

Appendix G: Ontario Toxic Emissions Inventory

BACKGROUND

The province of Ontario, Canada, has prepared an air toxic emissions inventory on the target compounds for the Great Lakes Regional Air Toxic Emissions Inventory for the 2001 calendar year. This 2001 air toxics emissions inventory includes point, area and mobile sources. Ontario followed the Air Toxic Emissions Inventory Protocol and the emissions source methodologies agreed upon by the inventory's Technical Steering Committee in developing the regional inventory, where applicable.

Emissions related source information was collected from regulated domestic emissions inventories for point sources, statistical organizations (i.e., Statistics Canada) for area sources and the Ontario Ministry of Transportation for mobile sources. Point, area and mobile source emissions information were deposited into Ontario's Regional Air Pollution Inventory Development System (RAPIDS Version 2.1.4). Point, area and mobile source emissions were compiled using reference tables and air toxic emission factors from the Factor Information Retrieval System (FIRE 6.23). In addition to using FIRE 6.23, MOBTOX emissions profiles and MOBILE 5C were used to estimate mobile source emissions.

MERCURY

As part of the effort to improve the estimates of mercury emissions for the 2001 inventory, Ontario identified major emission source categories of mercury and updated various emission factors based on recent mercury research and industry source test results. Ontario was also involved in the stakeholder workgroup which recommended revisions to the mercury reporting requirements for the National Pollution Release Inventory (NPRI) in Canada. This reporting requirement has improved the coverage of mercury emission sources by the inventory.

DATA SOURCES

Point Sources:

The point source emissions inventory contains industrial air releases information provided by regulated reporting programs, such as Ontario's "Airborne Contaminant Discharge - Monitoring and Reporting" regulation (O.Reg.127/01) and the federal "National Pollutant Release Inventory" (NPRI). The point source sector profile includes emissions data for 105 of the 213 toxic substances targeted by the Great Lakes Commission (GLC).

Area Sources:

The area source emissions inventory represents smaller emission sources. These include wide-spread sources and various industrial sources that cannot be included in the point source inventory because of a lack of facility and/or process specific information. The area source

emissions are based on available statistical information, including energy demand statistics, census data, housing data, industrial production statistics, and employment information. The 2001 Ontario area source inventory includes 11 source sectors. The area source sector profile includes emissions data for 79 of the 213 toxic substances targeted by the GLC.

Architectural Surface Coating

VOC emissions from architectural surface coating were estimated by applying emission factors to the quantity of paint used per capita. The VOC emissions were speciated into specific targeted air toxics.

Commercial and Consumer Solvent Use

Emissions from commercial and consumer solvent use were estimated by applying per capita based emission factors, provided by the GLC protocol, to the population in Ontario. The provincial total was apportioned by county using population statistics.

Dry Cleaning

A tetrachloroethylene (perchloroethylene) emission factor of 0.16 lb/person/year was developed using provincial emissions from a provincial solvent use survey. The provincial total was apportioned by county using population statistics.

Fuel Marketing

Emissions for fuel marketing were estimated using VOC speciation and toxic specific emission factors that were applied to county level fuel sale statistics. Emissions were estimated for Trucks in Transit Losses, Stage I Losses (Gasoline Retail Operations - Balanced Submerged Filling), and Stage II Losses (Filling Vehicle Gas Tanks - Vapour Loss and Liquid Spill Loss w/o Control).

Graphic Arts

Emissions from the Graphic Arts sector were estimated using employee based emission factors. The specific employee data were obtained from Statistics Canada's "Manufacturing Industries of Canada: National and Provincial Areas" report. Since the 2001 statistics were not available at the time that this 2001 air toxic emissions inventory was being prepared, the most recent 1999 statistics were used. The Canadian NAICS used for this category is 32311 (Printing). The total provincial emissions were apportioned by county using population statistics.

Human Cremation

The number of human cremations were estimated using death rate and cremation statistics. The default body weight (150 lb/body) and the GLC toxic emissions profile were used in the estimation of emissions from this sector.

Industrial Surface Coating

Emissions from industrial surface coating were estimated using employee based VOC emission factors. This sector includes the following sub-sectors:

Table G-1: Industrial Surface Coating Sub-sectors

Sub-sector	Employee Information in Canadian NAICS	VOC Speciation Profile
Sub-sectors using employee based emission factors		
Factory Finished Wood	321211, 321215, 321911, 321919, 321920, 321992, 337100	2404
Wood Furniture	337x minus 337100	2405
Metal Cans	33243	2408
Miscellaneous Finished Metal	33122, 332619, 332720	2409
Machinery and Equipment	333x	2412
Large Appliance	3352x	2411
Electronic and other Electrical	335311, 33592	2410
New Motor Vehicles	33611, 33612, 336211	2413
Other Transportation	336x minus "New Motor Vehicles" & "Marine Coating"	2414
Marine Coating	33661	2415
Sub-sectors using population based emission factors		
Miscellaneous Manufacturing	Population	2417
Industrial Maintenance	Population	2418
Other Special Purpose	Population	2419

The total VOC emissions from these sub-sectors were calculated using employee based emission factors except for the Miscellaneous Manufacturing, Industrial Maintenance, and Other Special Purpose Coatings sub-sectors where emissions were calculated using population based emission factors. The VOC emissions from the point source inventory were subtracted from the area source emissions. All sub-sectors of VOC emissions were speciated into the GLC targeted air toxics using the corresponding VOC speciation profiles as listed in the above table. Since the 2001 statistics were not available at the time that this 2001 air toxic emissions inventory was being prepared, the most recent 1999 statistics were used.

Publicly Owned Treatment Works (POTWs)

POTW emissions were estimated using effluent flow information from POTWs in Ontario. Since the 2001 statistics were not available at the time that this 2001 air toxic emissions inventory was being prepared, the most recent 1999 statistics were used. The emission factors from the GLC protocol were used to estimate these emissions.

Residential Wood Combustion

Emissions from residential wood combustion were based upon merchantable fuelwood (softwood and hardwood production) statistics from the National Forestry Database and the 2001 consumption data estimated from the residential wood energy use statistics from Natural Resources Canada. Emission factors were used for the three wood burning stove types used in Ontario: conventional, catalytic, and non-catalytic. Total provincial wood burning stove emissions were apportioned by county according to regional wood use statistics and rural

dwelling statistics taken from an Ontario Ministry of Natural Resources wood use study and Statistics Canada respectively.

Residential Fuel Combustion

Residential Fuel Combustion emissions were estimated using residential fuel consumption data from Statistics Canada and emission factors from the GLC protocol. The fuel types for which targeted toxic emissions were estimated are fuel oils, liquid petroleum gas and natural gas. Fuel use was apportioned by county according to population statistics.

Traffic Markings

Emissions from traffic markings were estimated using the total paint used for traffic markings in each county and the air toxics profile from the GLC protocol. Total paint use was estimated by applying a paint use factor to the county road length statistics provided by the Ontario Ministry of Transportation.

Mobile Sources:

The mobile source inventory included 2 major categories, on-road sources and non-road sources. The 2001 Ontario mobile source inventory included 13 source sectors (7 in the on-road category and 6 in the non-road category). The mobile source sector profile includes emissions data for 28 of the 213 toxic substances targeted by the Great Lakes Commission (GLC).

On-road Mobile Sources

The on-road mobile sources include the vehicle categories as defined by the U.S. transportation model MOBILE 5. These are light-duty gasoline vehicles (LDGV), light-duty gasoline trucks (LDGT), heavy-duty gasoline vehicles (HDGV), light-duty diesel vehicles (LDDV), light-duty diesel trucks (LDDT), heavy-duty diesel vehicles (HDDV) and motorcycles (MC).

The Canadian version of the MOBILE model (MOBILE 5C) was used to estimate the evaporative and exhaust related VOC emissions from on-road vehicles. The PART5 model was used to estimate the particulate matter (PM) emissions. The MOBTOX toxic speciation profiles were applied to VOC and PM emissions to obtain the toxic emission values.

Non-road Mobile Sources

Non-road mobile sources include the following categories: i) off-road gasoline engines/vehicles; ii) off-road diesel engines/vehicles; iii) off-road equipment; and iv) locomotives, marine engines, and aviation. The following sections provide details on the emission estimation methodologies associated with non-road mobile sources. The VOC and PM emissions were estimated using corresponding emission factors. The MOBTOX toxic speciation profiles were then applied to VOC and PM emissions to obtain the toxic emission values.

Off-road Gasoline Engines/Vehicles

The fuel consumption of off-road gasoline engines/vehicles was obtained from provincial statistics and used to estimate VOC and PM emissions. Corresponding toxic substance speciation profiles were applied to the VOC and PM emissions to obtain the toxic emission values.

Off-road Diesel Engines/Vehicles

The fuel consumption of off-road diesel engines/vehicles was obtained from provincial statistics and used to estimate VOC and PM emissions. Corresponding toxic substance speciation profiles were applied to the VOC and PM emissions to obtain the toxic emission values.

Off-road Equipment

The estimated number of off-road equipment (e.g., lawnmowers) was obtained from a federal Environment Canada field survey and used to estimate VOC and PM emissions. Corresponding toxic substance speciation profiles were applied to the VOC and PM emissions to obtain the toxic emission values.

Locomotives

The fuel consumption of locomotives was obtained from provincial statistics and used to estimate VOC and PM emissions. Corresponding toxic substance speciation profiles were applied to the VOC and PM emissions to obtain the toxic emission values.

Marine Engines

The fuel consumption and the operating statistics (i.e., movement) of marine engines (i.e., vessels) was obtained from provincial statistics, whereas the number of pleasure crafts was estimated via the federal Census. This information was used to estimate VOC and PM emissions. Corresponding FIRE emission factors/toxic substance speciation profiles were then applied to the VOC and PM emissions to obtain the toxic emission values.

Aviation

The aircraft movement statistics for each airport were obtained from the Ontario Ministry of Transportation to derive the landing-takeoff (LTO) cycles. Corresponding toxic substance speciation profiles were applied to the estimated VOC and PM emissions to obtain the toxic emission values.

QUALITY CHECK ACTIVITIES

During the development of this air toxics inventory, quality check activities, such as technical reviews and accuracy checks, were performed to ensure that the most appropriate emission profiles were used for each source.

UNCERTAINTIES

The emission estimates in this air toxic emissions inventory were based on the best available source information and source emission profiles. The use of O.Reg.127/01 and NPRI data in the point source sector profile is limited primarily to larger sources.

Uncertainties exist when using emission factor tables, which vary in terms of data quality. In preparing this emission inventory, Ontario has further updated some of the RAPIDS emission factor tables with the most recent information from FIRE, AP-42, and EIIP.

INFORMATION

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Table G-2: Ontario - Province Wide Summary of 2001 Emissions (lb/yr)

POLLUTANT	Point Sources	Area Sources	Offroad Mobile Sources	Onroad Mobile Sources	Total
1,1,1-TRICHLOROETHANE	13	4,489,457			4,489,470
1,1,2,2-TETRACHLOROETHANE	42				42
1,1,2-TRICHLOROETHANE	1,116				1,116
1,2-DIBROMOETHANE	13	14			27
1,2-DICHLOROETHANE	172	7,092			7,264
1,3-BUTADIENE	157,503		599,113	1,020,828	1,777,444
1,3-DICHLOROPROPENE		1,903,178			1,903,178
1,4-DICHLOROBENZENE	251	926,134			926,385
1,4-DIOXANE	721	350			1,071
2,3,7,8-TETRACHLORODIBENZOFURAN	0.0022				0.0022
2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	0.0017				0.0017
2-NITROPROPANE		23			23
4,4-METHYLENEDIPHENYL DIISOCYANATE	179,117				179,117
ACENAPHTHENE	363	8,593			8,955
ACENAPHTHYLENE	3,018	172,550			175,569
ACETALDEHYDE	377,238		2,146,916	1,605,547	4,129,701
ACETAMIDE		1			1
ACETONITRILE	13,296				13,296
ACETOPHENONE		101			101
ACROLEIN	22,509		193,047	222,555	438,111
ACRYLAMIDE	225				225
ACRYLIC ACID	774	0.0430			774
ACRYLONITRILE	16,771				16,771
ANILINE	825				825
ANTHRACENE	8,412	11,810			20,222
ANTIMONY	11,029	47			11,077
ARSENIC	145,695	183	1	14	145,893
BENZ(A)ANTHRACENE	5,938	16,858			22,797
BENZENE	1,401,685	2,065,738	3,692,904	7,901,562	15,061,889
BENZO(A)PYRENE	6,018	3,579			9,597
BENZO(B)FLUORANTHENE	5,341	5,089			10,430
BENZO(G,H,I)PERYLENE	370	4,077			4,446
BENZO(K)FLUORANTHENE	3,465	1,708			5,173
BENZYL CHLORIDE	18				18
BERYLLIUM	191	86			277
BIPHENYL	22,050	900			22,950
BROMOMETHANE	2	2,640,660			2,640,662
CADMIUM	15,704	441			16,145
CARBON DISULFIDE	123,524				123,524
CARBON TETRACHLORIDE		4,873			4,873
CHLORINE	605,003	2,246,737	1,576	20,737	2,874,055
CHLOROBENZENE	9	851,910			851,919

POLLUTANT	Point Sources	Area Sources	Offroad Mobile Sources	Onroad Mobile Sources	Total
CHLOROETHANE	118,067				118,067
CHLOROFORM	25,432	38,122			63,555
CHROMIUM	103,512	514	2,224	425	106,674
CHROMIUM (VI)	9,664	2			9,667
CHRYSENE	8,818	10,334			19,152
COBALT	12,392	80			12,472
COPPER	718,186	451	1,124	55,007	774,768
CRESOL- MIXED ISOMERS	49,048				49,048
CUMENE	5,565			16,272	21,837
CYANIDE	1,438				1,438
DIBENZO(A,H)ANTHRACENE	5,641	239			5,880
DIBENZOFURAN		88			88
DIBUTYL PHTHALATE	1,021	68,405			69,426
DIETHANOLAMINE	12,864				12,864
DIETHYLHEXYL PHTHALATE	15,283				15,283
DIMETHYLFORMAMIDE, N,N-	212	374			586
DIOCTYL PHTHALATE	346				346
ETHYL ACRYLATE	3,259				3,259
ETHYLBENZENE	1,319,399	1,260,175	2,154,111	3,372,905	8,106,590
ETHYLENE GLYCOL	108,495	1,775,696			1,884,191
ETHYLENE OXIDE	18,641	179,612			198,254
FLUORANTHENE	12,703	16,694			29,397
FLUORENE	1,698	20,197			21,894
FORMALDEHYDE	937,262	199,686	4,877,743	4,344,079	10,358,770
GLYCOL ETHERS (MISC.)	6,893,780	834,094			7,727,874
HEXACHLOROBENZENE	9				9
HYDRAZINE	357				357
HYDROCHLORIC ACID	22,847,348	4,602			22,851,950
HYDROGEN CYANIDE	37,322				37,322
HYDROGEN FLUORIDE	1,361,138	154			1,361,291
HYDROGEN SULFIDE	7,384,629				7,384,629
HYDROQUINONE	2				2
INDENO(1,2,3-C,D)PYRENE	2,049	970			3,019
ISOPHORONE		11,264			11,264
LEAD	575,199	434	3,318	18,812	597,762
MALEIC ANHYDRIDE	24				24
MANGANESE	202,593	456	2,502	795	206,346
MERCURY	3,308	174	497	288	4,267
METHANOL	13,594,725	7,592,491		14,132,625	35,319,841
METHYL CHLORIDE	1,527,913				1,527,913
METHYL ETHYL KETONE	7,537,998	7,674,297		256,256	15,468,550
METHYL ISOBUTYL KETONE	1,382,462	7,058,413			8,440,875
METHYL METHACRYLATE	23,155				23,155
METHYL TERT BUTYL ETHER	84	256			339
METHYLENE CHLORIDE	2,395,303	1,322,205			3,717,508
M-XYLENE	574,847	187,917		6,603,438	7,366,201

POLLUTANT	Point Sources	Area Sources	Offroad Mobile Sources	Onroad Mobile Sources	Total
NAPHTHALENE	168,940	1,005,545	1,432	500,460	1,676,378
N-HEXANE	3,478,326	1,467,710	1,282,652	2,395,747	8,624,436
NICKEL	294,350	1,493	68,719	519	365,080
O-XYLENE	235,978	240,477	501	3,566,831	4,043,787
PHENANTHRENE	26,066	85,310			111,376
PHENOL	352,965	41	618		353,625
PHOSPHORUS (YELLOW OR WHITE)	796	85	2,487	19,100	22,469
PTHALIC ANHYDRIDE	999				999
POLYCHLORINATED DIBENZODIOXINS, TOTAL	0.0548	0.0002			0.0550
POLYCHLORINATED DIBENZOFURANS, TOTAL		0.0003			0.0003
P-PHENYLENEDIAMINE	15				15
PROPIONALDEHYDE			355,301	304,980	660,281
PROPYLENE OXIDE	12,912				12,912
P-XYLENE	218,875	72,749			291,624
PYRENE	11,155	19,801			30,957
QUINOLINE	419				419
SELENIUM	217,076	425	140	534	218,174
STYRENE	735,288	12,149	147,308	1,832,341	2,727,086
TETRACHLOROETHYLENE	167,584	2,250,260			2,417,844
TOLUENE	8,828,487	29,599,682	8,565,510	23,039,626	70,033,305
TOLUENE-2,4-DIISOCYANATE	31				31
TRICHLOROETHYLENE	1,380,458	22,327			1,402,785
TRIETHYLAMINE	54,807	9,980			64,787
VINYL ACETATE	5,718	1			5,718
VINYL CHLORIDE	14,542	81,963			96,505
VINYLDENE CHLORIDE		5,303			5,303
XYLENES (MIXED ISOMERS)	9,903,890	23,662,423	8,899,201	13,060,639	55,526,152

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