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Manual for the Compilation of Canada's Air Pollutant Emissions

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This manual provides an overview of Environment Canada's procedures for the compilation of Canada's comprehensive air pollutant emissions data. These data are a key part of Canada's National Pollutant Release Inventory (NPRI), which is an important resource for understanding sources of pollution in Canada. This manual is intended for users of the data, such as government agencies, industries, industrial associations and non-governmental organizations.

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List of Acronyms and Description

Acronyms	Description
AS	Area Sources
AMWA	Air & Waste Management Association
CAC	Criteria Air Contaminants
CANA	Cremation Association of North America
CANSIM	Canadian Socio-Economic Information Management System
CAPP	Canadian Association of Petroleum Producers
CIFFC	Canadian Interagency Forest Fire Center
CORINAR	Core Inventory of Air Emissions
CMY	Canadian Mineral Yearbook
CTUMS	Canadian Tobacco Use Monitoring Survey
D/F	Dioxins and Furans
DOE	Department of Environment
EC	Environment Canada
EI	Emission Intensity
EMEP	European Monitoring and Evaluation Program
EPA	Environmental Protection Agency
FAAD	Forestry, Agriculture and Aquaculture Division
FIRE	Factor Information Retrieval
FVRD	Lower Fraser Valley Airsheds
GVRD	Greater Vancouver Regional District
HMA	Hot Asphalt Mix
MERAF	Multi-Pollutant Emission Reduction Analysis Foundation
NAICS	North American Industry Classification System
NAS	National Academy of Science
NPRI	National Pollutant Release Inventory
NRCan	Natural Resource Canada
PAHs	Polycyclic Aromatic Hydrocarbons
PIRD	Pollution Inventories and Reporting Division

Accronyms	Description
PM	Particulate Matter
POPs	Persistent Organic Pollutants
PS	Point Sources
QC	Quality Control
RESD	Report on Energy Supply and Demands in Canada
UOG	Upstream Oil and Gas
US	United States
VOC	Volatile Organic Compounds

1.0 Introduction

This manual provides an overview of Environment Canada's procedures for the compilation of Canada's comprehensive air pollutant emissions data. These data are a part of Canada's National Pollutant Release Inventory (NPRI), which is a key tool for understanding sources of pollution in Canada. This manual is intended to inform users of the data on the methods used to develop the inventory.

The air pollutant emissions data are comprehensive in that they consist of data and estimates from all emission sources that originate in Canada, including area, mobile and point sources. Key examples include forest fires, agricultural activities, motor vehicles, residential heating and industrial facilities.

The data are used to track and report on air pollutant emissions in Canada, and to support policies and regulations, air quality models, standards and science assessments.

The comprehensive air pollutant emissions data are normally compiled for the pollutants listed in Table 1.1 below. They include criteria air contaminants (the major contributors to smog, poor air quality and acid rain), several heavy metals, polycyclic aromatic hydrocarbons and persistent organic pollutants.

Table 1.1: Air Pollutants

Pollutants	Pollutant Name
Criteria air Contaminants (CACs)	Total particulate matter (TPM) Particulate matter under 10 microns (PM ₁₀) Particulate matter under 2.5 microns (PM _{2.5}) Sulphur oxides (SO _x) Nitrogen oxides (NO _x) Volatile organic compounds (VOCs) Carbon monoxide (CO) Ammonia (NH ₃)
Heavy Metals (HMs)	Mercury (Hg) Lead (Pb) Cadmium (Cd)

Pollutants	Pollutant Name
Polycyclic Aromatic Hydrocarbons (PAHs)	Benzo(a)pyrene (B(a)p) Benzo(b)fluoranthene (B(b)f) Benzo(k)fluoranthene (B(k)f) Indeno(1,2,3-cd)pyrene (I(cd)p)
Persistent Organic Pollutants (POPs)	Dioxins and furans (D/F) Hexachlorobenzene (HCB)

Area source emissions are compiled using a top-down approach, including activity levels and emission factors that result in air pollutant emissions for a sector at the provincial level. The methodology for estimating area source emissions is presented in Chapter 2.

The mobile source emissions are compiled using a combination of bottom-up and top-down approaches. Further details are outlined in Chapter 3.

Point source emissions are compiled using a bottom-up approach starting with emissions at the facility level. The procedures for the compilation of the point source emissions are discussed in Chapter 4.

The reconciliation of emission sources is discussed in Chapter 5, data quality control measures are outlined in Chapter 6 and finally, the uncertainty associated with the emission estimates is discussed in the Uncertainty Studies section of the NPRI web site.

Canada's air pollutant emissions data and historical trends are available on the NPRI section of Environment Canada's website. The emissions data is published according to certain source categories. The data sources and methods are referenced in this manual and detailed in Appendix 1.

2.0 Inventory Development Approach for Area Source Emissions

Canada's commitments in domestic and international agreements require the annual submission of data and reports on air pollutant emissions. The data and reports are based on the data (e.g. production data and activity levels for a given sector) that is available at the time of compilation. The data and methodology sources that are normally employed are summarized in Appendix 1 of this document. Note that the point source data used in the inventory may differ from the published values because of updates received after the data was assembled for the inventory.

An analysis of the 2005, 2006 and 2007 emissions inventories was undertaken in the fall of 2009 to rationalize the frequency of estimation of each area source sector for subsequent years. The results showed that not all area source sectors

require annual estimation based on the chosen criteria, namely the significance of the area source emissions, the availability of activity data and the change in emissions from year to year. In the following cases, the emission estimate from the most recent year was used:

- Asphalt
- Wood Industry (combustion emissions)
- Commercial Fuel Combustion
- Electric Power Generation (Natural Gas and Other)
- Residential Fuel Combustion
- Dry Cleaning
- General Solvent Use
- Printing
- Structural Fires
- Surface Coatings
- Construction Operations
- Landfills
- Mine Tailings
- Prescribed Burning
- Biogenics
- Forest Fires

Appendix 1 provides a complete summary of the methodologies and data sources that are normally used to compile the area source emission estimates.

The methodology used to compile the emission estimates for some sectors may vary from year to year depending on available updates.

2.1 Upstream Oil and Gas

The estimation model developed by Clearstone Engineering for the Canadian Association of Petroleum Producers in 2005 is used for all the upstream oil and gas (UOG) sectors, with a few exceptions described below. This model (UOG CAPP 2005 model) is also used to estimate emissions for the UOG sector in Environment Canada's Greenhouse Gas Inventory.

The UOG CAPP 2005 model does not adequately account for provincial regulations (specifically for Alberta) that were put in place for emissions of sulphur dioxide (SO₂) after the model was originally created. To account for this, the modelled SO₂ estimates were modified such that NPRI facility-reported SO₂ data (sub-class 12001) was used in place of the model's estimates for the Natural Gas Processing sub-sector emissions. The contributions from the other UOG sub-sectors of the model were left unchanged. NPRI point source data is used for the offshore UOG industry in Atlantic Provinces and for oil sand extraction facilities.

2.2 Mercury in Products

The estimates of emissions from mercury in products inventory have been thoroughly reviewed, updated and trended from 1990 to the present, utilizing the results from the ToxEcology Environmental Consulting Ltd. reports *Mass Balance Study for Mercury-Containing Products* for the 2003 and 2008 data years. The review and update involved:

- Examination and update of the partitioning to the various end points (Electric Arc Furnace (EAF)/Municipal Solid Waste (MSW)/Sewage or Air, Water, Land, etc.);
- Update of population figures, actual vehicle counts, ages and assumed scrapage;
- Elimination of duplication (mercury switches to EAFs); and
- Improved utilization of the included historical information and simple projections.

This update addresses some of the concerns that had been raised by provincial inventory practitioners. However, products, as sources of mercury, have only been included in the published emissions inventory beginning in 2007.

3.0 Inventory Development Approaches for Mobile Source Emissions

For the most part, the methodologies that are used for the estimation of the air pollutant emissions from mobile sources have remained unchanged since the compilation of the 2007 inventory.

Generally, mobile sources are estimated using bottom-up approaches while respecting the bounds of fuel availability (from the Statistics Canada publication Report on Energy Supply-Demand, 57-003). This approach is not possible for the international portion of marine transportation due to the nature of ship movements and fuelling.

Appendix 1 provides a list of the data sources and methods that are normally used for the compilation of the mobile source emission estimates.

4.0 Inventory Development Approach for Point Source Emissions

This section summarizes the procedures that are normally used to develop point source emission estimates by describing data sources and how they are integrated into the inventory.

4.1 Data Sources

The main source of facility-level emissions is stationary point sources that meet the reporting criteria under the National Pollutant Release Inventory (NPRI).

Using the NPRI database, facility information and emissions data for the pollutants in Table 1.1 are extracted for each province and territory. The extractions from NPRI provide the starting point for the point source (PS) emissions compilation for each province and territory. All NPRI facility-reported data is available in multiple formats on the NPRI section of Environment Canada's website.

4.2 Compilation Steps for Point Source Emissions

The point source emissions are compiled using the following approach.

4.2.1 NPRI Data and Facility Classification

Each facility in the point source component of the inventory is assigned to the applicable source category that is reflected in the comprehensive emission estimates. The classification includes categories, sectors and codes allocated to each facility. The class codes and the sub-class codes are defined internally by Environment Canada. They are used to store information about the subsector to which a facility belongs, and to enable analyses of the inventory.

For new NPRI reporting facilities, the North American Industry Classification System (NAICS) codes are used to assign the related Environment Canada codes. Naics codes were developed by statistical agencies of Canada, Mexico and the United States to provide common definitions of the industrial structure and a common statistical framework to facilitate the analysis of the three economies. In some cases, extensive research is needed to provide the proper classification for facilities whose activities are not accurately described by the NAICS code. In the NPRI database, NAICS codes are assigned based on the activities that generate the most emissions. This is different from Statistics Canada that assigns NAICS based on economic value.

4.2.2 Particulate Matter Distribution Procedure

A distribution procedure was developed to estimate the size fractions of the particulate matter (PM) emissions at the facility level that are not reported through the NPRI. Distributions were developed for each sector using the profile of the PM emissions for point sources for the year 2000. To estimate the missing PM emissions, the PM distribution procedure applies on a case-by-case basis to one or two of the three ratios, as defined below (Long description):

$$PM10_{ratio} = \frac{PM10_{emissions}}{TPM_{emissions}}$$

$$PM2.5_{ratio} = \frac{PM2.5_{emissions}}{TPM_{emissions}}$$

$$(PM2.5 / PM10)_{ratio} = \frac{PM2.5_{emissions}}{PM10_{emissions}}$$

The ratios are calculated for each facility in the 2000 inventory and then averaged by sector. The resulting distributions are presented in Table 4.1.

The PM emissions, calculated using the distribution procedure, are added to the list of point source emissions developed in the previous step (4.2.1).

4.2.3 Addition of Provincial/Territorial Data

When available, provincial/territorial point source data for facilities that have not reported to the NPRI are included in the inventory.

Table 4.1: Particulate Matter Distribution Ratios

(Based on 2000 point source emissions)

Sector	Subsector	PM ₁₀ Ratio	PM _{2.5} Ratio	PM _{2.5} /PM ₁₀ Ratio
Abrasives Manufacture		0.842	0.773	0.843
Aluminum Industry	Secondary Aluminum (Includes Recycling)	0.705	0.46	0.635
Asphalt Paving Industry		0.466	0.212	0.382
Bakeries		1	1	1
Cement and Concrete Industry		0.531	0.185	0.344
Chemicals Industry		0.866	0.762	0.833
Chemicals Industry	Paint and Varnish Manufacturing	0.891	0.729	0.775
Chemicals Industry	Petrochemical Industry	0.928	0.854	0.904
Chemicals Industry	Plastics and Synthetic Resins Fabrication	0.897	0.778	0.84
Mineral Products Industry		0.675	0.516	0.626
Foundries		0.74	0.618	0.827
Grain Industries		0.297	0.044	0.137
Iron and Steel Industries	Secondary (Electric Arc Furnaces)	0.605	0.457	0.755
Mining and Rock Quarrying		0.524	0.276	0.458
Non-Ferrous Mining and Smelting Industry		0.801	0.604	0.729
Pulp and Paper Industry		0.75	0.597	0.769
Wood Industry		0.56	0.377	0.638

Sector	Subsector	PM ₁₀ Ratio	PM _{2.5} Ratio	PM _{2.5} /PM ₁₀ Ratio
Upstream Petroleum Industry		0.975	0.971	0.995
Upstream Petroleum Industry	Oil Sands In-Situ Extraction and Processing	0.798	0.601	0.669
Upstream Petroleum Industry	Oil Sands Mining Extraction and Processing	0.798	0.601	0.669
Downstream Petroleum Industry	Refined Petroleum Products Bulk Storage and Distribution	0.72	0.447	0.519
Downstream Petroleum Industry	Other Downstream Petroleum Industry	0.833	0.632	0.736
Other Industries		0.808	0.684	0.78
Petroleum Product Transportation and Distribution		0.975	0.971	0.995
Commercial Fuel Combustion		0.823	0.711	0.833
Electric Power Generation (Utilities)		0.743	0.6	0.761
Industrial & Commercial Incineration		0.8	0.477	0.596
Municipal Incineration		0.64	0.55	0.832
Other Incineration and Utilities ¹		0.1	0.028	0.28
Dry Cleaning		1	1	1
Marine Cargo Handling Industry		0.512	0.156	0.303
Printing		0.932	0.904	0.964
Dust from Unpaved Roads ²		0.265	0.027	0.1
Waste		0.76	0.617	0.763

5.0 Reconciliation

To avoid double counting of emissions when incorporating point source (PS) data into the comprehensive inventory, the point sources and area sources (AS) datasets are reconciled. NPRI (facility-reported) and provincial PS data are considered to be more accurate than data estimated by the AS “top-down” approach. For most industrial sectors, the NPRI PS data captures all reportable emissions, resulting in the AS estimates not being required (i.e. ASREC = 0). Additionally, where emission estimates are not updated, the reconciliation completed for the previous inventory remains the same.

¹ All facilities classified under the “Other Incineration & Utilities” sector in the point source list are sewage treatment facilities. The PM ratios for this sector were derived from the 2008 area source emissions for sewage sludge incineration.

² The PM ratios for “Dust from Unpaved Roads” are derived from PM ratios provided in the NPRI Toolbox guidance document entitled Guidance on Estimating Road Dust Emissions from Industrial Unpaved Surfaces on the NPRI website.

The general methodology for reconciling PS and AS emissions from a particular sector (and sub-sector/category) and for a specific pollutant is as follows:

- If the total AS emission quantity of a specific pollutant from a particular sector and sub-sector is greater than or equal to the total PS emission quantity for that pollutant, sector and sub-sector, then the reconciled AS estimate is equal to the total AS estimate minus the total PS estimate, as outlined in equation (5a) below.

Equation [5a]:

If:

$$AS_{TOTAL, SECTOR X, SUB-SECTOR Y, POLLUTANT Z} \geq PS_{TOTAL, SECTOR X, SUB-SECTOR Y, POLLUTANT Z}$$

Then:

$$AS_{REC, SECTOR X, SUB-SECTOR Y, POLLUTANT Z} = AS_{TOTAL, SECTOR X, SUB-SECTOR Y, POLLUTANT Z} - PS_{TOTAL, SECTOR X, SUB-SECTOR Y, POLLUTANT Z}$$

- If the total AS emission quantity of a specific pollutant from a particular sector and sub-sector is less than or equal to the total PS emission quantity for that same pollutant, sector and sub-sector, then the reconciled AS estimate is equal to zero, as outlined in equation (5b) below.

Equation [5b]:

If:

$$AS_{TOTAL, SECTOR X, SUB-SECTOR Y, POLLUTANT Z} \leq PS_{TOTAL, SECTOR X, SUB-SECTOR Y, POLLUTANT Z}$$

Then:

$$AS_{REC, SECTOR X, SUB-SECTOR Y, POLLUTANT Z} = 0$$

Some points to consider:

- In general, ASREC represents non-reporting facilities (including smaller facilities that do not meet reporting requirements) or other emission sources that may not be captured through PS data.
- In cases where ASREC = 0 (Equation [5b]), reporting program(s) are considered to have good coverage over the ASTOTAL estimate, and generally, the PS emissions are considered to reflect a significant portion (if not all) of the industry/sector.

Reconciliation is done for the following sectors:

- Bakeries
- Cement and Concrete Industry (Concrete Batching & Products)
- Ferrous Foundries (Ferrous Foundries)

- Grain Industries
- Mining & Rock Quarrying (Rock, Sand and Gravel)
- Mining & Rock Quarrying (Metal Mining)
- Mining & Rock Quarrying (Coal Mining)
- Mining & Rock Quarrying (Other Minerals)
- Wood Industry (Sawmills)
- Wood Industry (Panel Board Mills)
- Downstream Petroleum Industry (Refined Petroleum Products Bulk Storage & Distribution)
- Industrial & Commercial Incineration
- Municipal Incineration
- Other Incineration & Utilities

6.0 Data Quality Control

Data quality control (QC) takes place in two phases: before the emissions compilation, where the QC is performed on the newly submitted point source data; and after the emissions compilation, where the emissions are verified based on established criteria.

6.1 Phase 1: Point Sources

The NPRI Quality Control (QC) process is a system of routine activities aimed at supporting the quality of NPRI data, such as identifying outliers, inconsistent data, inaccuracies and errors. The QC process ensures that all NPRI data receive a minimum level of verification consistent with the direction and priorities of Environment Canada. The results of the QC activities also support other efforts to improve the quality of the inventory data such as compliance promotion, guidance tools for facilities, public reports and analysis.

For more detailed information, please see the overview of the NPRI quality control page.

6.2 Phase 2: Area Sources

The objective of phase 2 of the QC process is to identify and verify inconsistencies in the area source emission levels by comparing the previous year's inventory to the current year. This comparison is performed for each sector and pollutant.

A comparison/verification exercise is undertaken on the inventory at the sector level annually. Increases and decreases in emission levels of up to 15% from year to year are considered acceptable. Any changes in emission levels exceeding +/-15% at the sector level are considered significant and require further investigation to identify the cause. Explanations for inconsistencies are noted and corrections are made where required.

7.0 Uncertainty

For details on uncertainty studies for Air Pollutant Emissions data, please consult the Data Quality section of the NPRI website.

Appendix 1: Summary of Estimation Methodologies for Area Source Emissions

References for activity data and emission factors for each sector can be found below:

- Category 1: Industrial Sectors
- Category 2: Non-Industrial Sectors
- Category 3: Mobile Sources
- Category 4: Incineration Sectors
- Category 5: Miscellaneous Sectors
- Category 6: Open Sources
- Category 7: Natural Sources

Category 1: Industrial Sectors

Sector	Activity Data Reference(s)	Emission Factor Reference(s)
Asphalt Industry	1) Asphalt production values: Statistics Canada. Report on Energy Supply and Demand in Canada (RESO). Catalogue No. 57-003-XWE. Annual.	1) Senes Consultants, 2008. Update of Process Emission Profiles for Hot Mix Asphalt (HMA) Manufacturing Establishments across Canada. 2) Senes Consultants, 2009. Asphalt paving VOC emissions (spreadsheet).
Bakeries	1) Statistics Canada. CANSIM Table 304-0014. "Manufacturers' sales, inventories, orders and inventory to sales ratios, by North American Industry Classification System (NAICS), Canada, monthly (dollars unless otherwise noted)." 2) Statistics Canada. CANSIM Table 304-0015. "Manufacturing sales, by North American Industry Classification System (NAICS) and province, monthly (dollars)." 3) Statistics Canada. "Industrial product price indexes, by commodity and commodity aggregations -- Fruit, vegetable, feeds and other food products." Catalogue No. 62-011-XWE, Table 2-3.	1) Environment Canada. 2005. "Survey of Small and Medium Commercial Baking Establishments to Estimate Average VOC Emission Factors."
Concrete Batching and Products	1) Natural Resources Canada. Mining and Mineral Statistics. Mineral Production of Canada, by Province and Territory. For total Canadian cement production. 2) Statistics Canada. CANSIM Table	1) Composition of Concrete; Emission Factors for TPM & PM10; Cd & Pb from AP-42 chapter 11 section 12. 2) Emission factors for PM2.5 are from "Multi-pollutant Emission Reduction Analysis Foundation (MERAF) for the

Sector	Activity Data Reference(s)	Emission Factor Reference(s)
	<p>051-0001. "Population by year, by province and territory." Annual.</p> <p>(for updated population - used to allocate cement production for provinces)</p>	<p>Canadian Ready-Mixed Concrete Sector," prepared by ICF Consulting Canada, Inc. for the Canadian Council of Ministers of the Environment and Environment Canada, 2002.</p>
Foundries	<p>1) Infometrica, 2002. Infometrica Economic Index Database "1981–2024."</p> <p>2) Statistics Canada. Monthly. Primary Iron and Steel. Catalogue No. 41-001-XIB.</p>	<p>1) United States Environmental Protection Agency, 1985. Compilation of Air Pollutant Emission Factors. Volume I. Stationary Point and Area Sources. AP-42, 4th Edition (and Supplements). Chapter 7: Metallurgical Industry. U.S. Environmental Protection Agency, Research Triangle Park, North Carolina.</p>
Grain Industry	<p>1) Statistics Canada. Canadian Agriculture at a Glance. Catalogue no. 96-325-XWE for Census Year 2006, released April 3, 2009.</p> <p>Note: The frequency of this report is every 5 years for the Census.</p> <p>2) Pinchin Environmental Ltd., 2008. CAC Emissions from the Canadian Grain Handling Industry 1985-2007. Prepared for Environment Canada. Contract Number: K8A42-07-0103. Note: Data is from the 2007 tables in this report.</p>	<p>1) United States Environmental Protection Agency, 1985. Compilation of Air Pollutant Emission Factors. Volume I. Stationary Point and Area Sources. AP-42, 4th Edition (and Supplements). Chapter 6: Food and Agriculture Industry. U.S. Environmental Protection Agency, Research Triangle Park, North Carolina.</p>
<i>Mining and Rock Quarrying</i>		
Rock, Sand & Gravel	<p>1) Statistics Canada. Non-metallic Mineral Mining and Quarrying. Table 9: Shipments of stone from Canadian quarries, by kind and purpose for which used, by province. Catalogue No. 26-226-XIB. Annual.</p> <p>2) Natural Resources Canada. Mineral Production.</p> <p>3) Statistics Canada. Annual Demographic Estimates: Canada, Provinces and Territories. Catalogue No. 91-215-XWE.</p>	<p>1) United States Environmental Protection Agency, 1998. Compilation of Air Pollutant Emission Factors. Volume I. Stationary Point and Area Sources. AP-42, 5th Edition (and Supplements). United States Environmental Protection Agency, Research Triangle Park, North Carolina. Chapter 11: Crushed Stone Processing and Pulverized Mineral Processing (11.19.2)</p> <p>2) United States Environmental Protection Agency, 1998. Compilation of Air Pollutant Emission Factors. Volume I. Stationary Point and Area Sources. AP-42, 5th Edition, Supplement B. Section 8.19. Tables 2-4 and 2-5. United States Environmental Protection Agency, Research Triangle Park, North</p>

Sector	Activity Data Reference(s)	Emission Factor Reference(s)
		<p>Carolina</p> <p>3) United States Environmental Protection Agency, EPA PM Calculator.</p>
Metal Mining	<p>1) Natural Resources Canada. Mineral Production.</p> <p>2) Statistics Canada. Metal Ore Mining. Table 7: Tonnage of ore removed from metal mines, by industry and province. Catalogue No. 26-223-XIB. Annual.</p> <p>3) Natural Resources Canada. List of Mining and Mineral Processing Operations in Canada.</p>	<p>1) United States Environmental Protection Agency, 1985. Compilation of Air Pollutant Emission Factors. Volume I. Stationary Point and Area Sources. AP-42, 4th Edition (and Supplements). Chapter 8: Mineral Products Industry. Section 8.32: Metallic Minerals Processing. United States Environmental Protection Agency, Research Triangle Park, North Carolina.</p>
Coal Mining	<p>1) Environment Canada. Climate Summaries.</p> <p>2) Natural Resources Canada. Mining and Mineral Statistics. Mineral Production of Canada, by Province and Territory. Latest version 2009.</p> <p>3) A Study of Fugitive Coal Dust Emissions in Canada, 2001.</p> <p>4) Informetrica, Code RNC.</p> <p>5) Coal Association of Canada.</p>	<p>1) United States Environmental Protection Agency, 1995. Compilation of Air Pollutant Emission Factors. Section 11.9: Western Surface Coal Mining. Volume I. Stationary Point and Area Sources. AP-42, 5th Edition (and Supplements). U.S. Environmental Protection Agency, Research Triangle Park, North Carolina.</p> <p>2) United States Environmental Protection Agency, EPA PM Calculator.</p> <p>3) A Study of Fugitive Coal Dust Emissions in Canada, 2001.</p>
Other Minerals	<p>1) Natural Resources Canada. Mineral Production.</p> <p>2) Natural Resources Canada. Minerals and Metals Sector. "Cement," a report by Doug Panagapko, 2003.</p> <p>3) Natural Resources Canada. Minerals and Metals Sector. "Potash," a report by Michel Prod'homme, 1995</p> <p>4) Statistics Canada. Non-metallic Mineral Mining and Quarrying. Catalogue no. 26-226-XIB, 2006. Table 6: Tonnage of ore removed from selected non-metal mines, by industry and province, 2005 to 2006. Released October 10, 2008.</p> <p>5) List of Mining and Mineral Processing Operations in Canada,</p>	<p>1) United States Environmental Protection Agency, 1985. Compilation of Air Pollutant Emission Factors. Volume I. Stationary Point and Area Sources. AP-42, 4th Edition (and Supplements). Chapter 8: Mineral Products Industry. United States Environmental Protection Agency, Research Triangle Park, North Carolina.</p> <p>2) United States Environmental Protection Agency, EPA PM Calculator.</p>

Sector	Activity Data Reference(s)	Emission Factor Reference(s)
	<p>NRCan</p> <p>6) Statistics Canada. Annual Demographic Estimates: Canada, Provinces and Territories. Catalogue No. 91-215-XWE.</p> <p>7) Natural Resources Canada. Canadian Mineral Yearbook (CMY). Latest version, 2008.</p>	
Wood Industry	<p>1) Process Activities: Sawmills and Panel Boards Production Reference Sources for Production Inventory</p> <ul style="list-style-type: none"> • 2010 NRCAN Closure List of Facilities • 2008 Spelter • 2008/2009 Madison • 2009 RISI (Resource Information Systems Inc.) • 2010 Annual Reports from facilities • 2010 Survey completed by FAAD <p>Note: The Forestry, Agriculture and Aquaculture Division (FAAD) of Environment Canada provided the estimations for the non-reporting facilities in the sector. This department should be contacted for the data (contact: Émile Boudreau).</p> <p>2) Combustion Activities Statistics Canada. Report on Energy Supply and Demand in Canada (RESO). Catalogue No. 57-003-XWE. Annual. Table 1(1-1 to 1-16) for Natural Gas, Light Fuel Oil and Heavy Fuel oil for all of Canada. Table 10 for consumption of solid wood waste and spent pulping liquor for energy production.</p> <p>Notes: 1) Table 10 does not include incineration activity. 2) Select the PDF report version corresponding to the reporting year.</p> <p>3) Combustion Activities: Sulphur Content of Liquid Fuels Environment Canada. "Sulphur in Liquid Fuels – 200x".</p>	<p>1) Process Activities The emission intensities (EI) from Y2008 were used for Y2010. In 2008, TPM emission intensities were developed for each wood products sub-category using NPRI reported emissions and production values. Air emissions of PM10 and PM2.5 were estimated from the TPM emissions for each facility based on the distribution factor created by PIRD. These distribution factors are provided in Section 4.2.2, Table 4.1.</p> <p>2) Combustion Activities H.A. Simons Ltd. 1995. Emissions and Control Options for Wood and Wood Derived Fuel Fired Industrial Combustion Systems. P.5517B. April.</p> <p>United States Environmental Protection Agency. 2004. Factor Information RETrieval (FIRE) v6.25, October 2004.</p>

Sector	Activity Data Reference(s)	Emission Factor Reference(s)
Upstream Oil & Gas	<p>1) Environment Canada. 2011. National Inventory Report 1990-2009: Greenhouse Gas Sources and Sinks in Canada. Annex 3: Section A.3.1.2.</p> <p>2) Canadian Association of Petroleum Producers (CAPP). 2005. Extrapolation of the 2000 UOG Emission Inventory to 2001, 2002 and 2003. Calgary (AB): Clearstone Engineering Ltd.</p>	<p>1) Environment Canada. 2011. National Inventory Report 1990-2009: Greenhouse Gas Sources and Sinks in Canada. Annex 3: Section A.3.1.2.</p> <p>2) Canadian Association of Petroleum Producers (CAPP). 2005. Extrapolation of the 2000 UOG Emission Inventory to 2001, 2002 and 2003. Calgary (AB): Clearstone Engineering Ltd.</p>

Category 2: Non-Industrial Sectors

Sector	Activity Data Reference(s)	Emission Factor Reference(s)
Commercial Fuel Combustion	<p>1) Statistics Canada - Report on Energy Supply-Demand in Canada (RES-D). Catalogue No. 57-003-XWE. Annual.</p>	<p>1) United States Environmental Protection Agency, 1998. Chapter 1: External Combustion Sources. Volume I. Stationary Point and Area Sources. AP-42, 5th Edition (and Supplements).</p> <p>2) United States Environmental Protection Agency. FIRE 6.25. Factor Information Retrieval (FIRE) Data System. 2004. Clearinghouse for Inventories & Emissions Factors, Technology Transfer Network, United States Environmental Protection Agency.</p> <p>3) United States Environmental Protection Agency. Draft Dioxin Reassessment. National Academy of Sciences (NAS) Review Draft 2003.</p>
Electric Power Generation	<p>1) Statistics Canada - Report on Energy Supply-Demand in Canada (RES-D). Catalogue No. 57-003-XWE. Annual.</p>	<p>1) United States Environmental Protection Agency, 1998. Chapter 1: External Combustion Sources. Volume I. Stationary Point and Area Sources. AP-42, 5th Edition (and Supplements).</p> <p>2) United States Environmental Protection Agency, 1998. Chapter 3: Stationary Internal Combustion Sources. Volume I. Stationary Point and Area Sources. AP-42, 5th Edition (and Supplements).</p> <p>3) United States Environmental Protection Agency, 1998. Factors Information Retrieval System United States Environmental Protection Agency (EPA). 2003. Draft Dioxin Reassessment.</p>

Sector	Activity Data Reference(s)	Emission Factor Reference(s)
		<p>(WebFIRE), Version 6.25. For Dioxin & Furans Emission Factors:</p> <p>4) United States Environmental Protection Agency. Draft Dioxin Reassessment. National Academy of Sciences Review Draft 2003.</p> <p>5) California Air Resources Board, 2005. California Air Toxic Emission Factor database.</p> <p>For Ammonia Emission Factors:</p> <p>6) Battye, R., Battye, W., Overcash, C. and Fudge, S., 1994. Development and Selection of Ammonia Emission Factors. Final Report. EPA Contract No. 68-D3-0034. Prepared for U.S. Environmental Protection Agency by EC/R, Inc., Durham, North Carolina. August.</p> <p>7) Coe, D.L., H.H. Main, L.R. Chinkin, C. Loomis, and J. Wilkinson, 1996. Review of Current Methodologies for Estimating Ammonia Emissions, Draft Final Report STI-95310-1580-DFR. Prepared by Sonoma Technology Inc., Santa Rosa, California and Alpine Geophysics, Golden, Colorado for the California Air Resources Board.</p>
Residential Fuel Combustion	1) Statistics Canada – Report on Energy Supply-Demand in Canada (RESO). Catalogue No. 57-003-XWE. Annual.	<p>1) United States Environmental Protection Agency, 1998. Chapter 1: External Combustion Sources. Volume I. Stationary Point and Area Sources. AP-42, 5th Edition (and Supplements).</p> <p>2) United States Environmental Protection Agency, 1998. Factors Information Retrieval System (WebFIRE), Version 6.25. For Dioxin & Furans Emission Factors:</p> <p>3) United States Environmental Protection Agency. Draft Dioxin Reassessment. National Academy of Sciences (NAS) Review Draft 2003.</p> <p>4) California Air Resources Board, 2005. California Air Toxic Emission Factor database. For Ammonia Emission Factors:</p>

Sector	Activity Data Reference(s)	Emission Factor Reference(s)
		<p>5) Battye, R., Battye, W., Overcash, C. and Fudge, S., 1994. Development and Selection of Ammonia Emission Factors. Final Report. EPA Contract No. 68-D3-0034. Prepared for United States Environmental Protection Agency by EC/R, Inc., Durham, North Carolina. August.</p> <p>6) Coe, D.L., H.H. Main, L.R. Chinkin, C. Loomis, and J. Wilkinson, 1996. Review of Current Methodologies for Estimating Ammonia Emissions, Draft Final Report STI-95310-1580-DFR. Prepared by Sonoma Technology Inc., Santa Rosa, California and Alpine Geophysics, Golden, Colorado for the California Air Resources Board.</p>
Residential Fuel Wood Combustion	1) Using Growth Factors: Environment Canada. Pollution Data Division. Criteria Air Contaminants Emissions Inventory 2006 Guidebook. Released January 2008.	<p>1) Environment Canada. Pollution Data Division. Criteria Air Contaminants Emissions Inventory 2006 Guidebook. Released January 2008.</p> <p>2) Houck, J.E. and Scott, A., 1999, Duraflame Emission Benefits Study, OMNI Environmental Services report to Duraflame, Inc., Stockton, CA.</p> <p>3) Shelton, J., Sorensen, D., Stern, C. H. and Jaasma, D. R., 1990, Fireplace Emissions Test Method Development, report to Wood Heating Alliance and Fireplace Emissions Research Coalition.</p> <p>4) Shelton, J.W. and Gay, L., 1987, Colorado Fireplace Report, Shelton Research, Inc. Report to Colorado Air Pollution Control Division.</p> <p>5) Houck, J.E., Chow, J. C., Watson, J.G., Simons, C.A., Pritchett, L.C., Goulet, J.M. and Frazier, C.A., 1989, Determination of Particle Size Distribution and Chemical Composition of Particulate Matter from Selected Sources in California, report to California Air Resources Board, 3 volumes plus executive summary, NTIS PB89 232805.</p> <p>6) OMNI Environmental Services, Inc, 1999, The Effects of Fireplace Design</p>

Sector	Activity Data Reference(s)	Emission Factor Reference(s)
		<p>Features on Emissions, draft report to Hearth Products Association, Arlington, VA.</p> <p>7) U.S. Environmental Protection Agency, 1996, Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I, Stationary Point and Area Sources, Chapter 1, External Combustion Sources, Section 1.9, Residential Fireplaces (Supplement B), October, 1996.</p> <p>8) Advanced Systems Technology, Inc., 1990, Development of AP-42 Emission Factors for Residential Fireplaces Apex, North Carolina, report to Emissions Measurement Branch, U.S. Environmental Protection Agency, EPA contract 68D90155.</p> <p>9) PEDCo-Environmental, Inc., 1977, Source Testing for Fireplaces, Stoves and Restaurant Grills in Vail, Colorado, report to U.S. Environmental Protection Agency, Region VIII, Denver, CO., EPA contract 68-01-1999.</p> <p>10) Dasch, J.M., 1982, Particulate and Gaseous Emissions from Wood-Burning Fireplaces, Environ. Sci. Technol, v. 16, n. 10, pp. 641-644.</p> <p>11) DeAngelis, D. G. and Ruffin, D.S., 1980, Preliminary Characterization of Emissions from Wood-fired Residential Combustion Equipment, EPA-600/7-80-040.</p> <p>12) Snowden, W.D., 1975, Source Sampling Residential Fireplaces for Emission Factor Development, EPA-450/3-76-010.</p> <p>13) Kosel, P., Perry, F.R. and Wong-Woo, H., 1980, Emissions from Residential Fireplaces, State of California Air Resources Board, Stationary Source Control Division, Engineering Evaluation Branch report C-80-027.</p> <p>14) Hayden, A.C.S. and Braaten, R.W., 1991, Reduction of Fireplace</p>

Sector	Activity Data Reference(s)	Emission Factor Reference(s)
		<p>and Woodstove Pollutant Emissions through the Use of Manufactured Firelogs, in proceedings of the 84th Annual Meeting and Exhibition of the Air and Waste Management Association, Vancouver, BC., paper 91-129.1.</p> <p>15) Barnett, S.G., 1991, In-Home Performance: Comparison of a Conventional Fireplace with a Retrofit Firecrest Masonry Insert in the Zagelow Residence, Vancouver, Washington, OMNI Environmental Services, Inc. report to Mutual Materials Company, Bellevue, WA.</p> <p>16) Barnett, S.G., 1991, In-home Evaluation of Emissions from Masonry Fireplaces and Heaters, OMNI Environmental Services, Inc. report to Western States Clay Products Association, San Mateo, CA.</p> <p>17) Barnett, S.G., McCrillis, R.C. and Crooks, R.B., 1992, Evaluation of Emissions from Masonry Fireplaces in Homes, in proceedings of the 85th Annual Meeting of the Air and Waste Management Association, Kansas City, MO, paper 92-118.06.</p> <p>18) Barnett, S.G., 1992. Particulate and Carbon Monoxide Emissions from a Bellfire 28 Rosin Fireplace Using a Simulated Real-World Test Procedure, OMNI Environmental Services, Inc. report to Sleepy Hollow Chimney, Inc., Brentwood, NY.</p> <p>19) Houck, J.E, Scott, A.T, Sorenson, J.T and Davis, B.N. "Comparison of Air Emissions Between Cordwood and Wax Sawdust Firelogs Burned in Residential Fireplaces" accepted for presentation at the Air and Waste Management Association International Specialty Conference on Recent Advances in the Science and Management of Air Toxics, Banff, AB, April 9–12, 2000.</p> <p>20) Fisher, L.H., Houck, J.E. and Tiegs, P.E, 1999, Long-Term</p>

Sector	Activity Data Reference(s)	Emission Factor Reference(s)
		<p>Performance of EPA-Certified Phase 2 Woodstoves, Klamath Falls and Portland, Oregon: 1998/1999, OMNI Environmental Services, Inc., draft report to U.S. Environmental Protection Agency.</p> <p>21) Barnett, S.G. and Fesperman, J., 1990, Field Performance of Advanced Technology Woodstoves in Their Second Season of Use in Glens Falls, New York, 1990; report prepared by OMNI Environmental Services, Inc. for Canada Centre for Minerals and Energy Technology; Energy, Mines, and Resources.</p> <p>22) Barnett, S.G. and Bighouse, R.D., 1992, In-home Demonstration of the Reduction of Woodstove Emissions from the Use of Densified Logs, OMNI Environmental Services, Inc. report to Bonneville Power Administration, DOE/BP-35836-1.</p> <p>23) Dernbach, S., 1990, Woodstove Field Performance in Klamath Falls, Oregon, Elements Unlimited report to Wood Heating Alliance, Washington D.C.</p> <p>24) Barnett, S.G., 1990, In-Home Evaluation of Emission Characteristics of EPA-Certified High Technology Non-Catalytic Woodstoves in Klamath Falls, Oregon, 1990, report prepared by OMNI Environmental Services, Inc. for Canada Centre for Minerals and Energy Technology; Energy, Mines, and Resources.</p> <p>25) Burnet, P., 1988, The Northeast Cooperative Woodstove Study, OMNI Environmental Services, Inc., EPA/600/S7-87/026.</p> <p>26) OMNI Environmental Services, Inc., 1987, An In-situ Performance Evaluation of Catalytic Retrofit Devices, report to Oregon Department of Environmental Quality.</p> <p>27) Simons, C.A., Christiansen, P.D., Pritchett, L.C. and Beyerman, G.A.,</p>

Sector	Activity Data Reference(s)	Emission Factor Reference(s)
		<p>1987, Whitehorse Efficient Woodheat Demonstration, OMNI Environmental Services, Inc. report to The City of Whitehorse, Yukon.</p> <p>28) Simons, C.A., Christiansen, P.D., Houck, J.E. and Pritchett, L.C., 1988, Woodstove Emission Sampling Methods Comparability Analysis and In-situ Evaluation of New Technology Woodstoves, OMNI Environmental Services, Inc. report to the U.S. Department of Energy Pacific Northwest and Alaska Regional Biomass Program, Bonneville Power Administration, Task G, DOE/BP-18508-6.</p> <p>29) OMNI Environmental Services, Inc., 1988, Particulate Emission Test, Emission Control System Inspection and Leak Check, Blaze King Stove in Home P02, report to Oregon Department of Environmental Quality.</p> <p>30) Barnett, S.G., 1990, Field Performance of Advanced Technology Woodstoves in Glens Falls NY, 1988-89, OMNI Environmental Services Inc., EPA-600/7-90-019a.</p> <p>31) Jaasma, D.R. and Champion, M.R., 1989, Field Performance of Woodburning Stoves in Crested Butte during the 1988-1989 Heating Season, Virginia Polytechnic Institute report to Town of Crested Butte, Colorado Department of Health and U.S. EPA Region VIII.</p> <p>32) Jaasma, D.R., Champion, M.R. and Gundappa M., 1991, Field Performance of Woodburning and Coalburning Appliances in Crested Butte during the 1989-90 Heating Season, EPA-600/7-91-005.</p> <p>33) Jaasma, D.R., Stern, C.H. and Champion, M., 1994, Field Performance of Woodburning Stoves in Crested Butte during the 1991-92 Heating Season, EPA-600/R-94-061.</p> <p>34) Correll, R., Jaasma, D.R. and</p>

Sector	Activity Data Reference(s)	Emission Factor Reference(s)
		<p>Mukkamala, Y., 1997, Field Performance of Woodburning Stoves in Colorado during the 1995-96 Heating Season, EPA-600/R-97-112.</p> <p>35) Houck, J.E. and Tiegs, P.E., 1998, Residential Wood Combustion Technology Review, EPA 600/R 98 174 a.</p> <p>36) Bighouse, R.D., Houck, J.E., Barnett, S.G. and Tiegs, P.E., 1994, Woodstove Durability Testing Protocol, EPA 660/R 94 193.</p> <p>37) U.S. Environmental Protection Agency, 1983, Emission Factor Documentation for AP-42: Section 1.10, Residential Wood Stoves.</p> <p>38) Shelton, J.W. and Gay, L.W., 1986, Evaluation of Low-Emission Wood Stoves, Shelton Research, Inc. report to California Air Resources Board, contract A3-122-32.</p> <p>39) Houck, J.E., Chow, J. C., Watson, J.G., Simons, C.A., Pritchett, L.C., Goulet, J.M. and Frazier, C.A., 1989, Determination of Particle Size Distribution and Chemical Composition of Particulate Matter from Selected Sources in California, report to California Air Resources Board, 3 volumes plus executive summary, NTIS PB89 232805.</p> <p>40) Shelton, J.W., 1985, Wood Stove Particulate Matter Test Methods and Emissions Factors, Shelton Energy Research report no. 1185 to Colorado Department of Health.</p> <p>41) Burnet, P.G., Houck, J.E. and Roholt, R.B., 1990, Effects of Appliance Type and Operating Variables on Woodstove Emissions, EPA-660/2-90-001.</p> <p>42) U.S. Environmental Protection Agency, October 21, 1999, Certified Woodstove List, Washington DC.</p> <p>43) U.S. Environmental Protection</p>

Sector	Activity Data Reference(s)	Emission Factor Reference(s)
		<p>Agency, 1996, Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I, Stationary Point and Area Sources, Chapter 1, External Combustion Sources, Section 1.10, Residential Wood Stoves (Supplement B), October, 1996.</p> <p>44) DeAngelis, D. G. and Ruffin, D.S., 1980, Preliminary Characterization of Emissions from Wood-fired Residential Combustion Equipment, EPA-600/7-80-040.</p> <p>45) McCrillis, R.C., 1995, Review and Analysis of Emissions for Residential Wood-Fired Central Furnaces, in proceedings of the 88th Annual Meeting and Exhibition of the Air and Waste Management Association, San Antonio, TX, paper 95-RP137.04.</p> <p>46) Brandon, R.J., undated, An Assessment of the Efficiency and Emissions of Ten Wood Fired Furnaces, report, Institute of Man and Resources, Charlottetown, P.E.I.</p> <p>47) Valenti, J.C., and Russell C.K., 1998, Emissions from Outdoor Wood-Burning Residential Hot Water Furnaces, EPA-600/R-98-017.</p> <p>48) Houck, J.E., Scott, A., Purvis, C.R., Kariher, P.H. and Crouch, J., 1999, Low Emission and High Efficiency Residential Pellet-Fired Heaters, publication in preparation.</p> <p>49) Barnett, S.G. and Roholt, R.B., 1990, In-home Performance of Certified Pellet Stoves in Medford and Klamath Falls, Oregon, OMNI Environmental Services Inc. report to U.S. Department of Energy and Oregon Department of Environmental Quality, DOE/BP-04143-1.</p> <p>50) Barnett, S.G. and Fields, P.G., 1991, In-home Performance of Exempt Pellet Stoves in Medford, Oregon, OMNI Environmental Services, Inc. report to U.S. Department of Energy,</p>

Sector	Activity Data Reference(s)	Emission Factor Reference(s)
		<p>Oregon Department of Energy, Tennessee Valley Authority, and Oregon Department of Environmental Quality, DOE/BP-04123-2.</p> <p>51) Whitfield, J., 1999, The Wood Burner. A Platform for Introducing “Renewable Biomass Fuels” into Residential Central Heating, Pyro Industries, Inc., Burlington WA.</p> <p>52) Barnett, S.G., Houck, J.E. and Roholt, R.B., 1991, In-Home Performance of Pellet Stoves in Medford and Klamath Falls, Oregon, presented at AWM&A 84th Annual Meeting, Vancouver, BC, June 16-21, 1991, paper 91-129.3.</p> <p>53) U.S. Environmental Protection Agency, 1996, Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I, Stationary Point and Area Sources, Chapter 1, External Combustion Sources, Section 1.10, Residential Wood Stoves (Supplement B), October, 1996.</p>

Category 3: Mobile Sources

Sector	Activity Data Reference(s)	Emission Factor Reference(s)
Transportation	<p>1) Aircraft: Statistics Canada. Aircraft Movements Statistics: NAV CANADA Towers and Flight Service Stations. Catalogue No. 51-007-X. 2007.</p> <p>2) Commercial Marine: Statistics Canada. Shipping in Canada. Catalogue No. 54-205-XWE. Annual.</p> <p>3) On-road Vehicles: Statistics Canada. Canadian Vehicle Survey. Catalogue No. 53-223-XWE. Annual.</p> <p>4) Off-road Engines: Statistics Canada. Canadian Vehicle Survey. Catalogue No. 53-223-XWE. Annual.</p> <p>Statistics Canada. Report on Energy Supply-Demand in Canada. Catalogue No. 57-003-XWE. Annual.</p>	<p>1) Aircraft: EMEP/CORINAIR (2007). Emission Inventory Guidebook, Chapter 8: Other mobile sources and machinery. European Environment Agency.</p> <p>2) Commercial Marine: EMEP/CORINAIR (2007). Emission Inventory Guidebook, Chapter 8: Other mobile sources and machinery. European Environment Agency.</p> <p>3) On-road Vehicles: Environment Canada. MOBILE6.2C Model. Modified from the United States Environmental Protection Agency MOBILE6.2 model to better reflect Canadian conditions.</p> <p>Link to United States Environmental Protection Agency’s MOBILE6 Model: Emission Factors for Criteria Air Contaminants, Ammonia, Heavy</p>

Sector	Activity Data Reference(s)	Emission Factor Reference(s)
	<p>5) Locomotives: Railway Association of Canada. Locomotive statistics. Annual</p>	<p>Metals, Polycyclic Aromatic Hydrocarbons and Toxics from MOBILE6.2C.</p> <p>Emission Factors for Dioxins/Furans from Exposure and Human Health Reassessment of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD) and Related Compounds (Environmental Protection Agency, 2000).</p> <p>For Environment Canada's 2006, 2007 and 2008 National Pollutant Release Inventory – comprehensive air pollutant emission -, the model version used was "27-May-2005."</p> <p>4) Off-road Engines: United States Environmental Protection Agency (EPA). NONROAD2004(draft) Model, using Canadian input data. User's Guide for the Canadian Adaptation of the United States Environmental Protection Agency NONROAD Emissions Inventory Model (Roland Vaivads, 2004).</p> <p>Link to United States Environmental Protection Agency's NONROAD2004 Mode</p> <p>Emission Factors for Criteria Air Contaminants (CACs) and Ammonia from NONROAD2004(draft).</p> <p>5) Locomotives: Southwest Research Institute. Locomotive Testing and Evaluation.</p>

Category 4: Incineration Sectors

Sector	Activity Data Reference(s)	Emission Factor Reference(s)
Cremation	<p>1) Number of cremations (excluding Quebec) obtained from the CANA document entitled "Annual Statistics Report" originally presented at the 93rd Annual CANA Convention, October 23-26, 2011, Chicago, Illinois.</p> <p>2) Number of cremations for Quebec obtained from the CANA document</p>	<p>1) United States Environmental Protection Agency. FIRE (Factor Information Retrieval Data System) version 6.25. Clearinghouse for Inventories & Emissions Factors, Technology Transfer Network, United States Environmental Protection Agency.</p>

Sector	Activity Data Reference(s)	Emission Factor Reference(s)
	<p>entitled "2008 Statistics and Projections to the Year 2025, 2009 Preliminary Data" SmithBucklin Corporation, 2010.</p> <p>A) Statistics Canada. Quarterly Demographic Estimates. April to June 2008. Catalogue No. 91-002-X, Table 2-2.</p> <p>B) Statistics Canada. Quarterly Demographic Estimates. October to December 2010. Catalogue No. 91-002-X, Table 4-2.</p>	<p>2) United States Environmental Protection Agency, 2000. Draft Dioxin Reassessment.</p> <p>3) Cremation Association of North America, 1993. Casket and Container Emission Study.</p> <p>4) Lee, Carol. 2009. Bay Area Air Quality Management District Permit Handbook, Section 11.6.</p>
Incineration	<p>1) Statistics Canada. Population by Year, by Provinces and Territories. CANSIM Table 051-0001.</p> <p>2) Environment Canada - 1992. An Assessment of the Physical, Economic and Energy Dimensions of Solid Waste Management. Volume 1. 2/UP/2/E. Hazardous Waste Branch.</p>	<p>1) United States Environmental Protection Agency, 1985. Compilation of Air Pollutant Emission Factors. Volume I. Stationary Point and Area Sources. AP-42, 4th Edition (and Supplements). Chapter 2: Solid Waste Disposal. U.S. Environmental Protection Agency, Research Triangle Park, North Carolina.</p> <p>2) U.S. EPA. 2000. Draft Dioxin Reassessment.</p>

Category 5: Miscellaneous Sectors

Sector	Activity Data Reference(s)	Emission Factor Reference(s)
Cigarette Smoking	<p>1) Health Canada. Canadian Tobacco Use Monitoring Survey (CTUMS) Supplementary Tables - Annual (February to December)</p>	<p>1) Ott, W.R., Switzer, P. and Robinson, J., 1996. Particle Concentrations Inside a Tavern Before and After Prohibition of Smoking: Evaluating the Performance of an Indoor Air Quality Model. Journal of the Air & Waste Management Association 46: 1120–1134.</p> <p>2) Wallace, L., Pellizzari, E., Hartwell, T., Perrit, R. and Ziegenfus, R., 1987. Exposures to Benzene and Other Volatile Compounds from Active and Passive Smoking. Archives of Environmental Health 42(5): 272–279.</p> <p>3) Ott, W.R., Langan, L. and Switzer, P., 1992. A Time Series Model for Cigarette Smoking Activity Patterns: Model Validation for Carbon Monoxide and Respirable Particles in a Chamber</p>

Sector	Activity Data Reference(s)	Emission Factor Reference(s)
		<p>and an Automobile. Journal of Exposure Analysis and Environmental Epidemiology 2: 175–200.</p> <p>4) Units are kg/person. Roe et al., 2004. Estimating Ammonia Emissions from Anthropogenic Nonagricultural Sources – Draft Final Report. Prepared for Emission Inventory Improvement Program.</p> <p>5) Gray, N. and Boyle P., 2002. Heavy Metals Range of Emissions from 26 Selected Brands. Annals of Oncology 13. pp 19-21.</p> <p>6) United States Environmental Protection Agency, 2003. Draft Dioxin Reassessment.</p> <p>7) Ding et al., 2005. Determination of 14 Polycyclic Aromatic Hydrocarbons in Mainstream Smoke from Domestic Cigarettes. Environmental Science Technology 39. pp 471-478.</p>
Human	1) Statistics Canada. CANSIM, table 051-0001. Population by year, by province and territory. Annual.	1) Roe, S.M., Spivey, M.D., Lindquist, H.C., Thesing, K.B., Strait, R.P. and E.H. Pechan & Associates, Inc., 2004. Estimating Ammonia Emissions from Anthropogenic Nonagricultural Sources – Draft Final Report. Prepared for the United States Environmental Protection Agency's Emission Inventory Improvement Program.
Meat Cooking	<p>1) Weights of meat and poultry and edible weight of fish available per person, per year: Statistics Canada. Canada Food Stats. Annual.</p> <p>2) Population data to obtain an estimate of total quantity consumed by province/territory: Statistics Canada. CANSIM table 051-0001. Population by year, by province and territory. Annual.</p> <p>3) Canadian consumption rate of each grade of ground meat: Beef Information Centre, 1996. 1996 National Purchase Diary. Survey of Food Consumption for 4300 households across Canada.</p>	1) Rogge, W.F., Hildemann, L.M., Mazurek, M.A. and Cass, G.R., 1991. Sources of Fine Organic Aerosol. 1. Charbroiling and Meat Cooking Operations. Environmental Science and Technology 25: 1112–1125.

Sector	Activity Data Reference(s)	Emission Factor Reference(s)
Structural Fires	<p>1) Number of structural fires per province/territory, per year. Availability of activity levels depends on the province/territory.</p> <p>- Some provinces/territories are behind by several years in publishing the number of structural fires that occurred annually, while others are quite up-to-date (i.e. data is available for the previous year).</p> <p>- For some provinces/territories, the number of structural fires is not available and was last available only as a 10-year average published in 2002.</p> <p>2) Emission Inventory Improvement Program 2001. Structure Fires. Revised Final. Prepared by Eastern Research Group Inc. for the Emission Inventory Improvement Program, United States Environmental Protection Agency.</p>	<p>1) Greater Vancouver Regional District and Fraser Valley Regional District, 2003. 2000 Emission Inventory for the Canadian Portion of the Lower Fraser Valley Airshed. Detailed Listing of Results and Methodology. Greater Vancouver Regional District and Fraser Valley Regional District. November.</p> <p>2) Battye, R., Battye, W., Overcash, C. and Fudge, S., 1994. Development and Selection of Ammonia Emission Factors. Final Report. EPA Contract No. 68-D3-0034. Prepared by EC/R, Inc., Durham, North Carolina, for United States Environmental Protection Agency. August.</p>
Fuel Marketing	<p>1) Statistics Canada, CANSIM, table 405-0002. Sales of fuel used for road motor vehicles, by province and territory.</p>	<p>1) Tecslut Inc 2006. Study on gasoline vapour recovery in Stage 1 distribution networks in Canada.</p> <p>2) Emission Factors obtained from 1995 CAC Emissions Inventory.</p>
Solvents		
<p>Dry Cleaning</p> <p>General Solvent Use</p> <p>Printing</p> <p>Surface Coatings</p>	<p>The domestic demand of solvents was estimated using a national supply and demand mass balance, based on production, trade and inventory changes data.</p> <p>The total Canadian domestic demand of each solvent was allocated into emissive or evaporative application areas based on historical allocation shares and research among major solvent suppliers and users.</p> <p>Market data and economic indicators were combined with mass balance data to estimate solvent use in each application area.</p> <p>Emission estimates for the four solvent sectors were calculated under contract. The estimation</p>	<p>Application-specific control efficiencies were applied to solvent use estimates to calculate VOC emissions estimates for the four solvent sectors.</p> <p>The estimation methodologies are provided in the following internal, unpublished studies:</p> <p>1) Cheminfo Services Inc. and Camford Information Services Inc. Volatile Organic Compound (VOC) Emissions from the Use of Solvents in Canada – Inventory Improvement and Trends Compilation - Task #2: VOC Emission Trends Compilation 1985–2005. Final Report, prepared for Environment Canada, March 2007.</p> <p>2) Cheminfo Services Inc. and Camford Information Services Inc.</p>

Sector	Activity Data Reference(s)	Emission Factor Reference(s)
	<p>methodologies are provided in the following internal, unpublished studies:</p> <p>1) Cheminfo Services Inc. and Camford Information Services Inc. Volatile Organic Compound (VOC) Emissions from the Use of Solvents in Canada – Inventory Improvement and Trends Compilation - Task #2: VOC Emission Trends Compilation 1985–2005. Final Report, prepared for Environment Canada, March 2007.</p> <p>2) Cheminfo Services Inc. and Camford Information Services Inc. Volatile Organic Compound (VOC) Emissions from the Use of Solvents in Canada – Inventory Improvement and Trends Compilation - Task #3: Mapping of Solvent Application Sub-Categories to NAICS Codes. Final Report prepared for Environment Canada, March 2007.</p>	<p>Volatile Organic Compound (VOC) Emissions from the Use of Solvents in Canada – Inventory Improvement and Trends Compilation - Task #3: Mapping of Solvent Application Sub-Categories to NAICS Codes. Final Report prepared for Environment Canada, March 2007.</p>
Other Miscellaneous Sources	<p>1) Infant Diapered Waste: The Census of Population published by Statistics Canada is used when available (every 5 years) which provides the number of children aged 0-3 by province/territory. For non-census years, the number of children aged 0-3 years is projected based on the overall growth rate of the population from the most recent census year to the target year.</p> <p>Statistics Canada. CANSIM, table 051-0001. Population by year, by province and territory. Annual.</p> <p>2) Non-agricultural Fertilizers: Statistics Canada. CANSIM, table 051-0001. Population by year, by province and territory. Annual.</p>	<p>1) Infant Diapered Waste: Roe, S.M., Spivey, M.D., Lindquist, H.C., Thesing, K.B., Strait, R.P. and E.H. Pechan & Associates, Inc., 2004. Estimating Ammonia Emissions from Anthropogenic Nonagricultural Sources – Draft Final Report. Prepared for the United States Environmental Protection Agency’s Emission Inventory Improvement Program.</p> <p>2) Non-agricultural Fertilizers: Roe, S.M., Spivey, M.D., Lindquist, H.C., Thesing, K.B., Strait, R.P. and E.H. Pechan & Associates, Inc. 2004. Estimating Ammonia Emissions from Anthropogenic Nonagricultural Sources – Draft Final Report. Prepared for the United States Environmental Protection Agency’s Emission Inventory Improvement Program.</p>

Category 6: Open Sources

Sector	Activity Data Reference(s)	Emission Factor Reference(s)
Animals (Agriculture)	<p>1) Cattle (Semi-Annual) Statistics Canada. Cattle Statistics. Catalogue No. 23-012-WXE. Semi-</p>	<p>For TPM, PM₁₀ and PM_{2.5}:</p> <p>1) Cattle, Hogs, Sheep, Horses</p>

Sector	Activity Data Reference(s)	Emission Factor Reference(s)
	<p>annual.</p> <p>2) Hogs (Quarterly) Statistics Canada. Hog Statistics, Fourth Quarter. Catalogue No. 23-010-X. Quarterly.</p> <p>3) Sheep (Semi-Annual): Statistics Canada. Sheep Statistics. Catalogue No. 23-011-X. Semi-annual.</p> <p>4) Poultry (Quarterly): Statistics Canada. Poultry & Egg Statistics. Catalogue No. 23-015-WXE. Quarterly.</p> <p>5) Alternative (Goats, Horses, Buffalo): Statistics Canada. Alternative Livestock on Canadian Farms. Catalogue No. 23-502-WXE. Occasional frequency.</p> <p>Note: The populations for goats, horses and buffalo are obtained from 5-year census. The last census was released in 2006.</p> <p>6) Poultry and Horse (every 5 years): Statistics Canada. 2007. Agricultural Profile of Canada in 2006, Census of Agriculture. Catalogue No. 95-632.</p>	<p>United States Environmental Protection Agency, 1985. Compilation of Air Pollutant Emission Factors. Volume I. Stationary Point and Area Sources. AP-42, 4th Edition (and Supplements). Chapter 6, Section 15. United States Environmental Protection Agency, Research Triangle Park, North Carolina.</p> <p>2) Poultry Greater Vancouver Regional District (GVRD), 2003. 2000 Emission Inventory for the Canadian Portion of the Lower Fraser Valley Airshed (FVRD). November.</p> <p>For Volatile Organic Compounds (VOCs):</p> <p>1) Hogs, Horses, Poultry, Sheep "2000 Emission Inventory of Agricultural Sources in British Columbia and the Lower Fraser Valley," October 2003. Table B.1.1.</p> <p>2) Cattle Environment Canada. Criteria Air Contaminants Section, Pollution Data Division. 2005.</p>
Fertilizer Applications	<p>1) Statistics Canada. Canadian Potato Production. Table 1. Area, production and farm value of potatoes (metric measures), Canada and provinces. Catalogue No. 22-008. Irregular frequency.</p> <p>2) Statistics Canada. Fertilizer Shipments Survey. Table 3. Fertilizer shipments to Canadian agriculture and export markets, by product type and fertilizer year, cumulative data. Catalogue No. 21-022. Quarterly.</p> <p>3) Statistics Canada. Field Crop Reporting Series – November estimate of production of principal field crops. Table 1-1. November estimate of production of principal field crops. Catalogue No. 22-002. Irregular frequency.</p>	<p>A) Poultry A. Lau, S. Bittman, and K. Chipperfield. "Determination of Ammonia Emission Factors for Land Application of Poultry Manure." October 2006.</p> <p>B) Swine K. Buckley et al. "Determination of Ammonia Emission Factors for Swine Manure in Western Canada." April 2007.</p>

Sector	Activity Data Reference(s)	Emission Factor Reference(s)
	<p>Note: The Field Crop publication is published eight times during the calendar year and released at strategic times of the year. The yields and levels of production by crop type are estimated twice (July and September) per year, based on expectation, whereas the November estimate is released after the harvest.</p> <p>Note: The November estimate of Field Crop Reporting series was used for the activity data. The activity data are categorized by Eco Region and then by province.</p> <p>4) Statistics Canada. Fruit and Vegetable Production. Table 3-1. Area, production and farm value of commercial vegetables in Canada, by province. Catalogue No. 22-003. Semi-annual.</p> <p>5) Statistics Canada. 2007. Agricultural Profile of Canada in 2006, Census of Agriculture. Catalogue No. 95-632.</p> <p>6) Statistics Canada. 1992. Agricultural Profile of Canada in 1991. Census of Agriculture. Catalogue No. 93-350.</p>	
Tilling/Wind Erosion	<p>1) Statistics Canada. Field Crop Reporting Series – November estimate of production of principal field crops. Table 1-1. November estimate of production of principal field crops. Catalogue No. 22-002. Irregular frequency.</p> <p>Note: The Field Crop publication is released eight times during the calendar year. However, there are only 4 estimates, which are July, September and November.</p> <p>2) Statistics Canada. Canadian Potato Production. Table 1. Area, production and farm value of potatoes (metric measures), Canada and provinces. Catalogue No. 22-008. Irregular frequency.</p>	<p>For TPM, PM₁₀ and PM_{2.5}:</p> <p>1) Tilling United States Environmental Protection Agency. 1985. Compilation of Air Pollutant Emission Factors. Volume I. Stationary Point and Area Sources. AP-42, 4th Edition (and Supplements). Chapter 6, Section 15. United States Environmental Protection Agency, Research Triangle Park, North Carolina.</p> <p>2) Wind Erosion United States Environmental Protection Agency 1988. Control of Open Fugitive Dust Sources. EPA-450/3-88-008. United States Environmental Protection Agency.</p>

Sector	Activity Data Reference(s)	Emission Factor Reference(s)
	<p>Note: Released 3 times per year (January, July and November)</p> <p>3) Statistics Canada. Fruit and Vegetable Production. Table 3-1. Area, production and farm value of commercial vegetables in Canada, by province. Catalogue No. 22-003. Semi-annual.</p> <p>Note: Released 2 times per year (June, February)</p> <p>4) Statistics Canada. 2007. Agricultural Profile of Canada in 2006, Census of Agriculture. Catalogue No. 95-632.</p>	
Construction Operations	Not currently available	Not currently available
Road Dust	<p>On-road Vehicles: Statistics Canada. Canadian Vehicle Survey. Catalogue no. 53-223-XWE. Annual.</p> <p>Weather Data: Environment Canada. Daily Climate Data from the National Archives and Data Management. Environment Canada.</p>	<p>For TPM, PM₁₀ and PM_{2.5}:</p> <p>1) Paved Road Dust United States Environmental Protection Agency, 1995. Compilation of Air Pollutant Emission Factors. Volume I. Stationary Point and Area Sources. AP-42, 5th Edition (and Supplements). Chapter 13, Section 2.1. October 1997. United States Environmental Protection Agency, Research Triangle Park, North Carolina.</p> <p>2) Unpaved Road Dust United States Environmental Protection Agency, 1995. Compilation of Air Pollutant Emission Factors. Volume I. Stationary Point and Area Sources. AP-42, 5th Edition (and Supplements). Chapter 13, Section 2.2. September 1998. United States Environmental Protection Agency, Research Triangle Park, North Carolina.</p> <p>Weather corrections applied to the estimates per later publications in of Chapter 13, Sections 2.1 and 2.2 in September 2002.</p> <p>3) Silt Loadings Innovacorp, 1997. Road Dust Report for Nova Scotia. 97-0682. August.</p>

Sector	Activity Data Reference(s)	Emission Factor Reference(s)
		<p>AGRA Earth & Environmental Ltd., 1997. Dust Loading Sampling in Winnipeg Region. WX-06022. Winnipeg, Manitoba. October.</p> <p>John D. Paterson & Associates Ltd., 1997. Road Dust Emissions Inventory. Ottawa, Ontario. September.</p> <p>Golder Associates, 1997. Road Dust Emission Characterization of the Paved and Unpaved Roads in the City of Calgary. Project 972-2006. Calgary, Alberta. October.</p> <p>NEIPTG. 1997. Road Dust Monitoring Study. Project No C0485-003. Prepared by SEACOR Environmental Engineering Inc., Vancouver, B.C., for the National Emissions Inventory and Projections Task Group. October.</p>
Landfill Sites	Not currently available	Not currently available
Open Burning	<p>1) Statistics Canada, 2002. Catalogue No. 16F0023XIE, Table A.6. Prorated by population for 2006 and later.</p> <p>2) Environics Research Group, 2001. Household Garbage Disposal and Burning. Survey, March.</p> <p>3) Statistics Canada, CANSIM, Table 051-0001 (for 2010 and later populations).</p>	<p>1) U.S. EPA. 1995. Compilation of Air Pollutant Emission Factors. Volume I. Stationary Point and Area Sources. AP-42, 5th Edition (and Supplements). U.S. Environmental Protection Agency, Research Triangle Park, North Carolina.</p> <p>2) GVRD, BC Ministry, November 2003. "2000 Emission Inventory for the Canadian Portion of the Lower Fraser Valley Airshed".</p> <p>3) Gartner Lee Limited, 2003. Dioxin/Furan Emissions from On-site Residential Waste Combustion in Canada. Prepared for Canadian Council of Ministers of the Environment, February.</p>
Mine Tailings	Not currently available	Not currently available
Prescribed Burning	Not currently available	Not currently available

Category 7: Natural Sources

Sector	Activity Data Reference(s)	Emission Factor Reference(s)
Biogenics	Not currently available	Not currently available
Forest Fires	<p>1) 2009 Canadian Interagency Forest Fire Centre Report Natural Resources Canada and Canadian Interagency Forest Fire Centre (CIFFC). Canada Report. Annual.</p> <p>Note: Total number of forest fires by province and the area burned, in hectares, by province.</p> <p>Current Annual Report</p> <p>Archived Annual Reports</p>	<p>1) U.S. EPA. 1995. Compilation of Air Pollutant Emission Factors. Volume I. Stationary Point and Area Sources. AP-42, 5th Edition (and Supplements). U.S. Environmental Protection Agency, Research Triangle Park, North Carolina.</p>
Mercury in Products	<p>Industrial, Commercial, Municipal and Sewage Sludge Incineration:</p> <p>1) Statistics Canada. Population by Year, by Provinces and Territories. CANSIM Table 051-0001. Annual.</p> <p>2) Environment Canada - 1992. An Assessment of the Physical, Economic and Energy Dimensions of Solid Waste Management. Volume 1. 2/UP/2/E. Hazardous Waste Branch.</p> <p>Waste: (Landfill, Sewage Sludge)</p> <p>1) Waste generation and landfilling data: Statistics Canada. 2000, 2003, 2004, 2007a, 2008a. Waste Management Industry Survey: Business and Government Sectors. System of National Accounts, Statistics Canada. Catalogue No. 16F0023XIE.</p> <p>2) Municipal wastewater data: Environment Canada. 1983–1999. Municipal Water Use Data Base.</p> <p>Human, Other Miscellaneous Sources: (Dental amalgams, Thermometer & measurement device breakage and loss, fluorescent tube breakage, transport loss)</p> <p>1) Statistics Canada. CANSIM, table 051-0001. Population by year, by</p>	<p>A mercury in products mass balance model was used, based on the following internal, unpublished studies:</p> <p>1) ToxEcology Environmental Consulting Ltd., 2007. Mass Balance Study for Mercury-Containing Products. Vancouver, British Columbia. January.</p> <p>2) ToxEcology Environmental Consulting Ltd., 2009. Socio-Economic Study and Mass Balance Study for Mercury-Containing Products. Vancouver, British Columbia. November.</p> <p>The mercury in products model adopted the same mass balance framework approach initiated by KEMI and subsequently refined by Barr Engineering and the US EPA:</p> <p>3) KEMI, 1997. Mercury in products – a source of transboundary pollutant transport. The Swedish National Chemicals Inspectorate. No. 10/97.</p> <p>4) Andrews, C.A., Monson, B.A. and Swain, E.B, 2002. Substance Flow Analysis of Mercury in Products. In Proceedings of the Air & Waste Management Association 95th Annual Meeting & Exhibition, A&WMA.</p>

Sector	Activity Data Reference(s)	Emission Factor Reference(s)
	<p>province and territory. Annual.</p> <p>2) Statistics Canada, 2006. Census of Population, Catalogue No. 97-554-XCB2006020.</p> <p>3) Statistics Canada. Canadian Vehicle Survey. Catalogue No. 53-223-XWE. Annual.</p>	<p>Baltimore, MD. Barr Engineering Company, 2001.</p>

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