Environment Canada Environnement Canada

www.ec.gc.ca

Data Sources and Methods for the Releases of Harmful Substances to the Environment Indicators

August 2014

Canada

Suggested citation for this document: Environment Canada (2014) Canadian Environmental Sustainability Indicators: Data Sources and Methods for the *Releases of Harmful Substances to the Environment* Indicators. Consulted *on day Month, year*. Available at: *www.ec.gc.ca/indicateurs-indicators/default.asp?lang=en&n=3C4C1124-1*.

ISBN: 978-1-100-24818-9
Cat. No.: En4-144/59-2014E-PDF

Environment Canada
Inquiry Centre
10 Wellington Street, 23rd Floor
Gatineau QC K1A 0H3
Telephone: 819-997-2800
Toll Free: 1-800-668-6767 (in Canada only)
Fax: 819-994-1412
TTY: 819-994-0736
Email: enviroinfo@ec.gc.ca

Aussi disponible en français

1 Introduction

The Releases of Harmful Substances to the Environment indicators (http://ec.gc.ca/indicateurs-indicators/default.asp?lang=en&n=3C4C1124-1) are part of the Canadian Environmental Sustainability Indicators (CESI) program (http://ec.gc.ca/indicateurs-indicators/default.asp?lang=En&n=47F48106-1), which provides data and information to track Canada's performance on key environmental sustainability issues. These indicators are also used to measure progress towards the goals and targets of the Federal Sustainable Development Strategy (http://www.ec.gc.ca/dd-sd/default.asp?lang=En&n=CD30F295-1).

2 Description and rationale of the Releases of Harmful Substances to the Environment indicators

2.1 Description

The Releases of Harmful Substances to the Environment indicators track anthropogenic releases to air and water of three toxic substances: mercury (Hg), lead (Pb) and cadmium (Cd) and their compounds. For each toxic substance, emissions to air are provided at the national level and by source. Facility and global emissions to air information are also provided for Hg. Releases to water for each toxic substance are provided at the national, regional (provincial and territorial) and facility level, and by source.

2.2 Rationale

Hg, Pb and Cd and their compounds are on the List of Toxic Substances (http://ec.gc.ca/lcpe-cepa/default.asp?lang=En&xml=0DA2924D-E77E-2E16-A9D2-95388AD49B21) under Schedule 1 of the *Canadian Environmental Protection Act, 1999* (CEPA 1999). This means that these substances 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 and releases of these toxic substances to air and water from human activity in Canada. These indicators also help the government to identify priorities and develop strategies to inform further risk management and to track progress on policies put in place to reduce or control air and water pollution.

2.3 Recent changes to the indicator

Previously, the Releases of Harmful Substances to the Environment indicators were grouped into "Emissions of Toxic Substances to Air" indicators and "Release of Toxic Substances to Water" indicators. This year includes the addition of the Pb and Cd emissions to air indicators. The hexavalent chromium and its compounds emissions to air indicators are no longer reported. This substance was removed from the Federal Sustainability Development Strategy (FSDS) because the pollution reduction targets had already been achieved.

The entire Hg emissions to air time series was recalculated for various sectors. Such recalculations occur when improved quantification methods are implemented, new data becomes available, gaps in coverage are addressed or errors are corrected. The Pb and Cd emissions to air time series have not been recalculated for the 1990 to 2011 period, but were updated by adding emissions for 2012.

Finally, the emissions to air from open sources, including waste, construction and agriculture, were included in the indicators. For more information about these changes, consult the data highlights (http://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=F98AFAE7-1#X-201302081512532) from the 2012 Air Pollutant Emission Summaries and Historical Emission Trends (http://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=F98AFAE7-1).

Emissions to air at the provincial/territorial level were not included in this update as the underlying data was not available at the time of the compilation of the indicators due to a methodological review now underway at Environment Canada. This review is being conducted in consultation with the provinces and territories. Once finalized, the source data by province/territory will be available online at Environment Canada's 2012 Air Pollutant Emissions Summaries and Historical Emission Trends (http://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=F98AFAE7-1).

3 Data

3.1 Data source

The data for the mercury, lead and cadmium emissions to air indicators reported in the Canadian Environmental Sustainability Indicators program are from the 2012 Air Pollutant Emissions Summaries and Historical Emission Trends (http://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=F98AFAE7-1) compiled by Environment Canada. The 2012 Air Pollutant Emission Summaries and Historical Emission Trends are compiled in collaboration with provincial/territorial and regional environmental agencies. The data therein includes emissions reported by industrial facilities to the National Pollutant Release Inventory (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 releases of toxic substances to water indicators reported in CESI are taken from the NPRI database (http://ec.gc.ca/inrp-npri/default.asp?lang=en), which is compiled by Environment Canada. The NPRI includes releases reported by industrial, commercial and institutional facilities. The indicators include the amounts of elemental Hg, Pb and Cd in any compound, alloy or mixture reported in the NPRI based on the NPRI reporting criteria (http://ec.gc.ca/inrp-npri/default.asp?lang=En&n=674761CE-1).

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

Emissions reported on the interactive map were retrieved from the Facility Reported Data (http://www.ec.gc.ca/inrp-npri/donnees-data/index.cfm?lang=En) of the NPRI database (http://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 when available.[1] Hg emissions to air and releases of Hg, Pb and Cd to water are displayed by facility on the CESI interactive map. International data are presented only for Hg emissions to air.

3.3 Temporal coverage

A historical trend is provided at the national and source level for emissions to air (1990 to 2012) and for releases to water (2003 to 2012). The latest year, 2012 is used for regional releases to water. The year 1990 was selected as the first year in the time series for heavy metals emissions because it is the base year for Canada's international commitment for reporting on heavy metals under the Convention on Long-Range Transboundary Air Pollution (CLRTAP). 2003 was selected as the first year for releases to water because this is the year the NPRI updated its reporting criteria for Hg, Pb, and Cd. International comparison of Hg emissions to air is provided for 2010 only.

3.4 Data completeness

Some portions of the 2012 Hg emissions to air in the 2012 Air Pollutant Emissions Summaries and Historical Emission Trends (http://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=F98AFAE7-1) were approximated using 2011 data because 2012 information was unavailable at the time of inventory production. Estimates for 2011 were used for some area source emissions.

Because the releases to water indicators are derived solely from the NPRI database, they only reflect releases from facilities that met NPRI reporting criteria (http://ec.gc.ca/inrp-npri/default.asp?lang=En&n=674761CE-1). As a result, the indicators do not include all releases in Canada, but are limited to the main point sources for each selected toxic substance.

3.5 Data timeliness

The data are current up to 2012 (except as described in section 3.4 above). The indicators are reported approximately a year and a half after data collection because of the time required for data validation, analysis and interpretation.

4 Methods

The emissions to air part of the Releases of Harmful Substances to the Environment indicators were calculated from the Air Pollutant Emission Summaries and Trends (APEST) tables (http://www.ec.gc.ca/inrp-npri/donnees-data/ap/index.cfm?lang=En). The emissions to air indicators were summed for each source for Canada for the year reported. The releases to water were calculated by summing the releases from the NPRI database (http://ec.gc.ca/inrp-npri/default.asp?lang=en). The releases to water indicators were summed for Canada, for each source, and for each province and territory for the years reported.

[1] The emissions to air data at the provincial/territorial level were not available at the time of the compilation of the indicators.

NPRI facilities releases and air emissions of toxic substances are measured or estimated through one of the following:

- continuous emission/release monitoring systems
- predictive emission/release monitoring
- source testing
- mass balance
- site-specific emission/release factors
- published emission/release 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). The source testing technique was the most common release estimation method used in the NPRI for the year 2012. Please consult the Reporting to the NPRI Web page (http://ec.gc.ca/inrp-npri/default.asp?lang=En&n=F6300E68-1) for more details on these calculation methods.

4.1 Air emissions estimation methods

Environment Canada uses the above methods in addition to models and statistical information in its estimations of the area, open and mobile sources included in the Air Pollutant Emissions Data (http://www.ec.gc.ca/inrp-npri/donnees-data/ap/index.cfm?lang=En) (such as motor vehicles and residential fuel combustion).

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 website on the Compilation of the Air Pollutant Emission Summaries and Trends (http://ec.gc.ca/inrp-npri/default.asp?lang=En&n=5C71562D-1).

In the comprehensive emissions tables for air emissions, four different emissions sources are included: area, open, 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 and open source emissions are from sources such as home heating that are too small or too numerous or spread over too large an area to be reported as individual point sources. Emissions are usually estimated through a top-down approach that applies emission factors to activity levels. Mobile source (transportation) emissions are compiled using a combination of bottom-up and top-down approaches. Emissions are estimated using models (e.g., MOBILE Canadian model) that include fuel consumption, number of vehicles, movement, distance travelled and many other parameters.

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.

4.2 Source classification

The Canadian Environmental Sustainability Indicators program classifies emission sources differently by summarizing emissions from multiple sources as defined in the APEST and the NPRI. These are outlined in Table 1 and 2.

Source description for the air emissions indicators were taken from the APEST tables (http://www.ec.gc.ca/inrp-npri/donnees-data/ap/index.cfm?lang=En). Source descriptions for the releases to water indicators were taken from the North American Industry Classification System (NAICS) (http://www.statcan.gc.ca/subjects-sujets/standard-norme/naics-scian/2007/list-liste-eng.htm) used by Statistics Canada. The four-digit NAICS code, as reported by the facilities, was used for source classification.

Table 1: Comparison of sources used in CESI and the APEST for air emissions

CESI Sources	APEST Sources
Cement and Concrete Industry	Cement and Concrete Industry
Iron and Steel Industry	Iron and Steel Industries
Non-ferrous Smelting and Refining	Non-Ferrous Smelting and Refining Industry
Other Industries	Abrasives Manufacture
	Aluminum Industry
	Asbestos Industry
	Asphalt Paving Industry
	Bakeries
	Chemicals Industry
	Mineral Products Industry
	Foundries
	Grain Industries
	Iron Ore Mining Industry
	Mining and Rock Quarrying
	Pulp and Paper Industry
	Wood Industry
	Upstream Petroleum Industry
	Downstream Petroleum Industry
	Petroleum Product Transportation and Distribution
	Other Industries
	Metal Fabrication
	Glass Manufacture
	Vehicle Manufacture (Engines, Parts, Assembly, Painting)
	Electronics
	Plastics Manufacture
	Food Preparation

CESI Sources	APEST Sources
	Paint and Varnish Formulation
	Textiles
	Miscellaneous Industrial Sectors
	Biofuel Production
Fuel for Electricity and Heating	Electric Power Generation (utilities)
	Commercial Fuel Combustion
	Residential Fuel Combustion
Home Firewood Burning	Residential Fuel Wood Combustion
Transportation (Road, Rail, Air, Marine)	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 Vehicles	Off-road Use of Diesel
	Off-road Use of Gasoline/LPG/CNG
Incineration and Miscellaneous	Incineration Sources
	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
	All Open Sources except Waste
Waste	Waste

Table 2: Comparison of sources used in CESI and the NPRI (NAICS)* for releases to water

CESI Sources	NPRI Sources (NAICS)
Non-ferrous Smelting and Refining	Metal Ore Mining
	Non-Ferrous Metal (except Aluminum) Production and Processing
Oil and Gas Industry	Oil and Gas Extraction
Other Industries	Coal Mining
	Non-Metallic Mineral Mining and Quarrying
	Alumina and Aluminum Production and Processing

CESI Sources	NPRI Sources (NAICS)
	Basic Chemical Manufacturing
	Coating, Engraving, Heat Treating and Allied Activities
	Electrical Equipment Manufacturing
	Engine, Turbine and Power Transmission Equipment Manufacturing
	Foundries
	Motor Vehicle Parts Manufacturing
	Other Chemical Product Manufacturing
	Other Electrical Equipment and Component Manufacturing
	Other Miscellaneous Manufacturing
	Pesticide, Fertilizer and Other Agricultural Chemical Manufacturing
	Petroleum and Coal Product Manufacturing
	Pharmaceutical and Medicine Manufacturing
	Plastic Product Manufacturing
	Steel Product Manufacturing from Purchased Steel
	Veneer, Plywood and Engineered Wood Product Manufacturing
Fuel for Electricity and Heating	Electric Power Generation, Transmission and Distribution
	Other Professional, Scientific and Technical Services
Transportation (Road, Rail, Air, Marine)	Support Activities for Water Transportation
Iron and Steel Industry	Iron and Steel Mills and Ferro-Alloy Manufacturing
Cement and Concrete Industry	Cement and Concrete Product Manufacturing
Pulp, Paper and Paperboard Industry	Pulp, Paper and Paperboard Mills
Waste	Water, Sewage and Other Systems
	Remediation and Other Waste Management Services

Note: ** NAICS code used for the CESI indicators refers to the level 3 NAICS code (four-digit codes) which represents industry groups.*

5 Caveats and limitations

Total emissions of mercury, lead and cadmium to air reported in the Releases of Harmful Substances to the Environment indicators exclude natural sources (e.g., volcanos). This is consistent with Environment Canada's 2012 Air Pollutant Emission Summaries and Historical Emission Trends (http://ec.gc.ca/inrp-npri/default.asp?lang=En&n=F98AFAE7-1).

The number and composition of facilities that report releases to water to the National Pollutant Releases Inventory varies each year. This variation is due to the fact that only facilities that meet or exceed the 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 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.

In 2012, a facility (NPRI ID = 8742) reported a very high amount of mercury. This value is currently under review and was not included in the indicators.

The Canadian Hg emissions to air used for the international comparison were estimated with different estimation techniques and different source classifications than the Hg emissions to air used for the national indicators (Environment Canada). In addition, some air emissions sources were not quantified in the international Hg emissions; these include biofuel production and combustion, vinyl-chloride monomer production, secondary metals production and ferro-alloys, oil and gas extraction, transport and processing other than refinery emissions, industrial/some hazardous waste incineration and disposal sewage sludge incineration, preparation of dental amalgam fillings and disposal of removed fillings containing Hg.

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

The releases to water indicators only reflect the releases reported by facilities to the NPRI. They do not estimate or include potential releases from other sources in Canada.

6 References and further reading

6.1 References

Environment Canada (2014) Air Pollutant Emissions Summaries and Trends. Retrieved in March, 2014. Available from: http://www.ec.gc.ca/inrp-npri/donnees-data/ap/index.cfm?lang=En.

Environment Canada (2014) Guide for Using and Interpreting National Pollutant Release Inventory (NPRI) Data. Retrieved in March, 2014. Available from: http://ec.gc.ca/inrp-npri/default.asp?lang=En&n=B5C1EAB8-1.

Environment Canada (2014) National Pollutant Release Inventory – 2012 Data and Trends. Retrieved in March, 2014. Available from: http://ec.gc.ca/inrp-npri/default.asp?lang=En&n=C0B6019F-1.

Environment Canada (2014) National Pollutant Release Inventory – Database. October 11 2013 version. Retrieved in March, 2014. Available from: http://ec.gc.ca/inrp-npri/default.asp?lang=en&n=0EC58C98-#Facility.

Environment Canada (2014) National Pollutant Release Inventory - Pollution Data and Reports. Retrieved in March, 2014. Available from: http://ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1.

United Nations (2013) Global Mercury Assessment 2013: Sources, emissions, releases and environmental transport. Retrieved in April, 2013. Available from: http://www.unep.org/publications/contents/pub_details_search.asp?ID=6282.

www.ec.gc.ca

Additional information can be obtained at:
Environment Canada
Inquiry Centre
10 Wellington Street, 23rd Floor
Gatineau, QC K1A 0H3
Telephone: 1-800-668-6767 (in Canada only) or 819-997-2800
Fax: 819-994-1412
TTY: 819-994-0736
Email: Enviroinfo@ec.gc.ca