

# **Appendix G: Ontario Toxic Emissions Inventory**

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## **BACKGROUND**

The province of Ontario, Canada, has prepared an air toxic emissions inventory on the target substances for the Great Lakes Regional Air Toxic Emissions Inventory Project for the 1999 calendar year. This 1999 emissions inventory includes point and area sources only. In order to prepare the inventory, Ontario followed the Air Toxic Emissions Inventory Protocol and the emission source methodologies agreed upon by the project's Technical Steering Committee in developing the regional inventory where applicable.

Emissions related information was collected from domestic regulatory and voluntary inventories for point sources. As well, area source information was collected from statistical organizations such as Statistics Canada. These sources of information were deposited into Ontario's Regional Air Pollution Inventory Development System (RAPIDS Version 2.1) and emissions were compiled using its reference tables and the air toxic emission factors from the U.S. EPA's Factor Information Retrieval System (FIRE 6.23) and source specific profiles.

## **MERCURY**

As part of the effort to improve the estimates of mercury emissions for the 1999 inventory, Ontario identified major emission source categories of mercury and updated various emission factors based on recent industry source test results and a mercury study (Sang and Lourie, 1996). 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. However, this revision came into effect for the 2000 reporting year and thus the results of these revisions will not be reflected in the 1999 Ontario inventory.

## **DATA SOURCES**

### **Point Source Emissions**

The point source emissions inventory contains industrial process and release information provided by regulatory and voluntary reporting programs, which include the National Pollutant Release Inventory (NPRI), the Strategic Option Processes (SOP), the National Emissions Reduction Master Plan (NERM) of the Canadian Chemical Producers Association, and the Accelerated Reduction and Elimination of Toxics (ARET). The point source sector profile includes emissions data for 127 of the targeted toxics on the GLC substance list (over 210 substances).

## **Area Source Emissions**

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, employment information, etc. The 1999 Ontario area source inventory includes 10 source sectors. The area source sector profile includes emissions data for 77 substances out of the targeted toxics on the GLC substance list.

### **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 of the GLC substances were estimated by applying the per capita emission factors as provided by the GLC protocol to the population in Ontario. The provincial total was distributed at the county level using population statistics.

### **Dry Cleaning**

A tetrachloroethylene (perchloroethylene) emission factor of 0.3666 lb/person/year was developed using provincial emissions from a provincial solvent usage survey. The provincial total was distributed at the county level 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 sales 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 for the graphic arts sector were estimated using employee based emission factors. The specific employee data were taken from Statistics Canada's 1999 "Manufacturing Industries of Canada: National and Provincial Areas" document. The Canadian NAICS used for this category is 32311 (Printing). The total provincial emissions were apportioned to the county level using population statistics.

### **Industrial Surface Coating**

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

**Table G-1: Emissions for industrial surface coating using employee based VOC emission factors**

<b>Sub-sector</b>	<b>Employee Information in Canadian NAICS</b>	<b>VOC Speciation Profile</b>
<b>Sub-sectors using employee based emission factors</b>		
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
<b>Sub-sectors using population based emission factors</b>		
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.

### **Publicly Owned Treatment Works (POTW)**

POTW emissions were estimated using effluent flow information from POTWs in Ontario. The emission factors from the GLC protocol were also used to estimate emissions.

### **Residential Wood Combustion**

Emission estimations were based upon merchantable fuelwood (softwood and hardwood production) statistics from the National Forestry Database and the 1999 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 stove emissions were apportioned to the county level 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 to the county level according to population statistics.

### **Traffic Markings**

Emissions for traffic markings were estimated from the total paint used for traffic markings in each county and a typical air toxics profile as suggested in 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.

## **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 are based on the best available source information and source emission profiles. The use of NPRI data in the point source sector profile is limited to larger sources. Additional point sources from major industrial sectors were included (from SOP, NERM, and ARET inventories) in this inventory's point source sector profile.

In preparing this emission inventory, Ontario has used the most recent U.S. EPA FIRE 6.23 emission factors to estimate emissions for various point sources. Uncertainties exist when using emission factor tables, as they vary in terms of data quality.

## REFERENCES

Environment Canada. 2001. 1999 National Pollutant Release Inventory. Government of Canada, Ottawa, Ontario.

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Natural Resources Canada. Updated: 2001. National energy end use database. Government of Canada, Ottawa, Ontario.

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Sang, S. and B. Lourie. 1996. Mercury in Ontario: An Inventory of Sources, Uses and Releases. Pollution Probe, Toronto, Ontario.

Statistics Canada. 2002. 31-203, Manufacturing industries of Canada, national and provincial areas. Government of Canada, Ottawa, Ontario.

Statistics Canada. 2001. 57-003, Quarterly report on energy supply-demand in Canada for year 1999. Government of Canada, Ottawa, Ontario.

U.S. EPA. 2000. Factor Information Retrieval System (FIRE 6.23).

<http://www.epa.gov/ttn/chief/fire.html>

## **INFORMATION**

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**Table G-2: Ontario - Statewide Summary of Emissions (lb/yr)**

<b>Pollutant</b>	<b>Point Sources</b>	<b>Area Sources</b>	<b>Total</b>
1,1,1-TRICHLOROETHANE	43067.16664	4349833.159	4392900.326
1,1,2,2-TETRACHLOROETHANE	5.763055221		5.763055221
1,1,2-TRICHLOROETHANE	1830.15		1830.15
1,1-DICHLOROETHANE	0.097539522		0.097539522
1,2-DIBROMOETHANE	10.68715812	13.34043448	24.0275926
1,2-DICHLOROETHANE	39.79277297	7075.130124	7114.922897
1,3-BUTADIENE	173290.9351		173290.9351
1,3-DICHLOROPROPENE		1843628.32	1843628.32
1,4-DICHLOROBENZENE	1.760975713	897155.6312	897157.3922
1,4-DIOXANE	749.7	346.1110424	1095.811042
2,3,7,8-TETRACHLORODIBENZOFURAN	0.056010082		0.056010082
2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	0.003487408		0.003487408
2,4,5-TRICHLOROPHENOL	4.991606456		4.991606456
2,4,6-TRICHLOROPHENOL	276.5896141		276.5896141
2,4-DINITROPHENOL	6.704386198		6.704386198
2-CHLOROACETOPHENONE	0.403054155		0.403054155
2-NITROPROPANE		22.40008409	22.40008409
4,4-METHYLENEDIPHENYL DIISOCYANATE	4851		4851
4-NITROPHENOL	0.245789833		0.245789833
ACENAPHTHENE	18.96726122	7245.529069	7264.49633
ACENAPHTHYLENE	125.6213075	145501.3846	145627.0059
ACETALDEHYDE	398274.5679		398274.5679
ACETAMIDE		1.39770072	1.39770072
ACETONITRILE	17632.55813		17632.55813
ACETOPHENONE	4.80903885	98.28843481	103.0974737
ACROLEIN	1349.299608		1349.299608
ACRYLAMIDE	595.35		595.35
ACRYLIC ACID	882	0.041631432	882.0416314
ACRYLONITRILE	16904.90813		16904.90813
ANILINE	815.85		815.85
ANTHRACENE	2075.450806	9958.35319	12033.804
ANTIMONY	2667.483625	16.505895	2683.98952
ARSENIC	154541.7406	196.396504	154738.1371
BENZ(A)ANTHRACENE	599.7172521	14215.70525	14815.4225
BENZENE	1964754.38	1807423.654	3772178.034
BENZO(A)PYRENE	1153.774524	3018.151312	4171.925836
BENZO(B)FLUORANTHENE	0.470683084	4291.159631	4291.630314
BENZO(G,H,I)PERYLENE	0.80321683	3437.831658	3438.634874
BENZO(K)FLUORANTHENE	0.579561749	1440.394511	1440.974072
BENZYL CHLORIDE	22.05		22.05
BERYLLIUM	201.2825969	102.9816713	304.2642682
BIPHENYL	20969.55	759.27852	21728.82852
BROMOFORM	12.55720792		12.55720792
BROMOMETHANE	15.60220549	2558034.294	2558049.896
CADMIUM	10972.72924	446.508532	11419.23777
CARBON DISULFIDE	261920.5709		261920.5709
CARBON TETRACHLORIDE	34.416791	4873.27083	4907.687621
CARBONYL SULFIDE	34713.315		34713.315
CHLORDANE	0.46743795		0.46743795
CHLORINE	726718.0416	2246741.519	2973459.561
CHLOROENZENE	210.9272526	825254.1267	825465.054
CHLOROETHANE	137330.8582		137330.8582
CHLOROFORM	23565.89906	37754.79586	61320.69492
CHROMIUM	39887.78878	521.2728669	40409.06165
CHROMIUM (III)	0.354979623		0.354979623
CHROMIUM (VI)	570.2887281	0.77970704	571.0684352
CHROMIUM COMPOUNDS	1.08448956		1.08448956
CHRYSENE	819.4824197	8714.339783	9533.822203
COBALT	11057.89856	44.08632139	11101.98489
COPPER	1005771.342	470.3081158	1006241.65
CRESOL- MIXED ISOMERS	45423		45423
CUMENE	2599.607236		2599.607236

Pollutant	Point Sources	Area Sources	Total
CYANIDE	2007.646933		2007.646933
DIBENZO(A,H)ANTHRACENE	0.596553424	201.9041027	202.5006561
DIBENZOFURAN		85.2678098	85.2678098
DIBUTYL PHTHALATE	2624.794767	72420.02495	75044.81971
DIETHANOLAMINE	12546.45		12546.45
DIETHYLHEXYL PHTHALATE	2315.25		2315.25
DIMETHYL SULFATE	22.05		22.05
DIMETHYLFORMAMIDE, N,N-		362.733872	362.733872
DIOCTYL PHTHALATE (DEHP)	3101.0532		3101.0532
ETHYLBENZENE	1249873.281	1241094.106	2490967.388
ETHYLENE GLYCOL	144625.95	1720135.125	1864761.075
ETHYLENE OXIDE	27628.65	173992.4227	201621.0727
FLUORANTHENE	3014.167224	14077.36171	17091.52893
FLUORENE	56.77487675	17030.86142	17087.6363
FORMALDEHYDE	952748.4299	210026.7017	1162775.132
GLYCOL ETHERS (MISC.)		1157201.267	1157201.267
HEXACHLOROBENZENE	0.002088096		0.002088096
HYDRAZINE	396.9		396.9
HYDROCHLORIC ACID	18110817.5	17.96385344	18110835.46
HYDROGEN CYANIDE	108993.15		108993.15
HYDROGEN FLUORIDE	957291.6377	148.7577601	957440.3955
HYDROGEN SULFIDE	6195657.264		6195657.264
INDENO(1,2,3-C,D)PYRENE	0.578728077	817.7842089	818.3629369
ISOPHORONE	33.3959157	10911.97512	10945.37103
LEAD	292569.2482	452.6379499	293021.8861
LEAD COMPNDS	0.071664705		0.071664705
LEAD OXIDE	89197.10031		89197.10031
LINDANE, (ALL ISOMERS)	0.158678415		0.158678415
MALEIC ANHYDRIDE	1962.45		1962.45
MANGANESE	123872.4026	447.6277997	124320.0304
M-CRESOL	4564.35		4564.35
MERCURY	490.8029138	177.4817782	668.284692
METHANOL	13364427.6	7398376.744	20762804.35
METHYL CHLORIDE	790724.3306		790724.3306
METHYL ETHYL KETONE	9859557.104	7797700.699	17657257.8
METHYL HYDRAZINE	9.78845805		9.78845805
METHYL IODIDE	0.56116653		0.56116653
METHYL ISOBUTYL KETONE	1480679.55	6998623.622	8479303.172
METHYL METHACRYLATE	40086.9		40086.9
METHYL TERT BUTYL ETHER		247.507102	247.507102
METHYLENE CHLORIDE	3824382.282	1281616.74	5105999.022
M-XYLENE	86.00208731	183271.1669	183357.1689
NAPHTHALENE	93296.53169	945120.3793	1038416.911
N-HEXANE	3226538.779	1429641.962	4656180.741
NICKEL	575942.0924	1003.361472	576945.4539
NICKEL(II) OXIDE (1:1)	6689.782523		6689.782523
O-XYLENE	66.02030369	212385.1951	212451.2154
P-CRESOL	2535.75		2535.75
PENTACHLOROPHENOL (PCP)	0.225465873		0.225465873
PHENANTHRENE	30.79930066	71936.73177	71967.53107
PHENOL	294491.2314	34.51266	294525.7441
PHOSPHORUS (YELLOW OR WHITE)	3062.205181	29.7420508	3091.947232
PHTHALIC ANHYDRIDE	1499.4		1499.4
POLYCHLORINATED BIPHENYLS (PCBS)	3.858992313		3.858992313
POLYCHLORINATED DIBENZODIOXINS, TOTAL	1.217038463		1.217038463
POLYCHLORINATED DIBENZOFURANS, TOTAL	3.736041762		3.736041762
PROPYLENE DICHLORIDE	25.56818812		25.56818812
PROPYLENE OXIDE	23266.26177		23266.26177
P-XYLENE	7.980373868	70950.96184	70958.94221
PYRENE	5.252266784	16697.40776	16702.66003
QUINOLINE	441		441
QUINONE	1039.603815		1039.603815
SELENIUM	16858.53268	505.8556876	17364.38837
STYRENE	766222.6352	12149.28631	778371.9215

<b>Pollutant</b>	<b>Point Sources</b>	<b>Area Sources</b>	<b>Total</b>
TETRACHLOROETHYLENE	314632.315	4560613.317	4875245.632
TOLUENE	11648081.17	28765607.9	40413689.07
TRICHLOROETHYLENE	1418205.354	22157.63356	1440362.988
TRIETHYLAMINE	142751.7	9667.526003	152419.226
VINYL ACETATE	5115.6	0.521977268	5116.121977
VINYL CHLORIDE	23476.49211	81962.67345	105439.1656
VINYLDENE CHLORIDE	2936.386486	5303.467105	8239.853592
XYLENES (MIXED ISOMERS)	10934105.38	22965762.7	33899868.09