & Company, LLC	20200202	0.01091	8.00E-10	8.73E-12
A6220	Intertape Polymer Group	20200202	0.033	8.00E-10	2.64E-11
A8638	Detroit Diesel Corporation	20200202	0	8.00E-10	0.00E+00
A8645	Ford Motor Co/ Livonia Transmission	20200202	0.08737	8.00E-10	6.99E-11
A8648	Ford Motor Co Rouge Complex	20200202	0.0596	8.00E-10	4.77E-11
A9365	Akwel Cadillac USA, Inc.	20200202	0.000884	8.00E-10	7.07E-13
A9831	Marathon Petroleum Company LP	20200202	0	8.00E-10	0.00E+00
B1771	Ford Motor Company-Van Dyke Plant	20200202	0.126	8.00E-10	1.01E-10
B1798	General Motors LLC - Warren Transmission Plant	20200202	0.0015	8.00E-10	1.20E-12
B3350	FCA US LLC Trenton Engine Complex	20200202	0.243	8.00E-10	1.94E-10
B4032	General Motors LLC Pontiac Engineering Center	20200202	0.0173	8.00E-10	1.38E-11
B4049	Gm Technical Center	20200202	1	8.00E-10	8.00E-10
B4282	Marysville Hydrocarbons, LLC.	20200201	2.63	8.00E-10	2.10E-09
B4292	Lambda Energy Resources, LLC - Kalkaska Gas Plant	20100201	449.1	8.00E-10	3.59E-07
B4292	Lambda Energy Resources, LLC - Kalkaska Gas Plant	20200201	0.01	8.00E-10	8.00E-12
B5421	Wolverine Power Supply Cooperative	20200201	35.249	8.00E-10	2.82E-08
B6001	Herman Miller, Inc.	20200202	1.2	8.00E-10	9.60E-10
B6230	Ford Motor Co Research & Dev. Center	20200202	0.259	8.00E-10	2.07E-10
B6478	DTE Gas Company - Belle River Compressor Station	20200201	388.05	8.00E-10	3.10E-07
B6481	ANR Pipeline Company - Capac Compressor Station	20200202	0	8.00E-10	0.00E+00
B6508	Clinton, Village of	20200202	0.038	8.00E-10	3.04E-11
B6636	Consumers Energy - Ray Compressor Station	20200201	6.424	8.00E-10	5.14E-09
B6637	Consumers Energy - St. Clair Compressor Station	20200201	144.919	8.00E-10	1.16E-07
B8570	The Andersons Marathon Holdings LLC	20100201	7875	8.00E-10	6.30E-06
B8573	Great Lakes Gas Trans Station #11 (TransCanada #11	20200201	183.45	8.00E-10	1.47E-07
K3249	Michigan State University	20200202	1.14	8.00E-10	9.12E-10
M4085	FCA US LLC - Mack Avenue Engine Plant	20200202	0	8.00E-10	0.00E+00
M4174	Detroit Metropolitan Wayne County Airport	20100201	1.552	8.00E-10	1.24E-09
M4780	Roush Industries	20200202	2.966	8.00E-10	2.37E-09
N1216	Westside Recycling and Disposal Facility	20200202	87.57	8.00E-10	7.01E-08
N1436	FCA US Technology Center	20100201	0.25	8.00E-10	2.00E-10
N1652	West Branch Production Gathering & Compressor Station	20200202	30.566	8.00E-10	2.45E-08
N1685	TES Filer City Station	20200202	0.046	8.00E-10	3.68E-11
N2168	Great Lakes Gas Transmission Station #7	20200201	54.84	8.00E-10	4.39E-08
N2901	Consumers Energy - Muskegon River Compressor Station	20200201	109.09	8.00E-10	8.73E-08
N2940	DCP Antrim Gas LLC	20100201	649	8.00E-10	5.19E-07
N2954	Cargill Salt - Hersey	20200201	497.2	8.00E-10	3.98E-07
N3391	DTE Gas Company - Washington 10 Compressor Station	20200202	376.013	8.00E-10	3.01E-07
N3392	DTE Gas Company - Taggart Compressor Station	20200202	286.93	8.00E-10	2.30E-07
N3758	Great Lakes Gas Transmission Station #10	20200201	56.55	8.00E-10	4.52E-08

SRN	Facility Name	SCC	Natural gas in MMCF	Emission factor in Lb/MMCF	MAERS Emission Estimates in Lbs
N3759	Great Lakes Gas Transmission Station #9	20200201	3.5	8.00E-10	2.80E-09
N3760	Great Lakes Gas Transmission Station #8	20200201	831.02	8.00E-10	6.65E-07
N3818	Great Lakes Gas Transmission Station #13	20200201	133.98	8.00E-10	1.07E-07
N5574	ANR Pipeline Company - Hamilton Compressor Station	20200201	689.624	8.00E-10	5.52E-07
N5575	ANR Pipeline Company - Bridgman Compressor Station	20200201	122.34	8.00E-10	9.79E-08
N5576	ANR Pipeline Co. - Goodwell Compressor Station	20200201	117.89	8.00E-10	9.43E-08
N5576	ANR Pipeline Co. - Goodwell Compressor Station	20200202	0.07	8.00E-10	5.60E-11
N5578	ANR Pipeline Co. - Winfield Compressor Station	20200202	12.14	8.00E-10	9.71E-09
N5581	Great Lakes Gas - Farwell Compressor Station 12	20200201	5.06	8.00E-10	4.05E-09
N5724	City of St. Louis	20200202	0.0834	8.00E-10	6.67E-11
N5798	Core Energy, LLC., Chester 10 CO2 Recovery	20200202	203.5	8.00E-10	1.63E-07
N6242	HRF Exploration & Production - West Ossinekee 9	20200202	54.3	8.00E-10	4.34E-08
N6266	Federal Mogul Powertrain Inc	20200202	0.676201	8.00E-10	5.41E-10
N6631	Dearborn Industrial Generation	20100201	27757	8.00E-10	2.22E-05
N6838	Vector Pipeline L.P., Highland Compressor Station	20200201	890.579	8.00E-10	7.13E-07
N6950	General Motors LLC-Lansing Delta Township	20200202	0.072	8.00E-10	5.76E-11
N7421	DTE Gas Company - Willow Run Compressor Station	20200202	0.0436	8.00E-10	3.49E-11
N7624	Vector Pipeline L.P. Washington Compressor Station	20200201	713.765	8.00E-10	5.71E-07
N8151	Vector Pipeline L.P., Athens Compressor Station	20200201	601.212	8.00E-10	4.81E-07
P0271	South Buckeye 127 CPF - Gas Plant	20200202	22.226	8.00E-10	1.78E-08
Total					3.47E-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 2017 NEI (EGLE, 2021). Wood consumption, or throughput, is expressed in tons. The default MAERS emission factor was utilized except for Genesee Power Station Limited Partnership and Viking Energy of Lincoln, LLC, which reported mercury based on stack-testing data. Between the more accurate stack test-based estimates for these two facilities, and a decline in wood-firing, the emissions from this sector dropped from the 38.01 lbs estimated for 2014 to 12.34 lbs in 2017.

The following wood-fired electric utilities were included in the estimate.

Table 16. Electric Utilities, Wood Combustion

SRN	Facility Name	SCC	Factor in Lb/Ton	Wood in Tons	Estimated Emissions in Lbs
B1966	White Pine Electric Power LLC	10200905	3.64E-05	0	0.00
B4260	L'Anse Warden Electric Company LLC	10100903	3.64E-05	94527.87	1.38
N0890	Viking Energy of Lincoln, LLC	10100902	0.00E+00	178935	0.00
N1266	Hillman Power Co.	10100902	3.64E-05	198371	2.89
N1395	Cadillac Renewable Energy Facility	10100902	3.64E-05	259177.41	3.77
N2388	Grayling Generating Station Ltd. Partnership	10100902	3.64E-05	264997	3.86
N3570	Genesee Power Station Limited Partnership	10100911	2.99E-06	146857	0.44
Total					12.34

Industrial/Commercial Wood Combustion

Point source estimates such as those for industrial and commercial combustion of wood were collected from MAERS (EGLE, 2020). These point source estimates were generated as part of Michigan's submittal to the USEPA's 2017 NEI.

Table 17. Industrial/Commercial, Wood Combustion

SRN	Facility Name	SCC	Wood in Tons	Emission Factor in Lbs	Estimated Emissions in Lbs
A0749	Ameriwood Industries	10300903	1794	3.64E-05	0.065
A0999	Michigan Maple Block Co.	10200906	2200	5.15E-06	0.011
A5937	Howard Miller Company	10200906	422	5.15E-06	0.002
B1471	Timber Products Michigan	10200905	31260	5.15E-06	0.161
B1476	Decorative Panels International/Alpena Biorefinery	10200903	34008	3.54E-06	0.120
B6001	Herman Miller, Inc.	10200907	0	5.15E-06	0.000
B6620	Coldwater Veneer, Inc.	10300903	2600	3.64E-05	0.095
B7099	Connor Aga Sports Flooring LLC	10200905	4277	5.15E-06	0.022
B7192	Verso Quinnesec, LLC	10200911	241975	NA	2.400
B8603	Jeld-Wen Interior Door - Grand Rapids	10300903	0	3.64E-05	0.000
E4437	Northwest Hardwoods	10200906	3336	5.15E-06	0.016
K2460	Central Michigan University	10300903	0	3.64E-05	0.000
M3546	Battle Creek VA Medical Center	10200907	0	5.15E-06	0.000
N0780	Louisiana-Pacific Corp Newberry Plant	10200905	15234	5.15E-06	0.078
N1271	Fiber Char Corp.	10200910	197	NA	0.115
N1315	Louisiana-Pacific Corp Sagola Plant	10200904	19234	5.15E-06	0.040
N2206	Banks Hardwoods, Inc.	10200906	7249	5.15E-06	0.037
N2454	Wolverine Hardwoods Inc.	10100903	1004	3.64E-05	0.037
N5940	PotlatchDeltic Land & Lumber LLC.	10200905	39736	5.15E-06	0.205
TOTAL					3.405

Residential, Wood Combustion

For residential wood combustion, the USEPA's estimate of mercury emissions from the 2017 NEI was utilized. The USEPA calculated that 44.54 lbs of mercury was emitted from residential wood burning in Michigan. This estimate is based on inputs and emission factors included in the USEPA's Residential Wood Combustion Tool v4.0, an Access database designed for estimating pollutants from the residential wood sector. The sector includes estimates for freestanding woodstoves (USEPA certified catalytic and non-catalytic, and non-certified), inserts (USEPA certified catalytic and non-catalytic, and non-certified), fireplaces burning cordwood, indoors wood furnaces, outdoors hydronic heaters, wood pellet stoves, and miscellaneous woodburning devices not elsewhere classified. This is an increase since the 2014 estimate of 7.20 lbs of mercury emissions from this sector. The change is due to an updated mercury emission factor in the latest version of the USEPA's Residential Wood Combustion Tool (4.26E-05 lb/ton instead of the previous factor of 2.6E-09 lb/ton).

Table 18. Residential Wood Combustion

Data Source	Mercury Emissions in Lbs	Nonpoint Sector
2017 NEI	44.54	Fuel Comb. - Residential Wood

Tire-Derived Fuel Combustion

Several facilities utilized tire-derived fuel (TDF) to fire their boilers. Viking Energy of Lincoln, LLC and Genesee Power Station Limited Partnership reported their own mercury estimates based on stack testing and other calculations (EGLE, 2021). The other facilities' values are default MAERS estimates based on a USEPA emission factor. The emissions estimate of 22.75 lbs for 2017 is substantially lower than the estimate of 301.37 lbs from 2014. This is due to several of the facilities from the 2014 inventory not burning TDF in 2017. And lower and more accurate mercury estimates were submitted by three of the facilities based on stack testing or other calculations.

Table 19. TDF Boilers

SRN	Facility Name	Emission Unit ID	SCC	Emission Estimation Basis	Tire-Derived Fuel in Tons	Estimated Emissions in Lbs
B4260	L'Anse Warden Electric Company LLC	EU0009	10201201	MAERS default factor	8935.1	13.81
B6611	Michigan Hub, LLC	EU0003	10101201	MAERS default factor	0	0.00
N0890	Viking Energy of Lincoln, LLC	EU0003	10101201	Stack test	11125	0.00
N1160	Viking Energy of McBain	EU0003	10101201	Facility calculation	10670	2.80
N2388	Grayling Generating Station Limited. Partnership	EU0008	10101201	MAERS default factor	3952	6.11
N3570	Genesee Power Station Limited Partnership	EU0009	10101201	Stack test	4749	0.04
Total						22.75

Petroleum Refining

Marathon Ashland Petroleum (A9831), the only petroleum refinery in the state, emitted 33.35 lbs of mercury in 2017 according to data gathered from MAERS as part of Michigan's submittal to the USEPA's 2017 NEI (EGLE, 2021).

Table 20. Petroleum Refining

SRN	Facility Name	SCC	Process Gas in MMCF	Emission factor in Lb/MMCF	Estimated Emissions in Lbs
A9831	Marathon Petroleum Company LP	30600106	12215.31	2.73E-03	33.35

Residential LPG (Propane) Combustion

Residential fuel combustion estimates were generated as part of Michigan's submittal to the USEPA's 2017 NEI. For residential Liquefied Petroleum Gas (LPG) or propane combustion, an emission factor of 1.20E-05 lbs/1,000 gallons was selected. This factor was used along with 2017 statewide fuel consumption data from the EIA, USDoE to generate estimated emissions of mercury for 2017 (EGLE, 2021). LPG consumption, or throughput, is expressed in thousands of gallons.

Table 21. Residential Propane Combustion

Category	Throughput in E3 GAL	Emission Factor in LB/E3 GAL	Mercury Emissions in Lbs
Residential LPG (Propane) Combustion	381,444	1.20E-05	4.58

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 health sewage sludge incinerators, which have a venturi scrubber, impingement scrubber, quencher, and afterburner controls. Stack testing data from 2014 was referenced in an AQD inspection report from March 5, 2015 (Lane, 2015). A maximum value of 0.086 grams per day was recorded, compared to a permitted emission limit of 10 grams per day. If the facility operated 365 days per year with that emissions rate, estimated emissions are 0.069 lbs annually (McGeen, 2021).

According to MAERS, 25,834.7 tons of biosolids (sewage sludge) were incinerated at the Detroit WWTP in 2017. Using an emission factor derived from a 2012 stack test at the facility, 27.90 lbs of mercury were likely released to the air in 2017 (McGeen, 2021).

The Flint Water Pollution Control Plant ceased operation of its incinerators on March 10, 2016, due to pending compliance requirements of 40 CFR Part 60 Subpart MMMM, Emission Guidelines and Compliance Times for Existing Sewage Sludge Incineration Units, which were due to take effect on March 30, 2016. The permits were subsequently voided and the building, which once housed the incinerators, has been repurposed for sludge dewatering, as verified by AQD field staff in 2017 (EGLE, 2021). Accordingly, a 2017 estimate is not included for this facility.

In the 2017 NEI, emission estimates from incineration at the Warren Wastewater Treatment Plant were augmented by the USEPA in accordance with an ERAU-estimated mercury value based on the facility's stack testing data. The emission estimates from the Ypsilanti Community Utilities Authority (YCUA) were also augmented within the 2017 NEI, with a facility-reported mercury value based on stack testing. The values were mapped by the USEPA to representative SCC codes for the two facilities, to 50100802 and 50100803, which indicate governmental facilities with sewage sludge incineration via multiple hearth incinerator and fluidized bed combustor, respectively. The SCC code used by the facilities within MAERS was more generic and specified "Other Incineration" rather than "Sewage Sludge Incineration."

Several sewage sludge incinerators have closed in the last 20 years. The East Lansing publicly owned treatment works (POTW) shut down its incinerator in 2002. And the Trenton WWTP removed its incinerator in 2003. The Ann Arbor WWTP incinerator ceased operations and the permit was voided in 2006. The Port Huron WWTP removed its incinerator by 2010 as verified during an inspection by AQD district staff (EGLE, 2020).

The following sewage sludge incinerators were included in the calculation.

Table 22. Sewage Sludge Incinerators

SRN	Facility Name	SCC	Sludge in Tons	Best Estimate in Lbs	Notes for 2017 Calculations
B1792	Warren Wastewater Treatment Plant	50100515	4981	8.80	EPA augmentation under SCC 50100802, per ERAU calculation based on facility stack test and hourly operations.
B1950	Pontiac Wastewater Treatment Plant	50100515	0	0.00	Zero activity
B6237	Ypsilanti Comm. Utilities Authority	50100516	5144	1.22	EPA augmentation under SCC 50100803, per facility-reported value based on stack test.
B6307	City of Battle Creek Wastewater Treatment Plant	50100515	3097.2	0.069	ERAU calculation based on stack test
B2103	Detroit Wastewater Treatment Plant	50200506	25834.7	27.90	ERAU calculation based on stack test
TOTAL				37.99	

Trends for Mercury in Michigan Biosolids (EGLE, 2021).

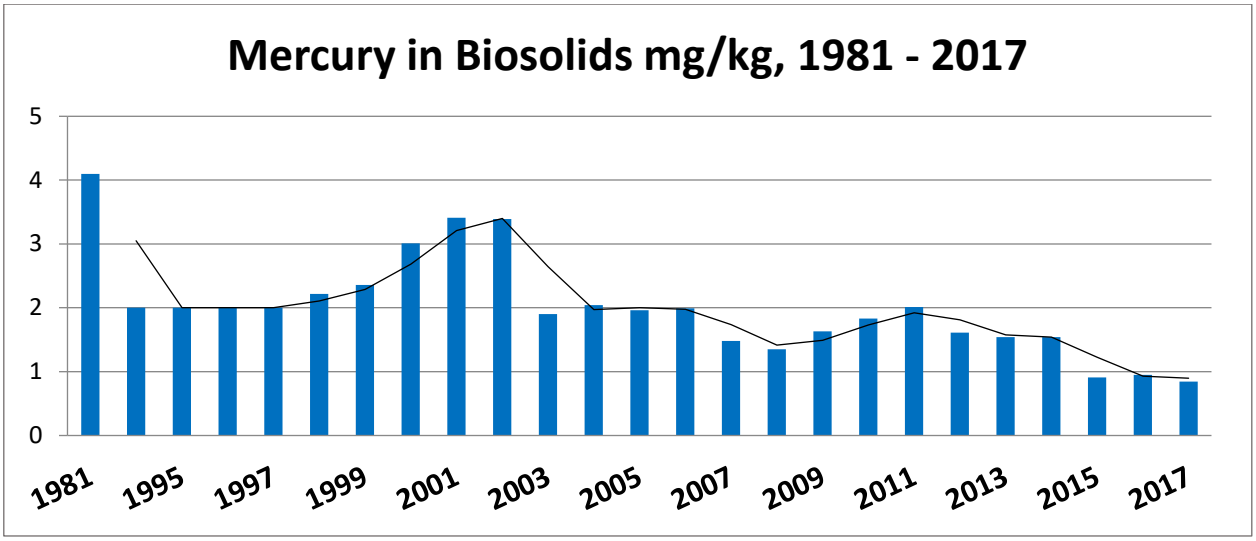
Table 23. Mercury Concentrations in Biosolids, 2002-2017

Year	Hg Concentrations in Biosolids mg/kg
2002	3.39
2003	1.9
2004	2.0
2005	1.96
2006	1.99
2007	1.48
2008	1.35
2009	1.63
2010	1.83
2011	2.01
2012	1.61
2013	1.54
2014	1.54
2015	0.91
2016	0.95
2017	0.85

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."

Historic and current trends in biosolids are shown below, as documented by EGLE's Water Bureau (EGLE, 2021).

Table 24. Mercury Concentration Trends in Biosolids, 1981-2017



Municipal Waste Incineration

Two municipal waste combustors were operating in Michigan in 2017. Kent County Waste-to-Energy submitted facility-verified estimates of 1.55 lbs of mercury to MAERS for the 2017 operating year based on stack testing (EGLE, 2021).

Detroit Renewable Power, LLC (formerly Greater Detroit Resource Recovery Facility) reported 21.50 lbs of mercury emissions from Boilers 11, 12, and 13 to MAERS for the 2017 reporting year based on stack testing. The facility was shut down on March 26, 2019, and the facility boilers have not operated on refuse-derived fuel since that date (Zynda, 2020).

The Jackson County Waste to Energy facility (N1125) ceased operations in 2013 and the Renewable Operating Permit (ROP) was voided in 2014 (EGLE, 2020). Accordingly, estimates have not been prepared for this facility.

Table 25. Municipal Waste Incineration

SRN #	Facility Name	Emission Unit Name	SCC	Stack Test Factor (Lb/Ton)	Stack Test factor (Lb/Hour)	Hours/ Year	Refuse in Tons	Reported to MAERS in Lbs
M4148	Detroit Renewable Power, LLC	EUBOILER011	50100103	1.40E-05			263616	3.7
M4148	Detroit Renewable Power, LLC	EUBOILER012	50100103	1.35E-05			260380.1	3.5
M4148	Detroit Renewable Power, LLC	EUBOILER013	50100103	6.11E-05			233362.5	14.3
N1604	Kent County Waste To Energy Facility	EU-UNIT-01	50100102		1.13E-04	8760	93029	0.92
N1604	Kent County Waste To Energy Facility	EU-UNIT-02	50100102		7.65E-05	8760	92180	0.63
TOTAL								23.05

Hazardous Waste Incineration

One facility, Dow Chemical (A4033), operates a hazardous waste incinerator in Michigan. In 2003, Dow began operating a new incinerator, the 32 Incinerator, to replace the existing 830 Building and 703 Building Incinerators. Based on stack testing conducted on the 32 Incinerator in 2009, for Dow's HWC MACT Notification of Compliance and Comprehensive Performance Test, less than 1.59E-04 lbs of mercury per hour were emitted from this facility under test conditions year-round design to simulate extreme operating parameters. Based on the continuous year-round operating schedule reported to MAERS in 2017, 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. The most recent stack testing for the Incinerator HWC MACT Notification of Compliance and Comprehensive Performance Test was in November 2019. Based on those results, year-round emissions of 0.53 lbs were estimated (McGeen 2021).

Table 26. Hazardous Waste Incineration, Dow Chemical

SRN	Facility Name	Emission Factor in Lb/Hour	Estimate in Lbs	Comments
A4033	Dow Chemical	1.59E-04	1.39	Based on 2009 stack test
A4033	Dow Chemical	6.05E-05	0.53	Based on 2019 stack test

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 Cremation (Point Source)

The one university which reported the incineration of human remains in 2014 reported zero tons of human remains incinerated in 2017. Accordingly, a value of zero emissions is presented for this category. Incinerators at other universities have been included under animal cremation or pathological waste incineration as appropriate.

Table 27. Human Cremation, Point Sources

SRN	Facility Name	Emission Unit Name	Emission Unit Description	SCC in MAERS	Human remains in tons	Emission Basis	Estimate in Lbs
M0239	Wayne State University	EUINCINERATORFG	Emission Unit covers all 3 Incinerators (2 @ Scott Hall & 1 @ Mott) in FGINCIN of PTI No. 80-06. A combined throughput has been entered for all units.	50200505	0.00	MAERS Emission Factor	0.00

Animal Cremation

Two incinerators at Michigan State University (MSU), identified in MAERS as EUCREMATORY and EUDCPAHINC01, were used for cremation of small animals and animals tested for tuberculosis, respectively (McGeen, Daniel, 2020). No human remains are cremated at MSU, although it would be permissible at EUDCPAHINC01 under the facility's ROP. A third incinerator, EUFLRINC01, has been moved to the pathological waste incinerator category as it is not used for cremations. Instead, it incinerates animal waste and bedding, wood infested by emerald ash borers, pharmaceuticals, and low-level radioactive waste.

Three facilities which cremate animal remains (Monroe County Animal Control, Rainbow Bridge, and Union Lake Veterinary Hospital) were removed from the annual MAERS reporting requirement after 2005 but still conduct cremations. Therefore, estimates were made using 2005 throughput values as surrogates.

For estimation of mercury from animal cremations, a 2012 emission factor prepared by Reindl was utilized. This emission factor is based on a study of mercury emissions from blood and tissue (but not teeth) from humans. In the absence of cremation emission factors specific to animals, this factor is used as a surrogate. It is likely to be more representative of animal cremations than factors based on cremation of humans with mercury dental amalgam due to the absence of amalgam in animals (McGeen, 2021).

Table 28. Animal Cremation, Point Source

SRN	Facility Name	Emission Unit Name	Emission Unit Description	SCC in MAERS	Animal remains in tons	Emission Basis	Estimate in Lbs
K3249	Michigan State University	EUDCPAHINC01	ASC design incinerator located at new DCPAH facility on Bennett Rd. Gas-fired with 1200 lb/hr capacity at 1800 F and 1 second retention time in secondary chamber.	50200505	425.24	EPA augmentation for 2017 NEI	0.312
K3249	Michigan State University	EUCREMATORY	Small animal crematorium located at DCPAH	50200505	3.91	EPA augmentation for 2017 NEI	0.003
N6543	Monroe County Animal Control	EU00001	ANIMAL CREMATORY INCINERATOR	50200505	1.41	Reindl emission factor (1.50E-03 lb/ton)	0.002
N7158	Rainbow Bridge	EU002		50200505	2.50	Reindl emission factor (1.50E-03 lb/ton)	0.004
N6494	Union Lake Veterinary Hospital	EU00001		50200505	27.00	Reindl emission factor (1.50E-03 lb/ton)	0.041
TOTAL							0.361

Pathological Waste Incineration

Zoetis P&U LLC (N3519), a medical research and development facility, is estimated to have emitted 1.25E-02 lbs of mercury in 2017 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.

The laboratory animal waste incinerator at Ferris State University reported 0.01 tons of animal waste incinerated. This was under the SCC code of 50200505, which designates infectious waste disposed of in a medical waste incinerator.

The waste incinerator at MSU, which operates under the emission unit EUFLRNIC, was identified as a pathological waste incinerator. Per AQD district staff, this incinerator does not incinerate human or animal remains. It incinerates animal waste and bedding, wood from trees infested with the emerald ash borer, pharmaceuticals, and low-level radioactive waste (McGeen, Daniel, 2020).

Table 29. Pathological Waste Incineration

SRN	Facility Name	Throughput in Tons	Default MAERS Emission Factor in Lb/Ton	Estimated Emissions in Lbs
N3519	Zoetis P&U LLC	17.01	7.34E-04	0.0125
K2155	Ferris State University	0.01	7.34E-04	7.34E-06
K3249	Michigan State University	104.49	7.34E-04	0.0767
TOTAL				0.0892

INDUSTRIAL SOURCES

Cement Manufacturing

There are two cement manufacturing facilities in Michigan: Lafarge, and St. Marys Cement, Inc. (US). Throughput values for both of the facilities were obtained from MAERS. Lafarge's own 2017 estimate of mercury from their cement manufacturing facility was 26.60 lbs, as reported to MAERS. Speciation data for kiln emissions, and raw materials grinding and drying, was obtained from a 2007 report prepared for Lafarge (Advanced Environmental Management Group, 2007).

Table 30. Cement Manufacturing Speciation Profiles

Facility Name	2017 Mercury Emissions Reported to MAERS (in lbs)	Particulate divalent speciation factor	Gaseous divalent speciation factor	Elemental gaseous speciation factor	Hg(p)	RGM	Hg(0)	Comments
Lafarge	26.60	var	var	var	0.27	22.84	3.50	LaFarge speciation profiles are from report of 11/01/07.
St. Marys Cement Inc. (US)	28.60	0.12	0.13	0.75	3.43	3.72	21.45	
Totals	55.20				3.70	26.55	24.95	

A facility-submitted MAERS value was available for St. Marys Cement Inc. (US) for 2017. A total of 55.20 lbs of mercury was estimated from cement manufacturing in Michigan in 2017. The following cement manufacturing facilities were included in the inventory:

Table 31. Cement Manufacturing

SRN	Facility	Throughput in Tons	MAERS Estimate in Lbs	Source for Best Estimate	Lbs Hg Emitted, Best Estimate
B1477	Lafarge	6,663,064	26.60	Facility-reported value in MAERS, 2017	26.60
B1559	St. Marys Cement Inc. (US)	1,189,925	28.60	Facility-reported value in MAERS, 2017	28.60
TOTAL					55.20

Taconite Processing

Michigan has two taconite processing plants: Empire Iron Mining Partnership (Empire) and Tilden Mining Company LLC (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/year of mercury, based on reported continuous operation of 8,760 hours (Tilden, 2002). More recent stack testing is not available for mercury. Based on the 2002 factor and the 2017 operating schedule for coal-fired and gas-fired production from Tilden, an estimate of 37.25 lbs was created for 2017.

Empire (B1827) only produces taconite from magnetite. Based on the facility being idled in 2017, zero lbs of mercury was estimated from Empire for 2017. Empire has continued to be idle since 2017.

Total estimated mercury emissions from taconite processing amount to 37.95 lbs for 2017.

Table 32. Taconite Production

SRN	Facility Name	Estimated Emissions in Lbs
B1827	Empire Iron Mining Partnership	0.00
B4885	Tilden Mining Company LC	37.25

Dental Amalgam Manufacturing

In 2017 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, which has a volume of 44,309 m^3 and has nine air exchanges per hour (MDEQ, 2009).

Table 33. Dental Amalgam Manufacturing

Year	Facility	Estimated Emissions in Lbs	Estimate Basis
2017	Kerr Industries	< 4	AQD calculation from 2009 based on Lumex RA915+ monitoring inside facility.

Lime Manufacturing

Throughput values for facilities with lime kilns were obtained from 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 Verso Escanaba LLC and Verso Quinnesec LLC. Using the WebFIRE and Pilgrim emission factors, and the USEPA's augmentation of the 2017 NEI, it is estimated that 8.14 lbs of mercury was emitted to the air in 2017 from lime manufacturing kilns (McGeen 2021). The following lime kilns were included in the calculation:

Table 34. Lime Manufacturing

SRN	Facility	Lime or unbleached pulp in tons[1]	WebFIRE and Pilgrim Emission Factors[2]	Mercury Estimate in Lbs				
				MAERS Default	EPA augmentation	ERAU Calculations	2014 TRI Data[3,4,5]	Best Estimate
A0884	Verso Escanaba LLC	80625	2.90E-07	0.02		0.02	37.82	0.02
A3900	Martin Marietta Magnesia Specialties, LLC	23794	1.20E-04	1.05		2.86		2.86
B2169	Carmeuse Lime Inc, River Rouge Operation	280325			1.88		3.46	1.88
B7192	Verso Quinnesec, LLC	509824	2.90E-07	0.14		0.15		0.15
N7362	Graymont Western Lime, Inc.	252799	1.20E-04			30.34	3.23	3.23
Totals				1.21				8.14

[1] For Verso Escanaba LLC and Verso Quinnesec LLC, the throughput was reported in tons of unbleached paper.

[2] 1.2E-04 lb/ton of lime from Pilgrim; 2.9E-07 lb/ton of unbleached pulp from WebFIRE.

[3] These facilities reported mercury emissions to the 2014 TRI but not the 2017 TRI; the 2014 values are included here for comparison to the 2017 estimates.

[4] The majority of the Verso Escanaba LLC mercury emissions from the 2014 TRI were from their coal-fired boiler, rather than lime manufacturing. This is supported by their 2014 mercury value in MAERS from coal-firing. The 2017 emissions from their coal-fired boiler are already accounted for under fuel combustion, and are substantially lower based on a reduction of over 90% in coal-firing.

[5] The USEPA utilized the 2014 TRI-reported value from Graymont Western Lime, Inc., for augmentation of the 2014 NEI v2; based on the USEPA's acceptance of that value, the self-reported 2014 TRI value is considered more likely to be representative of actual 2017 emissions than the ERAU-estimated value which is an order of magnitude higher.

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, Advanced Micronutrient Products, Inc. (EGLE 2021). This facility's NAICS code of 325314 indicates "Fertilizer (Mixing Only) Manufacturing."

Brick Manufacturing

Hanson Brick (A6497) in Corunna, emitted 0.37 lbs from its two gas-fired kilns in 2017, based on the facility reported throughput and the application of a standard USEPA default emission factor by the MAERS emission estimator (EGLE, 2021).

Table 35. Brick Manufacturing

SRN	Facility	Emission Unit Name	Throughput Tons	Emission Factor	Lbs Emitted
A6497	Meridian Brick	EUKILN01	58997	7.50E-06	0.21
A6497	Meridian Brick	EUKILN02	44532	7.50E-06	0.16
Total					0.37

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). In the 2017 NEI, the USEPA augmented the facility's data with a mercury estimate of 0.02 lbs. This is based on the facility's reporting of fugitive mercury emissions to the TRI. The emissions were assigned to the miscellaneous SCC code of 3999999 since the USEPA was not able to assign the facility-wide mercury value to a single process. The USEPA's 2017 NEI value, based on the facility-reported estimate, is used for the purposes of the AQD's mercury inventory as the most defensible number.

Table 36. Coke Production

Year	Facility	AQD-Estimated Emissions in Lbs[1]	TRI Value in Lbs[2]	Best Estimate in Lbs
2017	EES Coke	52.56	0.02	0.02

[1] Maximum estimated hourly emission rate from 2014 permit application.

[2] USEPA augmentation for 2017 NEI, based on facility-reported mercury estimate to TRI under the Form R reporting.

Medical Waste Autoclave

A review of permits to install issued by AQD was undertaken to identify any medical waste autoclaves operating in Michigan in 2017. Three medical waste autoclaves were identified. Two of the autoclaves were dynamic autoclaves where no mercury emissions are expected, based on design and operational practices to prevent the formation and release of mercury emissions. The third autoclave has the potential for release of mercury emissions, with a maximum calculated release of 0.45 lbs of mercury per year (EGLE, 2021).

Table 37. Medical Waste Autoclaves

SRN	Company	Permit Approved Date	Process	Description	Estimated Mercury Emissions in Lbs
N7127	Hospital Network Healthcare	12-Jun-17	Vacuum autoclave	Dynamic autoclave; utilizes design and permitting requirements and operational practices to prevent generation and release of mercury emissions.	0.00
P0083	Daniels Sharpsmart, Inc.	29-Sep-10	Autoclave system	Maximum estimated mercury emissions of 0.45 lbs/year noted in Evalform by AQD permits engineer.	0.45
P0379	Treatmed, Inc.	21-Sep-12	Ecodas T2000 Sterilizer (autoclave)	Dynamic autoclave; utilizes design and permitting requirements and operational practices to prevent generation and release of mercury emissions.	0.00
Total					0.45

PRODUCTION OF METALS

Basic Oxygen Furnaces 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% molten pig iron and 30% scrap (Grinstern, 2010). Input material is refined by injecting high-purity oxygen into a furnace; 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: Cleveland-Cliffs Steel Corporation Dearborn Works (known in 2017 as AK Steel – Dearborn Works [A8640]), and US Steel Great Lakes Works (A7809). For 2017 operations, AK Steel – Dearborn Works reported 43.75 lbs of mercury emissions MAERS based on stack testing and other calculations. TRI data for 2017 indicates that US Steel emitted 86.1 lbs of mercury. In total, it is estimated that facilities engaged in steelmaking via the Blast/BOF process emitted 129.85 lbs of mercury to the atmosphere in 2017.

Table 38. Steel Manufacturing

SRN#	site name	SCC	Steel in Tons	Process Description	Emission Estimation Basis	Emission Rate in Lb/Hour	Reported 2017 Emissions in Lbs
A8640	AK Steel - Dearborn Works	30301526	2,644,501	BOF: Open Hood-Stack - ESP Emissions	Stack Test	2.83E-03	23.5
A8640	AK Steel - Dearborn Works	30301528	2,110,219	Charging: BOF - Roof Emissions	Stack Test	9.56E-06	0.4
A8640	AK Steel - Dearborn Works	30301529	2,644,501	Tapping: BOF - Roof Emissions	Other	0.00E+00	0
A8640	AK Steel - Dearborn Works	30301564	324,882	Steel furnace slag tapping and dumping - Roof fugitive emissions	Other	0.00E+00	0
A8640	AK Steel - Dearborn Works	30301599	2,644,501	BOF Secondary Emission Baghouse Emissions	Stack Test	2.39E-03	19.85
A8640	AK Steel - Dearborn Works	30301581	2,110,219	Blast Heating Stoves	Other	0.00E+00	0
A8640	AK Steel - Dearborn Works	30301517	2,110,219	Hot Metal Transfer - Roof emissions not collected by baghouse	Other	0.00E+00	0
A7809	US Steel Great Lakes Works	303015**	2,843,148	Facility-wide	TRI	NA	86.1
TOTAL							129.85

Electric Arc Furnaces in Primary Metal Production (Steel Manufacturing)

Electric Arc Furnaces (EAFs) 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).

The USEPA augmented the 2017 NEI with an estimate of 22.30 lbs for Gerdau Special Steel North America – Jackson Mill (B4306) in Jackson, Michigan. This calculation was based on the facility's 2014 stack test emission factor of 4.00-03 lb/hr, and the 2017 operating schedule of 5,544 hours reported to MAERS (McGeen, 2021).

Gerdau MacSteel Monroe (B7061) estimated in their 2017 MAERS report that their mercury emissions for the year were 10.14 lbs. This is based on facility stack test data from 2016. The estimate is about 115 lbs lower than the facility's self-reported value from 2014, which was based on a 2013 stack test. The ERAU also added 0.03 lbs to the 2017 value 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 10.17 lbs of mercury was estimated for Gerdau MacSteel Monroe. These emissions are comprised of elemental and gaseous reactive mercury (McGeen 2021).

Ervin Amasteel (B1754) conducted stack testing in 2013 on their EAF baghouse exhaust. The emission rate of 3.04E-07 gr/dscf was utilized by the ERAU to estimate annual emissions of 6.16 lbs of mercury from the facility (McGeen, 2021).

Table 39. Electric Arc Furnaces in Michigan

SRN	Facility Name	SCC	Throughput in Tons Iron or Steel	Emission Factor	Hours Per Year	Basis	Estimated Emissions in Lbs
B1754	Ervin Amasteel Division	30400701	97698	3.04e-07 gr/dscf	4112	ERAU estimate based on facility's 2013 stack test.	6.16
B4306	Gerdau Special Steel North America - Jackson Mill	30300904	276433.4	4.0E-03 lb/hour	5544	ERAU estimate based on facility's 2014 stack test.	22.18
B7061	Gerdau MacSteel Monroe	30301544	551417.66	1.50E-03 lb/hour	6744	Facility estimate based on 2016 stack test; and 0.03 lbs from baghouse dust analysis...	10.17
Total							38.51

EAFs and Electric Induction Furnaces in Secondary Metal Production (Steel Foundries)

EAFs and Electric Induction Furnaces (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 from MAERS. 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).

Michigan Steel (B1929) and Ancast, Inc. (N7276) closed permanently in 2012 and are therefore not included in the 2017 inventory. Barron Industries, Inc. was removed from the MAERS reporting requirement in 2012. The facility's 2011 reported throughput is used as the basis for an estimate in the absence of more recent information (McGeen, 2021).

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).

The 2017 estimate increased since the 2014 inventory, due to increased activity at Eagle Alloy, Inc. and the resumption of activity at Barber Steel Foundry.

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

Table 40. EAFs and EIFs in Michigan

SRN	Facility Name	Emission Unit Name	SCC	Iron in Tons	Emission Factor in Lb/Ton[1]	Estimated Emissions in Lbs
B1961	Barber Steel Foundry Corporation	EU-MELTING	30400705	7398.8	6.90E-04	5.11
B7013	Huron Casting, Inc (Blue Diamond Steel Casting)	EU-POURINGA	30400705	19619	6.90E-04	13.54
B7357	Temperform LLC	EUSCRUBBER1	30400705	1064	6.90E-04	0.73
B7870	Eagle Alloy Inc.	RG02	30400705	16864	6.90E-04	11.64
N3246	Ervin Technologies	EU_INDUCTIONR1	30400705	3775.3	6.90E-04	2.60
N2631	Barron Cast Inc.	EU-E I Furn	30400705	910	6.90E-04	0.63
Total						34.25

[1] Emission factor from "Toxics In Vehicles: Mercury" (Ecology Center & Great Lakes United, 2001).

Table 41. Supporting Data from *"Toxics in Vehicles: Mercury"* (Ecology Center & Great Lakes United, 2001)

Company	State	Production Capacity Short Tons/Yr[a]	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 data capacity from Iron & Steel Maker, EAF Roundup, May 2000.

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

Secondary Metal Production (Grey Iron)

Grey iron is a type of cast iron with a 3.5% carbon content and is used in industry. Much of the carbon in this type of cast iron separates out as graphite, which gives 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 Cadillac Casting, Inc. (B2178), recent stack test data was available per ton of throughput and used for updated calculations. Emission rates in lbs/hour were also used where applicable. The resulting values were several times lower than the MAERS default estimates and the estimates were based on the New Jersey or WebFIRE emission factors (McGeen, 2021).

Stack testing data from other cupolas engaged in secondary metal production of grey iron were not available. 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). Cupolas emitted an estimated 32.98 to 33.13 lbs of mercury in 2017.

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

Table 42. Cupolas, Grey Iron

SRN	Facility Name	Iron in Tons	Default 2017 NEI Estimate in Lbs[1]	Estimated Emissions from Stack Testing, NJ Emission Factors and NEI[2,3,4]	Estimated Emissions from Stack Testing, NJ Emission Factors, Controlled FIRE Factors and NEI[5]
A0767	EJ USA, Inc.	107006	16.98	26.75	17.01
A3934	Great Lakes Castings LLC	55364.86	18.11	13.84	13.84
B1577	Grede LLC - Iron Mountain	60401	21.02	1.45	1.45
B1909	CWC Textron	63227	0.17	0.17	0.17
B2178	Cadillac Casting, Inc.	137485	0.50	0.50 - 0.65	0.50 - 0.65
Total			56.79	42.72 - 42.87	32.98 - 33.13

[1] B1909 stack test on September 12, 2017

[2] B1577 stack test on May 8, 2012

[3] B2178 stack test on October 25, 2016, which resulted in an hourly emission rate and a lb/ton emission rate, producing two different emission estimates

[4] Emission factor of 2.50E-04 lb/ton from New Jersey study applied to A3934 calculation

[5] Controlled FIRE factor of 1.59e-04 lb/ton applied to A0767 calculations

Table 43. Supporting Data from *"Toxics in Vehicles: Mercury"* (Ecology Center & Great Lakes United, 2001)

Facility	Permitted Production Capacity (short tons per year)	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	0.0032	0.000016
			Nov. 1999	108		
Griffin Pipe Co.	182,000	312	Sept. 1997	10	0.000055	0.000027
US 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 charged 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 several EAFs and EIFs involved in the secondary metal production of grey iron. Throughput information was obtained from MAERS. An emission factor of 2.70E-04 lb/ton 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 factor of 7.20E-05 lb/ton corresponding to grey iron production from WebFIRE to generate a range of emissions. Mercury estimates for the Michigan facilities which did conduct their own stack testing were one to two orders of magnitude lower than the estimates calculated with the IDEM and WebFIRE factors (McGeen, 2021).

The following EAFs and EIFs engaged in the production of grey iron in 2017 were included in the calculations:

Table 44. EAFs and EIFs, Grey Iron

SRN	Facility Name	SCC	Iron in Tons	Stack Test Rate in Lb/Hour	Stack Test-Based Estimate in Lbs	Estimate in Lbs per WebFIRE Factor	Estimate in Lbs per IDEM Factor	Estimate in Lbs per Stack Test and IDEM Factors
A0171	Hastings Manufacturing Company	30400303	2638.7			0.19	0.71	0.71
B1709	Federal-Mogul Powertrain Systems	30400303	13825			1.00	3.73	3.73
B1716	Betz Industries Inc.	30400303	38627	< 4.969E-05	0.11	2.78	10.43	0.11
B1737	Kent Foundry Co.	30400303	5796.65			0.42	1.57	1.57
B2015	Metal Technologies, Inc. Three Rivers Gray Iron	30400303	165092			11.89	44.57	44.57
B4538	PSG Grand Rapids (Previously Blackmer, a Dover Co.)	30400303	2503			0.18	0.68	0.68
N5814	Asama Coldwater Manufacturing, Inc.	30400303	77735	6.11E-06	0.04	5.60	20.99	0.04
N5866	Metal Technologies, Inc., Ravenna Ductile Iron	30400303	97262			7.00	26.26	26.26
N6226	Brembo North America, Inc.	30400303	67357.75			4.85	18.19	18.19
Totals						33.90	127.13	95.86

EAFs and EIFs engaged in the production of grey iron likely produced between 33.90 and 95.86 lbs of mercury emissions in 2017 (McGeen, 2021).

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 a nonpoint source component from unpermitted facilities.

Table 45. Shredding of Autos

Auto Switches - Estimated Mercury Emissions in Lbs			
Year	**Flow Diagram Estimate in Lbs**	**2017 NEI Estimate in Lbs[1]**	**Subset**
2017	17.08	151.44	Shredding
2017	4.27	NA	Auto fluff
2017	NA	NA	Storage, transit and transfer (MSW)
2017	NA	NA	Storage, transit and transfer (recycling)
2017	NA	NA	Landfills
2017	NA	NA	Recycling
2017	NA	NA	Mass burning and RDF
2017	NA	NA	Burn barrels
TOTAL	21.35	151.44	Area source and point source totals
	2.74	132.83	Area source total
	18.61	18.61	Point source total
Assignment in TABLE 1			
TABLE 1		132.83	MERCURY-CONTAINING PRODUCTS
TABLE 1		18.61	Point source deduction entry

[1] USEPA's methodology accounts for state collection of automobile switches which is documented in the ELVS Mercury Switch Recovery Program Reporting.

Using Michigan data about scrapped vehicles, a range of emissions from 21.35 lbs to 151.44 lbs of mercury were emitted statewide to the atmosphere from shredding (McGeen, 2021). It was estimated that a maximum of 18.61 lbs were emitted by point sources in 2017 per the table below. Estimates were based on the availability of stack test data and permitted hours of operation, or Lumex monitoring.

In the nonpoint source section, the methodology for estimating the nonpoint source component of auto shredding emissions (2.74 lbs to 132.83 lbs) will be presented.

The USEPA estimated a nonpoint emissions value of mercury from auto shredding for Michigan in the 2017 NEI, of 132.83 lbs. That calculation is based on the latest USEPA methodology and factor. Therefore, it considered to be the most defensible emissions value for the nonpoint component of auto shredding.

Table 46. Point Source Auto Shredding

Company	SRN	Emission Control Equipment	Emissions (lbs/yr)	Comments
Louis Padnos Iron & Metal Co., 2001 Turner Ave NW, Grand Rapids, MI 49504	A2457	Shredder has "water only" spray in the hammer mill.	11.44	2008 stack test
SLC Recycling, Inc. (Ferrous Processing & Trading)	A4750	Baghouse	0.4	2001 stack test; EU-SHREDDER currently permitted under 309-00B which has mercury limit of 0.0012 lbs/hour mercury and restriction for 6240 hours of annual operation
Louis Padnos Iron & Metal Co., 120 S. River Avenue, Holland, MI 49423	B1982	Multicyclone, water injection	NA	365-98A, active, for AUTOMOBILE SHREDDER-WATER INJECTION SYSTEM/REVISE.
Ferro-Met Corp., 1011 N. Washington, Saginaw, MI 48601	B1997	Not currently operating	NA	201-88, active, for SHREDDING SYSTEM.
Jackson Iron & Metal, 810 Lewis Street, Jackson, MI 49201	B2281	Shredder has "water only" spray in the hammer mill.	2.01	PTI 93-04 voided on 1/06/2005. PTI 93-04A issued on 1/06/2005 and is currently active; FG-SHREDDERAPC has limit of 0.02 lbs Hg/hour. EUSHREDDER has limit of 3120 hours per rolling 12 month time period. Per inspection report of 7/03/2019, 2005 stack test report had results of 0.008 lb/hr Hg from EU-SHREDDER. At 3120 hours per year, this results in a calculation of 24.96 lbs of Hg emissions annually. However, per an 8/04/2015 inspection report, 2500 to 3000 cars are shredded annually at this facility. The total available mercury in vehicle switches for those automobiles ranges from 3 to 4 lbs. Utilizing the same emission factors as for the area source calculations, up to 2.01 lbs of mercury are estimated to have been released from the 2500 to 3000 vehicles processed annually at this facility.
Fritz Enterprises, 23550 Pennsylvania Rd, Taylor, MI 48180	B3240	Water spray and cyclone on shredder.	1	2003 Lumex Monitoring (assuming 8 hour workday/ 365 days/yr)
FPT-Pontiac Division LLC, 500 Collier Rd, Pontiac, MI 48056	B4146	Water spray on hammer mill with a control system of primary cyclone, followed by a quad cyclone, then a fabric filter (cloth filter/roller). Material handling systems down line are controlled by cyclones.	NA	120-80, active, for HAMMERMILLS CAR SHREDDER AND FABRIC FILTER AND CYCLONIC COLLECTORS.
Sturgis Iron & Metal, 70675 Centerville, Sturgis, MI 49091	B4372	Shredder ducted to a cyclone and cyclones on material handling.	NA	25-03A for aluminum shredder (particulate limits), active. 355-79A (particulate limits), active.
Louis Padnos Iron & Metal Co., 1900 West Willow, Lansing, MI 48917	B4884	Shredder has "water only" spray in the hammer mill.	NA	100-18 for new shredder voided on 8/18/2020. 205-75 and 52-75 still active.

Company	SRN	Emission Control Equipment	Emissions (lbs/yr)	Comments
Huron Valley Steel Corp., 41000 Huron River Dr., Belleville MI 48111	B6178	Two cyclones	NA	No stack test, TRI, permit or MAERS data available for mercury emissions
West Michigan Iron and Metal, 1845 Chicago Dr. SW, Wyoming, MI 49509	B7634	Shredder enclosed by a metal hood and ducted to a cyclone followed by a wet scrubber.	NA	1094-80, 15 CAT/HOUR FRAGMENTIZER WITH WET SCRUBBER AND CYCLONE
Rifkin Scrap Iron & Metal, 1445 N. Niagara Street, Saginaw, MI 48602	N0844	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)
Portland Iron & Metal, 3130 Knoll Rd, Portland, MI 48875	N1340	Water spray on shredder. Z-box with cyclone for material separation.	NA	PTI 2-15, PM emission limit only. 381-98, opacity limits.
Kalamazoo Metal Recyclers, 1525 King Highway, Kalamazoo, MI 49001	N1373	Shredder enclosed by a metal hood and ducted to a cyclone followed by a wet venturi scrubber.	NA	PTI 364-78
E. Kingsford Iron and Metal, 100 Superior Avenue, Kingsford, MI 49801	N3753	NA	NA	No stack test, TRI, permit or MAERS data available for mercury emissions
Strong Steel Products, 6464 Strong, Detroit, MI 48211	N6293	Shredder has water added to control emissions.	1	2005 Lumex Monitoring (5008 max. operating hours)
S & S Metal Processing, 5032 Dort Highway, Flint, MI 48505	N6823	Shredder (60 ton/hr thruput) enclosed by a metal hood and ducted to a cyclone followed by a wet cyclonic scrubber.	6.13E-02	2011 stack test data associated with PTI 92-00B (currently active) found in 2015 MACES inspection report for Fritz Enterprises of Flint, SRN# N6823. Limit of 0.0022 lb/hour and stack testing results showed emissions of 7.0e-06 lb/hour. Based on that hourly rate, emissions of 6.13e-02 lbs would result from continuous year round operation. Emissions in 2014 may have been much lower as the facility had only operated 17 days in 2015 at the time of the inspection on 7/16/2015 due to a low price for steel on the commodities market.
TOTAL			18.61	

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Relay Manufacturers

MDI (Mercury Displacement Industry, SRN N5886) operates in Edwardsburg, Michigan. According to the facility's TRI report, it emitted 1 lb of mercury in 2017. MDI reported 83.4 lbs to the 2014 TRI. According to the 2005 NATA, mercury emissions from MDI are elemental mercury.

Table 47. Relay Manufacturers

Year	Point Source Sector	Estimated Emissions in Lbs	Estimate Basis
2017	Relay Manufacturers	1.00	2017 TRI

NONPOINT SOURCES

Mercury in Products

Incineration of wastes contaminated with mercury-containing products has 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. 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

In the 2017 NEI, the USEPA estimated nonpoint mercury emissions of 27.40 lbs for Michigan from dental amalgam. This covers dental office emissions from the placement and replacement of mercury dental amalgam, as well as consumer "in use" emissions. As the factors and methodologies used by the USEPA are considered the most recent, this value will be utilized within Michigan's mercury inventory for placement, replacement and "in use" emissions from dental amalgam. For comparison, the range of values estimated by Michigan through use of the USEPA Mercury Flow Diagram will be described below.

Substituting Michigan data for national data in the USEPA Mercury Flow Diagram, emissions from dental amalgam were calculated (McGeen, 2021). 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, 2018). According to the

December 2018 version of the fact sheet, there were 22,074 total lbs of mercury sold nationally in dental amalgam in 2016. The 2017 calculation assumes that 2017 sales were identical to 2016. Michigan's proportion of the national sales was determined by population (3.07% of the national value). Furthermore, it was assumed that all amalgam sold within the year was placed. Accordingly, 688.70 lbs was assumed for the weight of dental amalgam prepared in Michigan in 2017.

This corresponds to 47.16 lbs of mercury emissions, assuming that 7% of the mercury in an amalgam volatilizes to the air during placement.

Additionally, it was estimated that 383.38 lbs of mercury returned to the dental office in the form of mercury amalgam which was replaced with new amalgam. Seven percent of the replaced amalgam or 26.26 lbs of mercury was emitted from the dental office in the form of air emissions.

Consumer "in use" emissions were estimated through the flow diagram to be 9.96 lbs. This estimate was based on the assumption that 76% 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 municipal solid waste (MSW) landfills was estimated at 00.20 lbs. Mercury from disposal at MSWs was estimated at 1.17 lbs.

Mercury in the amount of 4.45 lbs from mass burn and refuse derived fuel (RDF) was estimated by the flow diagram but since this category is already accounted for in the point source inventory, this estimate was not included in the Michigan 2017 mercury inventory.

Through use of the USEPA Flow Diagram, mercury emissions in the amount of 83.38 lbs were estimated in total for the category of dental amalgam in 2017, for the placement of dental amalgam and consumer "in use" emissions. An additional value for mercury in the amount of 1.37 lbs was estimated for the waste stream, as noted above. These values do not include the emission estimates from cremation, which is a separate nonpoint source category.

Table 48. Dental Amalgam

Dental Amalgam			
Year	**Flow Diagram estimate in lbs**	**2017 NEI estimate in lbs**	**subset**
2017	26.26	27.40	Emissions from replacement (removal) of dental amalgam
2017	47.16		Emissions from placement of dental amalgam
2017	9.96		Consumer "in use" emissions
2017	0.20	NA	Storage, transit and transfer (MSW)
2017	1.17	NA	Landfills
2017	NA	NA	Recycling
2017	NA	NA	Mass burning and RDF (accounted for under point sources)
2017	NA	NA	Burn barrels
TOTALS	84.75	27.40	
Assignment in Table 1			
Table 1		27.40	MERCURY-CONTAINING PRODUCTS

Fluorescent and Non-fluorescent Lamps

In the 2017 NEI, the USEPA estimated recycling and non-recycling related mercury emissions from the breakage of fluorescent bulbs in Michigan. This covers emissions from recycling and non-recycling breakage. As the factors and methodologies used by the USEPA are considered the most recent, this value will be utilized within Michigan's mercury inventory. Total emissions from non-recycling breakage of bulbs were 55.88 lbs from the 2017 NEI, and recycling-related breakage emissions were estimated at 1.96E-03 lbs.

The range of values estimated by Michigan for recycling and non-recycling breakage of fluorescent bulbs, through use of the USEPA Mercury Flow Diagram, is described below. The flow diagram estimates 2.45 lbs of mercury emissions from production, and retail and consumer breakage of bulbs. The flow diagram estimate for recycling-related emissions was 35.81 lbs.

Substituting Michigan data for national data in the USEPA Mercury Flow Diagram, an emissions estimate for fluorescent lamp breakage was calculated (McGeen, 2021). In 2016, 3.1 tons of mercury was present in lamp sales based on data from IMERC's Mercury Use in Products fact sheet (IMERC, 2018). This represents a 71% decline since 2001 and a 64% decline since 2010. The fact sheet notes that mercury use in lamps is expected to decline with the increased availability and usage of LED lamps, as an alternative to fluorescents lamps. 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 2017 mercury report.

For the estimation of Michigan's 2017 emissions, it was assumed that 2017 lamp sales in the United States were the same as in 2016. Using Michigan and national population data for 2017, it was assumed that Michigan received a proportionate percentage of the lamps containing mercury (3.12% or 10,800,800 lamps). This number was increased to account for an additional 0.5% broken at retail locations for 10,854,804 lamps), and an additional 5.0% broken prior to delivery to retail locations (production total of 11,397,544 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 was 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 capped the total mercury content in Compact Fluorescent Lamps (CFLs) at less than 25 watts at 5 milligrams (mg) per unit. CFLs that use 25 to 40 watts of electricity were capped at 6 mg per unit (NEKA, 2007). The proportion of CFL to full-size fluorescent bulb sales was not available. Therefore, the more conservative assumption of 8 mg per unit is still being used for purposes of the 2017 emissions estimation for this nonpoint source category. This method yielded an emissions estimate of 0.37 lbs of mercury emitted from lamp breakage by retailers, and 1.90 lbs emitted from lamp breakage by consumers. An additional 0.18 lbs of mercury from lamps broken at production facilities were calculated for a total of 2.45 lbs directly from lamp breakage, as estimated by the USEPA Flow Diagram

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 (341.23 lb/yr in Michigan based on an estimate of lamps being discharged at the end of their life expectance in 2017), 78% or 266.16 lbs likely ended up in the solid waste stream. Assuming 10% of the mercury in each lamp was released while in transit, 26.61 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, 1.87 lbs of mercury emissions can be attributed to landfill emissions from disposed lamps. Another 3.62 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 15.76 lbs were estimated from lamps incinerated in mass burn/RDF combustion. However, Michigan's 2017 mercury inventory already accounts for solid waste incineration under point sources, so the 15.76 lbs of nonpoint source mercury emissions estimated by the USEPA Mercury Flow Diagram for mass burn/RDF has been omitted from the Michigan 2017 inventory.

Using the USEPA Mercury Flow Diagram and assuming that Michigan recycles fluorescent lamps at the same rate as the national average, 22%, about 6.7 million lamps should have been recycled in Michigan in 2017. Approximately 0.75 lbs of mercury was likely released during the transport of lamps to the recycling facility based on a 1% release factor. Another 0.51 lbs was estimated to have been emitted from recycling itself, via the USEPA Mercury Flow Diagram.

It can be estimated that the three companies permitted in Michigan in 2017 with fluorescent lamp recyclers emit 1.69 lbs of mercury per year, assuming they are emitting the maximum amount allowed by their permit conditions. These three facilities are not required to report to MAERS. Therefore, it was not known how many hours they operated, or in the case of the source permitted as both a stationary and portable facility, where it operated and emitted in 2017.

Table 49. Fluorescent Lamp Recyclers

SRN	Company	Portable or Stationary	Permit Limit	Maximum Emitted Lbs
N5948	USA Lamp & Ballast Recycling	Stationary	0.08 g/hr	1.50
N6821	Reliable Relamping, Inc.	Facility is permitted as both a stationary and a portable source.	0.01 g/hr	0.19
P0621	3S International, LLC	Stationary	The permittee shall not process more than 9,636 tons of fluorescent light bulbs per year in FGRECYCLERS per 12-month rolling time period.	NA
Total				1.69

Hence, fluorescent and non-fluorescent lamp breakage, recycling, and the solid waste stream are estimated with the USEPA Flow Diagram to have released 35.81 lbs of mercury to the atmosphere in 2017. Lamp breakage is estimated to have released 2.45 lbs of mercury by itself, and the remaining disposal activities (storage, transfer, transit, and recycling) are estimated to have released 33.36 lbs. of the disposal activities, the subset of fluorescent lamp recycling and recycling-related activities account for 1.29 lbs.

The USEPA's 2017 NEI contains a relatively close estimate for Michigan of 55.88 lbs from non-recycling breakage and 1.96E-03 lbs from recycling breakage. Ultimately, the 2017 NEI value has been used for the report as the most defensible calculation. Michigan's estimate of 1.69 lbs of mercury emissions from permitted lamp recyclers has been added to the mercury inventory under lamp recycling, based on information obtained from the individual permits.

Table 50. Fluorescent and Non-fluorescent Lamps

Fluorescent Lamps			
Year	**Flow Diagram Estimate in Lbs**	**2017 NEI Estimate in Lbs**	**subset**
2017	0.18	55.88	Production breakage
2017	0.37		Retail breakage
2017	1.90		Consumer breakage
2017	26.61		Storage, transit and transfer (MSW)
2017	1.87		Landfills
2017	0.75	1.96E-03	Storage, transit and transfer (recycling)
2017	0.51		Recycling
2017	NA	NA	Mass burning and RDF
2017	3.62	NA	Burn barrels
TOTALS	35.81	55.88	
Assignment in Table 1			
Table 1		55.88	MERCURY-CONTAINING PRODUCTS
Table 1		1.96E-03	All other values (recycling, and storage, transfer and transit en route to recycling) are included under Recycling

Drum Top Crushers

As of 2017, there were 7 active permits issued by EGLE for drum top crushers (DTCs) with an 8th permit voided but the process rolled into the facility's ROP. Accordingly, there were 8 permitted DTCs operating in 2017. of the active DTCs in 2017, the permits for several have since been voided. 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, and a range of 10 to 20 mg of mercury per lamp per Joy Taylor Morgan, EGLE), the amount emitted from this category in 2017 can be estimated at a minimum of 0.09 lbs and a maximum of 0.18 lbs (McGeen, 2021).

Table 51. Drum Top Crushers

Permit No	SRN	Company	Location	Approved	Voided	Comments
170-13	B8747	Johnson Matthey Vehicle Testing & Development	Taylor	12/11/2013	2/10/2020	
159-14	B8876	Flowserve Corporation	Kalamazoo	10/23/2014	2/23/2017	Include in 2017 calculation
112-10	N0929	Auto Alliance International	Flat Rock	6/9/2010	5/19/2011	Rolled into ROP
117-10	N5245	Marquette County Solid Waste Management	Marquette	7/19/2010		
138-06	N7614	Shaheen Chevrolet, Inc.	Lansing	7/13/2006		
40-10	P0063	McPhee Electric & Telecommunications	Potterville	3/8/2010	10/18/2017	Include in 2017 calculation
16-14	P0500	Sebewaing Light & Water Dept	Sebewaing	2/14/2014		
68-14	P0515	Tenneco Automotive, Inc.	Litchfield	5/27/2014	3/13/2018	

Auto Switches – Shredding of Autos (Nonpoint Sources)

The USEPA estimated a nonpoint emissions value of mercury from auto shredding for Michigan in the 2017 NEI of 132.83 lbs. That calculation is based on the latest USEPA methodology and factor, and it also accounts for mercury switch recovery in Michigan. It is seen as the most defensible emissions value for the nonpoint component of auto shredding and is used in the mercury inventory accordingly.

It was estimated that a maximum of 18.61 lbs were emitted by point source automobile shredders per the table below, resulting in a statewide estimate of 151.44 lbs if the NEI nonpoint value is used.

For comparison, calculations made with the USEPA Mercury Flow Diagram are presented. Using Michigan data about scrapped vehicles, 97.50 lbs of mercury emissions were estimated statewide by point and non-point sources from automobile shredding (McGeen, 2021).

Using Michigan data in the USEPA Mercury Flow Diagram, an estimated 97.50 lbs of mercury was emitted to the atmosphere from shredding, in total, with 18.61 lbs of that accounted for by point source facilities. It was estimated that 570.40 lbs of mercury was present in switches in end-of-life vehicles in Michigan in 2017, based on the estimated number of vehicles scrapped in Michigan (5.44% or 479,126 vehicles). Previous mercury inventories assumed 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.

The number of vehicles with mercury switches has declined as the vehicle population ages. As documented by End-of-Life Vehicle Solutions, vehicles manufactured in the 2003 model year and beyond do not contain mercury convenience switches (ELVS, 2007). The average age of vehicles in the U.S. in 2017 was 11.9 years (Bureau of Transportation Statistics, 2021). In Michigan, an average age of vehicles in 2019 was 11 years according to figures cited from data provider IHS Markit (Detroit News, 2019).

Based on End-of-Life Vehicle Solutions' report, 27.50 lbs of mercury was recovered from mercury switches in 2017 (ELVS, 2021). 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 18.61 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 78.89 lbs of mercury should be released from auto fluff, assuming a 25% release factor per the Barr report.

This results in a total of 97.50 lbs of mercury from the auto shredding sector as estimated by the USEPA Flow Diagram. Following the deduction of 18.61 lbs estimated for the point source component of auto shredding, the nonpoint source component is estimated to be 78.89 lbs in 2017.

The following table presents the range of emissions estimated for the nonpoint component of auto switches (automobile shredding). As noted earlier, the 2017 NEI estimate has been accepted as the final value for the mercury inventory.

Table 52. Auto Shredders Nonpoint

Auto Switches - Estimated Mercury Emissions in Lbs			
Year	**USEPA Mercury Flow Diagram**	**2017 NEI value[1]**	**Subset**
2017	18.61	151.44	Shredding
2017	78.89	NA	Auto fluff
2017	NA	NA	Storage, transit and transfer (MSW)
2017	NA	NA	Storage, transit and transfer (recycling)
2017	NA	NA	Landfills
2017	NA	NA	Recycling
2017	NA	NA	Mass burning and RDF
2017	NA	NA	Burn barrels
TOTAL	97.50	151.44	Area source and point source totals
	78.89	132.83	Area source total
	18.61	18.61	Point source total
Assignment in TABLE 1			
TABLE 1		132.83	MERCURY-CONTAINING PRODUCTS
TABLE 1		18.61	Point source deduction entry

[1] USEPA's methodology accounts for state-level collection of automobile switches from the ELVS Mercury Switch Recovery Program Reporting

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, 2021). Michigan accounted for 3.07% of the United States population in 2017 so national values were scaled down to reflect Michigan's proportion of the national population.

Approximately 0.49 kg (1.04 lbs) of mercury were emitted from the retail of switches and relays, assuming 0.1% of mercury in switches and relays is released during retail in 2017. The quantity of mercury sold annually in switches and relays nationally was based on the 2010 figure from the most recent IMERC fact sheet: Mercury Use in Switches and Relays (IMERC, 2014). The 2010 value was adjusted for an annual 4% decline by 2017.

For consumer breakage of switches and relays, a 0.05% release factor was used. It is estimated that 58.89 lbs of mercury was emitted from consumer breakage in 2017, for a total of 59.92 lbs from the consumer and retail category.

During the storage, transit, and transfer of MSW, 14.20 lbs of mercury was likely released assuming a 1.5% release factor. Another 18.92 lbs of mercury was released in 2017 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 6.57 lbs of mercury emissions under the assumption that 1% of the mercury is released. Another 18.54 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 92.04 lbs more would be lost due to mass burning and RDF combustion, but this was not included in the switch and relay nonpoint 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 28.22 lbs.

In total, 146.36 lbs of mercury was likely released from activities associated with mercury-containing switches and relays in 2017. This includes the solid waste stream.

Mercury in the amount of 59.92 lbs is listed in Table 1 for the switches and 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 53. Switches and Relays

Switches and Relays		
Year	**Flow Diagram Estimate in lbs**	**subset**
2017	1.04	Retail breakage
2017	58.89	Consumer breakage
2017	14.20	Storage, transit and transfer (MSW)
2017	18.92	Storage, transit and transfer (recycling)
2017	6.57	Landfills
2017	18.54	Recycling
2017	NA	Mass burning and RDF
2017	28.22	Burn barrels
TOTALS	146.36	
Assignment in Table 1		
Table 1	59.92	MERCURY-CONTAINING PRODUCTS
Table 1	86.44	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, 2020). 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, 2018). This fact sheet indicates that 102 lbs of mercury was sold nationally in thermostats in 2013 and 0 lbs in 2016. According to the IMERC fact sheet, the great decline nationally is due, in large part, to state laws banning the sale of thermostats containing mercury and the availability of non-mercury digital thermostats with programmable features that are sought after by consumers. As thermostats have a life expectancy of 30 to 50 years, emissions from discarded thermostats will occur for some years into the future.

Assuming that mercury use in 2017 thermostats sold is equal to 2016 levels of zero, no thermostats containing mercury were sold in Michigan in 2017.

Based on state and national population data, and national estimates for the number of thermostats replaced, an estimated 107,450 mercury-containing thermostats were replaced (discarded by consumers) in Michigan in 2017. 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 8.51 lbs of mercury was emitted from consumer breakage of the replaced thermostats. During consumer use, 1% of the mercury in thermostats was expected to have volatilized due to breakage. The total emission estimate from retail and consumer breakage is 8.51 lbs.

Based on the estimated 107,450 mercury-containing thermostats discarded by consumers in 2017, 18.34 lbs of mercury was contained in the 2% of thermostats that were recycled.

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

Mercury in the amount of 764.09 lbs in thermostats entered the solid waste stream. During the storage, transit, and transfer of MSW, thermostats contributed 11.46 lbs of emissions. Three percent of thermostats in MSW were likely burned in burn barrels emitting 90% or 22.80 lbs of the mercury they contained. Mercury in the amount of 5.29 lbs was likely released due to the 75% of thermostats in the MSW stream that were landfilled, assuming 1% of mercury would volatilize.

An additional 85.98 lbs of mercury was present in the 10% of thermostats which ended up under demolition debris disposal. Mercury in the amount of 0.86 lbs was emitted during the storage, transit, and transfer to demolition debris landfills. Additional mercury in the amount of 1.61 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. Mercury emissions in the amount of 0.88 lbs were estimated from wastewater treatment. Another 0.44 lbs) was estimated from land application air emissions, but this category has been estimated as a separate nonpoint source. Mercury in the amount of 0.88 lbs, 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, 51.08 lbs of mercury was likely emitted due to thermostats in 2017. Of this, 8.51 lbs was emitted directly from consumer breakage.

The USEPA's 2017 NEI includes an estimated 7.27 lbs of mercury emissions in Michigan from thermostats and thermometers under SCC 2650000000. The USEPA's methodology specifies that these emissions are "the portion that emit mercury prior to disposal at landfills or incinerators." The 2017 NEI calculation does not account for estimated emissions occurring at the numerous steps in the products disposal path, therefore the NEI v2 value is accepted as the most defensible value for consumer breakage, and the calculations from the USEPA Mercury Flow Diagram are utilized for the different waste and recycling outputs.

Table 54. Thermostats

Thermostats			
Year	**Flow Diagram Emissions in Lbs**	**2017 NEI Emissions in Lbs**	**Subset**
2017	0.00	0.00	Production losses
2017	8.51	7.27	Consumer breakage
2017	0.00	0.00	Retail breakage
2017	11.46	NA	Storage, transit and transfer (MSW)
2017	0.86	NA	Storage, transit and transfer (demolition debris landfills)
2017	0.37	NA	Storage, transit and transfer (recycling)
2017	5.29	NA	Landfills
2017	1.61	NA	Landfills (demolition debris)
2017	0.18	NA	Recycling
2017	NA	NA	Mass burning and RDF
2017	22.80	NA	Burn barrels
TOTAL	51.08	7.27	
Assignment in TABLE 1			
TABLE 1		7.27	MERCURY CONTAINING PRODUCTS

Measurement and Control Devices

Emissions from measurement and control devices were estimates as a proportion of national emissions using the USEPA Flow Diagram (McGeen, 2021). According to the IMERC fact sheet, Mercury Use in Measuring Devices, 0.77 tons of mercury was contained in measuring devices sold nationally in 2016 (IMERC, 2018). While an increase since 2013 when 0.58 tons was contained in measuring devices sold nationally, this still represents an 84% 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 the 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 otherwise. Michigan accounted for 3.07% of the U.S. population so national values were adjusted accordingly to generate Michigan-specific values.

Approximately 0.04 lbs of mercury was emitted from the retail 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. Mercury in the amount of 22.62 lbs was emitted from consumer breakage in 2017, for a total of 22.66 lbs from retail and consumer breakage.

During the storage, transit, and transfer of measurement and control devices as MSW, 0.26 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 0.13 lbs was released during storage and transfer of measurement and control devices bound for recycling. Another 0.13 lbs of mercury was likely released due to recycling assuming a 1% release factor.

Three percent of measurement and control devices in MSW were likely burned in burn barrels releasing 90% of the mercury contained in them. Accordingly, 0.53 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. They contribute 0.13 lbs of mercury emissions assuming 1% of the mercury is released.

In total, 23.85 lbs of mercury was likely released from all activities associated with mercury-containing measurement and control devices in 2017.

Table 55. Measurement and Control Devices

Measurement & Control Devices		
Year	**Flow Diagram Estimate in lbs**	**subset**
2017	0.04	Retail breakage
2017	22.62	Consumer breakage
2017	0.26	Storage, transit and transfer (MSW)
2017	0.13	Storage, transit and transfer (recycling)
2017	0.13	Landfills
2017	0.13	Recycling
2017	NA	Mass burning and RDF
2017	0.53	Burn barrels
TOTALS	23.85	
Assignment in Table 1		
Table 1	22.66	MERCURY-CONTAINING PRODUCTS
Table 1	1.19	All other values (storage, transfer and transit en route to MSW and recycling, and actual landfilling and recycling) are included under subsets of Waste Disposal category

Thermometers

In 2003, Michigan Public Act 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 2017 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 2017. Accordingly, mercury emissions from breakage and disposal of mercury thermometers are assumed to be minimal in 2017 and zero emissions have been calculated (McGeen, 2021).

Table 56. Thermometers

Year	Estimated Emissions in Lbs	Nonpoint Sector
2017	0.00	Thermometers

Bulk Mercury

Household hazardous waste collection sites operated by county and city health departments collected 398.34 lbs of elemental free-flowing mercury in 2017 (McGeen, 2021). The USEPA Flow Model estimates that 1% or 3.98 lbs of this mercury was released to the air. A total of 398.34 lbs of bulk mercury was also transported as waste in 2017. One percent or 3.98 lbs of this bulk mercury was expected to be released during waste transport. Approximately 5,311.20 lbs of mercury was calculated as the total consumer input by extrapolating from the total waste estimates. Due to the larger quantity of bulk mercury collected in 2017, the calculated stockpile value is actually higher than the stockpile estimated for the 2014 mercury inventory. This is due to the USEPA Flow Diagram assumption that that bulk mercury disposed of as waste in a given year comprises 7.5% of total consumer input. Mercury from consumers had an expected release factor of 0.2%, resulting in emissions of approximately 10.62 lbs of elemental mercury in 2017. Therefore, approximately 18.59 lbs of mercury was likely released from all aspects of the bulk mercury category in 2017 (McGeen, 2021).

Table 57. Consumer Use of Bulk Mercury

Consumer Use of Bulk Mercury		
Year	**Flow Diagram Estimate in lbs**	**subset**
2017	3.98	Released from collection of bulk mercury emissions (Clean Sweep sites)
2017	10.62	Consumer and retail
2017	3.98	Storage, transit and transfer (MSW)
2017	NA	Landfills
2017	NA	Recycling
2017	NA	Mass burning and RDF
2017	NA	Burn barrels
TOTALS	18.59	
Assignment in Table 1		
Table 1	10.62	MERCURY-CONTAINING PRODUCTS
Table 1	3.98	See CLEAN SWEEP SITES entry
Table 1	3.98	All other values (storage, transfer, transit as MSW) are included under subsets of Waste Disposal Category

Volatilization During Solid Waste Collection and Processing

Although the USEPA Mercury Flow Diagram includes calculations for emissions from solid waste processing (handling) for each product type, the AQD has prepared an in-house calculation for each triennial mercury inventory to represent any emissions that may occur above and beyond the Flow Diagram calculations.

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). In prior mercury reports, a mercury value was estimated for composted municipal solid waste in Michigan. However, since then it has been clarified that composting in Michigan consists almost entirely of yard waste. Yard waste was once sent to landfills but resulted in numerous odor issues and even fire hazards as it decomposed. Accordingly, it is kept separate from the MSW stream and is highly unlikely that batteries or mercury-containing devices would contaminate the yard waste compost (Hiday, 2020). Based on this information, composted yard waste is not included as a source of mercury emissions in the 2017 mercury report.

The quantity of solid waste combusted was calculated using MAERS throughput values (see Municipal Waste Incineration). Landfill data from 2017 was obtained from the Materials Management Division (EGLE, 2021). For this estimate, only Type II in-state waste (municipal solid waste) was considered. The value was 22,651,913 cubic yards and a weight of 0.333 tons per yard was assumed for an estimate of 7,543,087.03 tons. 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 509.14 lbs was estimated due to volatilization during the collection and processing of MSW in 2017 based on this method (McGeen, 2021).

The van Veizen emission factor from 2002 may not reflect trends by 2017 in the solid waste stream for mercury products and devices. Within the USEPA Flow Diagram mercury emissions estimated from solid waste collection and processing declined from 53 lbs to 17.84 lbs, or a decrease of 66%. If this information is used to scale the calculation based on the van Veizen factor, an adjusted estimate of 173.11 lbs of mercury from solid waste collection and processing is calculated for 2017. This AQD estimate may still be partially duplicative of the 17.84 lbs estimated mercury emissions from the flow diagram for solid waste collection and processing for different mercury-containing products.

Table 58. Solid Waste Collection and Processing

Fate of Municipal Solid Waste (MSW)	Amount	Reference
Resource Recovery (incineration in tons)	942,567.60	From 2017 Point Source MSW Incineration Sector
Landfill Type II In-State Waste (Tons)	7,543,087.03	MDEQ, Office of Waste Management & Radiological Protection, Report of Solid Waste Landfilled in Michigan (October 1, 2016 - September 30, 2017), Table 3
Total landfill, and combusted	8,485,654.63	
Calculated mercury content (lb/ton)	0.004	van Veizen (2002)
Mercury content in lbs of SW (excluding recycling)	33,942.62	
Volatilization in handling and transport, equals 1.5% of total content from waste landfilled and incinerated.	509.14	Emissions rate obtained from USEPA Mercury Flow Diagram
Scaled estimate in lb, based on 66% decline in mercury content in solid waste inputs from 2002 through 2017	173.11	2002 through 2017 product use and waste inputs within USEPA Mercury Flow Diagram

Landfill Volatilization

The USEPA's 2017 NEI estimated that 48.49 lbs of mercury emissions were emitted from the working face of landfills. The calculation was prepared by USEPA in 2020 utilizing their Landfill Tool v1.1, which includes the latest emission factors and assumptions. This calculation is seen as the most defensible and is used for the mercury inventory, although the range of calculations used by Michigan for previous mercury inventories is presented below with alternate 2017 estimates for comparison.

Michigan's alternate estimate for volatilization during placement of 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 2017, a Michigan-specific figure from the MDEQ's Office of Waste Management & Radiological Protection was utilized (MDEQ, OWMRP, 2017). For this estimate, total landfilled Type II (in-state and out-of-state) waste (50,604,692 cubic yards) was considered and a weight of 0.333 tons per yard was assumed. For this calculation it was assumed that the mercury concentration of MSW is approximately 0.004 lbs of mercury per ton of solid waste (van Veizen, 2002). From this method, approximately 62.66 lbs of mercury was likely emitted due to volatilization from landfilled MSW in 2017 (EGLE, 2021).

The emission factor utilized for landfill volatilization from the 2014 NEI v2 was applied to the 2017 landfilled Type II waste for Michigan to create an alternate estimate of 92.85 lbs.

The different calculations for mercury emissions from volatilization at the working faces of landfills range from 48.49 lbs to 92.85 lbs. The 2017 NEI calculation of 48.48 lbs for Michigan is utilized as the final value for the mercury inventory.

Table 59. Landfill Volatilization

Fate of Municipal Solid Waste	Amount	Reference
Total landfilled in-state and out-state Type II Waste (Municipal & Commercial Waste) in cubic yards, 2017	50,604,692	MDEQ, Office of Waste Management & Radiological Protection, Report of Solid Waste Landfilled in Michigan (October 1, 2016 - September 30, 2017), Table 1
Total landfilled Type II Waste in tons (assumes 0.333 tons/yd), 2017	16,851,362	MDEQ, Office of Waste Management & Radiological Protection
Calculated mercury content (lb/ton)	0.0040	van Veizen (2002)
Mercury content in lb of solid waste (excluding recycling)	67,405	
Estimated 2017 mercury emissions using 2014 NEI v2 volatilization rate for MSW, and Michigan Type II waste in tons	67.41	Alternative value using emission rate from USEPA 2014 NEI v2, Documentation for Estimation of 2014 Nonpoint Mercury Emissions (0.1% of mercury in MSW volatilizes)
Hg emissions rate in lb/ton (specific to landfill working face)	5.51E-06	2014 NEI v2 (Lindberg 2002)
Estimated 2017 mercury emissions from landfill working face using 2014 NEI v2 factor (Lindberg 2002) and Michigan Type II waste in tons	92.85	This calculation presents an alternate value using the 2017 activity data with the emission factor utilized in the 2014 NEI v2.
USEPA's 2017 NEI mercury estimate in lbs for Michigan, for landfill working face	48.49	USEPA Landfills Tool v1.1, run by USEPA on 2/15/2020

Burn Barrels

For the 2017 NEI, the USEPA calculated an estimate of mercury emissions from open burning of solid waste (burn barrels) in Michigan of 186.72 lbs. The calculation was based on the USEPA's Construction Dust and Open Burning Tool, v1.1. While the 2017 NEI value for Michigan of 186.72 lbs is accepted for the mercury inventory as the most defensible estimate, Michigan's alternate calculations are described below for comparison.

While the USEPA Mercury Flow Diagram includes calculations for emissions from burn barrels (open burning of MSW) for each product type, the AQD has prepared an in-house burn barrel calculation for each triennial mercury inventory to represent emissions, which may occur above and beyond the flow diagram estimates.

A methodology from Michigan's 2005 mercury inventory was utilized to estimate 103.45 lbs of mercury from the open burning of MSW in 2017. The methodology was from USEPA's 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 2010 US Census data, and then multiplied by a 2017 US Census Bureau estimate of the county population in Michigan to obtain an estimate of rural population in 2017. 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, 2008), 2% of MSW was assumed to be disposed of in burn barrels, resulting in the estimate of 103.45 lbs (McGeen, 2021).

From the USEPA's open burning estimates in the 2017 NEI, an estimated 213,635 tons of MSW were burned. Using this activity data, burn barrel emissions of mercury for 2017 are estimated at 854.54 lbs utilizing the van Veizen emission factor and the throughput from the 2017 NEI (McGeen, 2021). This value is substantially higher due to the assumption of a larger quantity of available waste being burned. The number of mercury-containing devices in use has declined since the 2002 study

was conducted by van Veizen, therefore this calculation may overestimate the quantity of mercury emissions from open burning of MSW in 2017.

In addition, an emissions component from burn barrels of 57.74 lbs has already been estimated for several of the mercury product use categories such as thermostats, switches and relays, and fluorescent and non-fluorescent bulbs based on the USEPA's Mercury Flow Diagram. These product types account for the likeliest sources of mercury in MSW in burn barrels, with the exception of mercury-containing batteries for which calculation methodologies are not available. For 2017, there is an estimated 77% less mercury emissions from burn barrels than the 2002 calculation from the USEPA's Mercury Flow Diagram. Therefore, the AQD calculations, utilizing the 2002 van Veizen factor, and waste inputs per MPCA's assumptions or the 2017 NEI, and the resulting emissions estimates of 103.45 lbs and 854.54 lbs, may be overestimates based on the reduced presence of mercury in the solid waste stream in 2017.

Scaling the AQD calculations, based on the 77% decline of mercury from the USEPA's Flow Diagram, produces an adjusted range of 23.79 lbs and 196.54 lbs for 2017. Even these values may pose some overlap with the 57.74 lbs of burn barrel emissions from other mercury-containing products in the flow diagram, but they are more likely to reflect current trends in the waste stream.

While the 2017 NEI value for Michigan of 186.72 lbs is accepted for the mercury inventory as the final value, Michigan's alternate calculations are presented below in table format.

Table 60. Open Burning of Solid Waste (Burn Barrels)

Methodology	Assumptions	Emission Estimation Basis	Estimated Emissions from Burn Barrel in Lbs
MPCA waste assumptions	2% of solid waste is assumed to be burned in barrels	Van Veizen emission factor (2002)	103.45
2017 NEI inputs with Van Veizen factor	Quantity of solid waste in burn barrels was estimated by USEPA	Van Veizen emission factor (2002)	854.54
Scaled estimate based on MPCA assumptions	77% estimated decline in open burning of solid waste (burn barrels), based on product and waste inputs in USEPA Mercury Flow Diagram from 2002 through 2017	Van Veizen emission factor (2002)	23.79
Scaled estimate based on 2017 NEI inputs and Van Veizen factor	77% estimated decline in open burning of solid waste (burn barrels), based on product and waste inputs in USEPA Mercury Flow Diagram from 2002 through 2017	Van Veizen emission factor (2002)	196.54
2017 NEI	EPA estimate	USEPA's Construction Dust and Open Burning Tool v1.1, run on 2/15/2020	186.72

Human Cremation

From the 2017 NEI, based on USEPA's Cremation Tool v1.1 which was run in 2020, Michigan's estimated nonpoint emissions of mercury from human cremation are 150.11 lbs. Different emission factors were developed by the USEPA for each age group based on the average quantity of mercury dental amalgam per person within that age group.

In 2017, there were 97 active permits in Michigan for crematories, located at 76 facilities. Human cremation was listed as the application reason for 42 of the permits. Animal, pet or veterinary cremations were listed as the application reason for 38 of the remaining permits.

Table 61. Human Cremation, Nonpoint

Year	Estimated Emissions in Lbs	Nonpoint Sector
2017	150.11	Human Cremation

Volatilization: Land Application of Sewage Sludge

Sewage sludge in the amount of 120,193 dry English tons was land applied in Michigan in 2017 according to estimates from the Biosolids Program of EGLE's Water Resources Division (EGLE, 2021). Sewage sludge had an average concentration of 0.85 ppm of mercury in 2017. 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, 2.04 lbs of mercury was likely emitted via volatilization from surface-applied sewage sludge in 2017 (McGeen, 2021).

Table 62. Land Application of Biosolids

Year	Estimated Emissions in Lbs	Nonpoint Sector
2017	2.04	Land Application of Biosolids

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. Site dredging began in late 2006 and was completed in the second week of 2007 (Sadoff, 2006). Therefore, in 2017, there are no known air emissions of mercury from contaminated site remediation.

Table 63. Contaminated Site Remediation

Year	Estimated Emissions in Lbs	Nonpoint Sector
2017	0.00	Contaminated Site Remediation

General Laboratory Activities

The USEPA's 2017 NEI contains an estimate for Michigan of 24.59 lbs of mercury emissions from general laboratory activities. This value was pulled forward from the 2008 NEI. The last survey on mercury use in laboratories was conducted in 2002. Accordingly, there is uncertainty as to whether the underlying assumptions used for the 2008 calculation are still representative of laboratory use of mercury in 2017. While the survey data may not be representative of laboratory activities in 2017, it has been included in this report as the best available estimate

Table 64. Laboratory Activities

Year	Estimated Emissions in Lbs	Nonpoint Sector
2017	24.59	Laboratory Activities

Oil and Gas Exploration and Production

In the 2017 NEI, the USEPA estimated mercury emissions for the nonpoint category of oil and gas exploration and production. The calculations were prepared with the USEPA's 2017 Nonpoint Oil and Gas Emissions Estimate Tool, version 1.2.

Table 65. Oil and Gas Exploration and Production

Year	Estimated Emissions in Lbs	Nonpoint Sector
2017	1.83E-05	Oil and Gas Exploration and Production - Drill Rigs
2017	0.00	Oil and Gas Exploration and Production - Hydraulic Fracturing Engines
Total	1.83E-05	

MOBILE SOURCES

On-road

The calculation from the USEPA's 2017 NEI suggests that 24.17 lbs of mercury was emitted from on-road vehicles in Michigan. Vehicle Miles Traveled (VMT) was obtained from the USEPA's documentation to provide a breakout by sector. In the 2011 and 2014 mercury inventories, the VMT for Michigan was only accessible as a total number and not by sector, therefore the individual sectors for those years were apportioned out based on 2008 on-road data. The 2017 VMT numbers were available by sector and provide a more accurate depiction of the miles traveled by each fuel and vehicle type. Alternative fuel vehicle miles are also included.

Table 66. 2017 Michigan Statewide Vehicle Miles Traveled and Estimated Mercury Emissions from 2017 NEI

On-road Sector	Vehicle Miles Traveled (in million miles)	Hg emissions in lbs from 2017 NEI
Light-duty Gasoline	89486.32	23.65
Heavy-duty Gasoline	2479.14	0.14
Light-duty diesel	776.86	0.06
Heavy-duty Diesel	6778.37	0.16
Compressed Natural Gas	1.06	0.00
Ethanol	628.88	0.17
Electric	28.79	0.00
Total VMT in Michigan	99,520.69	24.17

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). The project produced significantly different emission factors than those previously used to estimate mobile source mercury emissions from on-road vehicles. Michigan's 2002 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 67. Estimated On-road Emissions, CRC and USEPA/U of M Emission Factors

Year	Total on-road Hg emissions in lbs (CRC factor)	Total on-road low range Hg emissions in lbs (EPA/U of M factor)	Total on-road high range Hg emissions in lbs (EPA/U of M factor)	EPA NEI Hg estimate for on-road (in lbs)
2017	1503.80	0.17	0.51	24.17

Table 68. 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

The Light-duty Gasoline Vehicles emission factor from USEPA/U of M was applied to all gasoline vehicles for 2017 and the Heavy-duty Diesel Vehicles emission factor from USEPA/U of M was applied to all diesel vehicles. The resulting 2017 estimate prepared by Michigan suggests that <1 lbs of mercury was emitted from on-road vehicles (0.17 to 0.51 lbs).

It should be noted that the USEPA/U of M pilot project did not measure reactive gaseous mercury and because 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. The pilot study tested light-duty gasoline 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).

The estimate from the USEPA's 2017 NEI indicates that 24.17 lbs of mercury was likely emitted from on-road vehicles. Michigan's own calculations with other factors suggest a possible range of 0.17 to 0.51 lbs.

Non-road

The 2017 mercury inventory includes several non-road categories. These are off-road vehicles and equipment (diesel and gasoline powered), commercial marine vessels, and railroads.

The estimate from the USEPA's 2017 NEI non-road inventory estimates that 1.46 lbs of mercury was emitted from off-road vehicles and equipment. This includes snowmobiles, ATVs, agricultural, construction, mining, and lawn and garden equipment, and railroad maintenance of way equipment. Mercury in the amount of 0.13 lbs was from diesel equipment and vehicles, and 1.68 lbs of mercury was from gasoline-powered vehicles and equipment, with 0.39 lbs emitted by other fuel types (USEPA, 2017 NEI).

Table 69. Non-road Emissions

Source of Non-road Estimate	Fuel Type	Estimated Mercury Emissions in Lbs
2017 NEI	Non-road Gasoline	1.04
2017 NEI	Non-road Diesel	0.12
2017 NEI	Other	0.29
Total		1.46

The USEPA's 2017 NEI nonpoint inventory estimates that 0.0163 lbs of mercury was emitted from commercial marine vessels. This includes port and underway emissions for the marine vessels.

Table 70. Commercial Marine Vessel Emissions

Source of Marine Estimate	Commercial Marine Vessel Category[1]	Estimated Mercury Emissions in Lbs
2017 NEI	C1C2 Port emissions: Main Engine	4.51E-05
2017 NEI	C1C2 Port emissions: Auxiliary Engine	8.85E-04
2017 NEI	C3 Port emissions: Main Engine	8.79E-06
2017 NEI	C3 Port emissions: Auxiliary Engine	5.08E-05
2017 NEI	C1C2 Underway emissions: Main Engine	5.49E-03
2017 NEI	C1C2 Underway emissions: Auxiliary Engine	2.72E-03
2017 NEI	C3 Underway emissions: Main Engine	6.12E-03
2017 NEI	C3 Underway emissions: Auxiliary Engine	9.86E-04
Total		1.63E-02

[1] USEPA classifies marine diesel engines of < 30 liter displacement per cylinder, and > 800 horsepower, as Category 1 (C1) or Category 2 (C2) engines. Category 3 (C3) engines are the largest marine diesel engines. They have ≥ 30 liter displacement per cylinder and are typically rated at 3,000 to 100,000 horsepower.

The 2017 NEI non-road inventory estimates that 3.66 lbs of mercury were emitted by railroad locomotives in Michigan. This includes emissions from line-haul locomotives for Class I, II, and III railroads (large carriers, regional railroads, and shortlines, respectively).

Table 71. Rail Emissions (Line Haul Locomotives)

Source of Rail Estimate	Rail Category	Estimated Mercury Emissions in Lbs
2017 NEI	Line Haul Locomotives: Class I Operations	2.36
2017 NEI	Line Haul Locomotives: Class II / III Operations	1.06
2017 NEI	Line Haul Locomotives: Passenger Trains (Amtrak)	0.24
Total		3.66

An 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* burns 12,000 tons of bituminous coal per year on average, according to the USEPA (USEPA, 2013). Using the range of mercury concentration in bituminous coal of 0.01-0.45 ppm (MMEUW, 2005), the 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.

Table 72. Coal-burning Ferry

Year	Non-road Sector	Estimated Mercury Emissions in Lbs, Low Estimate	Estimated Mercury Emissions in Lbs, High Estimate
2017	Coal-burning Ferry	0.24	10.8

The statewide total emissions from the 2017 mercury inventory range from a low of 1,901 lbs to a high of 2,345 lbs.

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Acronyms and Glossary

CMV:

Commercial Marine Vessels (CMVs) are a component of the mobile source emissions inventory.

Emission factor:

This is an emission rate that specifies what quantity of an air pollutant is estimated per unit of material throughput. For example, USEPA's emission factor for Sulfur Dioxide from SCC 1-01-002-02 is 3.8E+01 lb/ton. This indicates that for every ton of coal burned at the process represented by the eight-digit SCC code, 38 lbs of sulfur dioxide are emitted.

ICE:

This acronym refers to an internal combustion engine, in which fuel is burned to provide power, propulsion or movement.

MAERS:

The Michigan Air Emissions Reporting System (MAERS) is the web-based air emissions reporting application maintained by the Air Quality Division (AQD) of the Michigan Department of Environment, Great Lakes, and Energy (EGLE). MAERS is used by over 1700 facilities each year in the fulfillment of their air emissions reporting obligations. The activity data and emissions estimates provided by the facilities to MAERS are audited and submitted to USEPA to satisfy AQD's requirement to provide an annual inventory of point sources to the National Emissions Inventory (NEI).

Mobile sources:

These are mobile sources of air pollutants. The mobile source category includes both on-road vehicles such as light and heavy duty diesel and gasoline vehicles. Mobile sources also include non-road equipment such as snowmobiles farm and construction equipment.

NEI:

The National Emissions Inventory (NEI) is an annual emissions inventory of point sources prepared by the USEPA, based on data submitted by state, local and tribal agencies in fulfillment of federal air emission reporting requirements. Every three years, USEPA also prepares a comprehensive triennial inventory for the NEI, which includes stationary nonpoint sources as well as mobile sources (on-road and non-road). The triennial inventory is prepared in collaboration with state, local and tribal agencies, and multi-jurisdictional planning organizations.

Nonpoint sources:

Nonpoint sources are those sources of air pollutants which are relatively small in quantity of emissions and do not trigger air pollution reporting requirements by themselves, but collectively the emissions from the aggregate group of sources are significant at a broader level such as statewide. When the term nonpoint is used it generally refers to stationary nonpoint sources, as mobile

nonpoint sources such as automobiles or riding lawnmowers or grouped under on-road and non-road emissions.

Non-road sources:

These are motorized mobile sources of air pollutants which operate off roadways. Farm and construction equipment are included, as are snowmobiles and recreational all-terrain vehicles.

On-road sources:

These are motor vehicles, and the category includes automobiles, trucks, buses and recreational vehicles such as motor homes. The vehicles may be gasoline or diesel-powered, or they may use electricity or other alternative fuels such as compressed natural gas.

Point source:

Point sources are traditional sources of air pollution such as electric utilities and industrial facilities. Commercial and institutional facilities can also be included if they meet or exceed air emission reporting thresholds. Point sources in Michigan are required to submit an annual report of air emissions to MAERS if they satisfy the conditions in AQD Policy and Procedures Document AQD-013.

SCC:

Source Classification Codes (SCCs) are eight-digit numeric codes specified by USEPA for designating different types of industrial processes. The SCC codes are commonly used within air emissions inventories to specify activity and equipment types. An example is the SCC 1-01-002-02 which represents External Combustion > Electric Generation > Bituminous/Subbituminous Coal > Boiler, Dry Bottom. Emission factors, where available, are associated with SCC codes for the purpose of estimating air emissions of pollutants including mercury.

TRI:

The Toxics Release Inventory (TRI) is a repository of toxics information submitted annually by facilities to USEPA in fulfillment of federal reporting requirements. The TRI was established under Section 313 of the federal Emergency Planning and Community Right-to-Know Act. The information for chemical emissions to air, water and land is submitted at a facility-wide level. While the air emissions estimates are not provided at the more detailed process level, the TRI reporting can be of value for supplementing available information in air emissions inventories.

WebFIRE:

WebFIRE is USEPA's web-based version of the Factor Information Retrieval system, a compendium of emission factors utilized for estimating air emissions.