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Data Sources and Methods for the Emission of Toxic Substances to Air Indicators

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1 Introduction

The Emission of Toxic Substances to Air indicators are part of the Canadian Environmental Sustainability Indicators (CESI) program, which provides data and information to track Canada's performance on key environmental sustainability issues.

2 Description and rationale of the emission of toxic substances to air indicator

2.1 Description

The indicators track anthropogenic emissions of two toxic substances to air: mercury (Hg) and hexavalent chromium (Cr(VI)). For each toxic substance, emissions are provided at the national, source, provincial or territorial, and facility level. International information is also provided for mercury.

2.2 Rationale

Mercury and hexavalent chromium and its compounds are on the List of Toxic Substances under Schedule 1 of the Canadian Environmental Protection Act, 1999 (CEPA 1999). This means that they are "entering or may enter the environment in a quantity or concentration or under conditions that 1) have or may have an immediate or long-term harmful effect on the environment or its biological diversity and/or 2) constitute or may constitute a danger to the environment on which life depends and/or 3) constitute or may constitute a danger in Canada to human life or health." The indicators inform Canadians about anthropogenic emissions of these two toxic substances to air by human activity in Canada. The indicators also help the Government to identify priorities and to develop and track progress on strategies and policies put in place to reduce or control air pollution.

3 Data

3.1 Data source

The data for the mercury (Hg) emissions indicators reported in CESI are from the Air Pollutant Emission Summaries and Trends (<http://www.ec.gc.ca/inrp-npri/Default.asp?lang=En&n=F98AFAE7-1>) compiled by Environment Canada's National Pollutant Release Inventory (NPRI) program (<http://www.ec.gc.ca/inrp-npri/default.asp?lang=en>). The Air Pollutant Emission Summaries and Trends are compiled in collaboration with provincial/territorial and regional environmental agencies. The data therein include emissions reported by industrial facilities to the NPRI; emissions from provincial, territorial and municipal inventories; and emissions estimated for other sources by Environment Canada using the latest published statistics or sources of information such as surveys, special emissions studies and emissions estimation techniques.

The Hg emissions for international comparison are from the Global Mercury Assessment 2013: Sources, emissions, releases and environmental transport report of the United Nations Environment Programme (UNEP) (http://www.unep.org/publications/contents/pub_details_search.asp?ID=6282).

The data for the hexavalent chromium (Cr(VI)) emissions indicators are solely from the NPRI database (<http://www.ec.gc.ca/inrp-npri/default.asp?lang=en&n=0EC58C98-1#Facility>) of Facility Reported Data (http://ec.gc.ca/pdb/websol/querysite/query_e.cfm). The indicators include the tonnes of Cr(VI), including that released in substances containing Cr(VI), reported in the National Pollutant Release Inventory (NPRI) based on the NPRI reporting criteria for

emissions of Cr(VI) and its compounds (<http://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=674761CE-1>).

Emissions reported on the interactive map for both Hg and Cr(VI) were retrieved from the Facility Reported Data of the NPRI database (<http://www.ec.gc.ca/inrp-npri/default.asp?lang=en&n=0EC58C98-1#Facility>).

3.2 Spatial coverage

The indicators provide national coverage and are also presented by province or territory. Emissions are displayed by facility on the interactive map. International data are presented only for Hg.

3.3 Temporal coverage

A historical trend is provided at the national level for Hg (1990 to 2011) and for Cr(VI) (2003 to 2011). The year 1990 was selected as the first year in the historical trend for Hg emissions because it is the base year for Canada's international commitment for reporting on Hg to the Convention on Long-Range Transboundary Air Pollution (CLRTAP). For Cr(VI), the first year reported in the historical trend is 2003.

Hg international comparisons are provided for the year 2010 only.

3.4 Data completeness

Some portions of the 2011 Hg emissions in the NPRI's Air Pollutant Emission Summaries and Trends were approximated using 2010 data because 2011 information was unavailable at the time of inventory production. Estimates for 2010 were used for some area and mobile-source emissions.

The Cr(VI) emissions reported in the indicator were compiled from emissions reported by facilities to the NPRI database, which only represent a portion of the emissions of this pollutant to air. The table below indicates the number of facilities that have reported emissions of Cr(VI) and its compounds to the NPRI since 2003.

Table 1: Number of NPRI facilities in Canada reporting emissions of Cr(VI) and its compounds to air	
Year	Number of facilities
2003	119
2004	129
2005	129
2006	123
2007	118
2008	115
2009	104
2010	102
2011	101
Common*	48

Note: * Number of facilities common to all years.

3.5 Data timeliness

The data are current up to 2011 (except as described in section 3.4 above). The indicators are reported approximately two years after data collection because of the time required for data validation, analysis and interpretation.

4 Methods

The indicators were calculated from the emissions from the Air Pollutant Emission Summaries and Trends tables and the NPRI database for Canada, and for each source and province or territory for the years reported.

Emissions of toxic substances to air are measured or estimated through one of the following:

- continuous emission monitoring systems (CEMS)
- predictive emission monitoring (PEM)
- source testing
- mass balance
- site-specific emission factors
- published emission factors
- engineering estimates
- special studies

These measurement methods and estimation techniques are used by the facilities to report their releases to the NPRI (point sources). For the year 2011, the published emission factor technique was the most common method used for estimating emissions of hexavalent chromium (Cr(VI)) and its compounds. Environment Canada uses the above methods and also uses models and statistical information in its estimations of the area and mobile sources included in the Air Pollutant Emissions Data (such as motor vehicles and residential).

The emissions estimation methods are reviewed updated and improved periodically in collaboration with sector experts from within and outside Environment Canada. Additional information on these methods is available through the Environment Canada NPRI website on the compilation of the Air Pollutant Emission Summaries and Trends (<http://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=5C71562D-1>).

In the comprehensive emissions tables for Hg, three different emissions sources are included: area, mobile and point (stationary) sources. Emissions are compiled using top-down and bottom-up approaches. The top-down approach refers to the estimation of emissions at a very general level (e.g. emissions from coal burned in Canada). In a bottom-up approach, the emissions are estimated with as many details as available and as close as possible to the actual source of emissions (e.g. emissions from power plants burning lignite coal in a boiler in Saskatchewan).

Area source emissions are from sources like home heating that are too small or too numerous to be reported as individual point sources. They are usually compiled through a top-down approach by applying emission factors to activity levels to estimate emissions.

Mobile source (transportation) emissions are compiled using a combination of bottom-up and top-down approaches. Emissions are estimated using models that include fuel consumption, number of vehicles, movement, distance travelled and many other parameters (e.g. MOBILE Canadian model).

Point-source emissions are compiled through a bottom-up approach starting with facility-level emissions from combustion, processes and fugitive sources. The NPRI and the provincial and territorial emissions inventories are used to compile emissions from point sources.

Double counting of emissions for the same source is eliminated through data reconciliation. If emissions can be compiled from point sources, the reconciliation process assures that they are not included in the area-source summation to avoid double counting. A data quality-control process is also in place to avoid discrepancies in the database, both in data compilation and in the production of summary tables.

Source classification

CESI classifies emission sources for Hg by summarizing emissions from multiple sources as defined in the NPRI. These are outlined in Table 2.

Table 2: Comparison of sources for Hg used in CESI and the NPRI	
CESI sources	NPRI Air Pollutant Emissions sources
Iron Ore Mining Industry	Iron Ore Mining Industry
Petroleum Industry	Upstream Petroleum Industry
	Downstream Petroleum Industry
Cement and Concrete Industry	Cement and Concrete Industry
Iron and Steel Industries	Iron and Steel Industries
Non-ferrous Smelting and Refining Industry	Non-ferrous Smelting and Refining Industry
Incineration	Crematorium
	Industrial and Commercial Incineration
	Municipal Incineration
	Other Incineration and Utilities
Electric Power Generation (Utilities)	Electric Power Generation (Utilities)
Other Sources	Abrasives Manufacture
	Aluminum Industry
	Asbestos Industry
	Asphalt Paving Industry
	Bakeries
	Chemicals Industry
	Mineral Products Industry
	Foundries
	Grain Industries
	Mining and Rock Quarrying
	Pulp and Paper Industry
	Wood Industry
	Petroleum Product Transportation and Distribution
	Other Industries
	Metal Fabrication
	Glass Manufacture
	Vehicle Manufacture (Engines, Parts, Assembly, Painting)
	Electronics
	Plastics Manufacture
	Food Preparation
	Paint and Varnish Formulation

Table 2: Comparison of sources for Hg used in CESI and the NPRI	
CESI sources	NPRI Air Pollutant Emissions sources
	Textiles
	Miscellaneous Industrial Sources
	Commercial Fuel Combustion
	Residential Fuel Combustion
	Residential Fuel Wood Combustion
	Air Transportation
	Heavy-duty Diesel Vehicles
	Heavy-duty Gasoline Trucks
	Light-duty Diesel Trucks
	Light-duty Diesel Vehicles
	Light-duty Gasoline Trucks
	Light-duty Gasoline Vehicles
	Marine Transportation
	Motorcycles
	Rail Transportation
	Tire Wear and Brake Linings
	Off-road Use of Diesel
	Off-road Use of Gasoline/Liquefied Petroleum Gas/Compressed Natural Gas
	Cigarette Smoking
	Dry Cleaning
	General Solvent Use
	Marine Cargo Handling Industry
	Meat Cooking
	Refined Petroleum Products Retail
	Printing
	Structural Fires
	Surface Coatings
	Human
	Other Miscellaneous Sources
	Biofuel Production

5 Caveats and limitations

The mercury (Hg) total emissions reported in the indicator exclude open and natural sources. This is consistent with Environment Canada's 2011 Air Pollutant Emission Summaries and Historical Emission Trends (<http://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=F98AFAE7-1>).

Mercury emissions from products are included in the 2007-2011 estimates. However, they are not yet included in the estimates for years prior to 2007. Updates to historical trends are currently being compiled by NPRI.

The number and composition of facilities that report emissions of Cr(VI) and its compounds to the NPRI each year varies. This variation is due to the fact that only facilities that exceed a certain reporting threshold should report to the NPRI. An analysis of how this might affect the apparent trends has not been undertaken.

Data reported to the NPRI by emitting facilities may be updated from time to time by the reporter as new and more up-to-date information is received and reviewed. Facilities reporting to the NPRI may use different methods to calculate emissions. These methods vary depending on the substance and/or facility, and may also change from year to year.

Even though the national Hg emissions used for the comparison follow the same reporting structure as the Global Mercury Assessment report and use the best data, measurements and methods available, users must be cautious when comparing the data, as emissions estimation methodologies differ among countries (http://www.unep.org/publications/contents/pub_details_search.asp?ID=6282).

6 References and further reading

6.1 References

Environment Canada (2013) Air Pollutant Emissions Summaries and Trends. Retrieved in March 2013. Available from: http://www.ec.gc.ca/pdb/websol/emissions/ap/ap_query_e.cfm

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