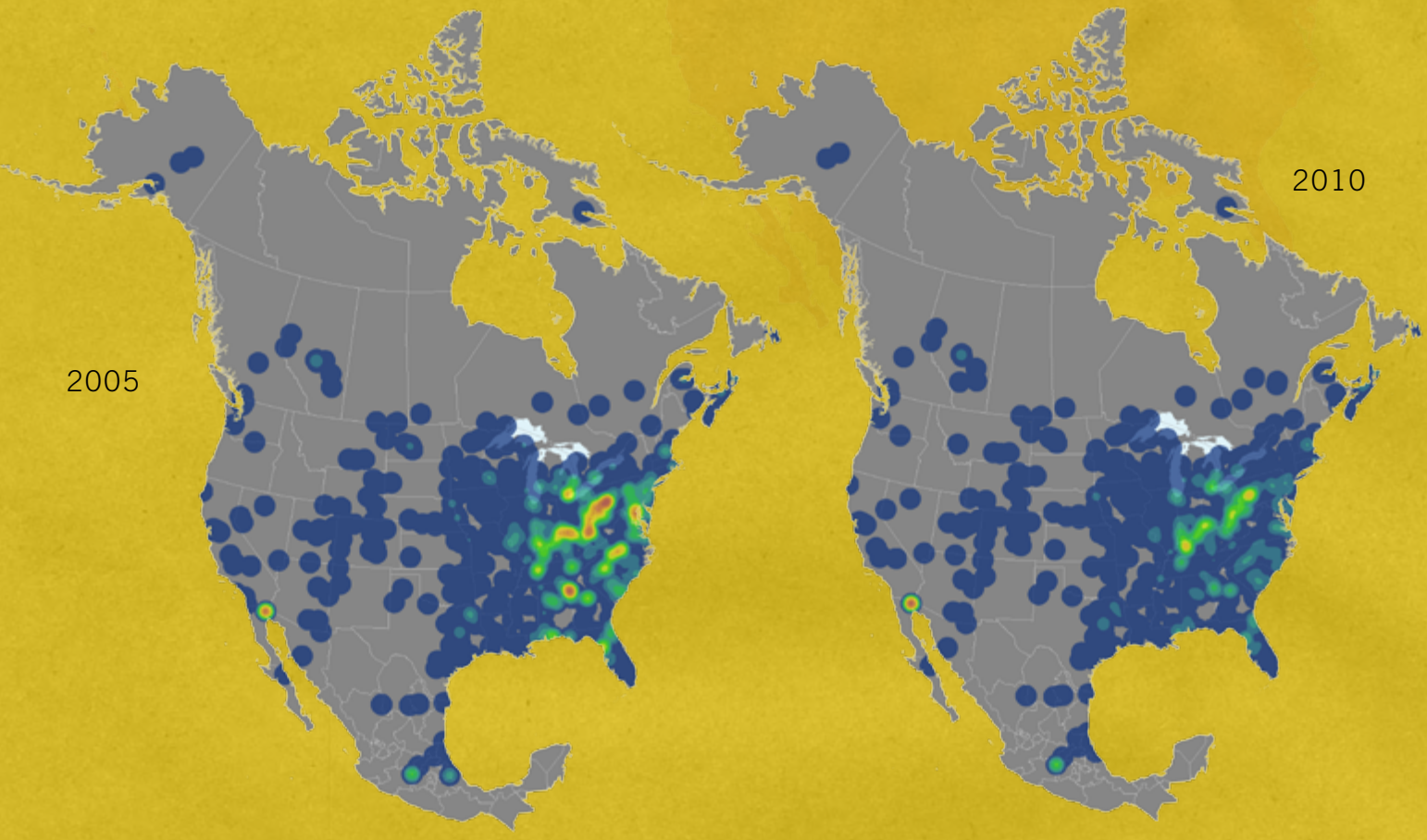
Taking Stock | North American Pollutant Releases and Transfers

14

Exploring Changes in PRTR Reporting, **2005–2010**



With a Focus on Releases to Air and Water from Pulp, Paper and Paperboard Mills

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Disclaimer

The national PRTR systems are constantly evolving, as facilities revise previous submissions to correct reporting errors or make other changes. For this reason, the three countries 'lock' their data sets on a specific date and use the 'locked' data for annual summary reports. Each year, the countries issue revised databases that cover all reporting years. The Commission for Environmental Cooperation (CEC) follows a similar process. For the purposes of this report, the Canadian NPRI and US TRI datasets of March 2012 and the Mexican RETC dataset of October 2012 were used. The CEC is aware that changes have occurred to the datasets, subsequent to the official release, that are not reflected in this report. Readers can visit the national PRTR websites to see if any changes to the data have occurred. This publication was prepared by the Secretariat of the CEC. The views contained herein do not necessarily reflect the views of the governments of Canada, Mexico, or the United States of America. Reproduction of this document in whole or in part and in any form for educational or nonprofit purposes may be made without special permission from the CEC Secretariat, provided acknowledgement of the source is made. The CEC would appreciate receiving a copy of any publication or material that uses this document as a source.

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14

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Table of Contents

Figures

Tables

Preface

As we celebrate the 20th anniversary of the North American Free Trade Agreement (NAFTA) and the North American Agreement on Environmental Cooperation (NAAEC), it gives me great pleasure to present a special edition of the *Taking Stock* report, a flagship series of the Commission for Environmental Cooperation (CEC) whose development has mirrored the growth of trilateral collaboration on North American environmental issues.

This particular report marks a significant achievement for the CEC, but more importantly, it represents a milestone for North American pollutant release and transfer register (PRTR) reporting. Much progress has been made under the CEC's North American PRTR Project since the first report, published in 1994—including the establishment of a mandatory PRTR in Mexico, collaboration on data quality, completeness and access issues, increased stakeholder engagement, and the achievement of comparable data publication schedules. This progress has made it possible for *Taking Stock* to present, for the first time, a detailed examination of the changes in pollutant releases and transfers reported over a six-year period by industrial facilities in North America—covering more than 500 pollutants and approximately 35,000 facilities in over 200 industrial sectors across the region.

This year's report also presents a special focus on releases to air and water reported between 2005 and 2010 by North American pulp, paper and paperboard mills. An examination of PRTR data from this important North American industrial sector reveals that reported releases to air and water have decreased. Through insights obtained from a survey of mills in the three countries and from industry representatives, *Taking Stock* is able to offer information about the possible drivers of these decreases and about environmental sustainability efforts within the sector.

The report also explores reported releases of pollutants considered to be of special concern because of their significant potential to cause harm to human health or the environment. Many of these pollutants have the potential to cause cancer, developmental or reproductive toxicity, and so on; however, of the hundreds of pollutants reported across the region, only a small subset are covered by the three PRTR programs. The *Taking Stock* report sheds light on the gaps in our picture of North American industrial pollution resulting from national differences in PRTR reporting requirements and other factors, and points to actions that can be taken to enhance data comparability—actions that are currently the focus of trinational collaboration under the CEC's Action Plan to Enhance the Comparability of PRTRs in North America. This ongoing effort is an essential step towards improving our understanding about North American industrial pollution and how to address it.

As an important complement to the report, we continue to enhance public access to PRTR information through the *Taking Stock Online* website and searchable database, allowing users to explore and visualize different aspects of the data. *Taking Stock Online* supports the CEC's objective of providing optimal access to North American PRTR data and additional context to enable readers to better interpret the information, thereby improving the utility of the data. These and other initiatives, such as the public meeting of the North American PRTR Project, seek to engage all stakeholders and to promote increased dialogue and collaboration across borders and industrial sectors.

Through *Taking Stock*, the CEC strives to provide information for decision-making at all levels of society, promote reductions in industrial pollution, and support the integration of PRTR data into an overarching framework for managing pollutants in North America. *Taking Stock* thus remains a cornerstone of the CEC's efforts to protect human health and enhance environmental sustainability across North America. We welcome your suggestions on how *Taking Stock* and the North American PRTR Project can evolve in order to achieve this goal.

Irasema Coronado, Ph.D.
Executive Director

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This report was made possible by the efforts of members of the Commission for Environmental Cooperation (CEC) Secretariat and, in particular, the Air Quality and Pollutant Releases Program team of Orlando Cabrera-Rivera, Program Manager; Danielle Vallée, Project Coordinator; Marilou Nichols, Program Assistant; and Zakir Jafry, resident GIS and mapping specialist. The publications staff of Douglas Kirk, Jacqueline Fortson, Johanne David and Joanne Padulo carried out the demanding job of editing, translating and publishing the report in three languages. Catherine Hallmich, Project Coordinator for the Healthy Communities and Ecosystems Program, and Lucie Robidoux, Project Coordinator for the Sound Management of Chemicals Program, also played a role in reviewing certain portions of the report. The graphic design of this report was done by Gray Fraser.

The CEC also wishes to recognize the valuable contributions of the following individuals who worked in a consulting capacity on the development of the pulp and paper facility survey, including the design and preparation of the survey questionnaire, contacts with facilities, and analyses of survey results: from Washington State University, Dr. Mark Stephan, Associate Professor, and Lynn Finley; from Western Washington University, Ben Kane, and in a supervisory capacity, Dr. Troy Abel, Associate Professor; and in Mexico, Dr. Luisa Manzanares Papayanopoulos and Dr. Arturo Keer Rendón. The CEC wishes to thank the individuals from the North American facilities who generously gave of their time to respond to our survey.

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And finally, the CEC wishes to recognize the invaluable support provided by Pangaea Information Technologies, Ltd, along with the CEC's IT (information technology) staff, who were instrumental in the development of the *Taking Stock Online* website, <www.cec.org/takingstock/>. In the spirit of right-to-know, this integrated and searchable North American PRTR database provides access to valuable information that enables governments, individuals, NGOs and communities to act in an informed manner to protect our shared environment. The enhanced access to these data greatly facilitated the task of preparing the analyses for this report.

Abbreviations and Acronyms

AOX	Adsorbable Organic Halogens
ATSDR	Agency for Toxic Substances and Disease Registry (US)
BOD	biological oxygen demand
CAC	criteria air contaminant
CAS	Chemical Abstracts Service
CEA	Canadian Energy Association
CEC	Commission for Environmental Cooperation
CFE	*Comisión Federal de Electricidad* (Federal Electricity Commission [Mexico])
EC	Environment Canada
FPAC	Forest Products Association of Canada
GHG	greenhouse gas
IARC	International Agency for Research on Cancer
kg	kilogram
NAICS	North American Industry Classification System
NCASI	National Council for Air and Stream Improvement, Inc.
NGO	nongovernmental organization
NOM	*Norma Oficial Mexicana* (Mexican Official Standard)
NPRI	National Pollutant Release Inventory (Canada's PRTR)
PBT	persistent, bioaccumulative and toxic substance
POTW	publicly owned treatment works (US public water and wastewater treatment facilities)
Prop 65	California's Office of Environmental Health Hazard Assessment (OEHHA) *Proposition 65* list
PRTR	pollutant release and transfer register
RETC	*Registro de Emisiones y Transferencia de Contaminantes* (Mexico's PRTR)
Semarnat	*Secretaría de Medio Ambiente y Recursos Naturales* (Secretariat for the Environment and Natural Resources [Mexico])
TEP	toxicity equivalency potential
TRI	Toxics Release Inventory (US PRTR)
TRS	total reduced sulfur
US EPA	United States Environmental Protection Agency

Abstract

This edition of the *Taking Stock* report examines the data on pollutant releases and transfers reported by industrial facilities from 2005 through 2010 to the three pollutant release and transfer registers (PRTRs) of North America: Canada's National Pollutant Release Inventory (NPRI); Mexico's *Registro de Emisiones y Transferencia de Contaminantes* (RETC); and the US Toxics Release Inventory (TRI). It provides details about specific pollutants, how they were managed, and the sectors and facilities reporting them over time and across North America. This year's edition places additional emphasis on reported releases to air and water, particularly of those substances considered to be of special concern because of their significant potential to cause harm to human health or the environment.

The report also presents a special focus on releases to air and water reported by North American pulp, paper and paperboard mills. From 2005 through 2010, this industry consistently ranked among the top sectors in North America, but PRTR data show decreases over time in its releases to air and water. Through analyses of these data and related information, a small survey of pulp and paper mills, and feedback from North American pulp and paper industry associations, the report explores the possible drivers of these decreases and offers additional insights about the environmental sustainability efforts within the sector.

Taking Stock seeks to enhance the understanding of the sources, locations and types of pollutant releases and transfers across North America. It also promotes greater comparability of PRTR data among the three countries, and increased dialogue and collaboration across borders and industrial sectors. Through these efforts, the report furthers the goals of the CEC to provide information for decision-making at all levels of society, promote reductions in industrial pollution, and support the integration of PRTR data into an overarching framework for managing pollutants in North America.

Zakir Jafry

This edition of *Taking Stock* examines the data on pollutant releases and transfers reported by North American industrial facilities from 2005 through 2010 to their respective pollutant release and transfer registers (PRTRs), namely:

- Canada's National Pollutant Release Inventory (NPRI);
- Mexico's *Registro de Emisiones y Transferencia de Contaminantes* (RETC);
- the US Toxics Release Inventory (TRI).

Taking Stock 14 shows that over this six-year period, reported releases and transfers increased by 14 percent (from over 4.83 billion kilograms to more than 5.53 billion kilograms). Releases to land increased by 108 percent, while off-site releases to disposal increased by 42 percent. These increases were driven primarily by the metal ore mining and oil and gas extraction sectors, with changes in Canadian NPRI reporting requirements playing a key role. Over this same period, reported releases to air decreased by 36 percent, largely due to reductions by the US electricity generation sector. Changes in regulations for fossil fuel–based power plants were a main driver, but factors such as changes in fuels and technologies, as well as facility closures, also played a role. Other reported releases and transfers declined between 2005 and 2010.

However, there were important differences among the three countries in terms of total reported releases and transfers; the number of reporting facilities and pollutants; and the direction of changes over this period. For example, an analysis of reported releases to air and water of substances of special concern—including known or suspected carcinogens; developmental or reproductive toxicants; persistent, bioaccumulative and toxic (PBT) substances; and certain metals—reveals that in 2010, approximately 74.4 million kilograms of such pollutants were released to air and more than 7.34 million kilograms were released to water (representing decreases of 38 percent and 5 percent, respectively, from 2005 levels). However, of the hundreds of reported pollutants, only a small number are common to the three PRTR programs. The report thus illustrates the gaps in the North American picture of industrial pollution created by varying national PRTR reporting requirements for pollutants and sectors, incomplete reporting, and other factors.

This report also presents a special focus on releases to air and water reported by North American pulp, paper and paperboard mills. From 2005 through 2010 this industry consistently ranked among the top reporting sectors in North America. Through analyses of PRTR data, a survey of pulp and paper mills, and insights from pulp and paper industry associations, the report explores the possible drivers of decreases in releases to air and water (of 19 percent and 6 percent, respectively) from this sector.

It reveals that in Canada and the United States (the countries accounting for the largest proportions reported by this sector), the total number of reporting facilities decreased, largely due to the shutdown of manufacturing operations. The report also illustrates how differences among the three countries' PRTR reporting requirements had an impact on the amounts and types of pollutants reported—including certain pollutants that are typical of this sector, such as methanol, that were reported in large proportions in only one or two of the three countries. These gaps were especially evident in Mexico, where mills reported relatively small proportions of total releases to air and water.

The results of the CEC's survey of North American pulp and paper mills reveal that more than one factor accounted for changes implemented by these facilities between 2005 and 2010; factors included changing government regulations and environmental management practices, economic considerations, PRTR data estimations, and production levels. The survey also yields information about how mills use their PRTR data—for example, to comply with facility permitting requirements, and in external communications with the public. A number of mills also noted that customer demand for non-toxic inputs played a role in the facilities' environmental management decisions; this suggests that PRTR data have impacts that go beyond compliance with reporting requirements, and that they are a useful tool not only for industrial facilities, but for external stakeholders as well.

Through these analyses, the report seeks to enhance the understanding of the sources, locations and types of pollutant releases and transfers over time, and across the region. By highlighting important gaps in the North American picture of industrial pollution, *Taking Stock* promotes greater comparability of PRTR data among the three countries, and increased dialogue and collaboration across borders and industrial sectors. In this way, the report furthers the goals of the CEC to provide information for decision-making at all levels of society, promote reductions in industrial pollution, and support the integration of PRTR data into an overarching framework for managing pollutants in North America.

Introduction

This edition of the *Taking Stock* report examines changes in the releases and transfers reported by industrial facilities to the three pollutant release and transfer registers (PRTRs) of North America from 2005 through 2010.[1] It provides details of reporting by pollutant, release and transfer category, and location. This year's edition places additional emphasis on reported releases to air and water of four categories of pollutants: known or suspected carcinogens; developmental or reproductive toxicants; metals; and persistent, bioaccumulative and toxic substances (PBTs). Some of the pollutants in these categories are considered to be of special concern because of their persistence in the environment and/or significant potential to cause harm to human health or the environment, even when released in relatively small amounts.

This report also presents a special focus on reported releases to air and water from North American pulp, paper and paperboard mills. From 2005 through 2010, this industry consistently ranked among the top sectors in North America; however, PRTR data for this sector also show decreases over time in reported releases to air and water. A key objective of this feature analysis is to identify the drivers of these decreases. Chapter 3 provides information about the sector, including pulp and papermaking processes and the pollutants typically associated with them; pollution prevention and control technologies in the sector; and the changing situation with regard to environmental regulations. Results from a survey of pulp and paper mills are presented, as are insights from pulp and paper industry associations, which add invaluable context about the economic, technical and environmental challenges facing this sector in North America.

Through these analyses, *Taking Stock* sheds light on questions about industrial pollution in North America; for example:

- How have pollutant releases and transfers changed over time and across the region?
- What are the potential impacts on human health and the environment of these industrial pollutants and especially, of certain substances released directly to the environment?
- What were the drivers of the reported changes?
- What can we learn about industrial efforts towards environmental sustainability?

Taking Stock seeks to enhance the understanding of the sources, locations and types of pollutant releases and transfers across North America, in order to promote reductions in releases of pollutants with the greatest potential risk to human health and the environment. It is based primarily on publicly available data reported to the three national pollutant release and transfer registers (PRTRs) of North America:

- Canada's National Pollutant Release Inventory (NPRI);
- Mexico's *Registro de Emisiones y Transferencia de Contaminantes* (RETC);
- the US Toxics Release Inventory (TRI).

Comparing pollutant releases and transfers from North American facilities presents challenges, due to differences among the three countries in PRTR reporting requirements for pollutants, sectors and facilities; variations in emission estimation methodologies; and other issues of data quality and completeness. However, this report demonstrates the usefulness of PRTR data for enhancing our understanding of industrial pollution in North America and the potential impacts on human health and the environment. Analyses of releases of specific pollutants also support the development of sector-specific baseline data and related pollution prevention and reduction activities.

This publication supports the goal of the Commission for Environmental Cooperation (CEC) to provide information for decision-making at all levels of society. Specifically, *Taking Stock* aims to:

- provide a picture of the industrial releases and transfers of pollutants in North America and serve as an information source for governments, industry and communities in analyzing such data and identifying opportunities to reduce pollution;
- promote greater comparability of PRTR data among the three countries;
- raise awareness of the important health and environmental issues associated with industrial releases of toxic substances in North America;
- increase dialogue and collaboration across borders and industrial sectors; and

1. Because facilities can submit revisions to their data at any point, the data presented in the *Taking Stock* report might differ from national datasets. For this report, the Canadian NPRI and US TRI datasets of March 2012 and the Mexican RETC dataset of October 2012 were used. Readers can visit the national websites to view changes to data.

- support the integration of PRTR data into an overarching framework for managing pollutants in North America.

It is important to remember that North American PRTR data represent only part of the pollution picture and do not cover other sources of pollution such as motor vehicles, agricultural practices, and other human activities (see Appendix 1). When exploring PRTR data, readers should keep in mind that the risks to human health and the environment associated with releases of pollutants reported by industrial facilities depend on a variety of factors, including a pollutant's physical and chemical characteristics, the nature of its release, and so on. North American PRTR data are limited in that they do not provide information on the *environmental fate of or risks* from the pollutants released or transferred, nor *levels of exposure* of human or ecological populations to the pollutants. In addition, the amounts reported to a PRTR are usually based on estimates, which are often derived from different methods, including mass balance, engineering calculations, and emission factors. Each of these approaches results in varying levels of accuracy.

Thus, PRTR data alone cannot provide enough information to assess the potential harm from a pollutant; however, the data, in combination with other information about a pollutant, can serve as a starting point for learning more about its potential impacts. Readers may wish to consult other sources for more information, including:

- ToxFAQs, from the US Agency for Toxic Substances and Disease Registry, <www.atsdr.cdc.gov/toxfaqs/index.asp>; and
- *Right-to-Know Hazardous Substances Fact Sheets*, from the State of New Jersey's Department of Health, <http://web.doh.state.nj.us/rtkhsfs/indexFs.aspx>.

Because of the large amount of data involved, readers are encouraged to visit the *Taking Stock Online* integrated, North American PRTR database, at <**www.cec.org/takingstock**>, to search the data by facility, industry sector, pollutant, or location. Data reported in the three countries from 2005 through 2011 can be explored. Cross-border transfer data, starting with the 2006 reporting year, are also accessible through the database. The data can be downloaded for use in spreadsheets or formatted for certain mapping applications. A guide to making queries follows herein.

What Is a Pollutant Release and Transfer Register?

PRTRs provide annual data on the amounts of pollutants released from a facility to the air, water and land and injected underground, as well as transferred off-site for recycling, treatment or disposal. PRTRs are an innovative tool that can be used for a variety of purposes—that is, they track certain chemicals, thereby helping industry, governments and citizens identify ways to reduce the release and transfer of these substances, increase responsibility for chemical use, prevent pollution and cut back on waste generation.

Corporations use the data to report on their environmental performance and to identify opportunities for reducing or preventing pollution. Governments use the data to guide program priorities and evaluate results. And communities, nongovernmental organizations and citizens use the data to gain an understanding of the sources and management of pollutants and to support dialogue with facilities and governments.

PRTRs collect data on individual pollutants rather than on the volume of waste streams containing mixtures of substances, because this approach allows the tracking of releases and transfers of specific substances. Reporting by facility is central to locating where releases occur and who or what generated them. Much of the power of a PRTR lies in public disclosure of the data and their dissemination in both raw and summarized form to a wide range of users. The public availability of pollutant- and facility-specific data allows interested persons and groups to identify local industrial sources of releases and support regional and other geographically-based analyses.

Using *Taking Stock Online*

In addition to the analyses found in this report, you can use the integrated, North American PRTR database on *Taking Stock Online*, **www.cec.org/takingstock**, to answer your questions about pollutant releases and transfers by year, facility, location, pollutant, or industry sector. For instance:

Do you want to know the total amount of releases and transfers reported by country?

Step 1: Under "Report Type," select "country"
Step 2: Under "Year," select one or more years
Step 3: Under "Country," select one or more country
Step 4: Click on "Submit"

Note: On this page, you also have the option of selecting a pollutant or category of pollutants, a specific industry sector, and a type of release or transfer.

Once on the Results Page, click on the country total to get a breakdown of total releases and transfers by facility, industry sector, and pollutant. You have the following options:

- Select the medium of release or transfer type from the media buttons (the default is "Total Releases and Transfers")
- Ungroup your results by pollutant or industry sector
- Sort the data in order of decreasing amounts reported
- View the facility locations on the map inset
- Download the data from this page in an Excel spreadsheet, or as a .kml or .kmz file to be displayed in Google Earth

Do you want to know which pollutants were released to air, water or land, and in what amounts?

Step 1: Under "Report Type," select "pollutant"
Step 2: Under "Year," select one or more years
Step 3: Under "Country," select one or more country (and one or more state, province or territory, if desired)
Step 4: Click on "Submit"

Note: On this page, you also have the option of selecting a category of pollutant (e.g., "known or suspected carcinogens"), or only those pollutants that are common to the countries selected. You can also select a specific industry sector and the type of release or transfer.

Once on the Results Page, you have the following options:

- Click the media button (e.g., air) to see all pollutants released to that medium
- For releases to air or water only, you can also check the "TEP score" box to obtain calculated risk scores for cancer and non-cancer effects (e.g., developmental or reproductive toxicity)
- Sort the data in order of decreasing amounts reported, or by TEP score
- Click on a pollutant name to get a breakdown of reported releases to that medium by facility, state/province/territory, and industry sector
- View the facility location on the map inset
- Download the data from this page in an Excel spreadsheet, or as a .kml or .kmz file to be displayed in Google Earth

Other sample queries that may be of interest:

- Do a Facility search for one or more countries, then export the query results as kml or kmz file, to map in Google Earth
- Use the "Summary Charts" tab in the side bar to get an overview of reporting in one or more countries by top pollutants or sectors
- Use the "Cross-border Transfers" tab in the side bar to see details of the pollutant transfers among the three countries.

Chapter 1

Overview of North American Pollutant Releases and Transfers, 2005–2010

1.1 Key Findings

- From 2005 through 2010, releases and transfers reported by North American industrial facilities increased by 14 percent (from over 4.83 billion kilograms to more than 5.53 billion kilograms).

- Reported releases to land and off-site disposal increased over this period by 108 percent and 42 percent, respectively (with releases to land accounting for over 32 percent of total releases and transfers in 2010, and off-site disposal for about 17 percent). These increases were driven primarily by two sectors, metal ore mining and oil and gas extraction. Changes in NPRI reporting requirements during this 6-year period affected the increases in reporting from these sectors in Canada, and illustrate the impacts of improved accounting within industry.

- Reported releases to air decreased by 36 percent from 2005 through 2010, particularly from the electricity generation sector in the United States. Changes in regulations for fossil fuel–generated power plants were a main driver of this decrease; however, other factors such as changes in fuels and technologies, as well as facility closures, also played a role. Other types of releases and transfers, including releases to water and underground injection, and transfers to recycling and other treatment, saw decreases from 2005 through 2010.

- There were important differences among the three countries in the reported amounts and the direction of changes over this period, due in part to key differences in national PRTR reporting requirements for pollutants and sectors. The data also reveal that a small number of facilities played a major role in some of the increases or decreases between 2005 and 2010.

- Apparent changes in reported releases from certain facilities in the oil and gas extraction sector in Canada were the result of reassignments in industry classification codes, and possible double-counting of two related substances—total reduced sulfur compounds and hydrogen sulfide.

- In 2010, reported releases and transfers of four categories of pollutants (known or suspected carcinogens; developmental or reproductive toxicants; metals; and PBTs) accounted for just over 3 billion kilograms (or more than 55 percent) of all pollutants reported. About 74.4 million kilograms were released to air (a decrease of about 38 percent from 2005); and more than 7.34 million kilograms were released to water (a decrease of about 5 percent from 2005). Of the 275 pollutants in these categories that were released to air and water throughout this period, only 42 are common to the three PRTR programs.

- Among all sectors reporting to the PRTRs of North America between 2005 and 2010, pulp, paper and paperboard mills consistently ranked second for releases to air, and third for releases to water. Facilities in this sector reported more than 92.6 million kilograms in releases to air in 2005, and about 75 million kilograms in 2010 (a decrease of 19 percent). They also reported releases to water of about 16.6 million kilograms in 2005, with these releases declining to about 15.7 million kilograms in 2010 (a decrease of 6 percent).

- Of over 500 active mills in North America, between 352 and 429 reported to the North American PRTRs each year, from 2005 through 2010. In Canada and the United States, the countries accounting for the largest proportions reported by this sector, the total number of reporting facilities decreased, largely due to the shutdown of manufacturing operations. This decrease played a key role in the reductions in releases to air and water reported over this period. In Mexico, the number of reporting mills increased.

- Differences among national PRTR reporting requirements for pollutants, as well as incomplete reporting, had an impact on the amounts and types of pollutants reported released to air and water. For example, some of the typical pollutants for this sector, such as methanol, were often reported in only one country. These gaps were especially evident in Mexico, where mills reported very small proportions of total releases to air and water.

- The majority of respondents to the CEC's survey of mills mentioned more than one driver of the changes implemented at their facilities between 2005 and 2010. These included changes in government regulations, environmental management practices, economic considerations, corrections or changes in PRTR data estimations, and decreases in production. The survey also revealed that mills use their PRTR data for internal information about environmental performance, as well as to comply with facility permitting requirements.

- A number of mills noted that PRTR data are used in external communications with the public, with comments also indicating that customer demand plays a role in their environmental management decisions, such as the choice of chemicals used at their facilities. This suggests that PRTR data have wider impacts and that they are a useful tool not only for industrial facilities, but for external stakeholders as well.

Comparing PRTR data from Canada, the United States and Mexico

Taking Stock presents PRTR data from Canada, Mexico and the United States, thereby providing the most complete picture currently available of reported industrial releases and transfers of pollutants in North America. This picture includes data that might be reported differently in each country because of variations among national reporting requirements, as well as differences in the methods used by facilities to estimate their releases. The features unique to each PRTR are described in Appendix 1, and this information provides the context needed for a better understanding of the North American picture of pollutant releases and transfers.

1.2 Releases and Transfers Reported by North American Facilities, 2005–2010

In 2010, industrial facilities reporting to the pollutant release and transfer registers (PRTRs) of Canada, Mexico and the United States reported a total of 5,530,710,253 kilograms in pollutant releases and transfers, an increase of almost 700 million kilograms (or 14 percent) from 2005 levels.[2]

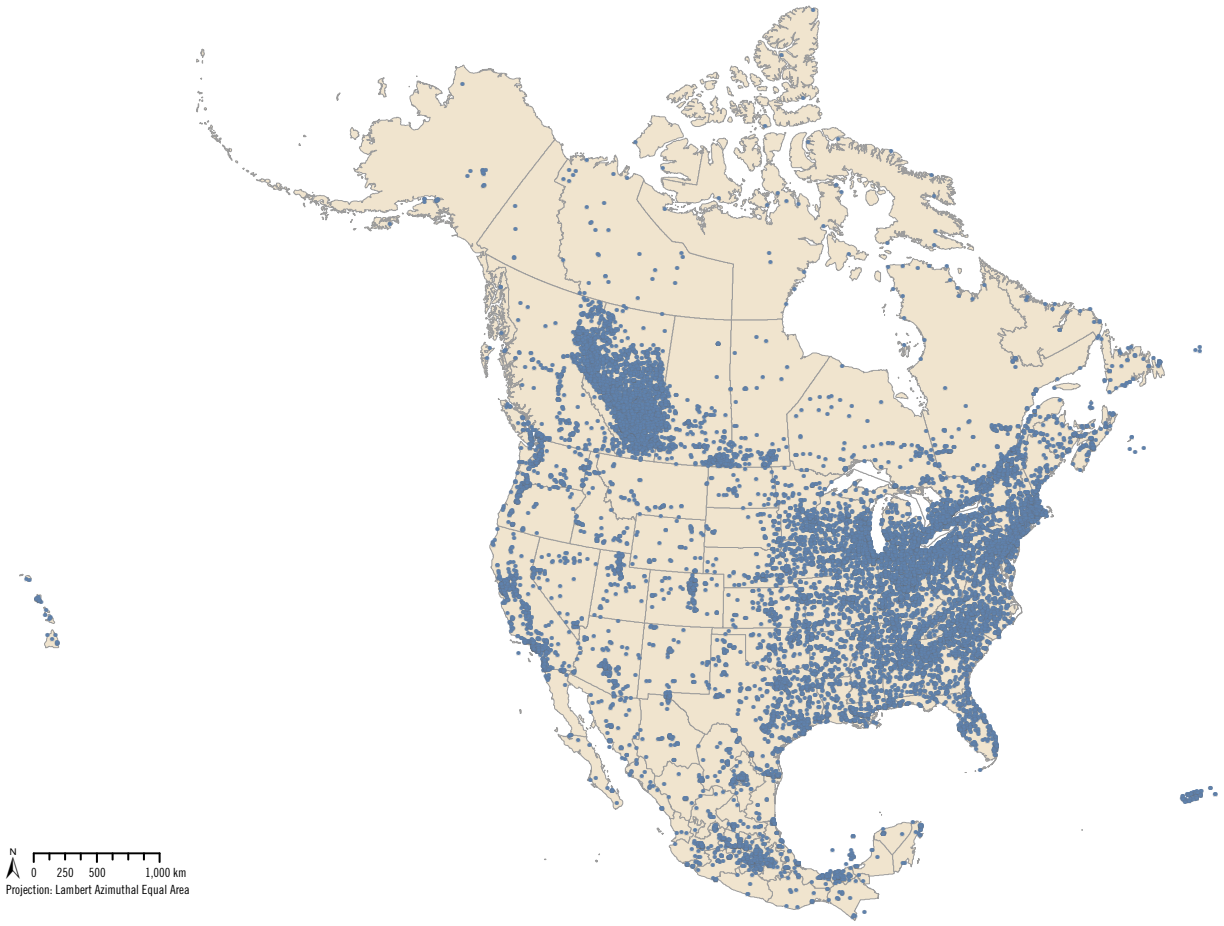
The following map shows the locations of the 28,456 facilities that reported releases and transfers of at least 0.0001 kilograms to the North American PRTRs in 2010. Among these facilities are 5,844 that reported releases of either criteria air contaminants (CACs) to Canada's NPRI, or greenhouse gases (GHGs) to Mexico's RETC, but no other PRTR pollutants. Because of major differences in the reporting and availability of data on CACs and GHGs in each country[3] these substances are excluded from *Taking Stock*.

The gaps created by differences among the three countries in PRTR reporting requirements for pollutants, sectors and facilities are the subject of ongoing work under the CEC's Action Plan to Enhance the Comparability of PRTRs in North America[4], which is in the process of being updated, with the revised plan expected to be published in 2014.

The stacked bars in Figure 2 illustrate the releases and transfers reported each year from 2005 through 2010, and the horizontal line represents the number of reporting facilities. There was an increase of 14 percent (or almost 700 million kilograms) in reported releases and transfers over this period. On-site releases (to air, water, land and underground injection) accounted for almost 2.9 billion kilograms (or 54 percent of the reported total), an increase of 24 percent from approximately 2.3 billion kilograms reported in 2005. There were notable increases in reported releases to land (108 percent) and off-site releases to disposal (42 percent), and a major decrease (of 36 percent) in reported releases to air. Reported releases to water and underground injection also declined, as did transfers to recycling and other off-site transfers.

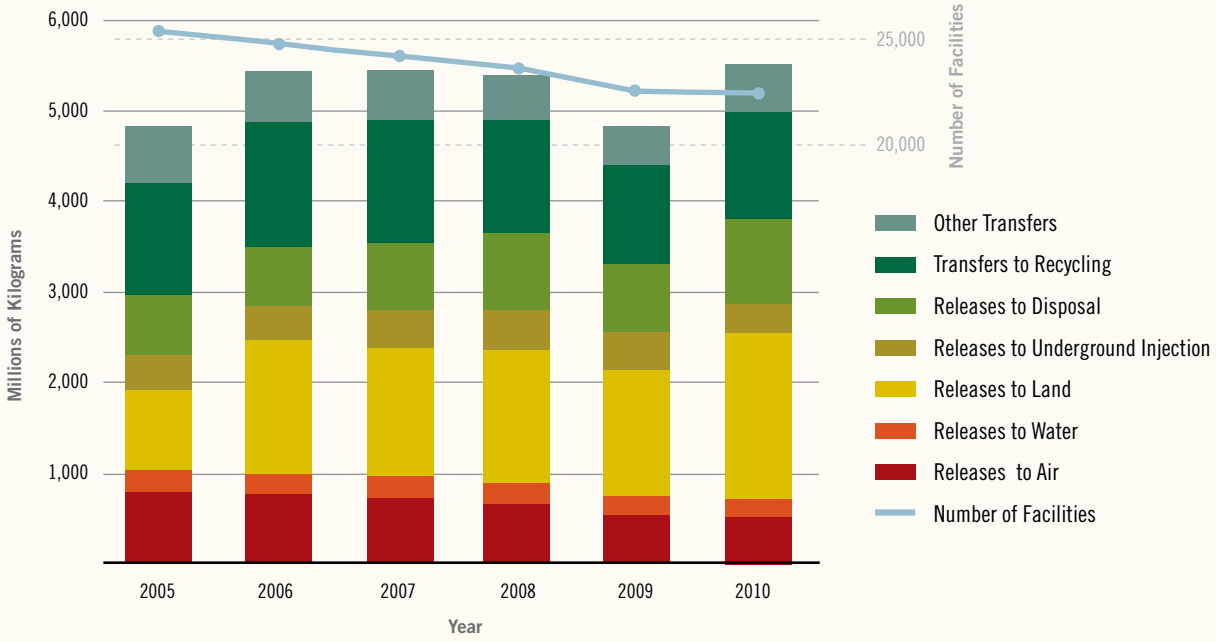
2. The amounts in the tables and figures presented in this report have been rounded.
3. For links to information on facility reporting of CACs and GHGs, see Appendix 1.
4. CEC. 2005. *Action Plan to Enhance the Comparability of Pollutant Release and Transfer Registers in North America*. Montreal, Canada: Commission for Environmental Cooperation.

Figure 1. Distribution of Facilities Reporting to the PRTRs of North America, 2010



Note: Among the Canadian and Mexican facilities shown on this map are 5,844 that reported releases only of criteria air contaminants or greenhouse gases, two pollutant groups that are excluded from the analyses in this report because of differences in national reporting requirements. Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

Figure 2. Releases and Transfers Reported to the North American PRTRs, 2005–2010



	Total Releases and Transfers (kg)	Releases to Air (kg)	Releases to Water (kg)	Releases to Underground Injection (kg)	Releases to Land (kg)	Releases to Disposal (kg)	Transfers to Recycling (kg)	All Other Transfers (kg)
2005	4,833,498,433	807,172,052	234,003,770	412,296,802	866,151,548	653,288,663	1,259,727,734	600,652,254
2010	5,530,710,253	514,173,851	221,806,836	340,822,984	1,802,531,538	930,493,737	1,182,757,774	536,970,141
Difference	697,211,821	-292,998,200	-12,196,935	-71,473,819	936,379,989	277,205,074	-76,969,961	-63,682,114
Change (%)	14	-36	-5	-17	108	42	-6	-11

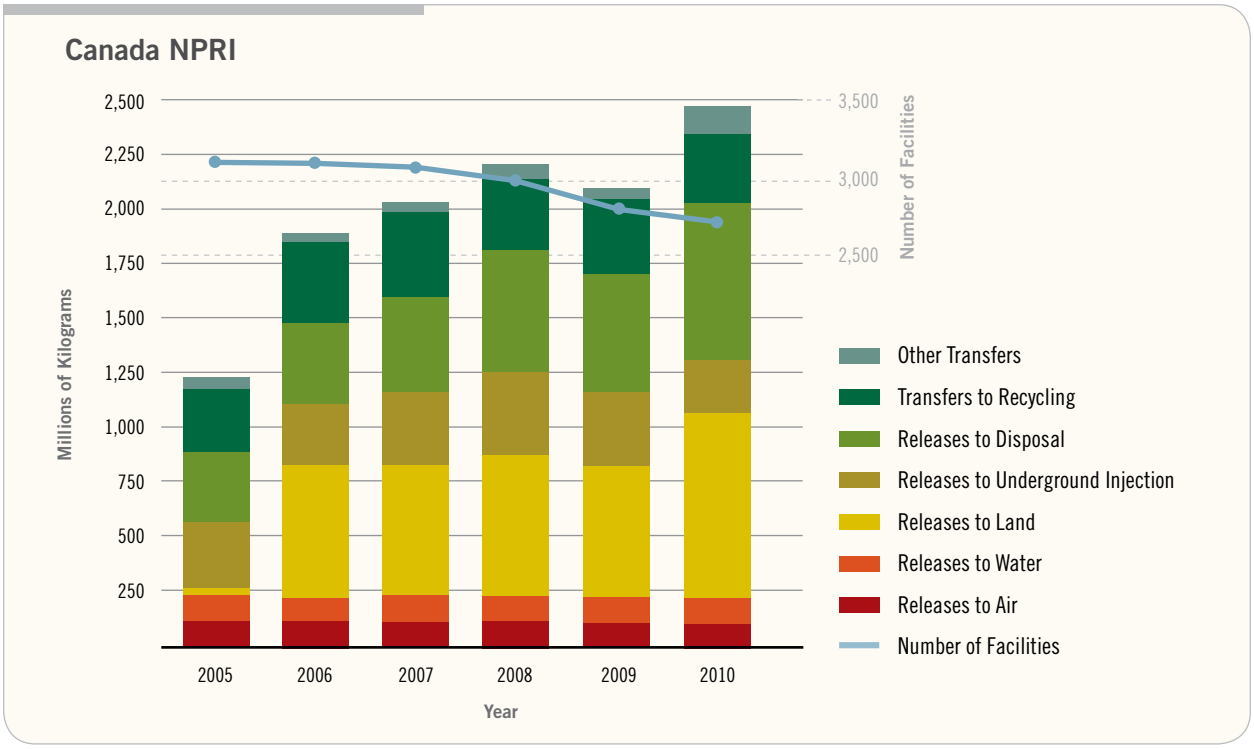
However, there were important differences among the three countries in the total amounts reported, how the pollutants were handled, and changes over time (see Figure 3). For instance, the increase in reported releases to land was primarily driven by facilities in Canada, largely due to changes in NPRI reporting requirements. In the United States, overall reported amounts declined from 2005 through 2010, but the relative proportions of releases and transfers each year remained fairly consistent (with the exception of releases to air, which decreased at a greater rate).

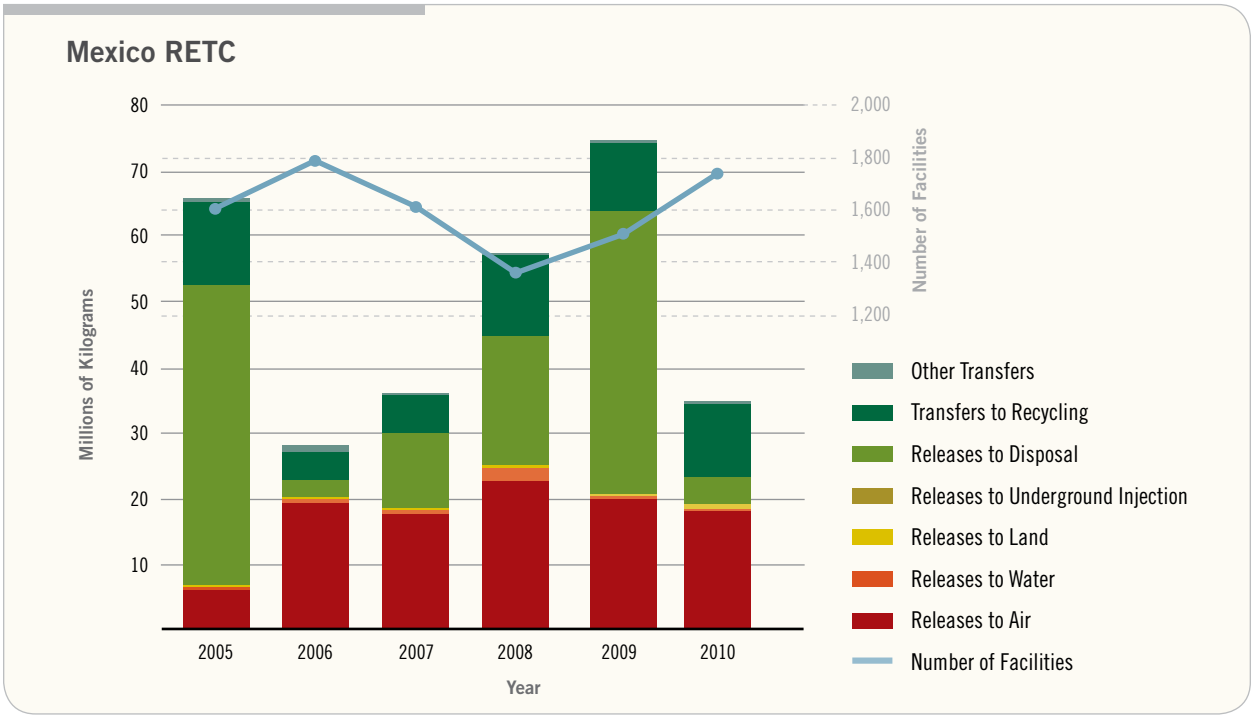
In Mexico, releases to air accounted for almost 53 percent of the reported country total in 2010. Meanwhile, offsite releases to disposal reported in that country fluctuated greatly over this period. The variability in reported releases and transfers in Mexico reflects fluctuations in the number of reporting facilities between 2005 and 2010 (see Table 1) and the fact that, similarly to the early years of PRTR reporting in Canada and the United States, there has been a steep learning curve for Mexico's RETC program. Factors including changes in facility identification, sector designations, and guidance relative to the reporting of substances have contributed to the variability in PRTR data for that country.

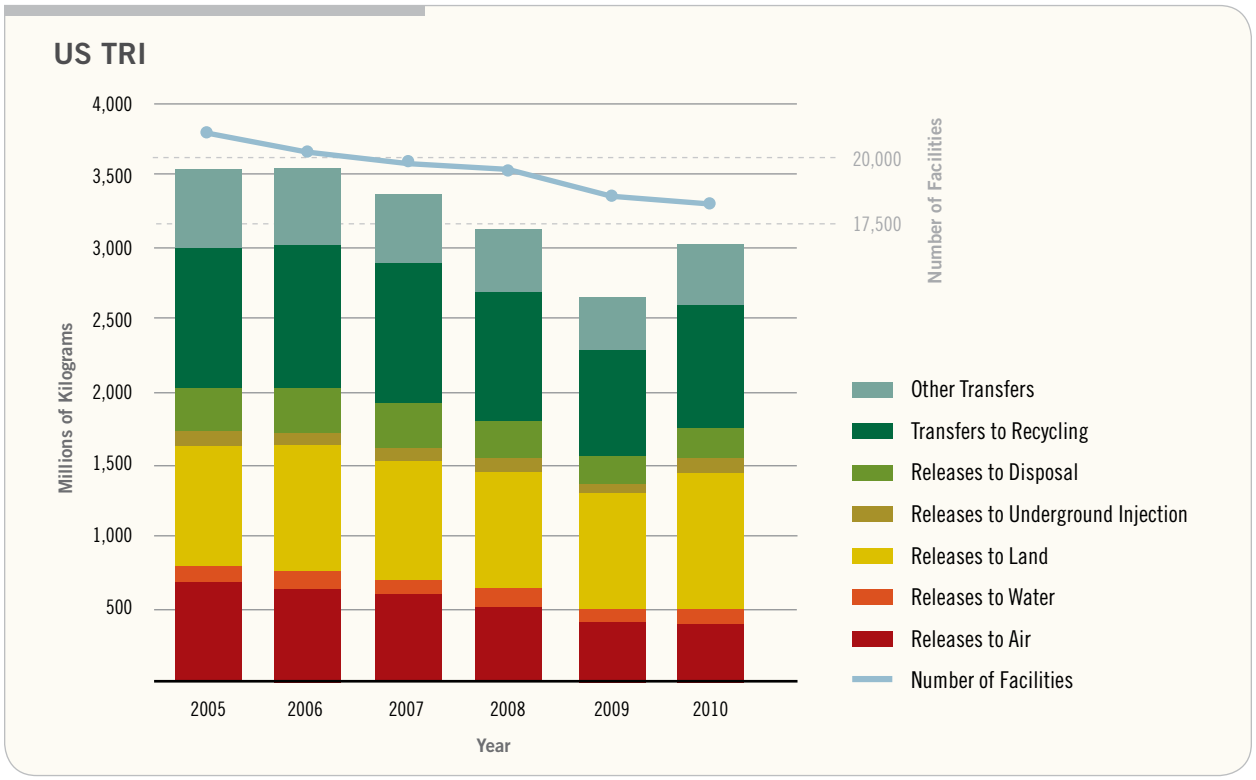
The data in Figure 3 also reflect differences among the three countries' PRTR reporting requirements. For example, releases to underground injection accounted for about 10 percent and 3 percent of Canadian and US reporting

in 2010, respectively; however, similar Mexican data are not available because underground injection is not subject to reporting under RETC. Readers are reminded that differences in national PRTR reporting requirements are an important factor to consider when interpreting the data in this report.

Figure 3. Releases and Transfers Reported in Canada, Mexico and the United States, 2005–2010







Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

Table 1. Overview of North American PRTR Data, 2005–2010

	Country	2005	2006	2007	2008	2009	2010	Difference 2005–2010	% Change 2005–2010
Total Releases and Transfers (kg)	Canada NPRI	1,228,841,372	1,891,885,324	2,028,051,891	2,203,986,243	2,091,768,875	2,474,610,253	1,245,768,881	101
	Mexico RETC	65,226,620	27,961,007	35,873,024	57,814,032	74,559,916	35,053,206	-30,173,414	-46
	US TRI	3,539,430,441	3,538,776,360	3,375,535,764	3,130,289,912	2,663,106,958	3,021,046,795	-518,383,646	-15
	North America	**4,833,498,433**	**5,458,622,690**	**5,439,460,679**	**5,392,090,187**	**4,829,435,749**	**5,530,710,253**	**697,211,821**	**14**
Number of Facilities Reporting	Canada NPRI	3,101	3,103	3,072	3,003	2,820	2,717	-384	-12
	Mexico RETC	1,608	1,790	1,621	1,359	1,521	1,736	128	8
	US TRI	20,810	20,141	19,743	19,480	18,403	18,159	-2,651	-13
	North America	**25,519**	**25,034**	**24,436**	**23,842**	**22,744**	**22,612**	**-2,907**	**-11**
Number of Pollutants Reported	Canada NPRI	182	189	202	196	194	191	9	5
	Mexico RETC	69	67	67	68	65	67	-2	-3
	US TRI	441	456	433	427	425	428	-13	-3
	North America	**484**	**503**	**491**	**486**	**483**	**486**	**2**	**0.4**

Note: The number of reporting facilities shown in this table includes those reporting total releases and transfers of at least 0.0001 kilograms, but excludes Canadian and Mexican facilities that reported only releases of criteria air contaminants (CACs) or greenhouse gases (GHGs). These two groups of pollutants are excluded from *Taking Stock* due to differences in national PRTR reporting requirements. Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

Table 1 provides a snapshot of PRTR reporting in each country from 2005 through 2010, including the number of reporting facilities, as well as the number of pollutants and total amounts reported each year. It shows that approximately 80 percent of all reporting facilities each year were located in the United States, which saw a decrease of 13 percent in the number of reporting facilities over time. This table also reveals an increase in total releases and transfers from 2005 through 2010 in Canada. As shown throughout this document, this increase occurred largely as a result of changes in NPRI reporting requirements.

1.3 Pollutants Reported to the North American PRTRs, 2005–2010

Table 2 presents the reported releases and transfers in 2005 and 2010, as well as the number of pollutants reported. It reveals some interesting contrasts—for example, the number of pollutants released to air in 2010 remained almost the same as in 2005, but total reported releases to air decreased by almost 300 million kilograms (36 percent) over this period. In terms of releases to land, facilities reported 33 fewer pollutants between 2005 and 2010, but reported amounts increased by 108 percent.

A number of the pollutants reported by North American industrial facilities are considered to be of special concern because of their persistence in the environment and/or their significant potential to cause harm to human health and the environment, even when released in relatively small quantities. Some of them belong to one or more of the following four categories of pollutants: *known or suspected carcinogens*; *developmental or reproductive toxicants*; *persistent, bioaccumulative and toxic substances (PBTs)*; and *metals*. Table 2 reveals that reported releases and transfers of such pollutants accounted for just over 3 billion kilograms (or more than 55 percent of total reported releases and transfers of all pollutants in 2010)—an increase from the 2.6 billion kilograms reported in 2005. This increase was mainly driven by reported releases to land.

While there was a small increase in the number of pollutants reported by North American facilities over this period, the number reported in each country varied considerably (see Table 1). The pollutants reported each year can change due to a number of reasons: for example, a facility's use or release of a pollutant in a given year might decrease to just below reporting thresholds; a change in PRTR reporting requirements might result in reporting of a pollutant for the first time; or new or revised emission estimation methodologies can yield more accurate reporting.

Differences among the three countries' PRTR reporting requirements for pollutants, sectors and facilities have significant impacts on the picture of industrial pollution obtained through PRTR data. For instance, of the hundreds of pollutants subject to PRTR reporting in North America, only 60 are common to the three countries. Approximately 350 pollutants[5] are subject to reporting under Canada's NPRI; 104 pollutants are subject to reporting under Mexico's RETC; and

Table 2. Pollutants Reported to the North American PRTRs, 2005–2010

Reported Releases and Transfers	All Pollutants				Known or Suspected Carcinogens, Developmental or Reproductive Toxicants, Metals, and PBTs*			
	2005		2010		2005		2010	
	Kg	# of Pollutants	Kg	# of Pollutants	Kg	# of Pollutants	Kg	# of Pollutants
Releases to Air	807,172,052	446	514,173,851	445	119,970,649	219	74,425,550	220
Releases to Water	234,003,770	276	221,806,836	247	7,756,161	142	7,347,276	130
Releases to Underground Injection	412,296,802	170	340,822,984	151	35,273,441	90	41,995,619	82
Releases to Land	866,151,548	245	1,802,531,538	212	844,883,772	139	1,522,069,757	116
Releases Off-site to Disposal	653,288,663	355	930,493,737	366	346,729,130	197	226,872,131	184
Transfers to Recycling	1,259,727,734	199	1,182,757,774	204	1,082,098,106	102	1,043,936,495	107
Other Transfers	600,652,254	413	536,970,141	402	165,133,480	206	158,026,744	201
Total Releases and Transfers**	**4,833,498,433**	**484**	**5,530,710,253**	**486**	**2,601,914,922**	**245**	**3,075,257,545**	**240**

* PBTs: Persistent, bioaccumulative and toxic substances. ** The sum of individual Reported Releases and Transfers categories might differ slightly from Total Releases and Transfers because in NPRI, On-site Releases of less than 1 tonne (1,000 kilograms) may be reported as an aggregate amount.
Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

5. "Pollutants" also refers to pollutant groupings (e.g., lead and its compounds).

about 650 pollutants are subject to the US TRI. In addition, each country has set certain reporting thresholds for pollutants, which can differ from the other countries' (see Appendices 1 and 2). The data presented in *Taking Stock* reflect these differences in national PRTR reporting requirements. In order to facilitate the reader's interpretation of the data in this report, the countries in which the mentioned pollutants are subject to reporting are indicated next to the pollutant names.

1.3.1 Changes in PRTR Reporting Requirements for Pollutants, 2005–2010

The national PRTR pollutant lists changed very little from 2005 through 2010, with the only modifications being to Canada's NPRI. Three polycyclic aromatic hydrocarbons (PAHs) were added to the list in 2006, and another nine were added in 2007. PAHs are organic substances that are formed from the incomplete combustion of hydrocarbons such as fossil fuels and organic matter. Canadian facilities must report if PAHs were incidentally manufactured or present in mine tailings and released, disposed of or transferred from a facility in a combined quantity of 50 kilograms or more (with certain exceptions). Facilities in a small number of sectors, including oil and gas extraction, basic chemical manufacturing, and iron and steel mill and ferroalloy manufacturing, reported relatively small releases and transfers of these PAHs in 2010. A number of PAHs are also subject to TRI reporting in the United States (where they are referred to as polycyclic aromatic compounds, or PACs).

In 2007, total reduced sulfur (TRS) was also added to the NPRI substance list. This change had a major impact on Canadian PRTR reporting, particularly from the oil and gas extraction sector (which accounted for 97 percent of total releases and transfers of this pollutant in 2010). TRS is subject to PRTR reporting in Canada, but not Mexico or the United States.[6] TRS represents the total amount, in a gaseous mixture, of compounds containing reduced sulfur, which are restricted on the NPRI list to the compounds hydrogen sulfide (which is found in the largest proportion), carbon disulfide, carbonyl sulfide, dimethyl sulfide, dimethyl disulfide, and methyl mercaptan. Three of these pollutants, hydrogen sulfide, carbon disulfide, and carbonyl sulfide, are also reported separately under NPRI. As shown throughout this report, the magnitude of reported releases and transfers of TRS compounds in Canada since 2007 provides a good example of the impacts of improved accounting within industry, and highlights gaps in the picture of North American industrial pollution created by differences in national PRTR reporting requirements.

1.3.2 Pollutants Released and Transferred in Largest Proportions, 2005–2010

Of the 567 substances reported by North American facilities over this period, the 10 shown in Table 3 accounted for 70 percent and 65 percent, respectively, of total reported releases and transfers in 2005 and 2010. In fact, the top 31 pollutants (see Appendix 3) accounted for 92 percent and 91 percent, respectively, of total reported releases and transfers in 2005 and 2010. These data thus provide a snapshot of the quantities and types of industrial pollutants needing to be managed by industrial facilities in North America.

It is important to note that of the substances presented in Table 3, the majority are subject to reporting under Canada's NPRI and the US TRI, with only lead (and its compounds) common to all three PRTR programs.

1.4 Industry Sectors Reporting to the North American PRTRs, 2005–2010

In 2010, North American facilities in 225 industry sectors reported to their respective PRTRs. These industry sectors are classified according to North American Industry Classification System (NAICS) codes, with six levels of detail available (e.g., code 325 for Chemical Manufacturing; 3251 for Basic Chemical Manufacturing; and 32511 for Petrochemical Manufacturing).[7]

However, as mentioned, there are differences among the three countries in the industrial sectors or activities subject to PRTR reporting, and these differences affect the North American picture of industrial pollution. In Canada, all sectors are subject to reporting, with exceptions for certain activities, such as research laboratories. In Mexico, 11 industry sectors under federal jurisdiction are subject to RETC reporting, as well as any facility that handles hazardous waste, or discharges pollutants to national water bodies (which means most water bodies in that country). For the mining sector, only beneficiation activities (i.e., extraction and refining of a mineral or metal from ore, but not the initial exploration and extraction of the ore) are subject to the RETC.

6. As of the 2012 reporting year, US facilities have to report their releases and transfers of hydrogen sulfide.
7. Throughout this report the NAICS-4 level is used, as it usually provides a sufficient level of detail about the industrial activities in question. In the United States, individual facilities can report up to five NAICS codes (with each code applying to a specific activity at the facility). The assignment of NAICS codes can vary from country to country. For more information, see: Statistics Canada. 2007. NAICS 2007, <www.statcan.gc.ca/subjects-sujets/standard-norme/naics-scian/2007/list-liste-eng.htm>. US Department of Commerce. 2007. US Census Bureau. NAICS 2007, <www.census.gov/cgi-bin/sssd/naics/naicsrch?chart=2007>. Instituto Nacional de Estadística y Geografía. 2007. SCIAN 2007. <www.inegi.org.mx/est/contenidos/espanol/metodologias/censos/scian2007_1.pdf>.

Table 3. Top Pollutants Reported to the North American PRTRs, 2005–2010

	Total Releases and Transfers			On-site Releases*		Off-site Releases to Disposal		Total Transfers**	
Pollutant	2005 (kg)	2010 (kg)	% Change 2005-2010	2010 (kg)	% Change 2005-2010	2010 (kg)	% Change 2005-2010	2010 (kg)	% Change 2005-2010
Zinc (and compounds) (CA, US)	641,233,326	728,410,100	14	359,657,700	32	78,427,592	-42	290,216,625	25
Hydrogen Sulfide (CA, MX)	549,418,432	632,563,242	15	152,867,297	-49	479,650,431	91	41,241	13
Lead (and compounds) (CA, MX, US)	454,007,439	467,277,324	3	278,044,395	37	16,424,428	-72	172,808,501	-10
Copper (and compounds) (CA, US)	423,077,058	414,654,953	-2	130,518,101	73	12,715,615	5	271,417,257	-19
Nitric acid/Nitrate compounds (CA, US)	282,522,125	261,770,018	-7	186,440,364	-2	6,194,076	-40	69,133,880	-15
Hydrochloric Acid (CA, US)	278,784,924	106,476,066	-62	100,709,277	-62	618,974	25	5,141,870	-61
Methanol (CA, US)	235,980,973	181,871,475	-23	82,718,244	-23	8,602,919	42	90,392,584	-26
Manganese (and compounds) (CA, US)	201,483,436	520,948,260	159	390,269,583	424	36,360,643	-16	94,295,640	13
Ammonia, Total (CA, US)	168,634,168	166,025,660	-2	146,010,710	-3	5,197,391	1	14,800,877	17
Sulfuric Acid (CA, US)	167,319,200	137,997,148	-18	61,167,004	-26	1,751,106	-80	75,047,148	0
Total, Top 10 Pollutants	**3,402,461,081**	**3,617,994,246**	**16**	**1,888,402,676**	**22**	**645,943,177**	**43**	**1,083,295,622**	**-8**
Total, All Pollutants	**4,833,498,433**	**5,530,710,253**	**14**	**2,879,335,208**	**24**	**930,493,737**	**42**	**1,719,727,915**	**-8**
%, Top Pollutants, of All Pollutants	**70**	**65**		**66**		**69**		**63**	

*Sum of On-site Releases to Air, Water, Land, and Underground Injection.
**Sum of Transfers to Recycling and Other Transfers.
Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

In the United States, some of the key industrial activities that are not subject to TRI reporting include:

- the oil and gas extraction sector,
- iron ore mining, and
- municipal- or state-owned water and sewage treatment facilities (called publicly-owned treatment works, or POTWs).

For additional information, see Appendix 1.

1.4.1 Changes in PRTR Reporting Requirements for Sectors, 2005–2010

Changes during this period in Canadian reporting requirements relative to certain industry sectors had an impact on the releases and transfers reported in that country. In 2006, NPRI removed a reporting exemption for mining extraction and crushing activities, resulting in the requirement for mining facilities to report their releases and transfers of many NPRI substances. Because of this change in reporting requirements, Canadian coal mines started reporting in 2006, with other types of mining facilities in that country also reporting additional releases and transfers. This change in NPRI reporting requirements thus resulted in improved accounting from mining activities in Canada.

There was another change to NPRI reporting requirements during this period. In 2009, NPRI introduced the requirement for mining facilities (including oil and gas extraction operations) to report their tailings and waste rock, retroactive to the 2006 reporting year. Tailings are the waste (such as sand, clay, water, bitumen, and chemicals) that remains after the processing of ore and other mined materials (e.g., oil sands); and waste rock is rock removed during mining extraction operations to provide access to the ore. This change in reporting requirements, along with the aforementioned addition of TRS to the NPRI list of pollutants, played a role in the 2005–2010 increases in reporting from mining and oil and gas extraction activities in Canada.

1.4.2 Industry Sectors Reporting the Largest Proportions of Releases and Transfers, 2005–2010

Table 4 presents the 10 industry sectors that accounted for between 64 percent and 72 percent of total releases and transfers reported from 2005 through 2010. It shows that most of these sectors reported reductions over this period, but that there was a net increase of 14 percent overall, with oil and gas extraction and metal ore mining activities being key drivers of this increase. A total of 30 industry sectors accounted for between 89 percent and 92 percent of total reported releases and transfers in North America over this period (see Appendix 4).

Table 4. Top Industry Sectors Reporting to the North American PRTRs, 2005–2010: Total Releases and Transfers

Industry Sector	NAICS-4 Code	Total Releases and Transfers 2005 (kg)	Total Releases and Transfers 2006 (kg)	Total Releases and Transfers 2007 (kg)	Total Releases and Transfers 2008 (kg)	Total Releases and Transfers 2009 (kg)	Total Releases and Transfers 2010 (kg)	% Change 2005-2010
Metal Ore Mining	2122	579,082,564	959,468,670	891,780,223	963,602,162	946,806,807	1,209,414,482	109
Electric Power Generation, Transmission, Distribution	2211	527,061,796	507,666,843	502,207,870	455,438,263	369,374,147	352,112,292	-33
Basic Chemical Manufacturing	3251	350,468,597	358,451,753	331,395,331	316,779,254	269,178,727	291,320,541	-17
Iron and Steel Mills and Ferroalloy Manufacturing	3311	312,281,935	326,250,943	335,333,978	324,699,283	234,061,306	307,514,746	-2
Oil and Gas Extraction	2111	299,959,066	352,648,093	425,045,364	519,514,573	521,838,245	975,143,329	225
Support Activities for Mining and Oil and Gas Extraction	2131	275,449,433	291,148,385	350,015,825	436,929,233	430,632,041	1,704,958	-99
Nonferrous Metal (except Aluminum) Product/Processing	3314	264,792,816	354,836,292	317,299,626	315,491,899	274,146,732	362,220,896	37
Waste Treatment and Disposal	5622	228,270,716	213,420,808	212,877,357	198,627,485	169,597,797	198,450,011	-13
Pulp, Paper, and Paperboard Mills	3221	144,571,800	137,973,131	133,797,656	127,707,178	119,378,035	124,141,452	-14
Water, Sewage and Other Systems	2213	129,606,665	126,646,951	130,512,863	137,716,716	132,559,661	131,651,071	2
Total, Top 10 Sectors		**3,111,545,388**	**3,628,511,869**	**3,630,266,092**	**3,796,506,046**	**3,467,573,498**	**3,953,673,778**	**27**
Total, All Sectors		**4,833,498,433**	**5,458,622,690**	**5,439,460,679**	**5,392,090,187**	**4,829,435,749**	**5,530,710,253**	**14**
%, Top Sectors, of All Sectors		**64**	**66**	**67**	**70**	**72**	**71**	

Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

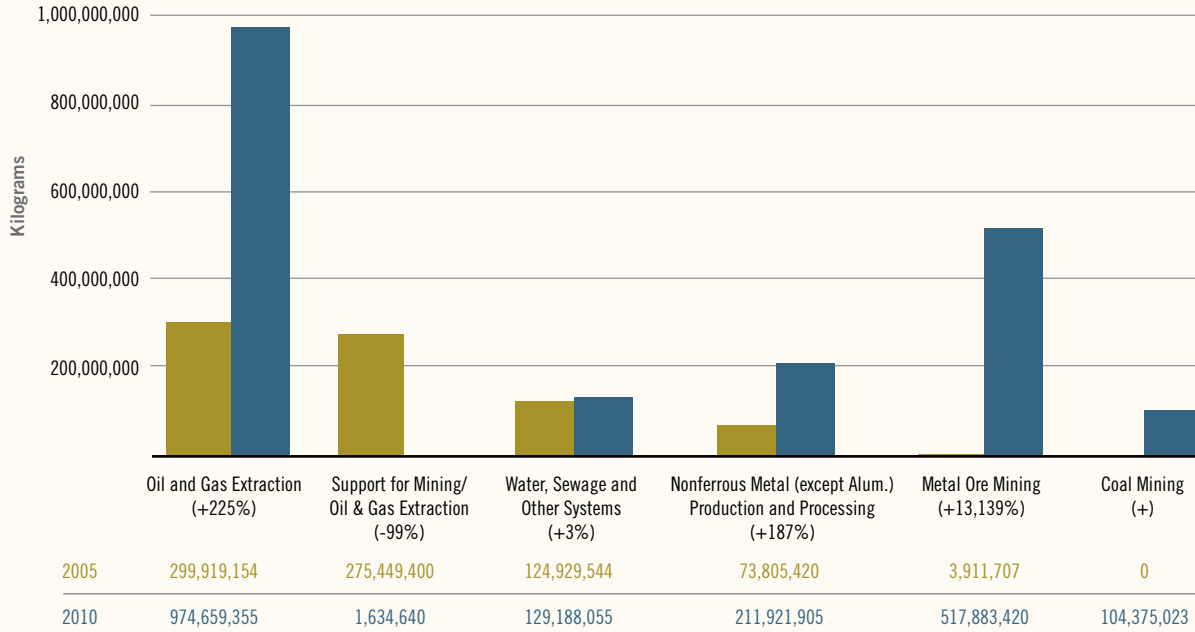
However, there were differences among the three countries in the top reporting sectors (see Figure 4). For example, while releases and transfers reported by the North American metal ore mining sector increased dramatically from 2005 through 2010, this increase reflects reporting in Canada and the United States but not Mexico (where this sector saw a 99 percent decrease in reported releases and transfers). The notable increase in Canada can be attributed in part to the change in NPRI reporting requirements for mining activities mentioned above. In the United States, metal ore mining remained the top reporting sector during this period, with reported releases and transfers increasing by 30 percent.

Similarly, the 225 percent increase in releases and transfers in the oil and gas extraction sector was driven by Canadian facilities, which accounted for 99.9 percent of the total for this sector each year (with Mexican facilities reporting relatively minor amounts). US data for oil and gas extraction activities, a large sector in that country, are absent due to the fact that this sector is not subject to TRI reporting. Table 4 shows that there was a gradual increase, from 2005 through 2009, in reported releases and transfers from the Canadian oil and gas extraction sector, followed by a substantial increase in 2010. That same year, there was a significant decrease in reporting from the sector that provides support services to mining and oil and gas extraction. In fact, these data are related: a few of the top facilities reported their releases and transfers through 2009 under the NAICS code for support activities for mining and oil and gas extraction; however, on the basis of guidance provided by NPRI, these facilities reported under the NAICS code for oil and gas extraction in 2010. One of these facilities, Spectra Energy Transmission's Kwoen gas plant in British Columbia, accounted for almost one-third of the total reported by the sector that year.

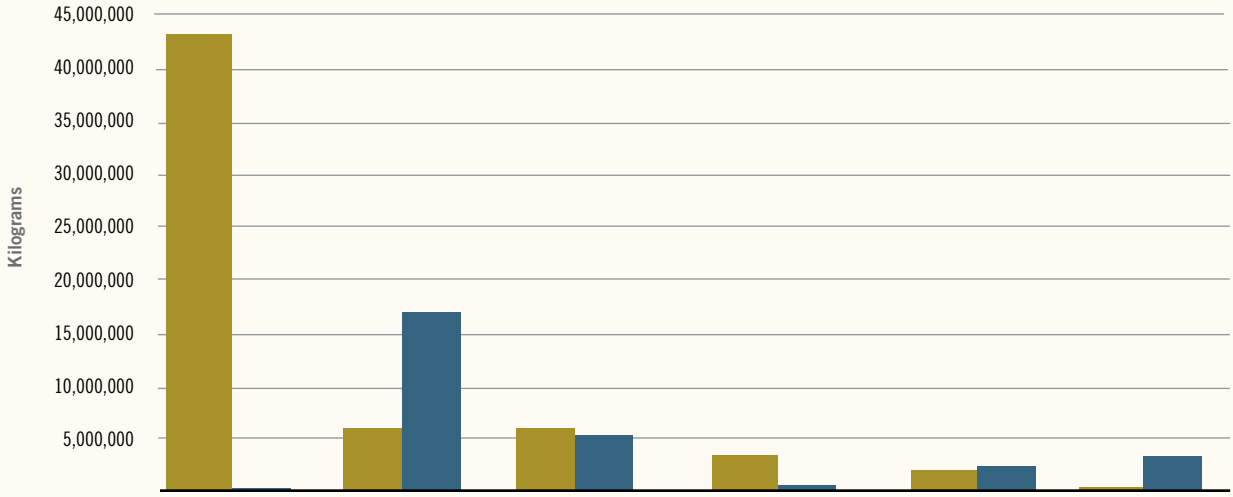
North American electric utilities saw a decrease of 33 percent in total reported releases and transfers from 2005 through 2010. Figure 4 reveals that this was a top sector in Mexico and the United States, but not in Canada. This can be attributed to the fact that in Canada, approximately 60 percent of the electricity produced is from hydroelectric power plants, while in the United States and Mexico about half of the electric power is derived from the combustion of coal and petroleum, respectively.[8] Total reported releases and transfers from this sector increased by 176 percent in Mexico (mainly due to reporting by one electric utility in Baja California), but decreased by 36 percent in the United States and 22 percent in Canada.

8. CEC. 2011. *North American power plant air emissions*. Montreal, Canada: Commission for Environmental Cooperation.

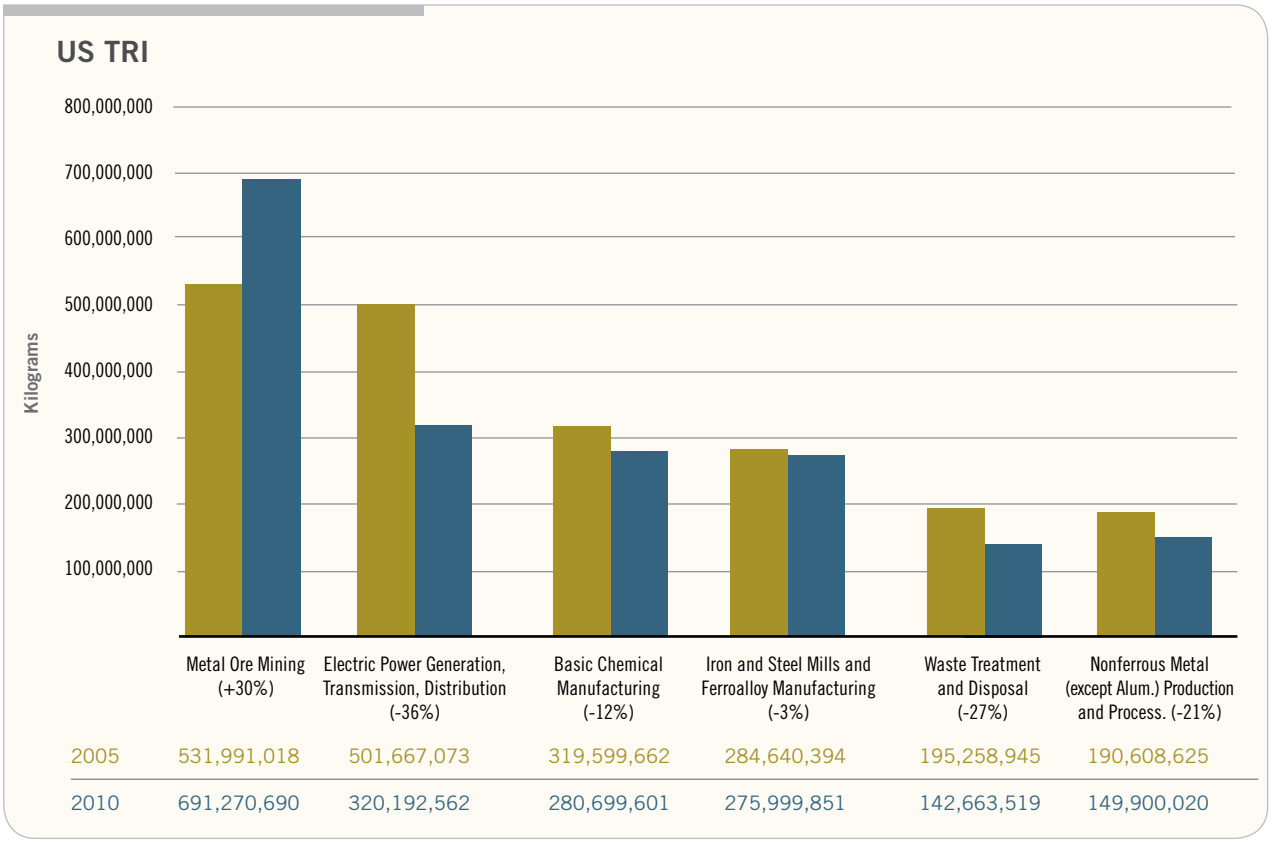
Figure 4. Top Reporting Industry Sectors in Canada, Mexico and the United States, 2005–2010: Total Releases and Transfers



	Oil and Gas Extraction (+225%)	Support for Mining/ Oil & Gas Extraction (-99%)	Water, Sewage and Other Systems (+3%)	Nonferrous Metal (except Alum.) Production and Processing (+187%)	Metal Ore Mining (+13,139%)	Coal Mining (+)
2005	299,919,154	275,449,400	124,929,544	73,805,420	3,911,707	0
2010	974,659,355	1,634,640	129,188,055	211,921,905	517,883,420	104,375,023



	Metal Ore Mining (-99%)	Electric Power Generation, Transmission and Distribution (+176%)	Other Electrical Equipment/Component Manufacturing (-15%)	Plastics Product Manufacturing (-77%)	Motor Vehicle Parts Manufacturing (+30%)	Foundries (+794%)
2005	43,179,839	6,102,060	6,029,412	3,379,851	1,847,018	369,879
2010	260,372	16,868,339	5,098,791	765,252	2,408,444	3,307,202



Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

In Mexico, the plastics product manufacturing sector, which ranked fourth for total releases and transfers in that country in 2005, reported a decrease of 77 percent over this period—due mainly to one facility, which reported a large amount in 2005 but did not report in 2010. Other Mexican industry sectors reporting large increases in releases and transfers over this period included foundries and waste collection services.

1.4.3 Changes in the Number of Facilities Reporting to the North American PRTRs, 2005–2010

From 2005 through 2010, the number of facilities reporting[9] to the North American PRTRs decreased (Table 1). In 2010, a total of 22,612 facilities across North America (80 percent of them located in the United States) reported to the three PRTRs, as compared with 25,519 facilities in 2005—a decrease of almost 3,000 facilities, with most of this decrease (2,651 facilities) occurring in the United States. An examination of the industry sectors with the largest changes in the number of reporting facilities can provide insight into the impacts of these changes on reported releases and transfers over this period.

The United States and Canada

Both Canada and the United States saw decreases in the total number of reporting facilities between 2005 and 2010. The ten industry sectors in both countries with the largest such decreases are shown in Table 5. These sectors accounted for just over half of the total decrease in the number of reporting facilities in the two countries.

This table shows that there were reductions in releases and transfers reported by each of these industry sectors. The data for certain sectors suggest that a relatively small number of facilities were drivers of these decreases. For example, the cement and concrete product manufacturing sector had a small decrease in the number of reporting facilities, but a 72 percent reduction in releases and transfers. In 2005, three US cement plants, the Buzzi Unicem facility in Indiana and two Holcim plants in Missouri and Michigan, reported a combined total of approximately 9.5 million kilograms (or 58 percent of the total for this sector). By 2010 the Holcim facility in Missouri had closed and the Buzzi Unicem plant reported about 570,000 kilograms.

9. Note that "reporting facilities" refers to those reporting at least 0.0001 kilograms in total releases and transfers.

The motor vehicle parts manufacturing sector reported the largest proportions of releases and transfers in both 2005 and 2010, but saw a 47 percent decrease in these amounts, with almost one-third fewer reporting facilities. However, as with the cement sector, a small number of facilities accounted for much of the reported decrease by this sector—including a couple of Canadian facilities that reported the largest proportions in 2005, but no releases and transfers in 2010.

While there was a net decrease in reporting facilities in these two countries, certain industry sectors saw increases. The ten sectors with the largest such increases are shown in Table 6.

Table 5. Industry Sectors with the Largest Decreases in the Number of Reporting Facilities, US TRI and Canadian NPRI, 2005–2010

Industry Sector (NAICS-4 Code)	Number of Reporting Facilities 2005	Number of Reporting Facilities 2010	Difference 2005–2010	Total Releases and Transfers 2005 (kg)	Total Releases and Transfers 2010 (kg)	% Change 2005-2010
Plastics Product Manufacturing (3261)	1,240	1,027	-213	48,867,077	47,384,513	-3
Coating, Engraving, Heat Treating& Allied Activities (3328)	1,057	874	-183	57,611,459	37,905,152	-34
Motor Vehicle Parts Manufacturing (3363)	888	627	-261	104,401,166	55,389,761	-47
Semiconductor & Other Electronic Component Mfg (3344)	856	646	-210	33,927,682	22,450,784	-34
Foundries (3315)	739	583	-156	53,024,387	37,645,384	-29
Paint, Coating, and Adhesive Manufacturing (3255)	713	571	-142	39,013,111	22,488,193	-42
Other Chemical Product/Preparation Mfg (3259)	704	572	-132	44,696,169	32,587,609	-27
Cement and Concrete Product Manufacturing (3273)	687	599	-88	16,291,297	4,633,081	-72
Household/Instit'l Furniture & Kitchen Cabinet Mfg (3371)	242	145	-97	8,218,724	3,720,411	-55
Motor Vehicle Body and Trailer Manufacturing (3362)	215	131	-84	6,730,858	5,171,531	-23
Total, Top 10 Sectors with Decreases	**7,341**	**5,775**	**-1,566**	**412,781,931**	**269,376,419**	**-35**
%, Top Sectors, of Total Releases and Transfers				**9**	**5**	

Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

Table 6. Industry Sectors with the Largest Increases in the Number of Reporting Facilities, US TRI and Canadian NPRI, 2005–2010

Industry Sector (NAICS-4 Code)	Number of Reporting Facilities 2005	Number of Reporting Facilities 2010	Difference 2005–2010	Total Releases and Transfers 2005 (kg)	Total Releases and Transfers 2010 (kg)	% Change 2005–2010
Basic Chemical Manufacturing (3251)	1,055	1,139	84	349,808,622	290,724,530	-17
Dairy Product Manufacturing (3115)	370	383	13	17,466,685	19,566,429	12
Machine Shops, Turned Product & Screw, Nut, Bolt Mfg (3327)	235	247	12	21,895,382	21,808,879	0
Agriculture, Construction, & Mining Machinery Mfg (3331)	234	240	6	10,091,755	44,790,625	344
Defence Services/National Security & Internat'l Affairs (9111/9281)*	204	298	94	13,173,252	16,254,943	23
Metal Ore Mining (2122)	113	166	53	535,902,725	1,209,154,110	126
Coal Mining (2121)	49	71	22	8,675,395	109,080,080	1,157
Remediation and Other Waste Management Services (5629)	27	58	31	6,055,107	91,797,630	1,416
Nonmetallic Mineral Mining and Quarrying (2123)	17	56	39	258,465	54,842,914	21,119
Warehousing and Storage (4931)	8	25	17	83,676	131,002	57
Total, Top 10 Sectors with Increases	**2,312**	**2,683**	**371**	**963,411,064**	**1,858,151,142**	**93**
%, Top Sectors, of Total Releases and Transfers				**20**	**34**	

* NAICS codes for Defence Services and National Security differ between the United States and Canada.
Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

For most of the sectors shown in this table, there was a wide variation in the changes in reported releases and transfers between 2005 and 2010. As with the preceding table, the data for certain sectors suggest that a small number of facilities were drivers of these changes. For example, the number of facilities in the agriculture, construction and mining machinery manufacturing sector increased slightly over this period, while total reported releases and transfers increased by 344 percent. One Texas facility, Baker Hughes Rankin, which provides services to the oil and gas industry, reported a notable increase in 2010—with over 24 million kilograms of metals and other pollutants transferred for recycling that year (or more than half of the total reported by that sector).

Similarly, the coal mining sector saw an increase of about 45 percent in the number of reporting facilities, but a 1,157 percent increase in reported releases and transfers. Thirteen Canadian facilities reported over 100 million kilograms, or about 95 percent of the total for this sector in 2010. As mentioned earlier, Canadian coal mines began to report in 2006, the year in which NPRI removed the reporting exemption for mining extraction and crushing activities. This new requirement had a significant impact on the increase in reported amounts for this sector. One facility, the Coal Valley Resources–Obed mine in Alberta, reported more than 80 million kilograms in 2010 and accounted for most of the increase for this sector shown in Table 6.[10] A small number of facilities in Canada also accounted for most of the substantial increase in reported releases and transfers by the nonmetallic mineral mining and quarrying sector. They included phosphate and potash mines in Ontario and Saskatchewan that supply manufacturers of fertilizer and agricultural products; and three diamond mines in the Northwest Territories.

The metal ore mining sector accounted for the largest releases and transfers in both 2005 and 2010, reporting a 126 percent increase over this period. There was also an increase in the number of reporting metal ore mining facilities, and a small number of mines in Canada that did not report in 2005 were among the top reporting facilities in 2010, with much of this change also due to the removal of the NPRI exemption for mining activities in 2006.

Mexico

The number of reporting facilities in Mexico saw wide year-to-year fluctuations over the 2005–2010 period (see Table 1) and therefore it is difficult to obtain a consistent picture of the direction of changes that occurred in PRTR reporting in that country. As mentioned earlier, the steep learning curve for Mexico's RETC (with many facilities not reporting in the first year or two of the program) has contributed to the PRTR data variability for that country.

Table 7 shows the sectors in Mexico with the largest number of reporting facilities over this period, and the changes from

Table 7. Industry Sectors with the Largest Changes in the Number of Reporting Facilities, Mexican RETC, 2005–2010

Industry Sector (NAICS-4 Code)	Number of Reporting Facilities 2005	Number of Reporting Facilities 2010	Difference 2005–2010	Total Releases and Transfers 2005 (kg)	Total Releases and Transfers 2010 (kg)	% Change 2005–2010
Motor Vehicle Parts Manufacturing (3363)	177	145	-32	1,847,018	2,408,444	30
Pipeline Transportation of Crude Oil (4861)	76	78	2	34,581	40,642	18
Pharmaceutical and Medicine Manufacturing (3254)	71	86	15	511,453	425,087	-17
Basic Chemical Manufacturing (3251)	67	69	2	659,975	596,011	-10
Foundries (3315)	60	63	3	369,879	3,307,202	794
Other Chemical Product and Preparation Manufacturing (3259)	60	58	-2	154,571	139,949	-9
Semiconductor and Other Electronic Component Manufacturing (3344)	60	33	-27	263,280	109,817	-58
Electric Power Generation, Transmission and Distribution (2211)	46	69	23	6,102,060	16,868,339	176
Coating, Engraving, Heat Treating, and Allied Activities (3328)	45	65	20	418,744	277,759	-34
Other Electrical Equipment and Component Manufacturing (3359)	40	28	-12	6,029,412	5,098,791	-15
Resin, Synthetic Rubber, Artificial Synthetic Fibers/Filaments Mfg (3252)	33	32	-1	175,723	139,180	-21
Plastics Product Manufacturing (3261)	31	44	13	3,379,851	765,252	-77
Beverage Manufacturing (3121)	29	42	13	43,688	35,656	-18
Metal Ore Mining (2122)	28	39	11	43,179,839	260,372	-99
Waste Collection (5621)	26	38	12	4,094	1,473,352	35,885
Total, Top 15 Sectors with Changes	**849**	**889**	**40**	**63,174,169**	**31,945,855**	**-49**
%, Top Sectors, of Total Releases and Transfers				**97**	**91**	

10. NPRI has flagged this as a likely reporting error (with the actual amount being orders of magnitude lower).

2005 to 2010 (disregarding the fluctuations in the interim years). These 15 sectors represented 97 percent and 91 percent, respectively, of total releases and transfers reported by all sectors in that country in 2005 and 2010.

This table reveals that the net number of reporting facilities in these 15 Mexican industry sectors increased by about 5 percent, while their total reported releases and transfers decreased by 49 percent, indicating that a relatively small number of facilities played a major role in the changes in releases and transfers over this period. Indeed, of total releases and transfers reported by the top 15 sectors, metal ore mining accounted for over 68 percent in 2005, but less than 1 percent in 2010. Two facilities, Compañía Fresnillo in Chihuahua, and Compañía Minera Nuevo Monte in Hidalgo, involved primarily in the extraction of lead, zinc and silver, accounted for almost all reported releases and transfers reported by this sector in 2005. Compañía Fresnillo did not report after 2005, and is currently examining the possibility that it overestimated its reported data for that year; while Compañía Minera Nuevo Monte did not report after 2007 and has since ceased to operate.[11]

Changes in releases and transfers from other industry sectors in Mexico also showed the impacts of reporting by a small number of facilities. For example, the foundry sector showed a small increase in the number of reporting facilities, but a 794 percent increase in reported releases and transfers. Relatively few facilities accounted for a large proportion of this increase, with many of the facilities that reported in 2005 no longer reporting in 2010, and vice versa. Similarly, one electric utility—a *Comisión Federal de Electricidad* (CFE) facility located in Baja California—accounted for much of the increase reported by the electricity generation sector over this period. The facility reported more than 73 percent of all releases and transfers by this sector in 2010, but did not report in 2005.

Table 8 presents some of the facilities in Mexico that reported large releases and transfers in either 2005 or 2010, but not both years. It illustrates the impact of certain facilities on total reported releases and transfers in that country, with just five facilities accounting for 77 percent of total releases and transfers reported by all sectors in 2005, and another five facilities accounting for 53 percent of total releases and transfers reported by all sectors in 2010.[12] There can be a number of reasons for inconsistent reporting by facilities, such as the aforementioned learning curve in relation to PRTR reporting; changes in estimation methodologies; a start-up, slowdown, or shutdown of operations at some point during the period in question; changes in industrial processes that can affect the amounts or the pollutants reported; and a lack of compliance with reporting requirements.

Table 8. Releases and Transfers from Mexican Facilities Reporting in 2005 or 2010, but Not Both Years

Facility Name	PRTR ID	State	Industry Sector	Total Releases and Transfers 2005 (kg)	Total Releases and Transfers 2010 (kg)
Compañia Fresnillo, S.A. de C.V.	FRE140806211	Chihuahua	Metal Ore Mining	36,235,208	–
Compañía Minera Nuevo Monte	MNMMK1308411	Hidalgo	Metal Ore Mining	6,774,926	–
Flextronics Plastics, S.A. de C.V.	FPLMA1412011	Jalisco	Plastics Product Manufacturing	3,206,344	–
Enertec Mexico, S. de R.L. de C.V. - Planta Monterrey	EMC8Z1903911	Nuevo León	Other Electrical Equipment and Component Mfg	2,345,644	–
Morestana, S.A de C.V	MOR8I0100111	Aguascalientes	Motor Vehicle Parts Manufacturing	1,476,444	–
Com. Federal de Electricidad, Campo y Central Geoterm. Cerro Prieto	CFEAD0200212	Baja California	Electric Power Generation, Transmission, Distribution	–	12,443,000
Monterrey Extrusions, S. de R.L. de C.V.	MEX9M1901211	Nuevo León	Motor Vehicle Parts Manufacturing	–	2,079,946
Hornos de Fundición, S.A. de C.V.	HFUTF2804011	Tamaulipas	Waste Collection	–	1,463,172
LBQ Foundry, S.A. de C.V	LFOLJ2201411	Querétaro	Foundries	–	1,376,500
Enertec Exports, S. de R.L. de C.V.	EEX8Z1901211	Nuevo León	Other Electrical Equipment and Component Mfg	–	1,321,078
			Subtotal, 5 facilities	50,038,567	18,683,696
			Total, all Mexican facilities	65,226,620	35,053,206
			%, Top 5 Facilities, of Total Releases and Transfers	77	53

11. Semarnat. 2013. Registro de Emisiones y Transferencia de Contaminantes (RETC). Personal communication with RETC officials, December 2013.
12. As mentioned earlier, Compañía Fresnillo is looking into probable reporting errors for 2005. Similarly, the CFE–Campo y Central Geotérmico Cerro Prieto facility in Baja California is examining a possible issue involving reporting under two different PRTR identification numbers between 2005 and 2010 (personal communication with RETC officials, 2013).

Chapter 2

Details of Reported Releases and Transfers, 2005–2010

This chapter examines, in greater detail, the changes in pollutant releases and transfers reported by North American industrial facilities over the 2005–2010 period, including on-site releases (to air, water, land, and underground injection); off-site releases to disposal; transfers to recycling; and other transfers. The industrial sectors and facilities reporting the largest proportions of these releases and transfers, and their distribution among the three countries, are presented—often revealing gaps in the picture of North American industrial pollution resulting from national differences in PRTR reporting requirements, and other factors.

In some cases, the data reveal notable changes in reporting by an industrial facility from one year to the next. These can be due to a variety of factors, including increases or decreases in production, or changes in waste management activities; implementation of pollution prevention or mitigation strategies; and so on. A major increase in reported data might also reflect reporting of an activity for the first time (for example, as a result of changes in reporting requirements), and not necessarily a change in the actual releases or transfers from a facility. While the reasons for important year-to-year changes in reporting are often not provided, readers should keep these considerations in mind.

This chapter also presents data on releases to air and water of known or suspected carcinogens, developmental or reproductive toxicants, metals, and persistent, bioaccumulative and toxic substances (PBTs). Some of the pollutants in these four categories are considered to be of special concern because of their persistence in the environment, and/or their significant potential to cause harm to human health or the environment even when released in relatively small amounts. *Taking Stock* provides toxicity-based information, in the form of toxicity equivalency potential (TEP) scores,[13] for releases to air and water of some of these pollutants. Information about their chemical properties and how these substances are used or produced in industry is also provided.

2.1 Reported Releases to Air, 2005–2010

Releases to air accounted for 9 percent of total reported releases and transfers in 2010, with North American facilities reporting 514,173,851 kilograms (a decrease of 36 percent from 2005 levels). Readers are reminded that the releases to air presented in this document exclude reporting of criteria air contaminants (CACs) to Canada's NPRI, and greenhouse gases (GHGs) to Mexico's RETC. Information about how to obtain data on releases of GHGs and CACs in the three countries is available in Appendix 1.

Table 9 presents the releases to air reported by North American facilities every year from 2005 through 2010. It reveals differences among the three countries in the amounts reported and the direction of the 2005–2010 changes. For example, the decrease in releases to air over this period was driven by reporting in the United States (43 percent decrease) and to a lesser extent, Canada (7 percent decrease). In Mexico, reported releases to air increased by 204 percent.

Of the total releases to air reported in 2005, Canadian facilities accounted for 14 percent, Mexican facilities for 0.7 percent, and US facilities for 85 percent. By 2010 these proportions had changed, with Canadian facilities reporting almost 21 percent of the total, Mexican facilities reporting 3.6 percent, and US facilities reporting 76 percent.

Figure 5 illustrates the reported releases to air in each country in 2005 and 2010, as well as the top 20 reported pollutants and changes in their releases over the 6-year period.

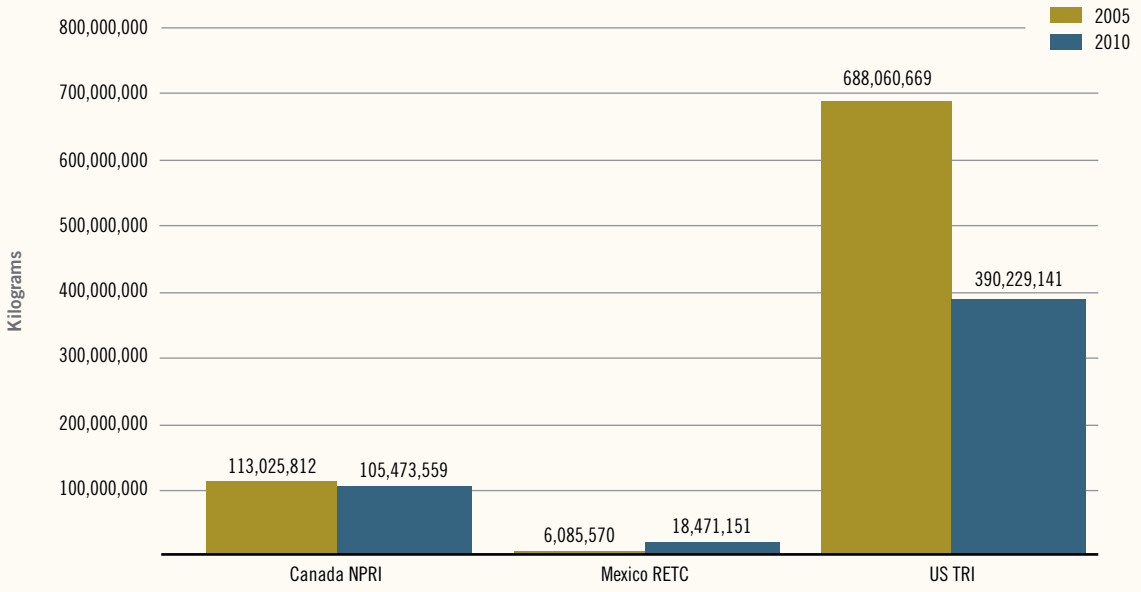
Table 9. Releases to Air Reported to the North American PRTRs, 2005–2010

PRTR	Releases to Air 2005 (kg)	Releases to Air 2006 (kg)	Releases to Air 2007 (kg)	Releases to Air 2008 (kg)	Releases to Air 2009 (kg)	Releases to Air 2010 (kg)	% Change 2005–2010	Number of Reported Pollutants	
								2005	2010
Canada NPRI	113,025,812	108,863,320	115,196,383	113,966,665	107,318,775	105,473,559	-7	160	158
Mexico RETC	6,085,570	19,629,156	17,650,031	22,644,705	20,153,686	18,471,151	204	52	48
US TRI	688,060,669	643,276,983	605,320,375	522,750,666	419,098,466	390,229,141	-43	409	398
Total, North America	807,172,052	771,769,460	738,166,789	659,362,037	546,570,927	514,173,851	-36	446	445

Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

13. For information on TEP scores, see section 2.3 and Appendix 1.

Figure 5. Releases to Air Reported in Canada, Mexico and the United States, and Top Reported Pollutants, 2005–2010



Pollutant	Releases to Air 2005 (kg)	Releases to Air 2010 (kg)	% Change 2005–2010
Hydrochloric Acid (CA, US)	264,854,293	99,871,342	-62
Methanol (CA, US)	86,891,338	59,539,501	-31
Sulfuric Acid (CA, US)	82,789,123	60,956,268	-26
Ammonia, Total (CA, US)	73,633,167	71,556,982	-3
Hydrogen Fluoride (CA, US)	37,592,308	20,406,613	-46
Toluene (CA, US)	29,113,207	17,367,509	-40
Styrene (CA, MX, US)	25,885,073	11,866,513	-54
n-Hexane (CA, US)	21,751,390	20,497,067	-6
Xylenes (CA, US)	21,305,370	11,793,636	-45
Carbonyl Sulfide (CA, US)	14,334,916	11,195,247	-22
Carbon Disulfide (CA, US)	11,851,707	8,399,476	-29
Ethylene (CA, US)	11,273,822	8,100,105	-28
Certain Glycol Ethers (US)	8,898,150	5,941,647	-33
Hydrogen Sulfide (CA, MX)	8,635,730	19,244,496	123
n-Butyl Alcohol (CA, US)	8,007,344	5,097,160	-36
Acetaldehyde (CA, MX, US)	7,273,669	4,730,047	-35
Formaldehyde (CA, MX, US)	7,135,349	3,572,996	-50
Propylene (CA, US)	6,511,391	4,700,635	-28
Zinc (and compounds) (CA, US)	3,915,861	3,500,678	-11
Total Reduced Sulfur (TRS) (CA)	–	15,522,608	50*
Total, Top 20 Pollutants Released to Air	**731,653,208**	**463,860,527**	**-37**
Total, All Pollutants Released to Air	**807,172,052**	**514,173,851**	**-36**
%, Top Pollutants, of Total Releases to Air	**91**	**90**	

* Percent change calculated from 2007 (first year of TRS reporting in Canada).

Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

These pollutants accounted for 91 percent and 90 percent, respectively, of total reported releases to air in 2005 and 2010. Almost all of them saw decreases over this period, with the exception of hydrogen sulfide and TRS (with the latter only subject to reporting as of 2007). Releases to air of hydrochloric acid accounted for the largest proportion (almost 33 percent) of the total in 2005, but by 2010 releases of this pollutant had declined and accounted for just over 19 percent of the total. This figure also reveals that of the pollutants shown, only acetaldehyde, formaldehyde and styrene are subject to the PRTRs of all three countries.

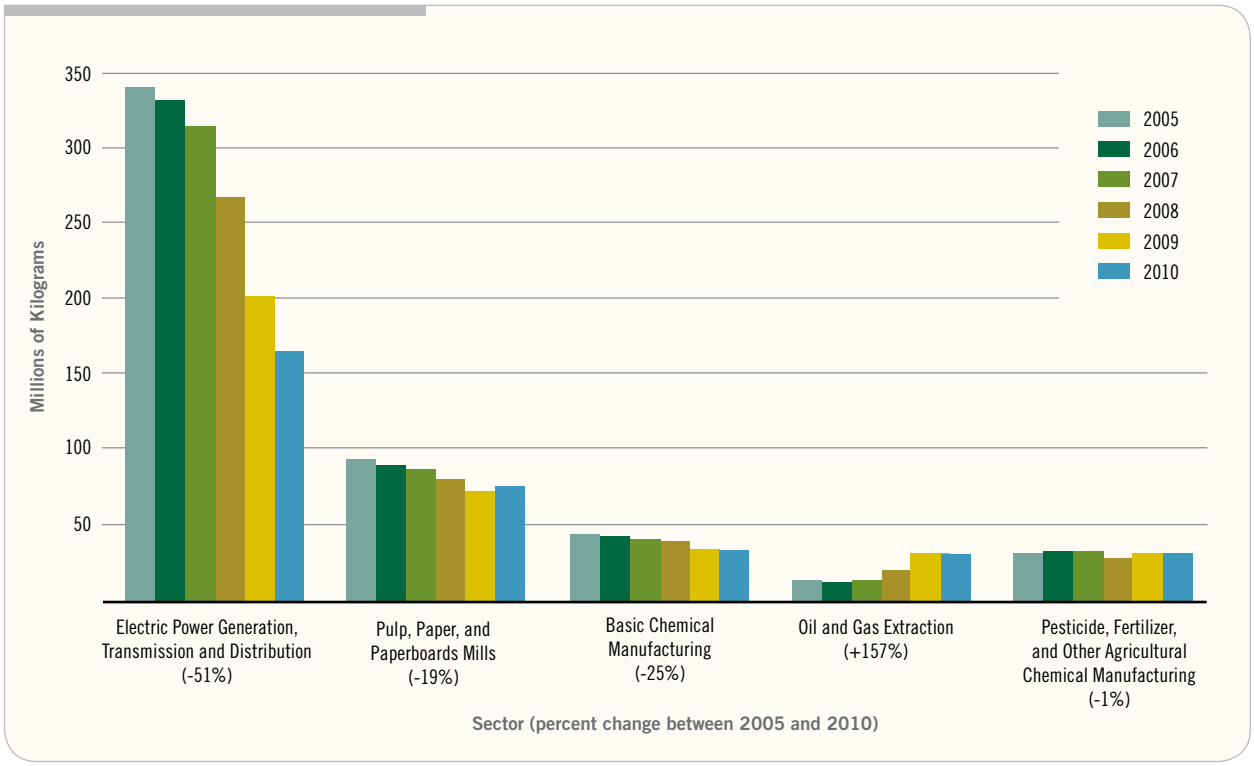
2.1.1 Top Sectors Reporting Releases to Air in North America, 2005–2010

The five North American industry sectors reporting the largest proportions of total releases to air from 2005 through 2010 are shown in Figure 6. These sectors accounted for 335,413,595 kilograms, or 65 percent of the total in 2010, with electric utilities alone reporting 32 percent.

However, there were differences among the three countries in the sectors reporting the largest releases to air. Figure 7 shows that the notable decrease in releases to air from electric utilities can be attributed to power plants in the United States (56 percent decrease) and Canada (29 percent decrease), while releases to air from this sector in Mexico increased by about 196 percent. As mentioned earlier, one electric utility, the CFE–Campo y Central Geotérmico Cerro Prieto facility in Baja California accounted for much of the reported increase. Electric utilities accounted for the largest proportions (i.e., between 80 percent and 92 percent) of total releases to air reported in that country every year between 2005 and 2010.

The oil and gas extraction sector, which by 2010 had replaced pulp, paper and paperboard mills as the top-ranked sector for releases to air in Canada, was not among the top reporting sectors in the other countries. It reported a 154 percent increase in releases to air over this period (see Fig. 7), partly due to the addition in 2007 of TRS compounds to the NPRI list of substances. The oil and gas extraction sector, along with TRS, is not subject to reporting under the US TRI; while in Mexico, the lack of reported data from this sector suggests incomplete reporting, since it is not exempt from the RETC.

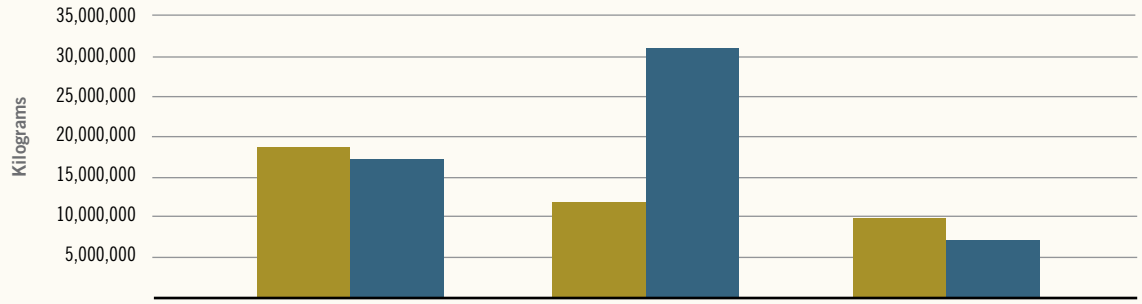
Figure 6. Top Reporting Industry Sectors for Releases to Air, North America, 2005–2010



Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

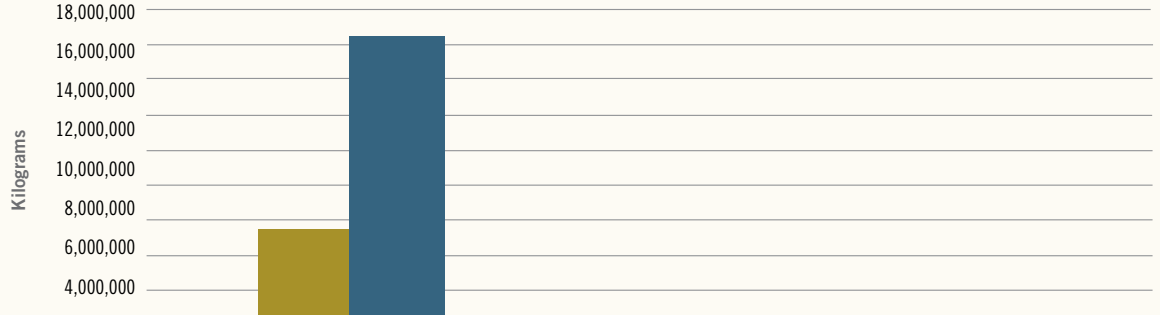
Figure 7. Top Reporting Industry Sectors for Releases to Air in Canada, Mexico and the United States, 2005–2010

Canada NPRI



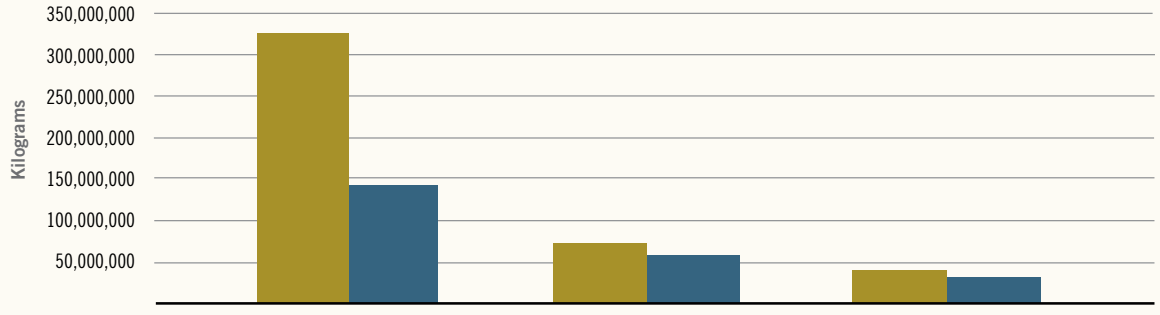
	Pulp, Paper, and Paperboard Mills (-9%)	Oil and Gas Extraction (+154%)	Electric Power Generation, Transmission, Distribution (-29%)
2005	18,842,150	12,193,949	9,893,416
2010	17,197,471	30,979,096	7,063,583

Mexico RETC



	Electric Power Generation, Transmission, Distribution (+196%)	Resin, Synthetic Rubber, Artificial Fibers Manufacturing (-46%)	Plastics Product Manufacturing (+914%)
2005	5,554,760	120,042	42,402
2010	16,419,094	65,073	430,022

US TRI



	Electric Power Generation, Transmission, Distribution (-56%)	Pulp, Paper, and Paperboard Mills (-22%)	Basic Chemical Manufacturing (-23%)
2005	324,741,379	73,805,730	40,121,615
2010	141,759,342	57,897,138	31,085,976

Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

Table 10 presents the top pollutants released to air by the top five North American industry sectors, which together accounted for 65 percent of total releases to air in 2010; the distribution of reporting among the three countries; and the changes in these releases from 2005 through 2010. The data illustrate the impacts of differences among national PRTR reporting requirements, with hydrogen sulfide being the only pollutant in this table that is subject to PRTR reporting in Mexico.

Electric utilities—the majority of them located in the United States—accounted for the largest proportions of releases to air of hydrochloric acid and sulfuric acid. These pollutants are associated with the combustion of fossil fuels such as coal, oil and natural gas, which are used more extensively in the United States and Mexico for the production of electricity. In contrast, more than half of Canada's power is derived from hydroelectricity. By 2010, electric utilities had cut their releases of hydrochloric acid and sulfuric acid by 67 percent and 20 percent, respectively. These two substances are subject to PRTR reporting in Canada and the United States, but not Mexico. Hydrochloric acid and sulfuric acid can react in the atmosphere to create acid rain, and can cause respiratory problems. A number of factors, including regulations for air pollutants from the burning of fossil fuels, contributed to the decreases in releases by this sector in both Canada and the United States (see section 2.1.2).

Mexican electric utilities accounted for almost 100 percent of all reported releases to air of hydrogen sulfide, with these releases increasing by about 196 percent from 2005 through 2010 (see Figure 7). A CFE facility in Baja California accounted for most of this increase (see Table 9). It is a geothermal facility and hydrogen sulfide is one of the gases contained in the geothermal stream. This pollutant has the characteristic odor of rotten eggs and occurs naturally in crude petroleum, natural gas and volcanic gases; it is also a byproduct of industrial activities (e.g., petroleum refining). Certain Canadian electric utilities (especially one co-generation facility in Sarnia, Ontario) reported relatively small amounts of this pollutant, which is not subject to reporting under the US TRI.

Pulp, paper and paperboard mills (with most reporting facilities located in the United States and Canada) accounted for 14 percent of total air releases in 2010. This sector reported a 19 percent decrease in releases to air from 2005 through 2010 (see Table 28), including substantial decreases of methanol, the top reported pollutant. Substances typically released to air during the wood pulping and bleaching processes, such as methanol and ammonia, have been the subject of regulatory controls in both countries (see Chapter 3). Methanol, a volatile organic compound (VOC), can contribute to the formation of photochemical smog when it reacts with other volatile organic

Table 10. Top Reporting Industry Sectors for Releases to Air, and Top Reported Pollutants, North America, 2005–2010

Industry Sector (NAICS-4 Code)	Releases to Air 2010 (kg)	Pollutant	Releases to Air 2010 (kg)	% Change 2005–2010	Canada NPRI (%)	Mexico RETC (%)	US TRI (%)
Electric Power Generation, Transmission and Distribution (2211)	165,242,019	**Hydrochloric Acid** (CA, US)	77,951,337	-67	4	--	96
		Sulfuric Acid (CA, US)	48,342,390	-20	3	--	97
		Hydrogen Sulfide (CA, MX)	16,254,130	197	0.01	99	--
Pulp, Paper, and Paperboard Mills (3221)	75,094,700	**Methanol** (CA, US)	46,608,814	-23	19	--	81
		Hydrochloric Acid (CA, US)	7,993,865	-12	22	--	78
		Ammonia, Total (CA, US)	7,811,700	-17	20	--	80
Basic Chemical Manufacturing (3251)	33,092,402	**Ethylene** (CA, US)	4,796,351	-29	10	--	90
		Ammonia, Total (CA, US)	4,265,469	4	3	--	97
		Carbonyl Sulfide (CA, US)	3,953,646	-32	0	--	100
Oil and Gas Extraction (2111)	31,376,515	**Total Reduced Sulfur (TRS)** (CA)	10,765,681	212*	100	--	--
		Carbon Disulfide (CA, US)	4,356,566	136	100	--	--
		Xylenes (CA, US)	3,308,466	323	100	--	--
Pesticide, Fertilizer, and Other Agricultural Chemical Mfg. (3253)	30,607,959	**Ammonia, Total** (CA, US)	27,023,573	0	32	--	68
		Methanol (CA, US)	1,125,870	-39	34	--	66
		Hydrogen Fluoride (CA, US)	682,277	20	7	--	93
Total, Top 5 Sectors	**335,413,595**	**Total, Top Pollutants**	**265,240,134**				
%, Top 5 Sectors, of Total Releases to Air	**65**						

* Percent change calculated from 2007 (first year of TRS reporting in Canada).
Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

substances in air. It is also used in the production of formaldehyde and other chemicals, as a solvent or antifreeze, and is present in other products.

Table 10 also reveals that ammonia accounted for approximately 88 percent of total annual releases to air reported by the pesticide, fertilizer and other agricultural chemical manufacturing sectors, with most reporting facilities located in the United States. Releases to air of ammonia are associated with a number of health and environmental effects, including respiratory illnesses, damage to vegetation and the formation of acid rain. This industry sector also reported a 20 percent increase in releases to air of hydrogen fluoride, a by-product released during the manufacturing of phosphate fertilizer. As mentioned, of the top 20 reported pollutants released to air between 2005 and 2010, only acetaldehyde, formaldehyde and styrene are common to the three North American PRTRs. These substances are all known or suspected carcinogens.

Table 11 provides information about the industry sectors in each country that reported the largest releases to air of these three pollutants, and the 2005–2010 changes. It reveals similarities, as well as differences—for example, the pulp, paper and paperboard mills sector reported the largest releases to air of acetaldehyde in both Canada and the United States, with reductions in these releases between 2005 and 2010. Trace quantities of acetaldehyde may be coincidentally manufactured by pulp, paper and paperboard mills during the chemical pulping process, after which it may be released to air. In Mexico, the resin and synthetic rubber manufacturing sector reported the largest releases to air of this pollutant. Acetaldehyde is used in the synthesis of other chemicals (e.g., resins), and is formed as a product of incomplete combustion, coal refining, and waste processing.

In Canada and the United States, releases to air of formaldehyde were reported in largest proportions by the veneer, plywood and engineered wood product manufacturing sector, with reductions in these releases from 2005 through 2010. By contrast, this pollutant was reported released to air in largest proportions by Mexican electric utilities, which reported an increase of 107 percent in these releases. Formaldehyde is used in urea-formaldehyde resins and glues that are sometimes used in wood panel production; as a preservative in some foods; and in household products such as antiseptics and cosmetics. It is also formed from the combustion of fossil fuels and other materials.

The plastics product manufacturing sector accounted for the largest proportions of total air releases of styrene in the three countries, with the largest amounts reported by US facilities. There was a large increase in releases to air of styrene from this sector in Mexico, mainly from one facility in Nuevo León which started reporting to RETC in 2008. Plastics product manufacturers in Canada and the United States reported large decreases in releases to air of styrene between 2005 and 2010. Styrene is used mainly in the production of polystyrene plastics and resins.

Table 11. Top Reporting Industry Sectors for Releases to Air of Pollutants Common to NPRI, RETC and TRI, 2005–2010

Pollutant	PRTR	Top Contributing Sectors, 2005	Releases to Air 2005 (kg)	% Change 2005–2010
Acetaldehyde	Canada NPRI	Pulp, Paper, and Paperboard Mills	595,841	-35
	Mexico RETC	Resin, Synthetic Rubber, Artificial Synthetic Fibers Mfg	19,260	-56
	US TRI	Pulp, Paper, and Paperboard Mills	3,462,118	-32
		Total Acetaldehyde, Top Sectors	**4,077,219**	
Formaldehyde	Canada NPRI	Veneer, Plywood, and Engineered Wood Prod. Mfg	1,734,235	-62
	Mexico RETC	Electric Power Generation, Transmission, Distrib.	76,140	107
	US TRI	Veneer, Plywood, and Engineered Wood Prod. Mfg	1,996,911	-70
		Total Formaldehyde, Top Sectors	**3,807,286**	
Styrene	Canada NPRI	Plastics Product Manufacturing	1,995,760	-62
	Mexico RETC	Plastics Product Manufacturing	33,281	1,153
	US TRI	Plastics Product Manufacturing	11,703,435	-54
		Total Styrene, Top Sectors	**13,732,476**	

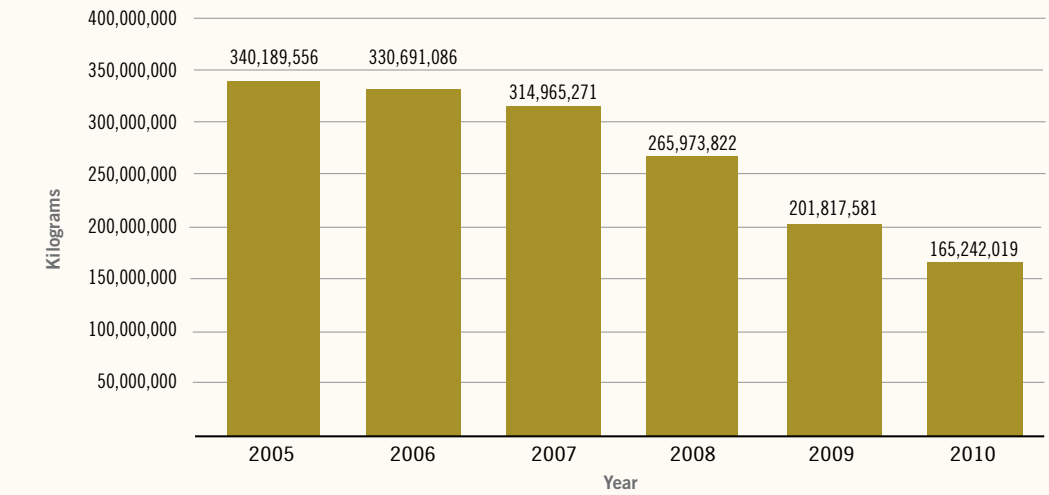
Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

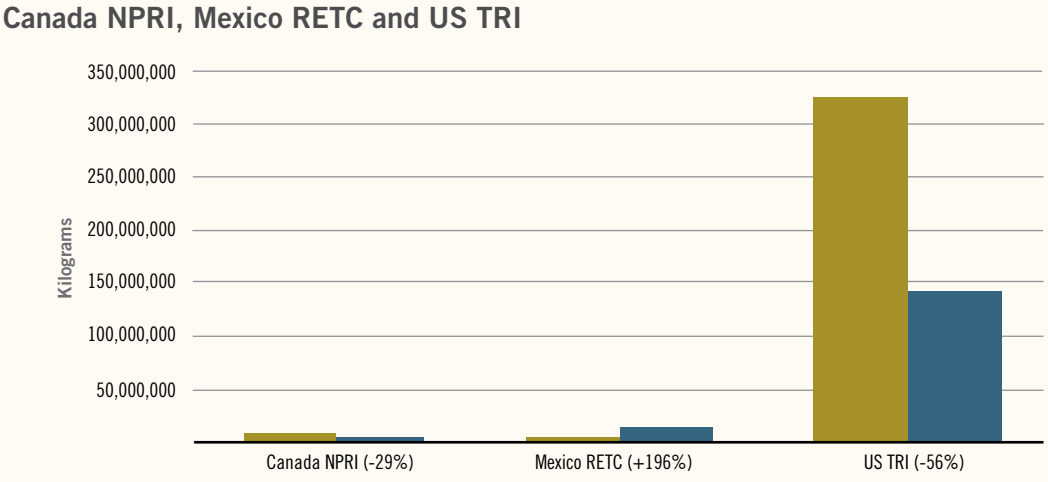
2.1.2 Spotlight: Releases to Air from Electric Utilities, 2005–2010

The important decrease in reported releases to air in North America between 2005 and 2010 was largely driven by electric utilities, which reported a 51 percent decrease in such releases. Figure 8 illustrates this decrease and also reveals important differences among the three countries. For example, US utilities accounted for the majority of air releases from this sector between 2005 and 2010, and the largest decrease. Unlike Canada and the United States, Mexican power plants reported increases in releases to air over this period.

Each country has a unique electricity generation profile involving different technologies and fuels (for example, about 60 percent of Canada's power is generated by hydroelectricity, while fossil fuels such as coal, oil and natural gas are more predominant in Mexico and the United States). Fossil fuel–based power plants are among the largest contributors of important air pollutants such as greenhouse gases, particulate matter, and mercury.[14] Tables 12a and 12b present the reported pollutants released to air by North American electric utilities between 2005 and 2010. The pollutants in Table 12a are the top-reported substances by volume of release, while those

Figure 8. Releases to Air Reported by North American Electric Utilities, 2005–2010





	Canada NPRI (-29%)	Mexico RETC (+196%)	US TRI (-56%)
2005	9,893,416	5,554,760	324,741,379
2010	7,063,583	16,419,094	141,759,342

14. CEC. 2011. *North American power plant air emissions*. Montreal, Canada: Commission for Environmental Cooperation.

in Table 12b are pollutants belonging to one or more of four categories (known or suspected carcinogens; developmental or reproductive toxicants; PBTs; and metals) and ranked by the highest TEP scores—in this case, for non-cancer risk. The TEP scores provide an indication of the potential toxicity of these pollutants, which accounted for less than 1 percent of the total volume of air releases in both 2005 and 2010, but almost 100 percent of the toxic loadings to air associated with health impacts of these emissions.

The North American energy landscape has changed in the past decade, with fossil fuel–based electric utilities affected by new environmental regulations and rising fuel costs. In Canada, existing provincial regulations for criteria air contaminants and greenhouse gases and the Canada Wide Standards for mercury have played a major role in the decreases in releases to air from power plants. The Province of Ontario's ongoing coal phase-out plan (to end the use of coal at Ontario's electricity-generating facilities by 2014) has also had impacts. Most of Ontario's coal-fired power plants have shut down or are in the process of doing so, and the remaining plants are considering converting to other fuel sources (e.g., biomass, natural gas). Under the new federal *Reduction of Carbon Dioxide Emissions from Coal-fired Generation of Electricity Regulations,* all Canadian coal-fired plants will be required, by the end of their useful life, to reduce emissions by installing carbon capture and storage technology,

Table 12a. Releases to Air Reported by North American Electric Utilities, 2005–2010: Top Pollutants, by Volume

Pollutant	Releases to Air 2005 (kg)	Releases to Air 2010 (kg)	% Change 2005–2010
Hydrochloric Acid (CA, US)	237,819,753	77,951,337	-67
Sulfuric Acid (CA, US)	60,596,971	48,342,390	-20
Hydrogen Fluoride (CA, US)	29,645,060	15,335,709	-48
Hydrogen Sulfide (CA, MX)	5,474,617	16,254,130	197
Ammonia, Total (CA, US)	2,456,634	4,576,201	86
Barium (and compounds) (US)	795,843	623,686	-22
Zinc (and compounds) (CA, US)	671,614	353,473	-47
Vanadium (and compounds) (CA, US)	484,836	109,482	-77
Aluminum (fume or dust) (CA, US)	343,950	342,830	0
Nickel (and compounds) (CA, MX, US)	291,829	114,227	-61
Total, Top 10 Pollutants to Air	**338,581,106**	**164,003,465**	
Total, All Pollutants to Air	**340,189,556**	**165,242,019**	
%, Top Pollutants, of Total Sector Releases to Air	**99**	**99**	

Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

Table 12b. Releases to Air Reported by North American Electric Utilities, 2005–2010: Top Pollutants, by TEP

Pollutant	Releases to Air 2005 (kg)	Releases to Air 2010 (kg)	% Change 2005–2010	Cancer Risk Score for Air (TEP) 2010	Non-cancer Risk Score for Air (TEP) 2010
Mercury (and compounds) (CA, MX, US)	45,832	31,736	-31	--	444,300,261,677
Dioxins and Furans (CA, MX, US)	0.5663	0.4341	-37	520,945,141	382,026,436,811
Lead (and compounds) (CA, MX, US)	82,833	47,437	-43	1,328,237	27,513,488,365
Thallium (and compounds) (US)	2,671	1,555	-42	--	18,656,308,636
Arsenic (and compounds) (CA, MX, US)	43,382	29,970	-31	479,526,627	2,517,514,790
Copper (and compounds) (CA, US)	87,346	57,237	-34	--	744,083,885
Cadmium (and compounds) (CA, MX, US)	212	209	-1	5,437,331	397,343,396
Nickel (and compounds) (CA,MX, US)	291,829	114,227	-61	319,836	365,527,295
Cobalt (and compounds) (CA, US)	15,582	9,980	-36	--	309,388,529
Chromium (and compounds) (CA, MX, US)	74,032	57,916	-22	7,529,040	179,538,645
Total, Top 10 Pollutants to Air	**643,719**	**350,268**		**1,015,086,212**	**877,009,892,030**
Total, All Pollutants to Air	**340,189,556**	**165,242,019**		**1,016,650,145**	**877,879,947,256**
%, Top Pollutants, of Total Sector Releases to Air	**0.19**	**0.21**		**99**	**99**

A "--" in place of a TEP score means that either the pollutant has a score of 0, or it has not been evaluated.
Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

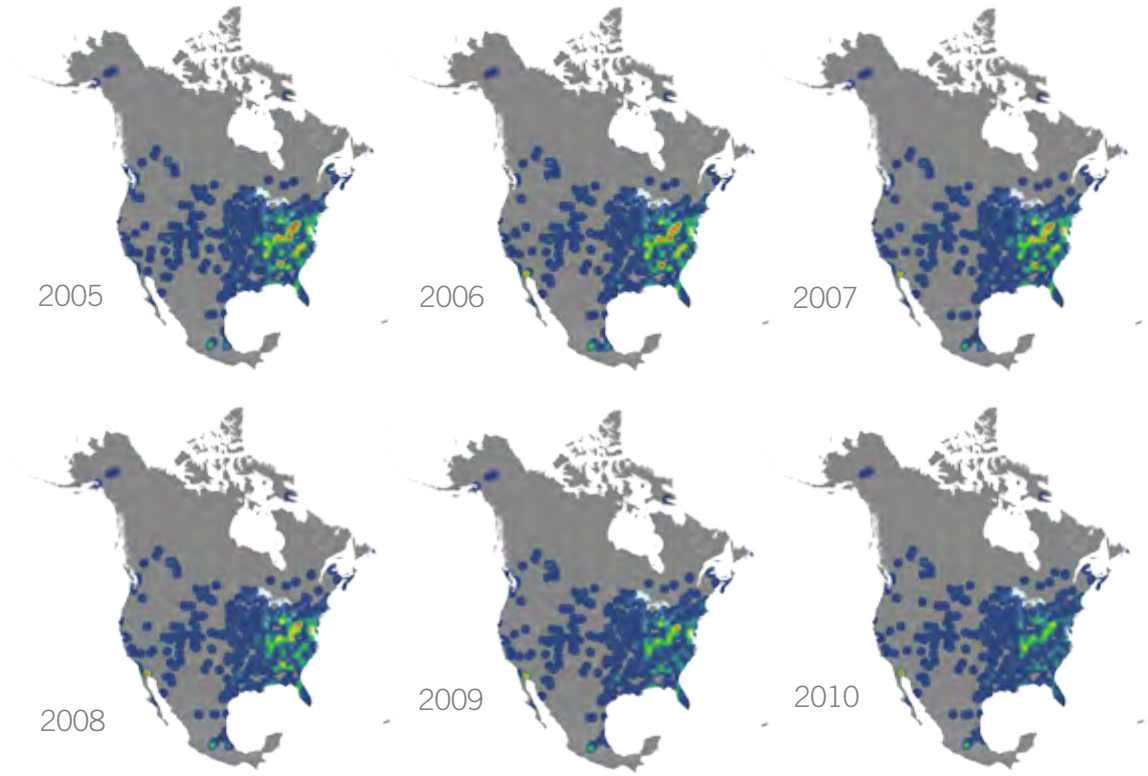
switching to lower-emitting fuel sources, or closing. It is estimated that by 2035, approximately half of all coal-generated electricity will be eliminated.[15]

In Mexico, electric utilities are regulated under the General Law of Ecological Equilibrium and Environmental Protection (*Ley General de Equilibrio Ecológico y Protección al Ambiente*—LGEEPA), with maximum permissible limits for releases to air and water and disposal of solid and hazardous waste defined under official standards called *Normas Oficiales Mexicanas* (NOMs). Electric utilities are also regulated under the *Reglamento de la LGEEPA en Materia de Prevención y Control de la Contaminación de la Atmósfera* (Regulation of the LGEEPA Concerning Prevention and Control of Atmospheric Pollution). It requires utilities to obtain operating licenses indicating details of regular monitoring and sampling activities for specific air pollutants, equipment and conditions to prevent and control air pollution, and so on.

In the United States, the Clean Air Act and the National Emissions Standards for Hazardous Air Pollutants (NESHAPs), which place limits on releases of 183 pollutants, have incited many fossil fuel–based power plants to install pollution control technologies, or to shift to other fuel sources. This has resulted in significant decreases in releases to air of pollutants such as hydrochloric acid and sulfuric acid, the top-reported pollutants for fossil fuel–generated electric utilities in that country. In 2011, the US EPA finalized the Mercury and Air Toxics Standards (MATS) to reduce mercury and other toxic air pollution from coal- and oil-fired power plants.[16]

The maps in Figure 9 depict the diminishing intensity of releases to air reported by North American power plants between 2005 and 2010. In 2005, a total of 703 power plants reported releases to air (44 in Canada, 13 in Mexico, and 646 in the United States). In 2010, 685 power plants reported: 53 in Canada, 22 in Mexico, and 610 in the United States.

Figure 9. Releases to Air Reported by North American Electric Utilities, by Year, 2005–2010



Note: The data used to create these maps exclude reported releases in Canada and Mexico of criteria air contaminants (CACs) and greenhouse gases (GHGs), which are not included in *Taking Stock* due to differences in national PRTR reporting requirements. Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

15. Environment Canada. 2012. Reduction of carbon dioxide emissions from coal-fired generation of electricity regulations (SOR/2012-167). Online at: <www.ec.gc.ca/lcpe-cepa/eng/regulations/detailreg.cfm?intReg=209>. Government of Ontario. 2013. Ending Coal for Cleaner Air Act, 2013. Online at: <www.ebr.gov.on.ca/ERS-WEB-External/displaynoticecontent.do?noticeId=MTIxMDQ3&statusId=MTgxMTk5&language=en>.
16. US Environmental Protection Agency. 2011. Mercury and Air Toxics Standards (MATS). Online at: <www.epa.gov/mats/basic.html>.

2.2 Reported Releases to Water, 2005–2010

Releases to water accounted for 4 percent of total reported releases and transfers in 2010, with North American facilities reporting 221,806,836 kilograms—a decrease of 5 percent from 2005 levels.

Table 13 presents the releases to water reported by North American facilities every year from 2005 through 2010. Of total reported releases to water in 2005, Canada and the United States each accounted for over 49 percent, while Mexican facilities accounted for less than 1 percent. By 2010, the proportion reported by Canadian facilities had increased to almost 54 percent of the total, while the proportion reported by US facilities had dropped to just over 46 percent. An important consideration with respect to releases to water is that a key reporting sector in Canada, public water and wastewater treatment plants, is not subject to the US TRI. As shown below, this difference in national PRTR reporting requirements has a significant impact on the picture of industrial releases to water in North America.

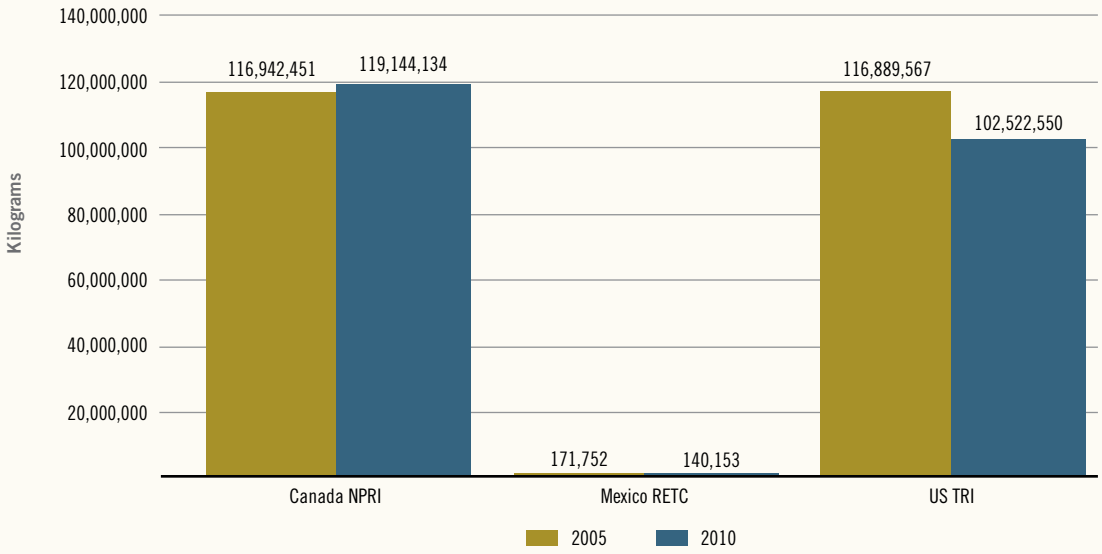
Figure 10 illustrates the reported releases to water in each country in 2005 and 2010, revealing the notable difference in the proportion reported by Mexican facilities, in comparison with Canada and the United States. In 2010 the proportion of releases to water reported by Mexican facilities remained almost the same as in 2005 (albeit with notable fluctuations in reported volumes in the intervening years). One reason for the relatively small volumes reported by Mexican facilities is that, of the top pollutants released to water shown in this figure, only six are subject to the RETC. This figure also shows that the top 20 pollutants accounted for more than 99 percent of total reported releases to water in 2005 and 2010, with two of them—nitric acid/nitrate compounds and ammonia—representing approximately 91 percent of the total.

Table 13. Releases to Water Reported to the North American PRTRs, 2005–2010

PRTR	Releases to Water 2005 (kg)	Releases to Water 2006 (kg)	Releases to Water 2007 (kg)	Releases to Water 2008 (kg)	Releases to Water 2009 (kg)	Releases to Water 2010 (kg)	% Change 2005-2010	Number of Reported Pollutants 2005	Number of Reported Pollutants 2010
Canada NPRI	116,942,451	114,787,399	117,849,702	123,617,457	119,281,087	119,144,134	2	85	87
Mexico RETC	171,752	442,353	544,461	2,224,441	255,694	140,153	-18	16	14
US TRI	116,889,567	114,758,518	109,661,271	113,344,183	94,338,147	102,522,550	-12	249	210
Total, North America	**234,003,770**	**229,988,270**	**228,055,434**	**239,186,081**	**213,874,929**	**221,806,836**	**-5**	**276**	**247**

Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

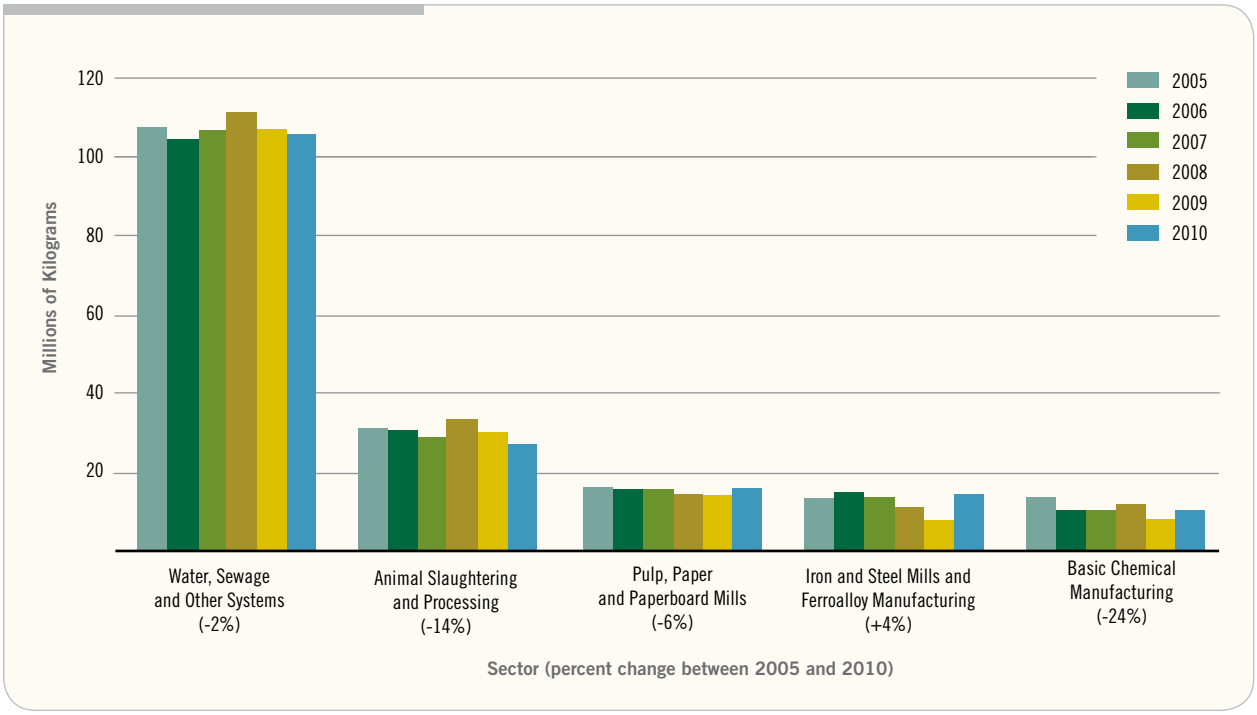
Figure 10. Releases to Water Reported in Canada, Mexico and the United States, and Top Reported Pollutants, 2005–2010



Pollutant	Releases to Water 2005 (kg)	Releases to Water 2010 (kg)	% Change 2005–2010
Nitric Acid and Nitrate Compounds (CA, US)	156,090,931	152,163,831	-3
Ammonia, Total (CA, US)	55,392,953	50,658,575	-9
Phosphorous, Total (CA)	7,016,983	5,548,071	-21
Manganese (and compounds) (CA, US)	4,268,432	3,798,677	-11
Methanol (CA, US)	3,964,939	3,158,471	-20
Sodium Nitrite (CA, US)	1,569,366	626,810	-60
Ethylene Glycol (CA, US)	819,066	955,498	17
Zinc (and compounds) (CA, US)	778,545	918,020	18
Barium (and compounds) (US)	521,014	598,194	15
Chlorine (CA, US)	513,630	249,478	-51
Copper (and compounds) (CA, US)	295,308	446,874	51
Formaldehyde (CA, MX, US)	208,093	122,103	-41
Vanadium (and compounds) (CA, US)	204,806	216,104	6
Nickel (and compounds) (CA, MX, US)	201,061	171,722	-15
Acetaldehyde (CA, MX, US)	182,652	174,523	-4
Formic Acid (CA, US)	138,252	229,773	66
Arsenic (and compounds) (CA, MX, US)	129,217	129,375	0
Phenol (CA, MX, US)	125,890	67,372	-46
Benzene (CA, MX, US)	114,416	127,501	11
Total Reduced Sulfur (TRS) (CA)	–	208,448	99*
Total, Top 20 Pollutants Released to Water	**232,535,554**	**220,360,972**	
Total, All Pollutants Released to Water	**234,003,770**	**221,806,836**	
%, Top 20 Pollutants, of All Releases to Water	**99.4**	**99.3**	

* Percent change calculated from 2007 (first year of TRS reporting in Canada).
Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

Figure 11. Top Reporting Industry Sectors for Releases to Water, North America, 2005–2010



Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

2.2.1 Top Sectors Reporting Releases to Water in North America, 2005–2010

The five North American industry sectors reporting the largest proportions of total releases to water from 2005 through 2010 are shown in Figure 11. These industry sectors accounted for 173,187,048 kilograms (or 78 percent of total reported releases to water by all sectors in 2010), with the water and sewage sector alone reporting almost 48 percent of the total.

As mentioned, the reported data for releases to water by North American industry sectors reflect key differences in national PRTR reporting requirements, especially for public water and wastewater treatment plants. These differences are illustrated in Figure 12, which presents the top industry sectors in each country for reported releases to water from 2005 through 2010.

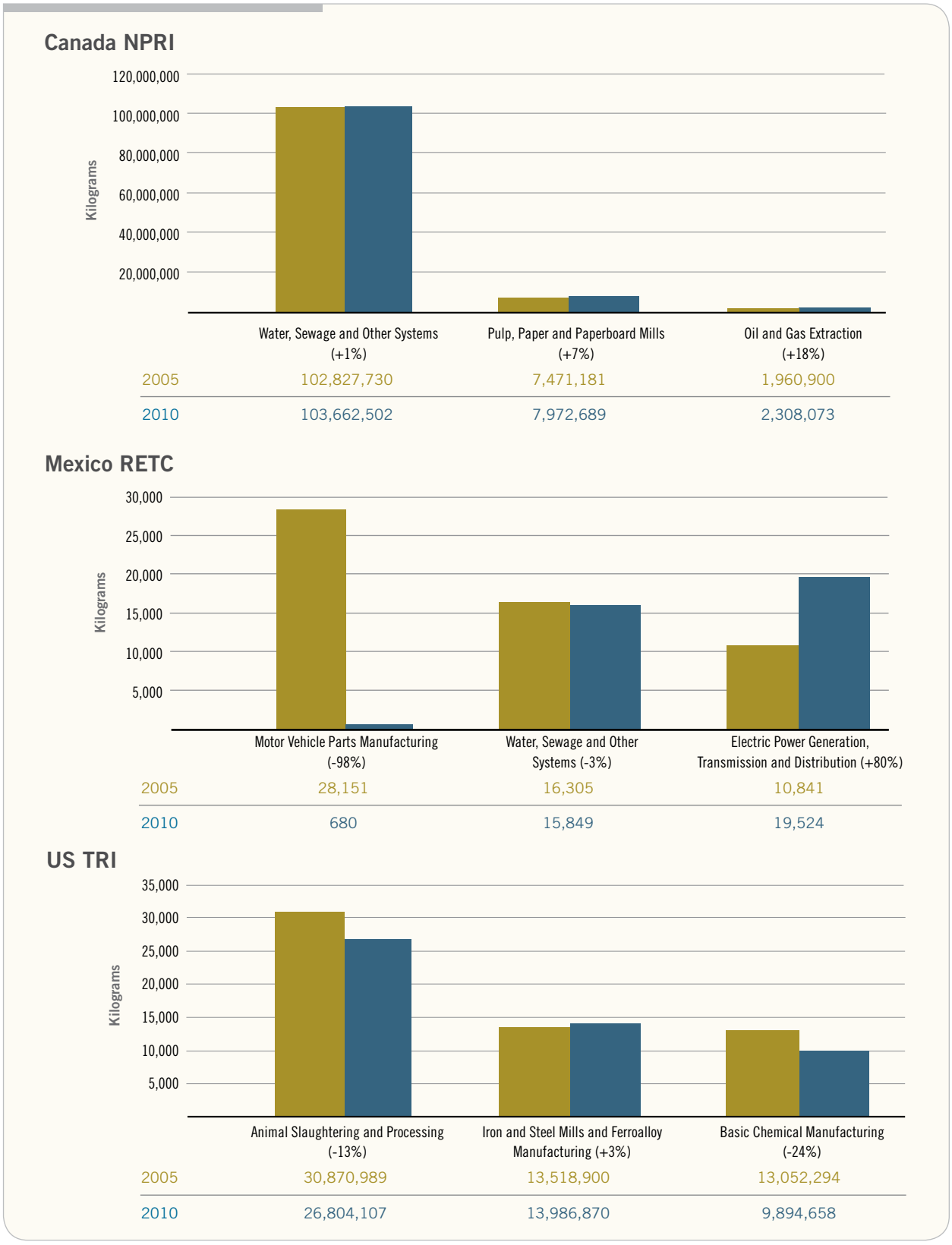
Figure 12 shows that releases to water from the water and wastewater treatment sector were driven by reporting in Canada. In 2010, 176 of the 3,700 such facilities in that country (mainly municipal wastewater treatment plants in large metropolitan areas) reported releases to water of more than 103 million kilograms, or 98 percent of all releases by this sector in North America. In Mexico, a total of 13 facilities in this sector (most of them privately owned) reported releases to water in 2010; while in the United States, a total of five water and wastewater treatment plants reported about 2 million kilograms in releases to water that year (most of which corresponded to one meat-processing facility).

It is important to note, however, that in the United States, municipal or state-owned water and wastewater treatment facilities (called publicly-owned treatment works, or POTWs) are not subject to TRI reporting; and while facilities discharging to national water bodies in Mexico are subject to RETC reporting, very few wastewater treatment plants reported in the 2005-2010 period. There are an estimated 16,000 POTWs in the United States and 1,600 public wastewater treatment plants in Mexico.[17] Considering the data reported by such facilities in Canada, there would likely be a substantial increase in the data for releases to water if facilities in this sector reported in all three countries.

The animal slaughtering and processing sector was the second-ranked industry for releases to water in North America, with Figure 12 showing these data driven by reporting in the United States. In 2010, approximately 100 US facilities in this sector reported releases to water, with many of them reporting decreases over the 2005–2010 period. US and Canadian animal slaughtering and processing facilities are subject to PRTR reporting, while in Mexico most facilities in this sector are under state jurisdiction and/or do not meet federal reporting requirements relative to discharges to national water bodies.

17. CEC. 2011. *Taking Stock: North American Pollutant Releases and Transfers 13*. Montreal, Canada: Commission for Environmental Cooperation.

Figure 12. Top Reporting Industry Sectors for Releases to Water in Canada, Mexico and the United States, 2005–2010



Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

Figure 12 reveals notable changes in reported releases to water from some of the top reporting sectors in Mexico, such as a 98 percent decrease from the motor vehicle parts manufacturing sector—with about 100 facilities in this sector reporting releases to water in 2005, but only 25 facilities reporting such releases in 2010. The 80 percent increase from the Mexican electric power sector can be mainly attributed to one private utility in Tamaulipas that reported about 59 percent of total releases to water for this sector in 2010, but did not report in 2005. Although fewer pollutants are subject to PRTR reporting in Mexico than in the United States and Canada, one might expect to see more reporting of releases to water in that country since, as mentioned earlier, any facility discharging into national water bodies is subject to the RETC.

Table 14 presents the top pollutants released to water by the top five North American sectors, which together accounted for 78 percent of total releases to water in 2010.

Water and wastewater treatment plants handle pollutants generated by a wide range of residential, commercial and industrial sources. This sector accounted for the largest releases to water of nitric acid and nitrate compounds, with these releases increasing between 2005 and 2010. It also reported large proportions of ammonia and phosphorous (with releases to water of both pollutants declining over this period). It should be noted that total phosphorous (a measure of all forms of phosphorus found in a sample) is only subject to PRTR reporting in Canada. These pollutants are often the result of organic matter, fertilizers and other pollutants in the waste stream which, when discharged to waterways, can lead to nutrient enhancement, a primary cause of excessive eutrophication (during the natural aging of aquatic systems)—which in turn contributes to the creation of areas of depleted oxygen that can kill fish and other aquatic organisms (often called "dead zones").[18]

Nitric acid and nitrate compounds and ammonia were the top reported pollutants for each of the sectors shown in this table, including the US animal slaughtering and processing sector, which reported decreases between 2005 and 2010. Nitrates are associated with processes such as meat packing and preparation in the food manufacturing sector. Reported releases to water of chlorine by this sector increased by over 2,500 percent, mainly due to one facility in Kentucky. In Canada, a total of five facilities in the animal slaughtering and processing sector reported over this period, with releases to water of approximately 732,000 kilograms in 2005 and 422,000 kilograms in 2010.

Table 14. Top Reporting Industry Sectors for Releases to Water, and Top Reported Pollutants, North America, 2005–2010

Industry Sector (NAICS-4 Code)	Releases to Water 2010 (kg)	Pollutant	Releases to Water 2010 (kg)	% Change 2005–2010	Canada NPRI (%)	Mexico RETC (%)	US TRI (%)
Water, Sewage and Other Systems (2213)	105,776,036	**Nitric Acid and Nitrate Compounds** (CA, US)	57,151,544	10	96	--	4
		Ammonia, Total (CA, US)	43,707,196	-12	100	--	0
		Phosphorous, Total (CA)	4,297,181	-11	100	--	--
Animal Slaughtering and Processing (3116)	27,227,048	**Nitric Acid and Nitrate Compounds** (CA, US)	27,139,413	-14	1	--	99
		Ammonia, Total (CA, US)	43,134	4	51	--	49
		Chlorine (CA, US)	34,643	2,576	--	--	100
Pulp, Paper, and Paperboard Mills (3221)	15,683,803	**Nitric Acid and Nitrate Compounds** (CA, US)	4,629,247	-6	37	--	63
		Ammonia, Total (CA, US)	4,105,726	58	83	--	17
		Manganese (and compounds) (CA, US)	2,952,440	-9	35	--	65
Iron and Steel Mills and Ferroalloy Manufacturing (3311)	14,236,669	**Nitric Acid and Nitrate Compounds** (CA, US)	13,378,193	7	0	--	100
		Sodium Nitrite (CA, US)	354,361	-53	0	--	100
		Ammonia, Total (CA, US)	148,131	7	63	--	37
Basic Chemical Manufacturing (3251)	10,263,491	**Nitric Acid and Nitrate Compounds** (CA, US)	8,747,811	-25	3	--	97
		Ammonia, Total (CA, US)	537,280	18	3	--	97
		Manganese (and compounds) (CA, US)	199,007	-48	7	--	93
Total, Top 5 Sectors	**173,187,048**	**Total, Top Reported Pollutants**	**167,425,308**				
%, Top 5 Sectors, of Total Releases to Water	**78**						

Note: A "--" means the pollutant has not been reported.
Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

18. CEC. 2011. *Taking Stock: North American Pollutant Releases and Transfers 13.* Montreal, Canada: Commission for Environmental Cooperation.

The basic chemical manufacturing sector (mainly in the United States) reported substantial decreases in releases to water of nitric acid and nitrate compounds. Two chemical manufacturers, BASF Corporation in Texas (which manufactures acrylic and styrene dispersions used as binders in coatings and adhesives) and the Dupont Belle plant in West Virginia (which produces chemicals for dyes, perfumes and fabric softeners, etc.), accounted for large decreases in releases to water of these compounds.

Releases to water of nitrates and of manganese and its compounds from Canadian and US pulp, paper and paperboard mills decreased between 2005 and 2010, while releases of ammonia increased by 58 percent. Ammonia can be released as a result of the treatment of wastewater at pulp and paper mills. A number of metals, including manganese compounds, are present in the fuels used in mill boilers, as well as are released from wood through various pulp and papermaking processes (see Chapter 3).

US iron and steel mills and ferroalloy manufacturers reported a 53 percent decrease in releases to water of sodium nitrite over this period. Reported releases to water of all pollutants from this US sector increased slightly between 2005 and 2010, but only five of the 100 facilities reported releases of sodium nitrite in 2005, with only one reporting in 2010. Sodium nitrite is often used as a cleaning and degreasing agent for metals, and is an effective rust inhibitor.

Table 15. Top Reporting Industry Sectors for Releases to Water of Pollutants Common to NPRI, RETC and TRI, 2005–2010

Pollutant	PRTR	Top Contributing Sectors, 2005	Releases to Water 2005 (kg)	% Change 2005–2010
Acetaldehyde	Canada NPRI	Pulp, Paper, and Paperboard Mills	21,816	-39
	Mexico RETC	–	--	–
	US TRI	Pulp, Paper, and Paperboard Mills	150,683	3
		Total Acetaldehyde, Top Sectors	**172,499**	
Arsenic (and compounds)	Canada NPRI	Metal Ore Mining	40,935	-96
	Mexico RETC	Motor Vehicle Parts Manufacturing	10,355	-100
	US TRI	Electric Power Generation, Transmiss/Distrib.	45,580	-60
		Total Arsenic (and compounds), Top Sectors	**96,870**	
Benzene	Canada NPRI	Oil and Gas Extraction	107,178	17
	Mexico RETC	–	--	–
	US TRI	Petroleum and Coal Products Mfg.	3,557	-74
		Total Benzene, Top Sectors	**110,735**	
Formaldehyde	Canada NPRI	Pulp, Paper, and Paperboard Mills	59,182	-41
	Mexico RETC	Motor Vehicle Manufacturing	96	–
	US TRI	Pulp, Paper, and Paperboard Mills	121,509	-43
		Total Formaldehyde, Top Sectors	**180,787**	
Nickel (and compounds)	Canada NPRI	Metal Ore Mining	29,807	-64
	Mexico RETC	Motor Vehicle Parts Manufacturing	7,635	-97
	US TRI	Electric Power Generation, Transmiss/Distrib.	49,900	-50
		Total Nickel (and compounds), Top Sectors	**87,342**	
Phenol	Canada NPRI	Oil and Gas Extraction	72,450	-31
	Mexico RETC	Grain and Oilseed Milling	222	–
	US TRI	Petroleum and Coal Products Mfg.	28,554	-85
		Total Phenol, Top Sectors	**101,226**	

Note: A "--" means the pollutant has not been reported.
Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

Of the top 20 reported pollutants released to water between 2005 and 2010 (see Figure 10), only six are subject to all three PRTR programs. They are phenol, acetaldehyde, benzene, formaldehyde, and nickel and arsenic (and their compounds). Table 15 shows the reported releases to water of these six pollutants in each country in 2005, and the sectors reporting them. It reveals both similarities and differences among the three countries in terms of reporting sectors, amounts released to water, and the magnitude and direction of 2005–2010 changes.

For example, in Canada and the United States, pulp, paper and paperboard mills reported the largest proportions of releases to water of acetaldehyde and formaldehyde, with these releases generally decreasing between 2005 and 2010. In the United States, there was a noticeable increase in releases to water of acetaldehyde in 2008 from two mills. Trace quantities of acetaldehyde and formaldehyde may be coincidentally manufactured during pulp and paper manufacturing processes. Releases to water of acetaldehyde were not reported by Mexican facilities, while relatively small amounts of formaldehyde were reported released to water in that country by the motor vehicle manufacturing sector, only through 2008.

Different sectors in each country accounted for the top releases to water of arsenic and its compounds, with each reporting decreases in these releases from 2005 through 2010. Arsenic is a naturally occurring metal found in the environment, especially as an impurity in metal ores. Arsenic compounds are commonly used to preserve wood, as metal alloys, and in pesticides.

Known or Suspected Carcinogens, Developmental or Reproductive Toxicants, Metals, and PBTs

In order to provide more information about PRTR pollutants, the *Taking Stock* report and *Taking Stock Online* database also categorize them as follows (with many of the pollutants reported to the North American PRTRs falling into one or more of these categories)[19]:

- **Known or suspected carcinogens**, based on the World Health Organization's International Agency for Research on Cancer (IARC) and California's Office of Environmental Health Hazard Assessment (OEHHA) *Proposition 65* list.
- **Developmental or reproductive toxicants**, based on California's *Proposition 65* list. These substances adversely affect reproductive capabilities and/or the development of the fetus. Metals, solvents, and pesticides have been widely implicated in reproductive and/or developmental impacts. Endocrine disruptors have also been added to this category.
- **Persistent, bioaccumulative and toxic substances (PBTs)**. These pollutants have properties that render them a long-term environmental and health threat, even in small quantities. When PBTs are released into the environment, they persist over long periods of time and do not break down easily into other compounds; they can be transported in the atmosphere over long distances, ending up far from the sources of their release; and they bioaccumulate in the food chain (increasing in concentration at higher levels). They are also toxic, often causing damage to humans, plants and wildlife.
- **Metals**. Metals occur naturally, but human activities such as mining and smelting increase the proportions of metals in the environment. The toxicity of certain metals and their compounds depends on the forms they take in the environment.

Assessing potential harm to human health or the environment from particular releases of a pollutant is a complex task, because the potential of a substance to cause harm arises from various factors, including its inherent toxicity and the nature of the exposure to the substance (e.g., the potential risk posed by asbestos sent to a secure landfill is considered to be much lower than the risk posed by asbestos released to air). However, the reported data and information about a pollutant's chemical properties and toxicity can serve as a starting point for learning more about its potential impacts.

19. For more information about the references for these categories of pollutants, see Appendix 1.

Releases to water of benzene and phenol were reported by the oil and gas extraction sector in Canada and the petroleum and coal products manufacturing sector in the United States (perhaps reflecting the fact that in the United States, the oil and gas extraction sector is not subject to the TRI). Benzene, a component of crude oil and gasoline, is a flammable liquid that evaporates into the air and dissolves slightly in water. It is used widely to make other chemicals for the production of plastics, resins, fibers, lubricants, and so on. Phenol is used mainly in the production of resins, nylon and other synthetic fibers. In Mexico, no releases to water of benzene, and relatively small quantities of phenol (from the grain and oilseed milling sector) were reported during this period.

The largest releases to water of nickel and its compounds were reported by different industry sectors in each country, with these releases declining between 2005 and 2010. Nickel is a metal found in the environment, and can be released into the atmosphere by fossil fuel–burning power plants, as well as through mining activities and the forging of metal alloys for the production of coins, jewelry, batteries, stainless steel, and so on.

2.3 Releases to Air and Water of Known or Suspected Carcinogens, Developmental or Reproductive Toxicants, Metals, and PBTs, 2005–2010

The preceding analyses of releases to air and water highlighted the top reported pollutants—that is, those released in largest proportions by North American industrial facilities between 2005 and 2010. This section examines reported releases to air and water over this period of pollutants belonging to one or more of four categories of pollutants: known or suspected carcinogens; developmental or reproductive toxicants; metals; and persistent, bioaccumulative and toxic substances (PBTs). A number of the pollutants in these categories are considered to be of special concern because of their significant potential to cause harm to human health and the environment, even when released in relatively small amounts.

Between 2005 and 2010, North American industrial facilities reported total releases and transfers of more than 200 pollutants belonging to one or more of these four categories (see Table 2). Of these substances, only 42 are common to the three PRTR programs. Some of these pollutants were among those reported in largest proportions by North American facilities; however, many others were reported in relatively small amounts. As a result, these substances might not appear in a table of "top" releases, even though the potential for some of them to cause harm when released directly to the environment (i.e., to air or water) is significant. Therefore, *Taking Stock* provides additional toxicity-based information for certain pollutants, in the form of toxicity equivalency potentials (TEPs). This chemical ranking system takes into account both a substance's toxicity and its potential for human exposure.

2.3.1 Releases to Air of Known or Suspected Carcinogens, Developmental or Reproductive Toxicants, Metals, and PBTs, 2005–2010

In 2010, facilities in North America reported a total of over 74.4 million kilograms in releases to air of 220 pollutants belonging to one or more of these four categories, compared to almost 120 million kilograms in 2005—a decrease of 38 percent. These pollutants accounted for about 15 percent of total releases to air reported in both 2005 and 2010.

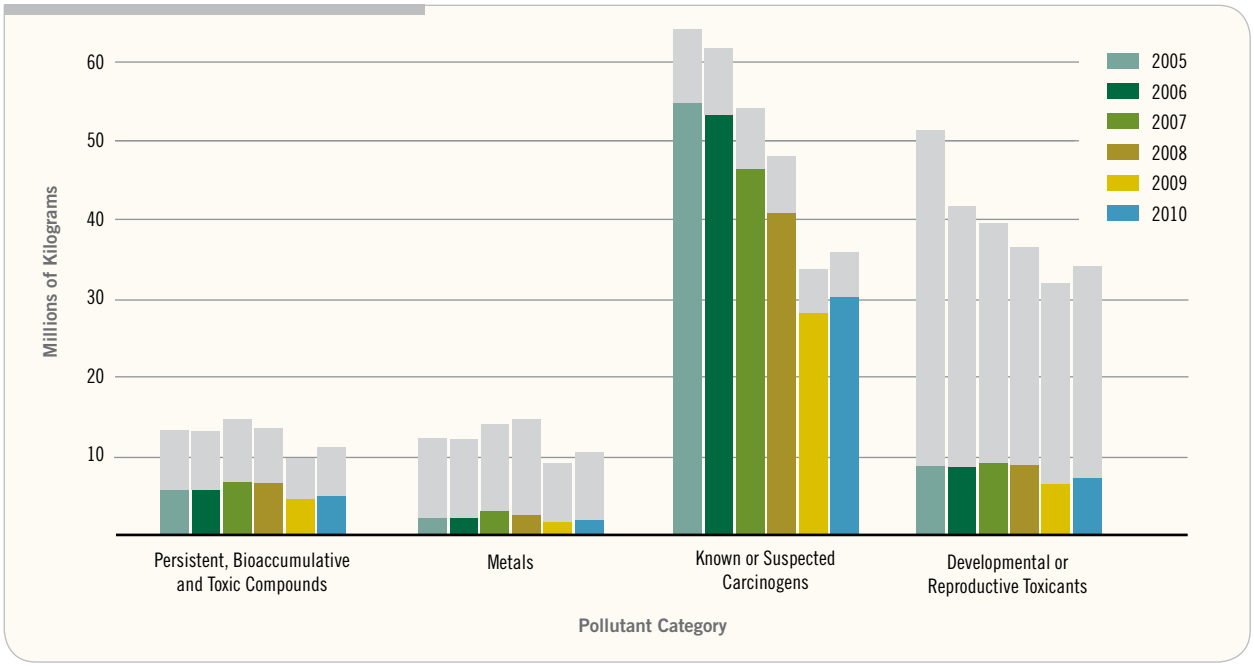
Toxic Equivalency Potentials (TEPs)

TEPs indicate the relative human health risk associated with the release of one unit of a pollutant, compared to the risk posed by the release of one unit of a reference substance. The reference chemical for carcinogens is benzene and the reference chemical for pollutants that produce non-cancerous health effects (e.g., developmental or reproductive toxicity, acute respiratory effects) is toluene. TEPs provide a chemical ranking system that takes into account both a pollutant's toxicity and its potential for human exposure. However, this analysis is limited in that a release does not directly correlate to actual exposures, nor to levels of risk. In addition, TEPs are only available for air and water releases, and not all of the PRTR pollutants have an assigned TEP (information on their toxicity or exposure potential may be missing). Nonetheless, they should not be assumed to be without risk. The TEPs used in *Taking Stock* are one of many different screening tools, each based on a series of assumptions and, therefore, possibly yielding different results. *Taking Stock* provides TEPs for air and water releases of known or suspected carcinogens and other substances with potential non-cancerous health effects. The TEP is multiplied by the amount of release and the result is used to rank the pollutants. For more information, see Appendix 1.

Petr Kratochvil

Figure 13 illustrates the impacts of differences in national PRTR reporting requirements on our understanding of pollutant releases to the environment by industrial facilities. Reported releases of pollutants in these four categories that are common to the three PRTRs are represented by the brightly-colored, bottom portions of the bars in this graph, while reported releases of all such pollutants are represented by the upper, gray portions. Particularly notable is the difference among reported releases of all developmental and reproductive toxicants, compared to releases of those that are common to the three PRTRs. Some of the pollutants in this category that were released to air in large proportions over this period include toluene (with about 17.3 million kilograms reported in 2010) and carbon disulfide (with 8.4 million kilograms reported in 2010). These substances are subject to PRTR reporting in Canada and the United States, but not Mexico.

Figure 13. Releases to Air of Known/Suspected Carcinogens, Developmental/Reproductive Toxicants, Metals and PBTs: North American PRTRs, 2005–2010



Note: Color columns refer to pollutants common to the 3 PRTRs; grey columns refer to pollutants in these categories subject to PRTR reporting in at least one country. Some pollutants belong to more than one category. Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

2.3.2 Releases to Water of Known or Suspected Carcinogens, Developmental or Reproductive Toxicants, Metals, and PBTs, 2005–2010

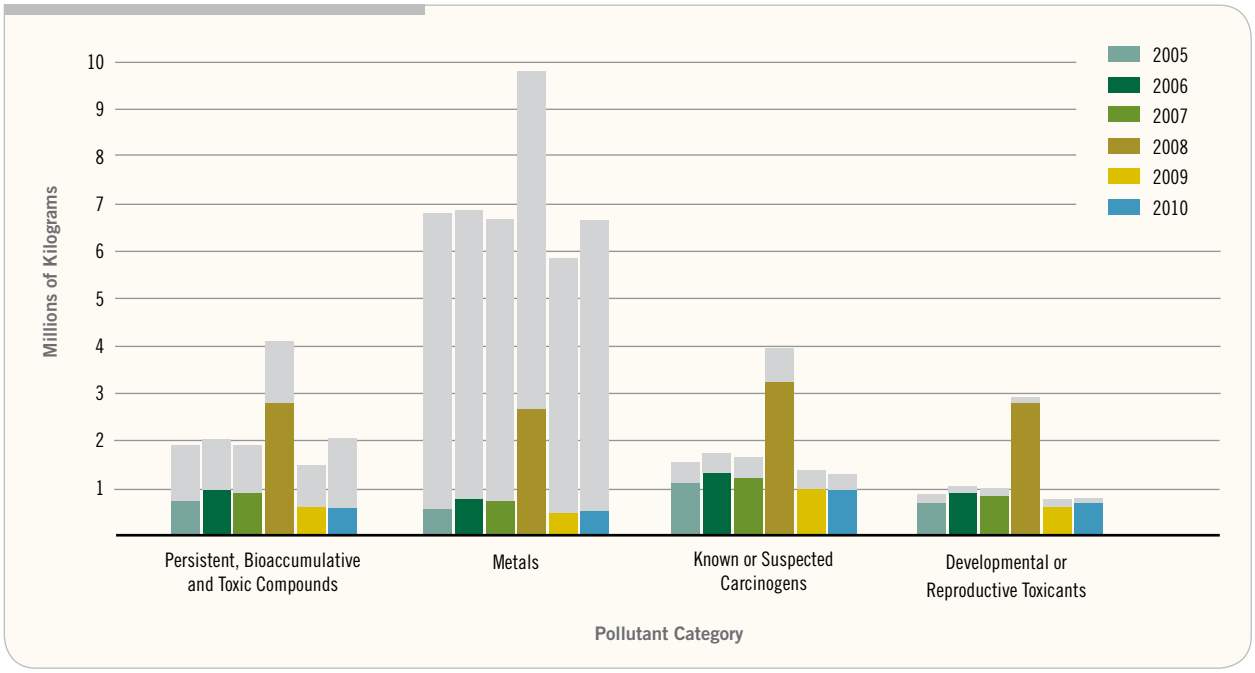
In 2010, facilities in North America reported releases to water of more than 7.34 million kilograms of pollutants belonging to one or more of these four categories, a decrease of about 5 percent in comparison with 2005 levels. These pollutants accounted for three percent of total releases to water reported in both 2005 and 2010, with metals accounting for the largest proportions.

As in the preceding figure, reported releases to water of pollutants in these four categories that are common to the three PRTRs are represented by the brightly-colored, bottom portions of the bars in Figure 14, while reported releases of all such pollutants are represented by the upper, gray portions. This graph reveals a very notable difference between reported releases to water of all metal compounds and those that are common to the three PRTRs. Some of the metals released to water in largest proportions over this period include manganese, zinc and copper and their compounds. These pollutants are subject to PRTR reporting in Canada and the United States, but not Mexico. In fact, 18 metals are common to Canada's NPRI and the US TRI, while only six are subject to reporting under Mexico's RETC.

The 42 pollutants in these categories that are common to the three North American PRTRs are featured in Table 16. This table presents their reported releases to air and water in 2010, and the percent change in these releases from 2005. It also provides each pollutant's corresponding cancer and non-cancer risk (TEP) scores, if available. The TEP score is obtained by multiplying the volume of air or water release of a pollutant by its assigned TEP weight.

This table reveals notable decreases between 2005 and 2010 in reported releases to air or water of pollutants that have very high cancer or non-cancer TEP scores, including lead and mercury compounds. It also shows increases for some pollutants, such as chromium and its compounds. In some cases, releases to air declined substantially while releases to water increased, or vice-versa (e.g., cadmium and its compounds).

Figure 14. Releases to Water of Known/Suspected Carcinogens, Developmental/Reproductive Toxicants, Metals and PBTs: North American PRTRs, 2005–2010



Note: Color columns refer to pollutants common to the 3 PRTRs; grey columns refer to pollutants in these categories subject to PRTR reporting in at least one country. Some pollutants belong to more than one category. Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

Table 16. Reported Releases of C, D, M, P Common to the North American PRTRs, 2005–2010

Pollutant	C	D	M	P*	Releases to Air 2010 (kg)	% Change 2005–2010	Cancer Risk Score for Air (TEP) 2010	Non-cancer Risk Score for Air (TEP) 2010	Releases to Water 2010 (kg)	% Change 2005–2010	Cancer Risk Score for Water (TEP) 2010	Non-cancer Risk Score for Water (TEP) 2010
1,1,2,2-Tetrachloroethane	X				6,713	359	59,743	6,041	135	4,867	852	176
1,1,2-Trichloroethane	X				8,691	16	18,252	42,588	106	-3	253	1,478
1,2,4-Trichlorobenzene				X	4,932	-80	592	47,345	0	--	--	--
1,2-Dichlorobenzene				X	18,024	-64	--	147,800	121	-76	--	1,206
1,2-Dichloroethane	X				214,725	-7	536,813	901,846	391	-71	1,133	1,875
1,3-Butadiene	X	X			632,593	-26	335,274	1,391,704	321	200	1,542	2,410
1,4-Dichlorobenzene	X			X	17,962	-64	25,147	39,517	5	-99	4	6
1,4-Dioxane	X				59,221	-19	4,738	2,961	15,776	-57	1,420	789
2,4-Dinitrotoluene	X	X			4,735	-70	20,832	473,464	0	--	--	--
2-Ethoxyethanol		X			44,979	16	--	58,473	38,793	155	--	3,103
2-Nitropropane	X				16,950	12	372,908	98,312	0	--	--	--
Acetaldehyde	X				4,730,047	-35	47,300	43,989,441	174,523	-4	1,099	890,068
Acrylamide	X				6,649	8	864,376	13,298,099	462	200	738	11,538
Acrylonitrile	X				187,531	-18	731,369	7,126,162	56	-99	89	1,059
Aniline	X				44,202	-40	442	4,022,372	1,321	19	9	75,297
Arsenic (and compounds)	X	X	X	X	100,012	-28	1,600,184,124	8,400,966,650	129,375	0	517,499,597	2,587,497,987
Asbestos	X				3,273	304	--	--	0	--	--	--
Benzene	X	X			2,673,221	-22	2,673,221	21,653,094	127,501	11	96,901	1,275,009
Bromomethane		X			231,994	13	--	371,190,081	569	2,750	--	511,924
Cadmium (and compounds)	X	X	X	X	22,227	-43	577,892,679	42,230,618,839	12,936	8	24,578,707	1,811,062,631
Carbon Tetrachloride	X				49,923	-42	13,479,084	114,821,830	207	18	53,766	475,623
Chloroform	X	X		X	273,049	-29	436,878	3,822,681	4,701	-66	7,052	75,222
Chloromethane		X			909,936	-11	600,558	51,866,333	1,065	100	415	36,210
Chromium (and compounds)	X	X	X	X	660,678	56	85,888,129	2,048,101,549	116,635	40	--	51,319,524
Cyanides				X	137,884	-34	--	--	29,360	-40	--	--
Dibutyl Phthalate		X		X	5,356	-49	--	58,912	65	-75	--	118
Dichloromethane	X				2,273,625	-27	454,725	15,915,377	1,047	-60	136	4,608
Dioxins and Furans	X	X		X	0.03	-39	36,604,320	26,843,168,000	0	-21	415,242	294,882,000
Epichlorohydrin	X	X			51,095	-9	56,205	10,730,050	3,077	-76	1,385	255,392
Formaldehyde	X				3,572,996	-50	71,460	57,167,936	122,103	-41	98	35,410
Hexachlorobenzene	X	X		X	130	-68	285,538	2,725,592	41	30	138,430	1,343,583
Hexachloroethane	X				536	131	139,366	2,948,130	0	--	--	--
Hydrazine	X				1,891	68	41,598	737,420	937	-64	2,249	131,201
Lead (and compounds)	X	X	X	X	523,674	-29	14,662,879	303,731,071,594	75,972	-30	151,944	3,190,824,850
Mercury (and compounds)	X	X	X	X	50,771	-27	--	710,796,430,922	2,215	-85	--	28,789,247,625
Nickel (and compounds)	X	X	X	X	704,364	-28	1,972,220	2,253,966,102	171,722	-15	--	4,464,777
Phenol				X	2,625,841	-7	--	997,820	67,372	-46	--	310
Pyridine	X				17,785	-50	--	1,316,100	434	-9	--	3,469
Styrene	X				11,866,513	-54	--	949,321	1,445	-43	--	491
Toluenediisocyanate (mixed isomers)	X				14,351	-2	--	--	0	--	--	--
Trichloroethylene	X				1,191,881	-62	59,594	750,885	334	38	43	401
Vinyl Chloride	X				234,773	-21	446,069	16,199,355	176	-62	811	24,693
Total, Reported C, D, M, P Pollutants Common to the 3 PRTRs					**34,195,732**				**1,101,298**			
Total, All Reported C, D, M, P Pollutants					**74,425,550**				**7,347,276**			
Total, All Reported Pollutants					**514,173,851**				**221,806,836**			

*C = known/suspected carcinogen; D = developmental/reproductive toxicant; M = metal; P = persistent, bioaccumulative, toxic (PBT) substance.
Note: A "--" in place of a TEP score means that either the pollutant has a score of 0, or it has not been evaluated.
Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

2.3.3 Reported Releases to Air and Water of Selected Pollutants of Special Concern

The six pollutants in Table 17 belong to at least three of the four pollutant categories. They were selected because they are subject to PRTR reporting in all three countries, and because of the contrast between their reported volumes (in kilograms) and their associated cancer and/or non-cancer risk (TEP) scores, which illustrate their potential toxicity even when released to air or water in relatively small amounts. These substances are therefore considered to be pollutants of special concern.

Information about the sectors and facilities reporting releases to air and water of these six pollutants is presented below. Additional information about their typical industrial uses or production, as well as their chemical properties and potential to cause harm to human health or the environment, is provided in Appendix 5.

Arsenic and its compounds: The nonferrous metal (except aluminum) production and processing sector accounted for about one-third of all releases to air of arsenic and its compounds in 2010. Among the 40 reporting facilities in this sector, two Canadian facilities accounted for a large part of

Table 17. Reported Releases of Pollutants of Special Concern Common to the Three PRTRs, 2005–2010

Pollutant	Category* of Pollutant	Medium of Release	Total Releases 2010 (kg)	Cancer Risk Score (TEP) 2010	Non-cancer Risk Score (TEP) 2010	Top Contributing Industry Sectors	Releases 2010 (kg)	% Change 2005–2010	Canada NPRI (%)	Mexico RETC (%)	US TRI (%)
Arsenic (and compounds)	CDMP	Air	100,012	1,600,184,124	8,400,966,650	Nonferrous Metal (except Alum.) Production/Processing	35,554	-48	78	2	20
		Water	129,375	517,499,597	2,587,497,987	Metal Ore Mining	94,709	120	2	0	98
Cadmium (and compounds)	CDMP	Air	22,227	577,892,679	42,230,618,839	Nonferrous Metal (except Alum.) Production/Processing	13,216	-60	91	4	5
		Water	12,936	24,578,707	1,811,062,631	Electric Power Generation, Transmission and Distribution	2,976	445	0	99	0
Lead (and compounds)	CDMP	Air	523,674	14,662,879	303,731,071,594	Nonferrous Metal (except Alum.) Production/Processing	146,836	-41	48	17	35
		Water	75,972	151,944	3,190,824,850	Water, Sewage and Other Systems	16,684	27	72	28	–
Mercury (and compounds)	CDMP	Air	50,771	-	710,796,430,922	Electric Power Generation, Transmission and Distribution	31,736	-31	5	–	95
		Water	2,215	-	28,789,247,625	Electric Power Generation, Transmission and Distribution	1,358	917	0	74	25
Hexachlorobenzene	CDP	Air	130	285,538	2,725,592	Basic Chemical Manufacturing	85	258	0	–	100
		Water	41	138,430	1,343,583	Basic Chemical Manufacturing	21	26	0	–	100
Chromium (and compounds)	CDMP	Air	660,678	85,888,129	2,048,101,549	Motor Vehicle Body and Trailer Manufacturing	389,159	5,925	0	–	100
		Water	116,635	-	51,319,524	Basic Chemical Manufacturing	33,034	544	0	12	88
Total, Releases of 6 Pollutants of Special Concern to Air			1,357,491	2,278,913,349	1,067,209,915,146	Total, Releases from Top Contributing Sectors to Air	616,585				
Total, Releases of 6 Pollutants of Special Concern to Water			337,173	542,368,678	36,431,296,200	Total, Releases from Top Contributing Sectors to Water	148,782				

*C = known or suspected carcinogen; D = developmental or reproductive toxicant; M = metal; P = persistent, bioaccumulative and toxic (PBT) substance.
Note: A "–" means that either the pollutant has not been reported or in the case of TEP, it has a score of 0 or has not been evaluated.
Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

the 48 percent decrease from 2005 through 2010: the Vale Canada Copper Cliff smelter in Ontario, and the Hudson Bay Mining and Smelting complex in Manitoba (which was in the process of shutting down during this period). The metal ore mining sector was the top reporter of releases to water of arsenic and its compounds, with the number of facilities increasing from 37 in 2005 to 55 in 2010. One US facility, the Jerritt Canyon mine in Nevada, accounted for 98 percent of the releases reported by this sector in 2010.

Cadmium and its compounds: The nonferrous metal (except aluminum) production and processing sector was also the top industry sector for releases to air of cadmium and its compounds, accounting for about 58 percent of all such releases in 2010. This sector reported a 60 percent decrease in releases of this pollutant from 2005 through 2010, with one facility, the Hudson Bay Mining and Smelting complex in Manitoba, accounting for much of this decrease (as mentioned above, this facility was shutting down during this period). Facilities in the electric power generation, transmission and distribution sector reported almost one-quarter of total releases to water of cadmium and its compounds in 2010, with most of these releases reported in Mexico. Three utilities, two Iberdrola Energía facilities in Tamaulipas and the Promotora Ecológica San Pedro Mártir facility in Querétaro, reported most of these releases to water, and accounted for the large increase from this sector.

Lead and its compounds: The nonferrous metal (except aluminum) production and processing sector also accounted for the largest proportion (28 percent) of releases to air of lead and its compounds in 2010, with reporting facilities located in the three countries. A small number of facilities accounted for much of the decrease in these releases, including the above-mentioned Hudson Bay Mining and Smelting complex in Manitoba; the Xstrata Canada–Kidd Metallurgical Site in Ontario; the Doe Run Herculaneum Smelter in Missouri; and the Nacional de Cobre, S.A. de C.V.–Planta Cobrecel facility in Guanajuato. Facilities in the water and wastewater treatment sector in both Canada and Mexico accounted for approximately 22 percent of total releases to water of lead and its compounds in 2010, an increase of 27 percent from 2005 through 2010. Of 106 reporting facilities (87 in Canada and 19 in Mexico), a small number of public utilities accounted for much of this increase, including the Fideicomiso del Sistema de Aguas Residuales del Alto Río facility in Veracruz, Mexico; and four Canadian utilities: two City of Toronto treatment plants; the City of Montreal treatment plant; and the Greater Vancouver Regional District–Iona treatment plant.

Mercury and its compounds: Fossil fuel–based electric utilities reported large proportions of total releases to air and water of mercury and its compounds in 2010. Releases to air of this pollutant (most of them reported in the United States) decreased by 31 percent from 2005 through 2010. Mexican electric utilities accounted for about 74 percent of the reported releases to water of mercury and its compounds by this sector. From 2005 through 2010, releases to water of this pollutant increased notably, mainly due to reporting by two Mexican utilities, Electricidad Águila de Tuxpan and Electricidad Sol de Tuxpan, both located in Veracruz; and two US utilities, Dominion Resources' Yorktown Power Station in Virginia, and the US TVA Cumberland Fossil Plant in Tennessee.

Hexachlorobenzene: Approximately 65 percent of all releases to air of hexachlorobenzene in 2010 were reported by the US basic chemical manufacturing sector, with an increase of 347 percent in these releases between 2005 and 2010. Two facilities, accounting for almost 85 percent of all such releases in 2010 but not reporting in 2005, were Dow Chemical facilities: the Louisiana Operations facility in Louisiana and the Freeport facility in Texas. These same facilities also accounted for 86 percent of all releases to water of hexachlorobenzene in 2010, and for most of the increase over this period.

Chromium and its compounds: The motor vehicle body and trailer manufacturing sector accounted for 59 percent of all releases to air of chromium and its compounds in 2010, with an important increase in these releases from 2005 through 2010. Almost 100 percent of all such releases were reported by US facilities, with two of them, both Hutchens Industries facilities in Missouri, accounting for most of the total reported in 2010. The basic chemical manufacturing sector was the top reporter of releases to water of chromium and its compounds in 2010, accounting for 28 percent of the total. These releases also increased notably from 2005. Two facilities, the PCS Nitrogen Fertilizer facility in Louisiana, and a Dupont facility in Tamaulipas, Mexico, accounted for most of the reported total in 2010.

2.3.4 PRTR Reporting Thresholds

As mentioned, of the hundreds of pollutants reported by North American facilities from 2005 through 2010, a relatively small number are common to the three PRTR programs. The differences among national PRTR reporting requirements thus create gaps in our picture of North American industrial pollution, particularly with respect to releases of pollutants of special concern.

Each PRTR sets thresholds for the pollutants subject to reporting in that country. The Canadian NPRI and the US TRI have a standard "manufacture, produce, or otherwise use" (MPO) threshold of approximately 10,000 kilograms (in the United States, it is 25,000 pounds, or 11,340 kilograms), while Mexico's RETC has both MPO and "release" thresholds for its list of 104 pollutants. For certain pollutants, the PRTR programs have set stricter reporting requirements and very low reporting thresholds (or in some cases, reporting of any amount, however small). These requirements have been developed on the basis of assessments of chemical toxicity and the potential for risk to human health and the environment. For some pollutants, such as dioxins, furans and hexachlorobenzene, the need for very low reporting thresholds and units in order to capture releases of concern has been widely recognized. Similarly, lead and mercury and their compounds are reported under lower thresholds to all three PRTRs.

However, while the three PRTR programs have generally set lower thresholds for pollutants of special concern, these thresholds can still vary considerably. For example, the Canadian NPRI threshold for arsenic and its compounds is 50 kilograms; under Mexico's RETC, the MPO threshold is 5 kilograms, and the release threshold is 1 kilogram; and the US TRI threshold for arsenic and its compounds is 11,340 kilograms. In fact, only one of the 60 pollutants common to the three PRTRs has fairly similar reporting thresholds: mercury and its compounds (with a 5-kilogram threshold under NPRI; a 5-kilogram MPO and 1-kilogram "release" threshold under RETC; and a 4.5-kilogram—or 10-pound—threshold under TRI).

Recently, Canada's NPRI conducted a review of industrial-sector reporting of certain pollutants, such as selenium compounds. Selenium is generally present in raw materials at very low concentrations and in small quantities often below standard NPRI reporting thresholds. Because of this, many facilities have not been required to report on this substance. However, levels of selenium that are potentially hazardous to human health and the environment have been detected downstream from facilities and therefore it was deemed necessary to lower the reporting threshold to 100 kilograms instead of the standard 10,000 kilograms, effective as of the 2011 reporting year. Selenium is also subject to reporting under the US TRI (at a threshold of 11,340 kilograms), but is not subject to Mexico's RETC.

More information about reporting requirements and thresholds for specific pollutants is provided in Appendices 1 and 2.

2.4 Reported Releases to Land, 2005–2010

Releases to land[20] accounted for almost one-third of total reported releases and transfers in 2010, with North American facilities reporting 1,802,531,538 kilograms—an increase of 108 percent from 2005 levels.

Table 18 presents the releases to land reported by North American facilities every year from 2005 through 2010. It reveals significant differences among the three countries in the amounts reported and in the changes that occurred over this period. For example, the significant increase in releases to land over this period was driven by reporting in Canada, where facilities reported increases of more than 2,200 percent, due to changes in reporting requirements. In the United States, facilities reported a 15 percent increase in releases to land. In Mexico, facilities also reported a substantial increase, but that country's proportion of the North American total was very small (i.e., less than 1 percent in both 2005 and 2010).

Figure 15 illustrates the reported releases to land in each country in 2005 and 2010, and also presents the top reported pollutants in 2005 and the changes in their releases. These pollutants accounted for 99 percent of total releases to land in both 2005 and 2010, with many of them seeing substantial increases over this period.

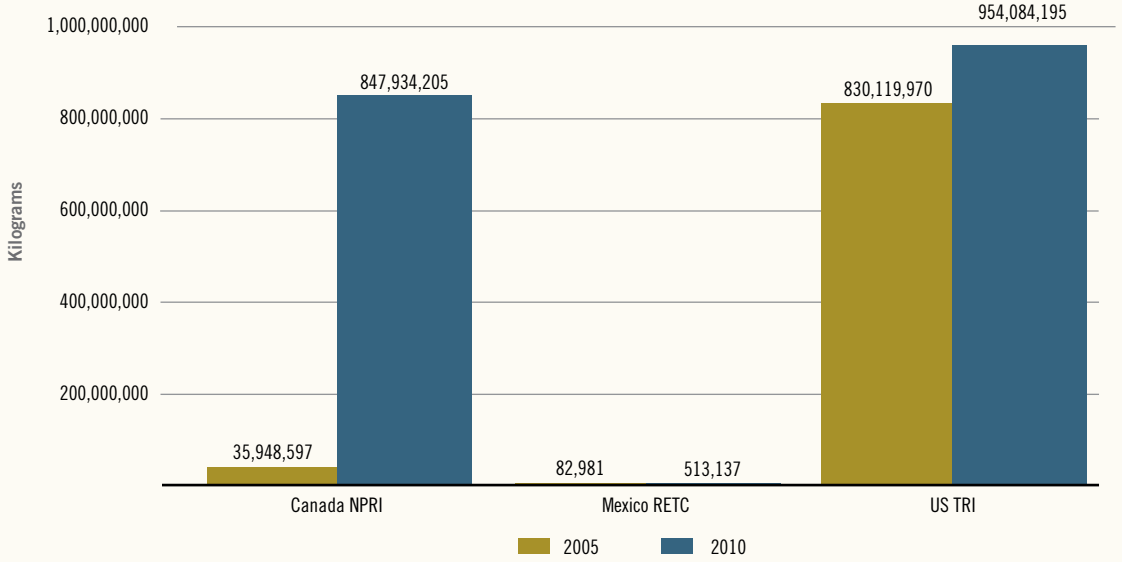
Table 18. Releases to Land Reported to the North American PRTRs, 2005–2010

PRTR	Releases to Land 2005 (kg)	Releases to Land 2006 (kg)	Releases to Land 2007 (kg)	Releases to Land 2008 (kg)	Releases to Land 2009 (kg)	Releases to Land 2010 (kg)	% Change 2005–2010	Number of Reported Pollutants	
								2005	2010
Canada NPRI	35,948,597	606,606,640	594,923,183	634,009,535	596,527,117	847,934,205	2,259	77	90
Mexico RETC	82,981	64,970	274,185	563,697	208,625	513,137	518	41	12
US TRI	830,119,970	864,578,518	811,258,930	815,119,661	781,845,861	954,084,195	15	215	183
Total, North America	**866,151,548**	**1,471,250,127**	**1,406,456,298**	**1,449,692,894**	**1,378,581,603**	**1,802,531,538**	**108**	**245**	**212**

Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

20. The term "releases to land" used in *Taking Stock* combines a variety of methods, due to differences in the terminology used by each PRTR program. Releases to land can include spills, leaks, or incidental releases; underground injection; land irrigation and land treatment/farming; and disposal on-site.

Figure 15. Releases to Land Reported in Canada, Mexico and the United States, and Top Reported Pollutants, 2005–2010



Pollutant	Releases to Land 2005 (kg)	Releases to Land 2010 (kg)	% Change 2005–2010
Zinc (and compounds) (CA, US)	263,090,340	347,235,371	32
Lead (and compounds) (CA, MX, US)	198,596,842	273,136,758	38
Arsenic (and compounds) (CA, MX, US)	82,534,116	117,629,339	43
Barium (and compounds) (US)	81,895,976	94,436,409	15
Copper (and compounds) (CA, US)	73,937,220	128,833,333	74
Manganese (and compounds) (CA, US)	65,201,853	379,759,801	482
Vanadium (and compounds) (CA, US)	21,315,594	29,746,058	40
Chromium (and compounds) (CA, MX, US)	14,390,959	35,231,655	145
Asbestos (CA, MX, US)	10,576,147	35,784,638	238
Nickel (and compounds) (CA, MX, US)	10,393,366	47,780,000	360
Nitric Acid and Nitrate Compounds (CA, US)	8,574,678	8,448,995	-1
Aluminum (fume or dust) (CA, US)	6,154,897	4,489,317	-27
Antimony (and compounds) (CA, US)	4,008,847	6,800,756	70
Phosphorous, Total (CA)	3,473,330	161,036,509	4,536
Ethylene Glycol (CA, US)	2,479,978	6,241,522	152
Cobalt (and compounds) (CA, US)	2,423,284	6,360,392	162
Ammonia, Total (CA, US)	2,113,536	5,340,296	153
Mercury (and compounds) (CA, MX, US)	1,877,839	2,225,147	18
Aluminum Oxide (fibrous forms) (CA, US)	519,382	57,317,164	10,936
Calcium Fluoride (CA, US)	114,200	28,810,147	25,128
Total, Top 20 Pollutants Released to Land	**853,672,386**	**1,776,643,606**	
Total, All Pollutants Released to Land	**866,151,548**	**1,802,531,538**	
%, Top 20 Pollutants, of Total Releases to Land	**99**	**99**	

Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

This figure reveals that the large increase in reported releases to land from 2005 through 2010 was driven by reporting in Canada and, especially, by changes in NPRI reporting requirements for mining and oil and gas extraction operations as of 2006—including the requirement to report tailings and waste rock, and the removal of the reporting exemption for mining extraction and crushing activities. The impact of these changes in NPRI reporting requirements on pollutant accounting is shown in Table 19, which reveals notable increases from 2005 to 2006 in releases to land of the top 15 reported pollutants in Canada. These pollutants accounted for about 4 percent of total reported releases to land in North America in 2005, but 40 percent of the total in 2006—with the large majority reported by the Canadian mining and extractive sectors.

Table 19. Top Pollutants Released to Land, Canadian NPRI, 2005–2006

Pollutant	Releases to Land 2005 (kg)	Releases to Land 2006 (kg)	% Change 2005–2006
Zinc (and compounds)	9,854,818	75,368,384	665
Asbestos	6,354,377	11,847,411	86
Manganese (and compounds)	5,331,181	197,522,419	3,605
Phosphorous, Total	3,473,330	84,273,678	2,326
Lead (and compounds)	3,039,718	29,075,962	857
Vanadium (and compounds)	1,289,762	10,228,328	693
Chromium (and compounds)	963,506	37,034,374	3,744
Copper (and compounds)	899,895	55,397,107	6,056
Nickel (and compounds)	576,158	54,354,071	9,334
Ammonia, Total	421,232	9,006,103	2,038
Arsenic (and compounds)	247,279	13,000,973	5,158
Nitric Acid and Nitrate Compounds	182,282	11,176,993	6,032
Cobalt (and compounds)	40,996	4,087,332	9,870
Antimony (and compounds)	17,002	495,838	2,816
Aluminum (fume or dust)	112	2,118,555	1,891,467
Total, Top 15 Pollutants Released to Land (NPRI)	32,691,648	594,987,526	
Total, All Pollutants Released to Land (North America)	866,151,548	1,471,250,127	
%, Top 15 Pollutants (NPRI), of Total Releases to Land (NA)	4	40	

2.4.1 Top Sectors Reporting Releases to Land in North America, 2005–2010

The five North American industry sectors reporting the largest proportions of total releases to land from 2005 through 2010 are shown in Figure 16. These sectors accounted for 1,568,703,713 kilograms, or 87 percent of total reported releases to land in 2010, with the metal ore mining sector alone reporting 1.18 billion kilograms (or almost 66 percent of the total).

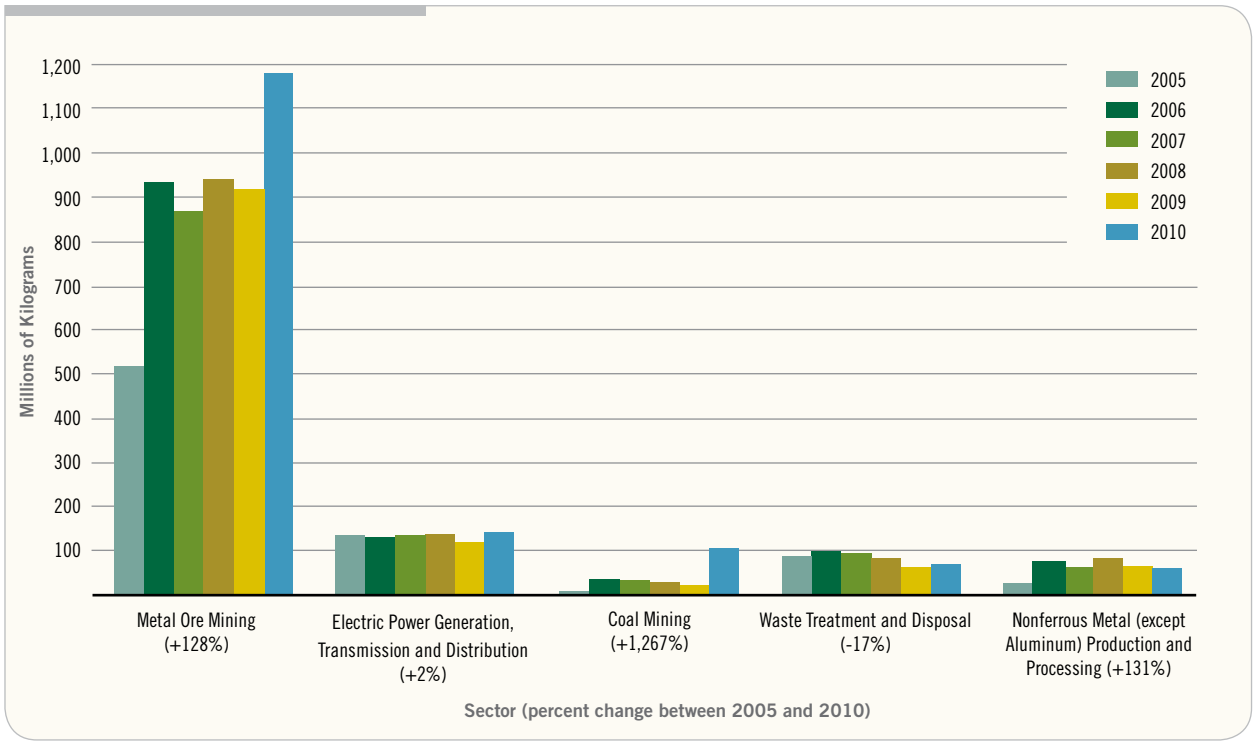
This figure shows an important increase as of 2006 in reported releases to land for this sector, along with the coal mining sector, illustrating the impact of changes in NPRI reporting requirements that year. Indeed, the number of reporting facilities in these sectors in Canada jumped from six in 2005 to 59 in 2006. Another notable increase in releases to land from mining activities occurred from 2009 to 2010, primarily due to increases reported by a small number of facilities in both Canada and the United States.

The top reporting sectors in each country for releases to land between 2005 and 2010 are shown in Figure 17. By 2010, releases to land in Canada by mining activities (and especially coal and metal ore mines) had displaced the waste treatment and disposal and iron and steel mill/ferroalloy manufacturing sectors, which in 2005 were the top reporting sectors for releases to land in that country.

In the United States, the 30 percent increase in releases to land by the metal ore mining sector can be attributed to reporting by a small number of facilities that together accounted for over 80 percent of all reported releases to land by this sector in 2010. They included a zinc mine in Alaska, two gold mines in Nevada and a copper mine in Utah. The US coal mining sector reported a decrease of 48 percent in releases to land over this period.

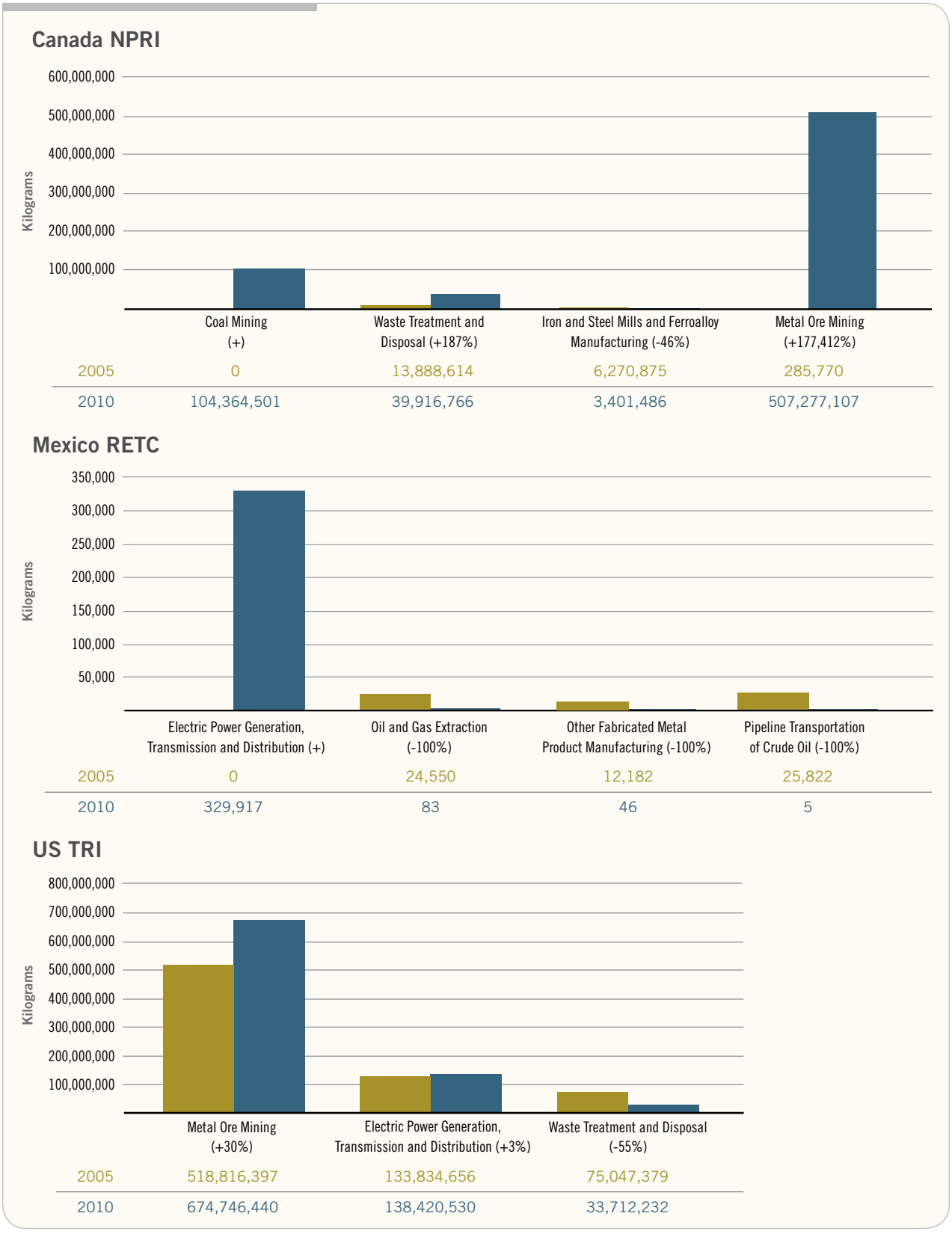
This figure also shows a large increase in releases to land by Mexican electric utilities in 2010, while releases from the other sectors (the top reporters in 2005) were almost negligible that year. Most of the increase from the electricity generation sector was reported by one CFE facility in Sinaloa.

Figure 16. Top Reporting Industry Sectors for Releases to Land, North America, 2005–2010



Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

Figure 17. Top Reporting Industry Sectors for Releases to Land in Canada, Mexico and the United States, 2005–2010



Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

Table 20 presents the top pollutants released to land by the top five North American industry sectors, which together accounted for 87 percent of total releases to land in 2010. It shows how these releases changed from 2005 through 2010, as well as their distribution among the three countries—revealing that there was very little reporting from Mexico. Mexican facilities in all sectors reported approximately 513,000 kilograms in releases to land in 2010, an increase from about 83,000 kilograms reported in 2005. A few of the largest reporters accounted for most of this increase, including the aforementioned CFE electric utility in Sinaloa; a John Deere agriculture, construction and mining machinery manufacturer in Coahuila; and the Coeur Mexicana silver mine in Chihuahua.

In the United States, significant proportions of the releases to land in 2010 of zinc and lead and their compounds were reported by the Red Dog mine in Alaska, one of the world's largest producers of zinc and lead concentrates, from ore extracted at the site. Zinc and its compounds were also reported by the Canadian and US nonferrous metal (except aluminum) production and processing sector, with these releases increasing from 2005. A few of the top reporting facilities in 2010 accounted for large proportions of this increase, including two Canadian facilities, the Xstrata Canada–Kidd Metallurgical Site in Ontario, and the Hudson Bay Mining and Smelting Complex in Manitoba; and a US facility, the Asarco LLC Ray Complex–Hayden Smelter and Concentrator in Arizona. These same facilities were also among the top facilities in this sector accounting for the large increase in releases to land of lead and copper and their compounds from 2005 through 2010.

In Canada, the Iron Ore Company of Canada's Carol Lake Project in Newfoundland and Labrador accounted for large proportions of reported releases of manganese and its compounds in 2010. This company operates an open-pit mine for the extraction of iron ore to be made into pellets for steelmaking plants. Manganese is a naturally occurring metal found in rocks. Releases to land of this pollutant from the metal ore mining sector increased dramatically between 2005 and 2010.

Large proportions of barium and its compounds were released to land by US electric utilities, with these releases increasing from 2005 through 2010. Barium and its compounds are only subject to PRTR reporting in the United States. Barium, a metal that is found only in ores, can be released to air during the mining and production of

Table 20. Top Reporting Industry Sectors for Releases to Land, and Top Reported Pollutants, North America, 2005–2010

Industry Sector (NAICS-4 Code)	Releases to Land 2010 (kg)	Pollutant	Releases to Land 2010 (kg)	% Change 2005–2010	Canada NPRI (%)	Mexico RETC (%)	US TRI (%)
Metal Ore Mining (2122)	1,182,056,081	**Zinc (and compounds)** (CA, US)	278,560,622	48	12	–	88
		Manganese (and compounds) (CA, US)	256,011,595	2,167	84	–	16
		Lead (and compounds) (CA, MX, US)	246,200,103	39	8	0	92
Electric Power Generation, Transmission and Distribution (2211)	141,871,753	**Barium (and compounds)** (US)	87,617,103	19	–	–	100
		Manganese (and compounds) (CA, US)	14,237,303	-6	6	–	94
		Vanadium (and compounds) (CA, US)	10,281,526	-31	9	–	91
Coal Mining (2121)	108,515,793	**Phosphorous, Total** (CA)	65,209,962	189*	100	–	–
		Manganese (and compounds) (CA, US)	35,236,649	2,475	98	–	2
		Barium (and compounds) (US)	2,143,851	-46	–	–	100
Waste Treatment and Disposal (5622)	73,628,998	**Asbestos** (CA, MX, US)	26,744,810	184	85	–	15
		Lead (and compounds) (CA, MX, US)	9,206,775	1	37	–	63
		Zinc (and compounds) (CA, US)	8,273,055	-78	53	–	47
Nonferrous Metal (except Aluminum) Production/Processing (3314)	62,631,087	**Zinc (and compounds)** (CA, US)	27,663,595	182	62	–	38
		Copper (and compounds) (CA, US)	14,949,119	92	26	–	74
		Lead (and compounds) (CA, MX, US)	6,478,015	36	25	0	75
Total, Top 5 Sectors	**1,568,703,713**	**Total, Top Pollutants**	**1,088,814,084**				
%, Top 5 Sectors, of Total Releases to Land	**87**						

* Prior to 2006, no releases or transfers were reported by the Canadian coal mining sector; this change calculation is based on 2006–2010.
Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

barium compounds, as well as during the burning of coal and oil. US coal mines also reported releases to land of barium and its compounds, with these releases declining between 2005 and 2010.

Canadian coal mines were the top reporters of releases to land of total phosphorous, a pollutant subject to PRTR reporting only in Canada. The large increase in these releases can be attributed mainly to a small number of facilities, including the Coal Valley Resources–Obed coal mine in Alberta, which accounted for almost 75 percent of total releases to land of this pollutant in 2010, but did not report in the preceding years.

Large releases to land of asbestos were reported in 2010 by the waste treatment and disposal sector, with 85 percent of these releases reported in Canada. A number of the facilities in this sector reported increases between 2005 and 2010, with two of them—the BFI Canada Ridge landfill in Ontario and the Paintearth landfill in Alberta—accounting for more than half of all these releases in 2010. Asbestos refers to a group of mineral fibers that occur naturally in the environment. Because of its heat-resistant characteristics, asbestos has been used in a wide variety of products, particularly for the construction industry (e.g., roofing shingles, tiles, cement products).

Petr Kratochvil

2.5 Reported Releases to Underground Injection, 2005–2010

On-site releases to underground injection accounted for 6 percent of total releases and transfers in 2010, with facilities in Canada and the United States reporting 340,822,984 kilograms—a decrease of 17 percent from 2005 levels. Underground injection is not subject to reporting under Mexico's RETC.

Table 21 presents the releases to underground injection reported by Canadian and US facilities every year from 2005 through 2010. While both countries saw reductions in these releases, the decrease was more appreciable in Canada (a decrease of more than 22 percent). In 2010, Canadian facilities accounted for just over 69 percent of total reported releases to underground injection (compared with 74 percent of the total in 2005), and US facilities accounted for just over 30 percent. This table also shows that the number of pollutants reported released to underground injection declined over this period.

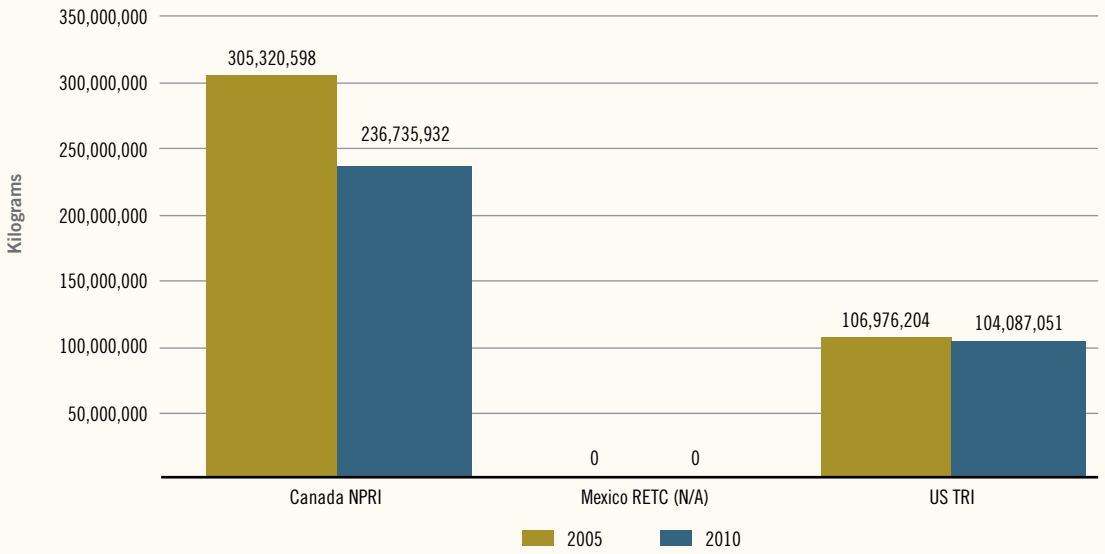
Figure 18 presents the top 21 pollutants released to underground injection from 2005 through 2010 (including TRS compounds, as a result of their addition to Canada's NPRI in 2007). These pollutants accounted for 97 percent and 96

Table 21. Releases to Underground Injection Reported to the Canadian NPRI and US TRI, 2005–2010

PRTR	Releases to Underground Injection, 2005 (kg)	Releases to Underground Injection, 2006 (kg)	Releases to Underground Injection, 2007 (kg)	Releases to Underground Injection, 2008 (kg)	Releases to Underground Injection, 2009 (kg)	Releases to Underground Injection, 2010 (kg)	% Change 2005–2010	Number of Reported Pollutants	
								2005	2010
Canada NPRI	305,320,598	275,573,878	331,393,025	379,401,822	339,662,982	236,735,932	-22	60	51
Mexico RETC	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
US TRI	106,976,204	101,684,627	95,457,452	87,242,354	82,275,125	104,087,051	-3	148	132
Total, North America	412,296,802	377,258,505	426,850,477	466,644,176	421,938,107	340,822,984	-17	170	151

Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

Figure 18. Releases to Underground Injection Reported in Canada and the United States, and Top Reported Pollutants, 2005–2010



Pollutant	Releases to Underground Injection 2005 (kg)	Releases to Underground Injection 2010 (kg)	% Change 2005–2010
Hydrogen Sulfide (CA, MX)	289,746,824	133,484,005	-54
Nitric Acid and Nitrate Compounds (CA, US)	24,846,936	25,012,591	1
Ammonia, Total (CA, US)	19,628,595	18,454,856	-6
Methanol (CA, US)	15,258,090	18,988,100	24
Acetonitrile (CA, US)	7,802,994	8,647,998	11
Zinc (and compounds) (CA, US)	5,244,585	8,003,631	53
Formaldehyde (CA, MX, US)	5,205,312	5,997,854	15
Formic Acid (CA, US)	4,884,996	6,582,334	35
Acrylamide (CA, MX, US)	3,982,023	3,211,170	-19
Acrylonitrile (CA, MX, US)	3,661,761	3,707,954	1
Manganese (and compounds) (CA, US)	3,599,440	5,287,010	47
Lead (and compounds) (CA, MX, US)	2,792,670	4,307,991	54
Acrylic Acid (CA, US)	2,470,638	1,537,303	-38
Cyclohexanol (CA, US)	1,576,962	660,867	-58
Hydrogen Cyanide (CA, US)	1,397,500	61,930	-96
Cyanides (CA, MX, US)	1,319,546	948,183	-28
Phosphorous, Total (CA)	1,296,185	1,490	-100
Ethylene Glycol (CA, US)	1,196,509	867,408	-28
N-Methyl-2-Pyrrolidone (CA, US)	1,110,273	1,366,346	23
Toluene (CA, US)	894,759	521,445	-42
Total Reduced Sulfur (TRS) (CA)	–	79,325,490	38*
Total, Top 21 Pollutants Released to Underground Injection	**397,916,600**	**326,975,956**	**-18**
Total, All Pollutants Released to Underground Injection	**412,296,802**	**340,822,984**	**-17**
%, Top Pollutants, of Total Releases to Underground Injection	**97**	**96**	

* Percent change calculated from 2007 (first year of TRS reporting in Canada).
Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

percent, respectively, of the total in 2005 and 2010. This figure shows that releases of about half of these pollutants decreased over this period, with some (e.g., hydrogen sulfide) decreasing notably. Releases to underground injection of other substances increased, some notably (e.g., zinc, manganese and lead and their compounds).

Of the substances shown in this figure, only five are subject to PRTR reporting in all three countries. Perhaps more importantly, given that underground injection is only reported in Canada and the United States, three of these pollutants are subject to PRTR reporting in Canada but not the United States, including two pollutants reported in very large proportions, hydrogen sulfide and TRS.

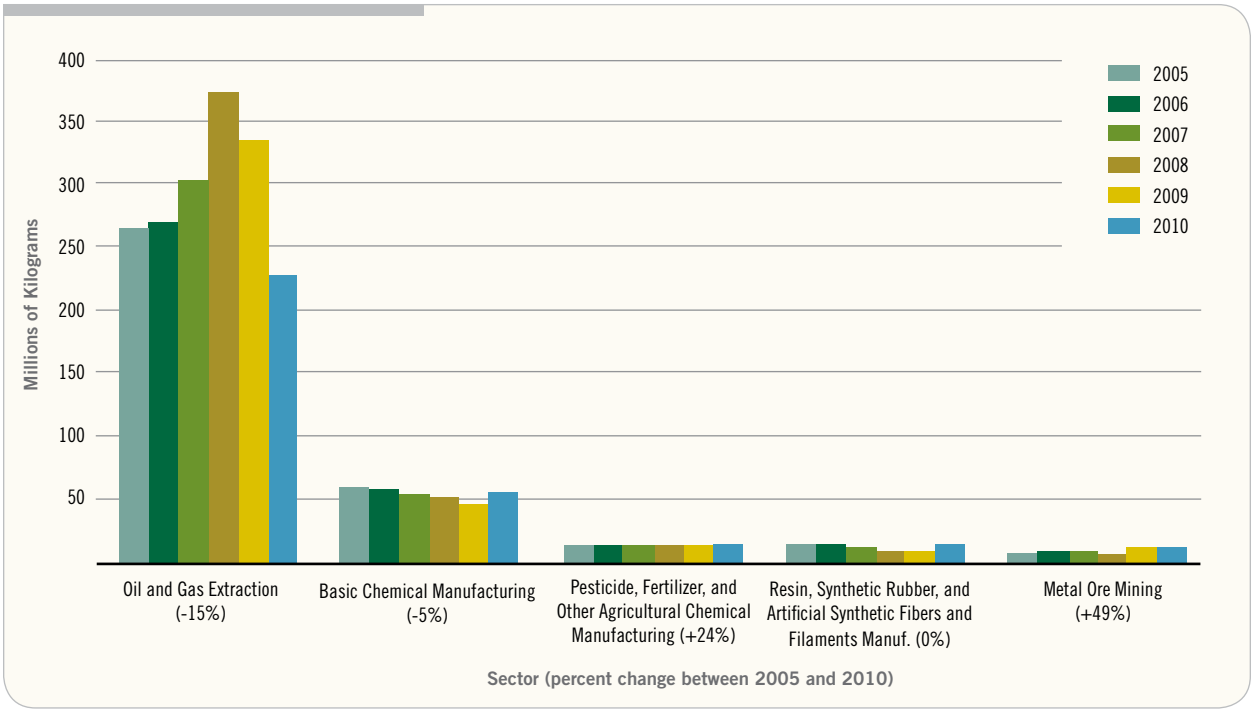
2.5.1 Top Sectors Reporting Releases to Underground Injection in Canada and the United States, 2005–2010

Figure 19 presents the top five sectors in Canada and the United States reporting releases to underground injection from 2005 through 2010. These sectors accounted for 325,903,515 kilograms, or almost 96 percent of the total in 2010, with the oil and gas extraction sector alone reporting 226.8 million kilograms (over 66 percent of the total). As mentioned earlier, the oil and gas extraction sector is not subject to the US TRI.

Figure 20 illustrates the predominance of the oil and gas extraction sector for releases to underground injection in Canada, even with a 15 percent decline in these releases between 2005 and 2010. Only ten sectors in Canada reported releases to underground injection throughout this period.

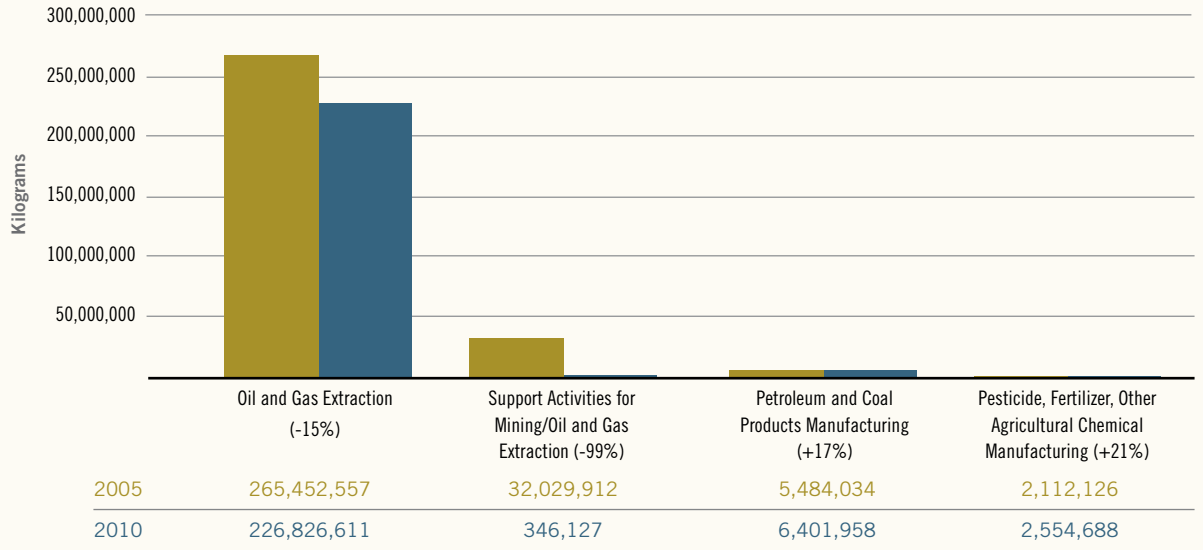
In the United States, the top reporting sector for releases to underground injection was the basic chemical manufacturing sector, which reported a decline of 5 percent in these releases from 2005 through 2010. The number of reporting facilities in this sector remained about the same in both years. The waste treatment and disposal sector in this country also reported a decrease over this period, of 54 percent. Only five facilities in this sector reported releases to underground injection in 2005 and of these, a couple of Texas facilities accounted for most of this decrease. There was a 49 percent increase in reported releases to underground injection by the US metal ore mining sector, due to reporting by the Hecla Greens Creek silver mine in Alaska (the top reporter among six US metal ore mining facilities reporting releases to underground injection over this period).

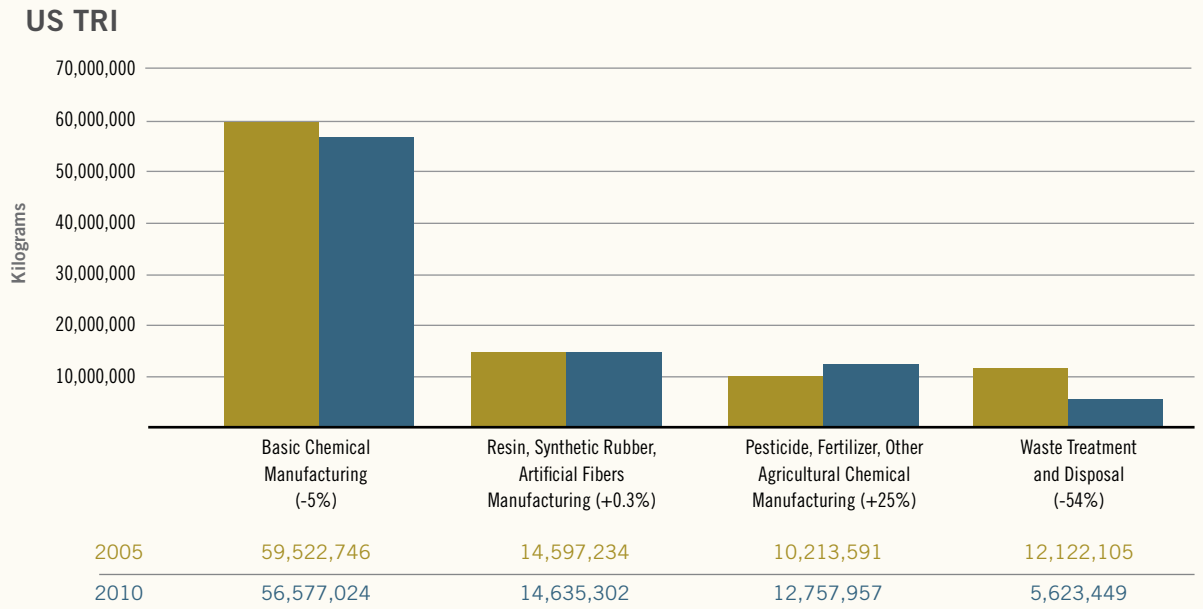
Figure 19. Top Reporting Industry Sectors for Releases to Underground Injection in Noth America*, 2005–2010



* Underground injection is not reported under Mexico's PRTR program.
Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

Figure 20. Top Reporting Industry Sectors for Releases to Underground Injection* in Canada and the United States, 2005–2010





* Underground injection is not reported under Mexico's PRTR program.
Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

Table 22 presents the top pollutants released to underground injection by the top five industry sectors, which together accounted for almost 96 percent of total releases to underground injection reported by Canadian and US facilities in 2010. It shows how these releases changed from 2005 through 2010, as well as their distribution between the two countries. The impacts of key differences in PRTR reporting requirements between the two countries are evident in this table—especially the lack of reporting in the United States by the oil and gas extraction sector, and lack of reporting of hydrogen sulfide and TRS, two of the top-reported pollutants in Canada.

In 2010, the Canadian oil and gas extraction sector reported more than 99 percent of total releases to underground injection of hydrogen sulfide, with these releases decreasing by 48 percent between 2005 and 2010. Two gas processing plants accounted for large proportions of this decrease: the Husky Oil–Rainbow Lake Gas plant in Alberta, and the Canadian Natural Resources–Stoddart 02-34 Sour Gas Plant in British Columbia. Together, these facilities reported over 95 million kilograms of hydrogen sulfide, or about 37 percent of the total, to underground to underground injection in 2005, but none in 2010. However, these same facilities reported significant increases in hydrogen sulfide sent for off-site disposal in 2010.

The largest proportions of pollutants released to underground injection by the Canadian oil and gas extraction sector were of hydrogen sulfide and TRS. As mentioned earlier, these two pollutants are closely related: hydrogen sulfide makes up the largest proportion of all the reduced sulfur compounds that are reported as TRS and is also reported separately. In fact, the data from this sector as of 2007 (when TRS was added to the NPRI list of substances) show that certain facilities reporting the largest releases to underground injection reported the exact same amounts of both hydrogen sulfide and TRS—suggesting likely double-counting. As a result, the NPRI conducted a review of these data with the objective of providing additional reporting guidance to this sector and others reporting these pollutants.

Reported releases to underground injection of methanol from this sector, and especially from gas-processing plants located in Alberta, increased between 2005 and 2010. This toxic substance is used in the production of a number of chemicals, and most commonly as a raw material for the production of methyl t-butyl ether (MTBE), a gasoline additive. It is also a common component of the fluids used in hydraulic fracturing, an activity that is not subject to reporting under any of the three PRTR programs.

Table 22. Top Reporting Industry Sectors for Releases to Underground Injection, and Top Pollutants, Canada and the United States, 2005–2010

Industry Sector (NAICS-4 Code)	Releases to Underground Injection 2010 (kg)	Pollutant	Releases to Underground Injection 2010 (kg)	% Change 2005–2010	Canada NPRI (%)	US TRI (%)
Oil and Gas Extraction (2111)	226,826,611	**Hydrogen Sulfide** (CA, MX)	132,870,129	-48	100	–
		Total Reduced Sulfur (TRS) (CA)	78,737,513	37*	100	–
		Methanol (CA, US)	12,284,369	129	100	–
Basic Chemical Manufacturing (3241)	56,663,807	**Ammonia, Total** (CA, US)	9,665,867	-16	–	100
		Acetonitrile (CA, US)	8,630,673	14	–	100
		Nitric Acid and Nitrate Compounds (CA, US)	7,737,925	-16	–	100
Pesticide, Fertilizer, Other Agricultural Chemical Manufacturing (3253)	15,312,645	**Formaldehyde** (CA, MX, US)	4,581,591	27	–	100
		Nitric Acid and Nitrate Compounds (CA, US)	3,988,795	50	6	94
		Formic Acid (CA, US)	2,902,991	23	–	100
Resin, Synthetic Rubber, and Artificial Synthetic Fibers/Filaments Manufacturing (3252)	14,635,302	**Nitric Acid and Nitrate Compounds** (CA, US)	11,026,107	2	–	100
		Formic Acid (CA, US)	2,596,341	60	–	100
		n-Butyl Alcohol (CA, US)	231,271	-58	–	100
Metal Ore Mining (2122)	12,465,150	**Zinc (and compounds)** (CA, US)	7,711,070	55	–	100
		Lead (and compounds) (CA, MX, US)	4,092,070	56	–	100
		Arsenic (and compounds) (CA, MX, US)	635,029	54	–	100
Total, Top 5 Sectors	**325,903,515**	**Total, Top Pollutants**	**287,691,742**			
%, Top 5 Sectors, of Total Releases to Underground Injection	**96**					

*Percent change calculated from 2007 (first year of TRS reporting in Canada).
Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

The majority of releases to underground injection by the other top industry sectors shown in this table were reported by facilities in the United States. As in Canada, a relatively small number of US sectors (i.e., a maximum of 25 between 2005 and 2010) use underground injection as a waste management method. Unlike the other US sectors featured in this table, which reported releases to underground injection of chemicals such as ammonia and nitric acid/nitrate compounds, the metal ore mining sector reported large proportions of metals: zinc, lead and arsenic and their compounds (with these releases increasing notably from 2005 through 2010).

Underground injection is a waste management method used by certain sectors, such as chemical manufacturing and the oil and gas industry. There is debate about whether injection of metals and other waste into deep wells below fresh-water aquifers can be done in a way that prevents the contaminants from leaking or migrating upward into the fresh water and contaminating wells.

2.6 Reported Off-site Releases to Disposal, 2005–2010

Reported off-site releases to disposal[21] accounted for 17 percent of total releases and transfers in 2010, with North American facilities reporting 930,493,737 kilograms—an increase of 42 percent from 2005 levels.

Table 23 presents the off-site releases to disposal reported by North American facilities every year from 2005 through 2010. It reveals differences among the three countries in the amounts reported, as well as the direction of the 2005–2010 changes. For instance, the data show that the large increase in these releases was driven by Canadian reporting, while reported releases in Mexico and the United States declined. Of the North American total for 2005, Canadian facilities accounted for almost 49 percent, Mexican facilities for 7 percent, and US facilities for just over 44 percent; by 2010, Canadian facilities accounted for almost 78 percent, Mexican facilities for 0.5 percent, and US facilities for almost 22 percent.

Figure 21 presents the top pollutants released off-site for disposal, and the changes in their reported amounts between 2005 and 2010. The list includes TRS, which Canadian facilities began reporting in 2007 as a result of its addition to the NPRI. These 21 substances accounted for 96 percent and 97 percent, respectively, of total reported off-site releases to disposal in 2005 and 2010.

Releases to disposal of eight of these pollutants declined between 2005 and 2010, some of them notably (e.g., lead and arsenic and their compounds, aluminum), while others saw very large increases over this period. Two pollutants, TRS compounds and hydrogen sulfide, were reported in very large proportions in 2010, but as indicated in this figure, these are not subject to reporting in all three countries. In fact, of the top pollutants shown in the table, only five are subject to the three PRTRs.

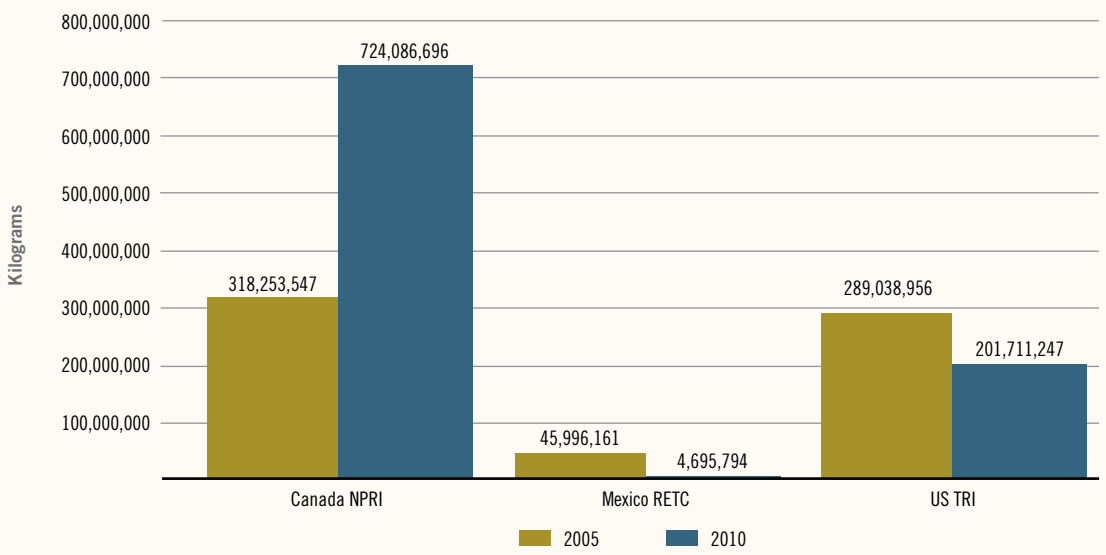
Table 23. Releases Off-site to Disposal Reported to the North American PRTRs, 2005–2010

PRTR	Releases to Disposal, 2005 (kg)	Releases to Disposal, 2006 (kg)	Releases to Disposal, 2007 (kg)	Releases to Disposal, 2008 (kg)	Releases to Disposal, 2009 (kg)	Releases to Disposal, 2010 (kg)	% Change 2005-2010	Number of Reported Pollutants	
								2005	2010
Canada NPRI	318,253,547	369,967,875	434,038,888	559,369,315	539,594,725	724,086,696	128	111	120
Mexico RETC	45,996,161	2,632,089	11,250,368	19,747,212	43,248,981	4,695,794	-90	51	49
US TRI	289,038,956	299,370,770	306,643,881	259,694,181	178,018,104	201,711,247	-30	318	321
Total, North America	**653,288,663**	**671,970,735**	**751,933,138**	**838,810,708**	**760,861,811**	**930,493,737**	**42**	**355**	**366**

Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

21. The term "off-site releases to disposal" used in *Taking Stock* combines a variety of methods, due to differences in the terminology used by each PRTR program. It includes some of the same methods used on-site, such as underground injection and disposal in either confined or unconfined conditions.

Figure 21. Releases to Disposal Reported in Canada, Mexico and the United States, and Top Reported Pollutants, 2005–2010



Pollutant	Releases to Disposal 2005 (kg)	Releases to Disposal 2010 (kg)	% Change 2005–2010
Hydrogen Sulfide (CA, MX)	250,948,839	479,650,431	91
Zinc (and compounds) (CA, US)	135,864,414	78,427,592	-42
Lead (and compounds) (CA, MX, US)	58,976,550	16,424,428	-72
Manganese (and compounds) (CA, US)	43,267,132	36,360,643	-16
Barium (and compounds) (US)	26,230,890	26,770,845	2
Aluminum (fume or dust) (CA, US)	17,222,123	3,962,937	-77
Chromium (and compounds) (CA, MX, US)	15,998,823	12,814,868	-20
Copper (and compounds) (CA, US)	12,081,462	12,715,615	5
Nitric Acid and Nitrate Compounds (CA, US)	10,349,008	6,194,076	-40
Arsenic (and compounds) (CA, MX, US)	9,589,421	1,862,287	-81
Phosphorous, Total (CA)	9,445,774	11,744,136	24
Sulfuric Acid (CA, US)	8,882,662	1,751,106	-80
Nickel (and compounds) (CA, MX, US)	8,597,411	9,371,894	9
Methanol (CA, US)	6,060,544	8,602,919	42
Ammonia, Total (CA, US)	5,161,660	5,197,391	1
Vanadium (and compounds) (CA, US)	4,023,761	6,344,130	58
Asbestos (CA, MX, US)	2,665,951	8,485,430	218
Aluminum Oxide (fibrous forms) (CA, US)	1,308,665	1,900,450	45
Ethylene Glycol (CA, US)	893,379	1,753,120	96
n-Hexane (CA, US)	98,888	1,513,498	1,431
Total Reduced Sulfur (TRS) (CA)	–	173,146,179	551*
Total, Top 21 Pollutants Released to Disposal	**627,667,356**	**904,993,977**	**44**
Total, All Pollutants Released to Disposal	**653,288,663**	**930,493,737**	**42**
%, Top 21 Pollutants of Total Releases to Disposal	**96**	**97**	

* Percent change calculated from 2007 (first year of TRS reporting in Canada).
Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

2.6.1 Top Sectors Reporting Off-site Releases to Disposal in North America, 2005–2010

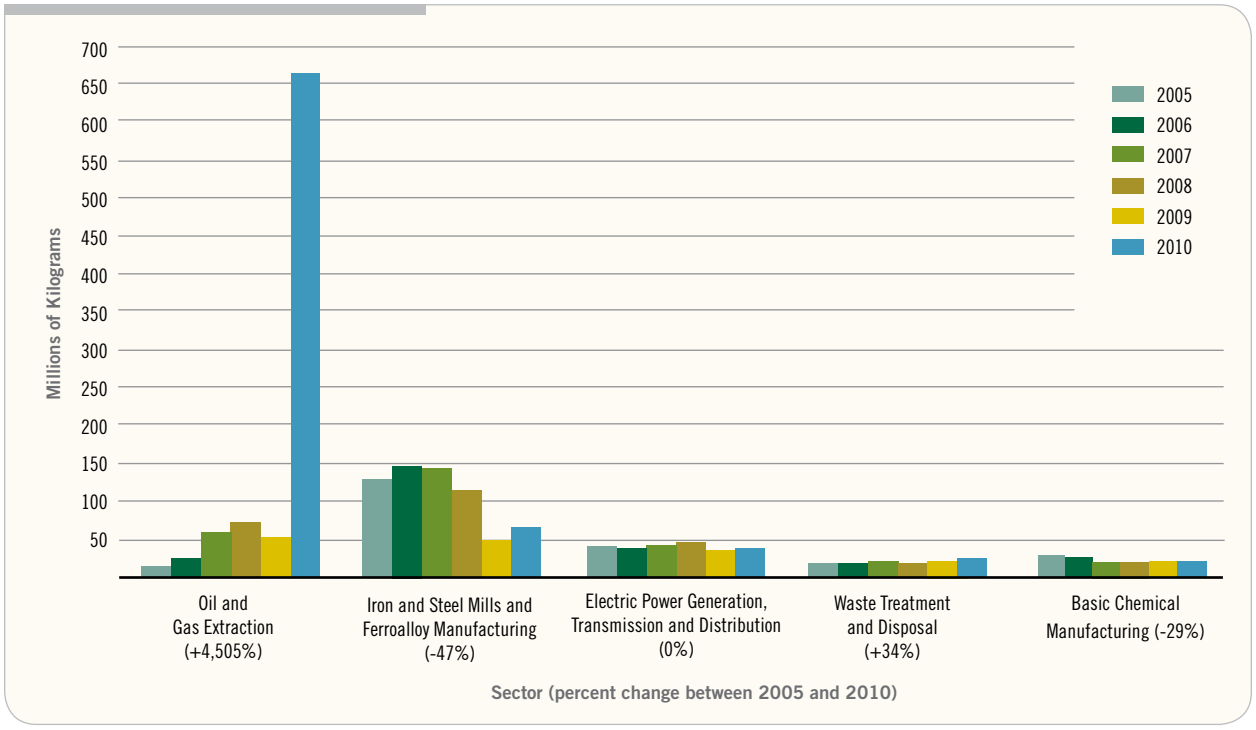
The five North American industry sectors reporting the largest proportions of total off-site releases to disposal between 2005 and 2010 are shown in Figure 22. These sectors accounted for 816,323,493 kilograms, or almost 88 percent of all such releases, in 2010.

This figure shows the significant increase in 2010 in reported releases to disposal from the oil and gas extraction sector, with this sector alone reporting more than 71 percent of the North American total for releases to disposal that year. Almost all of these releases were reported by Canadian facilities and much of the increase can be attributed to four facilities which together accounted for about 645 million kilograms in releases to disposal in 2010 (or almost 97 percent of the total for this sector). Of these four facilities, three did not report in 2005. The top reporter for this sector in 2010, the Spectra Kwoen gas plant in British Columbia, reported under the NAICS code for support activities for mining and oil and gas extraction in the preceding years; however, on the basis of guidance provided by NPRI, the facility changed its sector designation as of 2010.

Figure 23 presents the top sectors reporting off-site releases to disposal in each country. It reveals that the Mexican metal ore mining sector (the top sector for off-site releases to disposal in that country in 2005) reported an important decrease over the 2005–2010 period. Much of this decrease can be attributed to two facilities: the Compañía Fresnillo silver mine in Chihuahua, and the Compañía Minera Nuevo Monte lead and zinc mine in Hidalgo. Together, these facilities accounted for almost all of the reported off-site releases to disposal from this sector in 2005; however, the first facility did not report after 2005 (and, as mentioned previously, is looking into data reporting errors for 2005); and the second did not report after 2007 and has since ceased to operate (see Table 8).

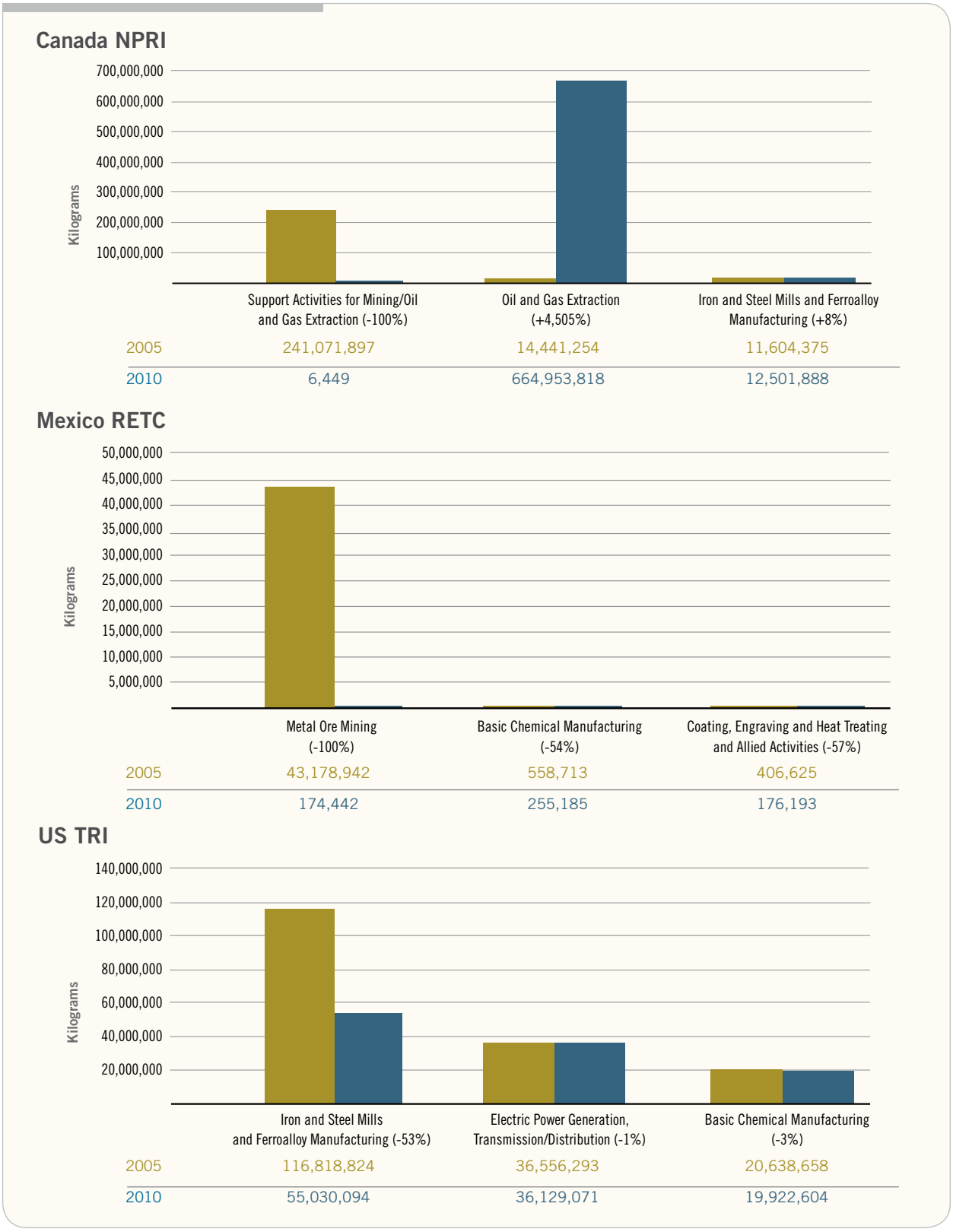
The decrease in reported off-site releases to disposal in the United States was driven by the iron and steel mills and ferroalloy manufacturing sector, whose releases declined by over 50 percent from 2005 through 2010. Among the top reporters in this sector were the Nucor Steel and Steel Dynamics facilities located in Indiana, which reported similarly large amounts in both 2005 and 2010; however, in 2010 the pollutants were transferred for recycling, instead of being released to disposal.

Figure 22. Top Reporting Industry Sectors for Releases Off-site to Disposal, North America, 2005–2010



Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

Figure 23. Top Reporting Industry Sectors for Releases to Disposal in Canada, Mexico and the United States, 2005–2010



Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

Table 24 presents the top pollutants released off-site to disposal by the five North American industry sectors, which together accounted for about 88 percent of all such releases in 2010. It shows how these releases changed from 2005 through 2010, as well as their distribution among the three countries. This table illustrates the impacts of differences in national PRTR reporting requirements, for both pollutants and sectors, on the releases to disposal reported by North American facilities. For example, only four of the top pollutants are subject to reporting in Mexico, where reported off-site releases to disposal were sparse. Less than 1 percent of the releases of hydrogen sulfide from the oil and gas extraction sector were reported in that country. Except for about 106,000 kilograms in 2009, this Mexican sector reported a maximum of 60,000 kilograms per year in releases and transfers of all substances over the 2005–2010 period (with the majority reported released to air).

In Canada, the largest proportions released off-site to disposal by the oil and gas extraction sector were of hydrogen sulfide and TRS. As with reported releases to underground injection by this sector, certain facilities reporting the largest off-site releases to disposal reported the exact same amounts of both hydrogen sulfide and TRS, indicating likely double-counting. The NPRI conducted a review of these data with the objective of providing additional reporting guidance to this and other sectors handling these two pollutants.

In addition to the aforementioned releases off-site to disposal by the iron and steel mills and ferroalloy manufacturing sector, mainly in the United States, US electric utilities also accounted for large releases to disposal of metals, including more than 22 million kilograms of barium and its compounds (which are not subject to PRTR reporting in Canada and Mexico).

This table also shows a notable increase in reported off-site releases to disposal of asbestos by the waste treatment and disposal sector, much of it reported by Canadian facilities. In fact, most of this increase can be attributed to one facility in the province of Ontario, which began reporting in 2007. It reported the majority of all off-site releases to disposal of this pollutant.

Table 24. Top Reporting Industry Sectors for Releases to Disposal, and Top Reported Pollutants, North America, 2005–2010

Industry Sector (NAICS-4 Code)	Releases to Disposal 2010 (kg)	Pollutant	Releases to Disposal 2010 (kg)	% Change 2005–2010	Canada NPRI (%)	Mexico RETC (%)	US TRI (%)
Oil and Gas Extraction (2111)	664,974,765	**Hydrogen Sulfide** (CA, MX)	479,624,522	4,439	100	0	–
		Total Reduced Sulfur (TRS) (CA)	173,140,605	551*	100	–	–
		Methanol (CA, US)	6,083,249	90	100	–	–
Iron and Steel Mills and Ferroalloy Manufacturing (3311)	67,735,221	**Zinc (and compounds)** (CA, US)	42,879,313	-56	16	–	84
		Manganese (and compounds) (CA, US)	14,022,430	-22	21	–	79
		Lead (and compounds) (CA, MX, US)	2,435,632	-56	19	0	81
Electric Power Generation, Transmission and Distribution (2211)	38,626,043	**Barium (and compounds)** (US)	22,376,547	4	–	–	100
		Manganese (and compounds) (CA, US)	4,231,980	-1	21	–	79
		Vanadium (and compounds) (CA, US)	3,521,065	10	16	–	84
Waste Treatment and Disposal (5622)	23,901,978	**Zinc (and compounds)** (CA, US)	6,396,020	90	13	–	87
		Asbestos (CA, MX, US)	3,129,075	23,005	98	–	2
		Copper (and compounds) (CA, US)	1,971,182	8	38	–	62
Basic Chemical Manufacturing (3251)	21,085,487	**Manganese (and compounds)** (CA, US)	4,299,221	-11	8	–	92
		Copper (and compounds) (CA, US)	4,103,569	294	0	–	100
		Nickel (and compounds) (CA, MX, US)	1,993,484	237	0	0	100
Total, Top 5 Sectors	**816,323,493**	**Total, Top Pollutants**	**770,207,896**				
%, Top 5 Sectors, of Total Off-site Releases to Disposal	**88**						

*Percent change calculated from 2007 (first year of TRS reporting in Canada).
Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

2.7 Reported Off-site Transfers, 2005–2010

Off-site transfers to recycling, as well as other transfers (i.e., for treatment, energy recovery or sewage)[22] accounted for 31 percent of total releases and transfers in 2010, with North American facilities reporting 1,719,727,914 kilograms—a decrease of 8 percent from 2005 levels. Of this amount, transfers to recycling accounted for almost 69 percent. These off-site transfers are presented in Table 25.

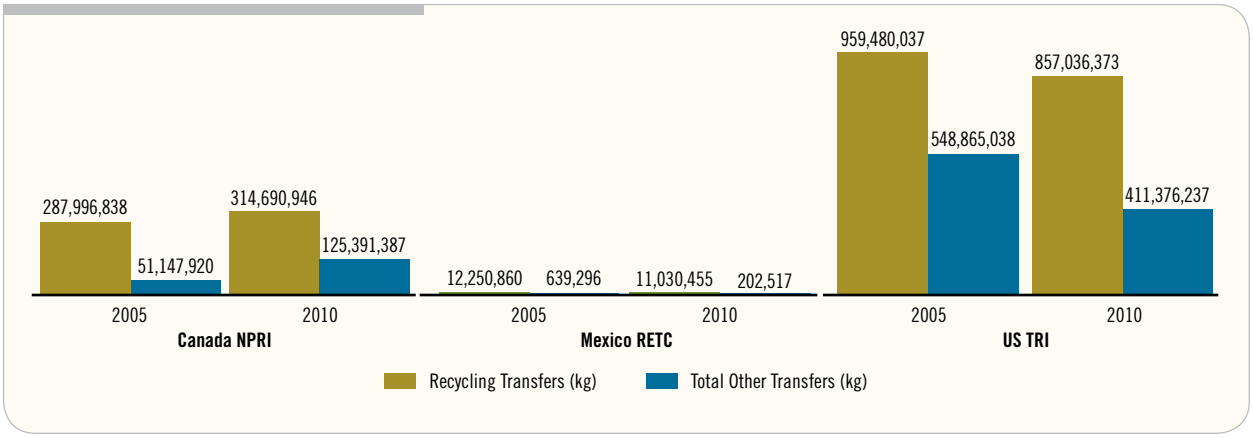
This table reveals that off-site transfers reported by Canadian facilities increased between 2005 and 2010, with transfers to treatment increasing notably. In Mexico and the United States, off-site transfers generally decreased over this period. The 8 percent decrease in reported off-site transfers in North America was driven by reporting in the United States, which accounted for 81 percent of the total in 2005, but almost 73 percent of the total in 2010. These proportions are shown in Figure 24.

Table 25. Transfers to Recycling and Other Transfers Reported to the North American PRTRs, 2005–2010

PRTR	Type of Transfer	2005 (kg)	2006 (kg)	2007 (kg)	2008 (kg)	2009 (kg)	2010 (kg)	% Change 2005–2010
Canada NPRI	**Transfers to Recycling**	**287,996,838**	**367,243,959**	**393,418,566**	**334,692,771**	**338,068,807**	**314,690,946**	**9**
	Other Transfers (except metals)	**51,147,920**	**48,632,111**	**41,048,987**	**58,726,305**	**51,142,593**	**125,391,387**	**145**
	Treatment	27,131,167	23,960,688	20,477,911	36,674,798	33,043,522	106,736,551	293
	Sewage/POTWs	12,918,998	13,080,557	11,987,838	14,305,327	12,178,100	13,239,389	2
	Energy recovery	11,097,755	11,590,866	8,583,238	7,746,180	5,920,972	5,415,448	-51
Mexico RETC	**Transfers to Recycling**	**12,250,860**	**4,301,382**	**5,740,531**	**12,062,700**	**10,454,526**	**11,030,455**	**-10**
	Other Transfers (except metals)	**639,296**	**891,057**	**413,448**	**571,276**	**238,404**	**202,517**	**-68**
	Treatment	74,755	73,366	135,897	349,767	67,124	63,877	-15
	Sewage/POTWs	242	507	19	46	362	436	80
	Energy recovery	564,299	817,184	277,531	221,464	170,918	138,203	-76
US TRI	**Transfers to Recycling**	**959,480,037**	**996,943,819**	**963,963,949**	**896,547,624**	**739,740,400**	**857,036,373**	**-11**
	Other Transfers (except metals)	**548,865,038**	**518,163,124**	**483,229,907**	**435,591,243**	**367,790,854**	**411,376,237**	**-25**
	Treatment	152,693,617	147,733,066	129,737,835	115,186,424	102,671,292	112,308,269	-26
	Sewage/POTWs	120,124,600	118,157,229	114,980,193	115,725,886	98,633,884	104,557,900	-13
	Energy recovery	276,046,821	252,272,830	238,511,879	204,678,933	166,485,678	194,510,068	-30
Total, North America	**Transfers to Recycling**	**1,259,727,734**	**1,368,489,160**	**1,363,123,046**	**1,243,303,095**	**1,088,263,733**	**1,182,757,774**	**-6**
	Other Transfers (except metals)	**600,652,254**	**567,686,293**	**524,692,341**	**494,888,824**	**419,171,852**	**536,970,141**	**-11**
	Total, All Transfers	**1,860,379,989**	**1,936,175,453**	**1,887,815,387**	**1,738,191,920**	**1,507,435,585**	**1,719,727,914**	**-8**

Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

Figure 24. Transfers to Recycling and Other Transfers Reported in Canada, Mexico and the United States, 2005–2010



Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

22. In order to harmonize data that are categorized differently among the three PRTR programs, "other transfers" exclude metals sent to treatment, energy recovery or sewage/sewage treatment plants. For more information, see Appendix 1.

Table 26 presents the top pollutants transferred to recycling and otherwise transferred between 2005 and 2010.

The top ten pollutants transferred to recycling accounted for 90 percent and 92 percent, respectively, of all such transfers in 2005 and 2010, with metal compounds accounting for close to 90 percent of the total each year. Most of the top pollutants saw decreases over this period, with the exception of zinc, manganese and chromium and their compounds. Many facilities choose to recycle metals because of their increased market value, and in order to recuperate some of the cost of these high-priced process inputs.[23]

Total amounts of the top ten pollutants otherwise transferred (for energy recovery, sewage, or other treatment) decreased somewhat between 2005 and 2010. Four of these top pollutants were the same as those sent for recycling, namely toluene, ethylene glycol, xylenes, and sulfuric acid; but while transfers to recycling of xylenes and sulfuric acid declined between 2005 and 2010, their transfers to other treatment increased notably. Of the top pollutants shown in this table, only five are subject to PRTR reporting in all three countries.

2.7.1 Top Sectors Reporting Off-site Transfers in North America, 2005–2010

The five North American industry sectors reporting the largest proportions of total off-site transfers between 2005 and 2010 are shown in Figure 25. These sectors accounted for just over 760 million kilograms, or about 41 percent of total reported transfers in 2010.

This figure shows that off-site transfers from the nonferrous metal (except aluminum) production and processing sector and the iron and steel mills and ferroalloy manufacturing sector increased notably between 2005 and 2010, while transfers from the other top sectors declined over this period. However, there were differences among the three countries in the top reporting sectors for off-site transfers, as shown in Figure 26.

This figure shows that the increase in off-site transfers from the nonferrous metal production and processing sector was driven by reporting in Canada, with facilities reporting an increase of 163 percent. Much of this increase was due to reporting by the Xstrata Canada–Kidd Metallurgical Site in

Table 26. Top Reported Pollutants, Transfers to Recycling and Other Transfers, North America, 2005–2010

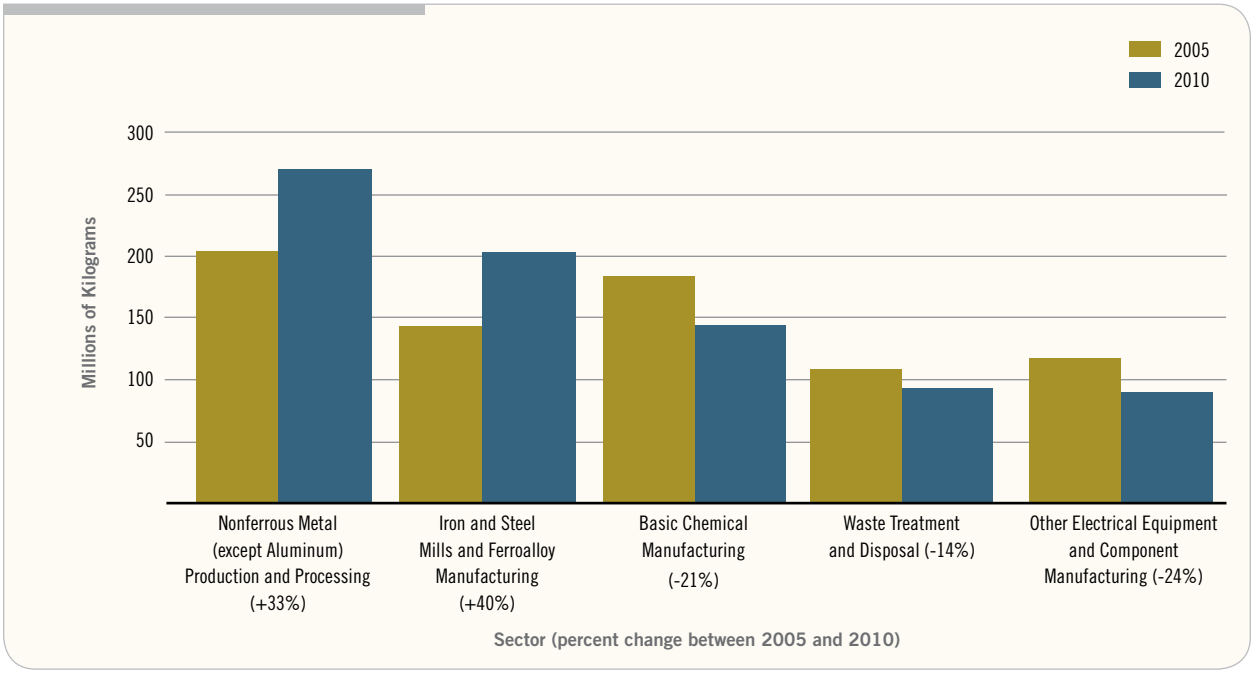
Pollutant	Recycling Transfers 2005 (kg)	Recycling Transfers 2010 (kg)	% Change 2005–2010
Copper (and compounds) (CA, US)	335,537,034	271,417,257	-19
Zinc (and compounds) (CA, US)	232,333,621	290,216,625	25
Lead (and compounds) (CA, MX, US)	192,799,213	172,808,501	-10
Manganese (and compounds) (CA, US)	83,729,375	94,295,640	13
Chromium (and compounds) (CA, MX, US)	73,951,815	82,440,520	11
Nickel (and compounds) (CA, MX, US)	73,886,623	66,300,180	-10
Sulfuric Acid (CA, US)	72,339,458	60,399,729	-17
Ethylene Glycol (CA, US)	36,816,433	30,350,377	-18
Xylenes (CA, US)	19,369,014	8,872,640	-54
Toluene (CA, US)	16,005,048	9,801,089	-39
Total, Top 10 Pollutants Transferred to Recycling	**1,136,767,634**	**1,086,902,559**	
Total, All Pollutants Transferred to Recycling	**1,259,727,734**	**1,182,757,774**	
%, Top Pollutants, of Total Recycling Transfers	**90**	**92**	

Pollutant	Other Transfers (except metals) 2005 (kg)	Other Transfers (except metals) 2010 (kg)	% Change 2005–2010
Methanol (CA, US)	114,301,833	81,765,295	-28
Nitric Acid/Nitrate Compounds (CA, US)	80,496,753	67,223,219	-16
Toluene (CA, US)	69,446,138	51,124,205	-26
Xylenes (CA, US)	51,327,726	69,734,430	36
Ethylene Glycol (CA, US)	21,134,478	18,374,290	-13
Ethylene (CA, US)	12,276,047	14,022,033	14
Ammonia, Total (CA, US)	10,776,237	12,657,515	17
Sulfuric Acid (CA, US)	2,907,129	14,647,419	404
1,2-Dichlorobenzene (CA, MX, US)	530,760	17,026,422	3,108
1,1,2-Trichloroethane (CA, MX, US)	234,645	14,230,314	5,965
Total, Top 10 Pollutants, Other Transfers	**363,431,745**	**360,805,143**	
Total, All Pollutants, Other Transfers	**600,652,254**	**536,970,141**	
%, Top Pollutants, of Total Other Transfers	**61**	**67**	

Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

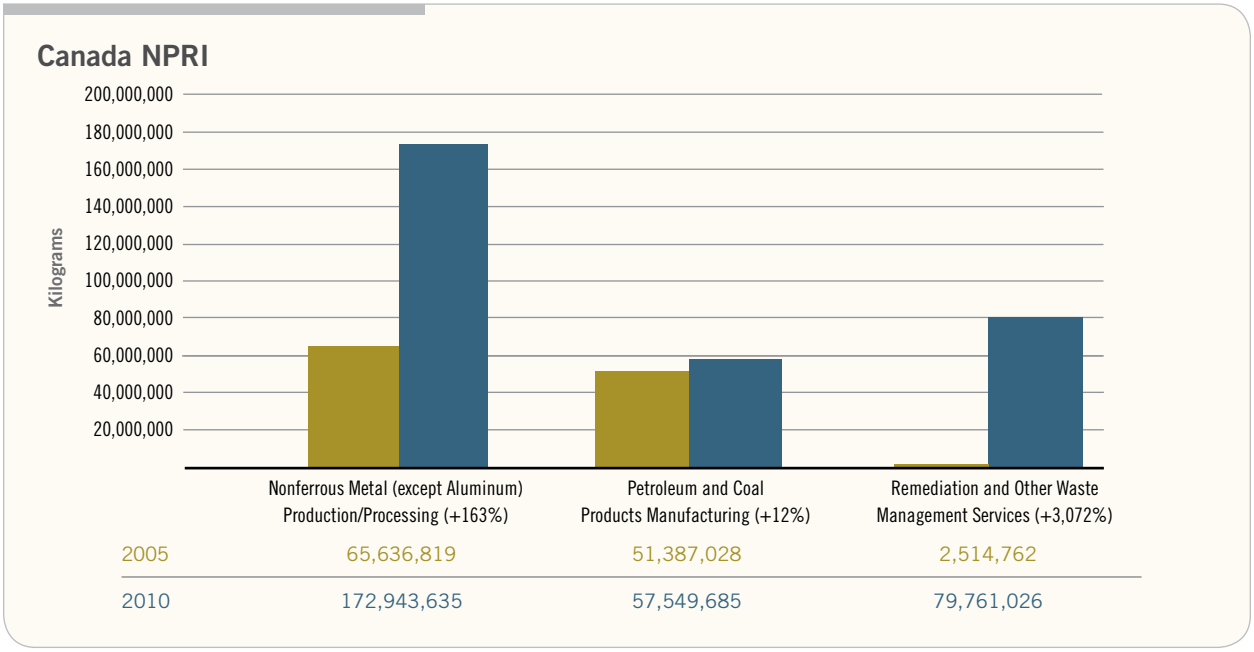
23. CEC. 2011. Taking Stock: North American Pollutant Releases and Transfers 13. Montreal, Canada: Commission for Environmental Cooperation.

Figure 25. Top Reporting Industry Sectors for Transfers to Recycling and Other Transfers, North America, 2005–2010

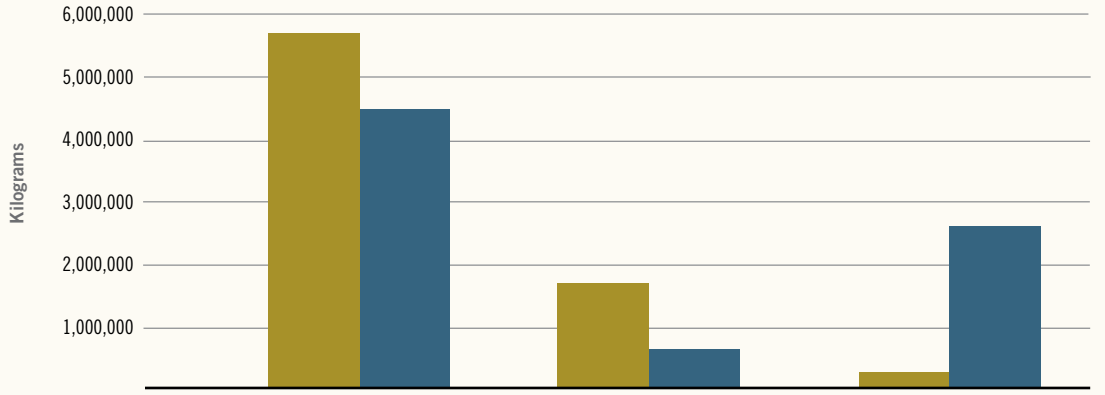


Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

Figure 26. Top Reporting Industry Sectors for Transfers to Recycling and Other Transfers, in Canada, Mexico and the United States, 2005–2010

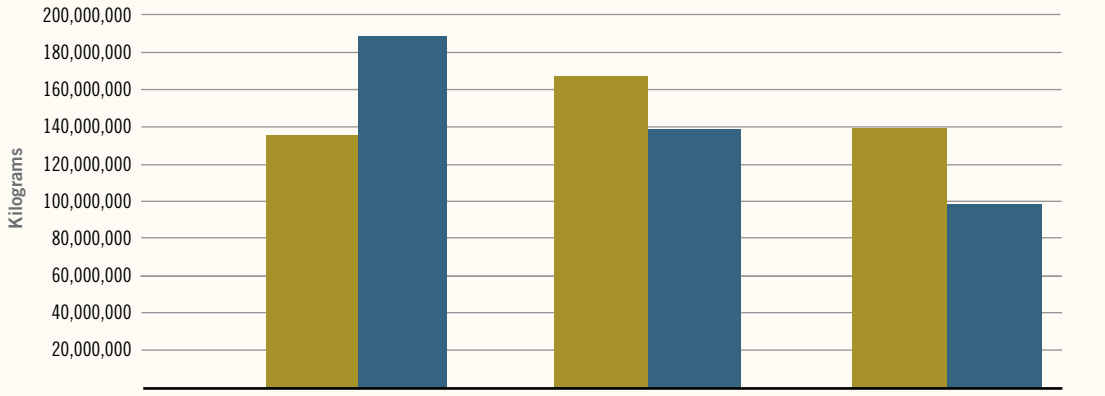


Mexico RETC



	Other Electrical Equipment and Component Manufacturing (-21%)	Motor Vehicle Parts Manufacturing (-61%)	Foundries (+758%)
2005	5,666,643	1,711,947	303,242
2010	4,483,358	664,695	2,602,119

US TRI



	Iron and Steel Mills and Ferroalloy Manufacturing (+39%)	Basic Chemical Manufacturing (-17%)	Nonferrous Metal (except Aluminum) Production/Processing (-29%)
2005	136,024,073	166,776,083	138,438,359
2010	188,445,837	138,454,147	98,004,190

Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

northern Ontario, which comprises a copper smelter and refinery for metals extracted at its nearby mine. This facility accounted for over 70 percent of all reported off-site transfers to recycling from this sector in 2010. In contrast, reported off-site transfers from the nonferrous metal sector in the United States declined by 29 percent between 2005 and 2010. In that country, the iron and steel mills and ferroalloy manufacturing sector reported a 39 percent increase, with a number of top reporting facilities, including the Steel Dynamics facility in Indiana and about ten Nucor Steel facilities, accounting for this increase (mainly as transfers to recycling).

A notable increase was also seen in reported off-site transfers from the Canadian remediation and waste management services sector. Most of this can be attributed to reporting by the Envirosort Inc. facility in Red Deer, Alberta (owned by Clean Harbors Canada), which began reporting in 2009. It reported transfers to treatment of more than 75 million

kilograms of the total 91.8 million kilograms reported by this sector in 2010.

In Mexico, the top two reporting sectors saw decreases in reported off-site transfers over this period. These transfers were dominated by the other electrical equipment and component manufacturing sector, which reported a 21 percent decrease between 2005 and 2010. Two of the facilities that accounted for the majority of off-site transfers to recycling from this sector in 2005 did not report in 2010. They were Enertec facilities based in Guanajuato and Nuevo León.

The Mexican foundry sector saw a large increase in off-site transfers. With no more than 11 facilities reporting, transfers to recycling reported by two of the top facilities in 2010—the LBQ Foundry in Querétaro and the Deacero–Celaya steel laminating facility in Guanajuato—accounted for almost 87 percent of total off-site transfers by the sector that year.

2.7.2 Reported Cross-border Transfers, 2006–2010

Some of the off-site transfers reported by industrial facilities were across national borders. They included pollutants transferred for disposal, recycling, treatment, or energy recovery. Integrated cross-border transfers data from the three PRTR programs are available starting with the 2006 reporting year.

In 2010, almost 125 million kilograms of pollutants were transferred across North American borders, a decrease of approximately 46 percent from 2006 levels. These transfers are depicted in Figure 27.

Figure 27. Reported Cross-border Transfers in North America, 2006–2010

Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

This graphic shows that Canadian facilities transferred pollutants to the United States between 2006 and 2010, but not to Mexico; similarly, Mexican facilities transferred pollutants to US facilities, but not to Canada. This is understandable from a geographic perspective, since transfers between Canada and Mexico would involve greater time and cost. US facilities transferred pollutants to both Canadian and Mexican facilities over this period.

Transfers from Canadian facilities to US facilities accounted for 78.3 million kilograms, or about 63 percent of total cross-border transfers in 2010. Approximately three-quarters of these transfers consisted of sulfuric acid for recycling, mainly from the petroleum and coal products manufacturing sector. These transfers decreased notably between 2006 and 2010, with the Irving Oil refinery in New Brunswick a main driver of this decrease. It reported more than 56 million kilograms in cross-border transfers of sulfuric acid to US facilities in 2006, but 46,151 kilograms in 2010. The Canadian chemical manufacturing sector also transferred just over 14 million kilograms of sulfuric acid to US facilities in 2006, but about 2 million kilograms in 2010.

Mexican facilities transferred 687,532 kilograms to the United States in 2010, a decrease from the 1.77 million kilograms transferred in 2006. Two-thirds of the transfers in 2010 were metals for recycling (especially lead and nickel and their compounds). The large decrease over this period can be attributed mainly to reductions in transfers of lead and its compounds from the Power Sonic electrical parts and accessories plant in Baja California, which transferred 1.44 million kilograms of these compounds in 2006 and almost one million kilograms in 2007, but nothing in the subsequent years.

Facilities in the United States transferred about 9.2 million kilograms of pollutants to Canada in 2010, a decrease from the 19.6 million kilograms reported in 2006. The US transportation equipment manufacturing sector and the chemical manufacturing sector together accounted for almost half of all these transfers. About 75 percent of the total consisted of metals for recycling (with copper and manganese and their compounds together accounting for 55 percent of the total). Another 1 million kilograms of various substances (e.g., toluene, tetrachloroethylene) were transferred to Canadian facilities for energy recovery or other treatment.

US facilities also transferred more than 36 million kilograms to Mexico in 2010, a decrease from about 45.5 million kilograms in 2006. Most of this amount comprised metals for recycling, with zinc and its compounds accounting for over 80 percent of the total. All of the zinc compounds transferred from US primary metal manufacturers were sent to the Zinc Nacional facility in the state of Nuevo León. However, zinc and its compounds are not subject to Mexico's RETC. In fact, of the 14 pollutants transferred in 2010 from US facilities to Mexico, only five are subject to PRTR reporting in that country (see Table 27). Therefore, it is not possible to track the management of these pollutants once they have crossed the border.

Table 27. Top Reported Pollutants Transferred from US Facilities to Mexico, 2010

Pollutant	Transfers for Disposal, 2010 (kg)	Transfers for Recycling, 2010 (kg)
Zinc (and compounds) (CA, US)	–	29,674,364
Manganese (and compounds) (CA, US)	120,109	3,219,645
Lead (and compounds) (CA, MX, US)	0	2,285,718
Copper (and compounds) (CA, US)	9,076	311,832
Chromium (and compounds) (CA, MX, US)	1,802	307,731
Di(2-Ethylhexyl) Phthalate (CA, US)	–	107,664
Aluminum (fume or dust) (CA, US)	–	81,800
Cadmium (and compounds) (CA, MX, US)	–	37,404
Nickel (and compounds) (CA, MX, US)	1,802	31,717
N-Methyl-2-Pyrrolidone (CA, US)	–	20,100
Barium (and compounds) (US)	1,228	1,843
Vanadium (and compounds) (CA, US)	832	2,167
Molybdenum Trioxide (CA, US)	1,117	1,724
Mercury (and compounds) (CA, MX, US)	12	331
Total, Top Pollutants Transferred, United States to Mexico	**135,978**	**36,084,040**

Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.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Chapter 3

Releases to Air and Water from North American Pulp, Paper and Paperboard Mills, 2005–2010

This chapter provides additional information and analyses regarding pollutant releases reported over time to the North American PRTRs by facilities in the pulp, paper and paperboard mill sector (NAICS code 3221). This industry sector was selected for further analysis because from 2005 through 2010 it consistently ranked among the top sectors in North America for reported releases to air (second rank) and releases to water (third rank). These releases decreased between 2005 and 2010, by 19 percent and 6 percent, respectively.

The main objectives of this feature analysis are to undertake a closer examination of releases to air and water reported by this sector from 2005 through 2010, to identify the drivers of the changes in these releases, and to thus gain a better understanding of the potential links between PRTR data and corporate environmental sustainability efforts.

This chapter also includes the results of a small CEC survey of pulp, paper and paperboard mills that reported fairly consistently to their respective PRTRs between 2005 and 2010. Additional insight has been provided by pulp and paper industry associations, which provides invaluable context to the data, particularly with respect to the economic, technical and environmental challenges facing this sector in North America.

3.1 Key Findings

- Among all sectors reporting to the PRTRs of North America between 2005 and 2010, pulp, paper and paperboard mills consistently ranked second for releases to air, and third for releases to water. Facilities in this sector reported more than 92.6 million kilograms in releases to air in 2005, and about 75 million kilograms in 2010 (a decrease of 19 percent). They also reported releases to water of about 16.6 million kilograms in 2005, with these releases declining to about 15.7 million kilograms in 2010 (a decrease of 6 percent).

- Of over 500 active mills in North America, between 352 and 429 reported to the North American PRTRs each year, from 2005 through 2010. In Canada and the United States, the countries accounting for the largest proportions reported by this sector, the total number of reporting facilities decreased, largely due to the shutdown of manufacturing operations. This decrease played a key role in the reductions in releases to air and water reported over this period. In Mexico, the number of reporting mills increased.

- Differences among national PRTR reporting requirements for pollutants, as well as incomplete reporting, had an impact on the amounts and types of pollutants reported released to air and water. For example, some of the typical pollutants for this sector, such as methanol, were often reported in only one country. These gaps were especially evident in Mexico, where mills reported very small proportions of total releases to air and water.

- The majority of respondents to the CEC's survey of mills mentioned more than one driver of the changes at their facilities between 2005 and 2010. These drivers included changes in government regulations, environmental management practices, economic considerations, corrections or changes in PRTR data estimations, and decreases in production. The survey also revealed that mills use their PRTR data for internal information about environmental performance, as well as to comply with facility permitting requirements.

- A number of mills noted that PRTR data are used in external communications with the public, with comments also indicating that customer demand plays a role in their environmental management decisions, such as the choice of chemicals used at their facilities. This suggests that PRTR data have wider impacts and that they are a useful tool not only for industrial facilities, but for external stakeholders as well.

3.2 Overview of the Pulp and Paper Sector in North America

The paper manufacturing industry has undergone a significant transformation in the past 20 years as a result of changing economic and market conditions, with technological advances aimed at addressing both productivity and environmental concerns. Traditionally, pulp and paper products were sold in the producing countries (in North America: Canada

Figure 28. Production and Consumption of Pulp, Paper and Paperboard Products, North America, 2008

*1 tonne = 1,000 kilograms.
Data from: UN Food and Agriculture Organization (FAO). 2011. *State of the World's Forests*. 2008 statistics. Rome: FAO.
Online at: <www.fao.org/docrep/013/i2000e/i2000e.pdf> (accessed August 2013).

and the United States; and in Western Europe: Sweden, Germany and Finland); however, since the 1990s there has been a burgeoning international trade in pulp and paper and a shift in the patterns of production and consumption of paper and paperboard products, with much growth in Asia (particularly China and Japan), as well as Brazil.[24]

There has been a decline in pulp and paper production and consumption in North America since 2007, due to the financial crisis in the United States and the shift in news and media from print to digital formats, which has had a major impact on newsprint production. As a result, pulp and paper companies have adopted innovative and more efficient processes, and there has been a consolidation of the global pulp and paper industry and the disappearance of many small companies. As of 2010, there were approximately 90 active pulp, paper and paperboard mills in Canada, 370 mills in the United States, and 64 mills in Mexico.[25]

At present, a relatively small number of transnational conglomerates are involved in sourcing fiber and producing pulp and paper products.[26] In China, total paper consumption surpassed that of North America for the first time in 2009.[27] To meet the growing demand in Asia, traditional pulp and paper producers have shifted a substantial part of their production to developing countries where raw materials and labor are cheaper.

Figure 28 illustrates the production and consumption of pulp and paper products in the three North American countries in 2008.

3.3 Processes and Technologies: Pulp, Paper and Paperboard Mills

Modern paper production basically involves the pulping of virgin or recycled fibers from trees, recycled paper, or agricultural residues such as straws derived from wheat, flax or rice; corn stalks; or sugar cane bagasse (or fibrous residue); followed by mechanical, chemical or semi-chemical processing of the fiber into pulp; then running the pulp through a paper machine to create large rolls of paper or paperboard; and finally, converting the paper into a variety of products such as office paper and cardboard boxes. The type of material (or mix of materials) used in pulp and paper production, the type of mills and technologies used (including pollution control and energy sources) have impacts on the amount and types of pollutants created and released from facilities in this sector. Figure 29 depicts the basic pulp and paper-making process.

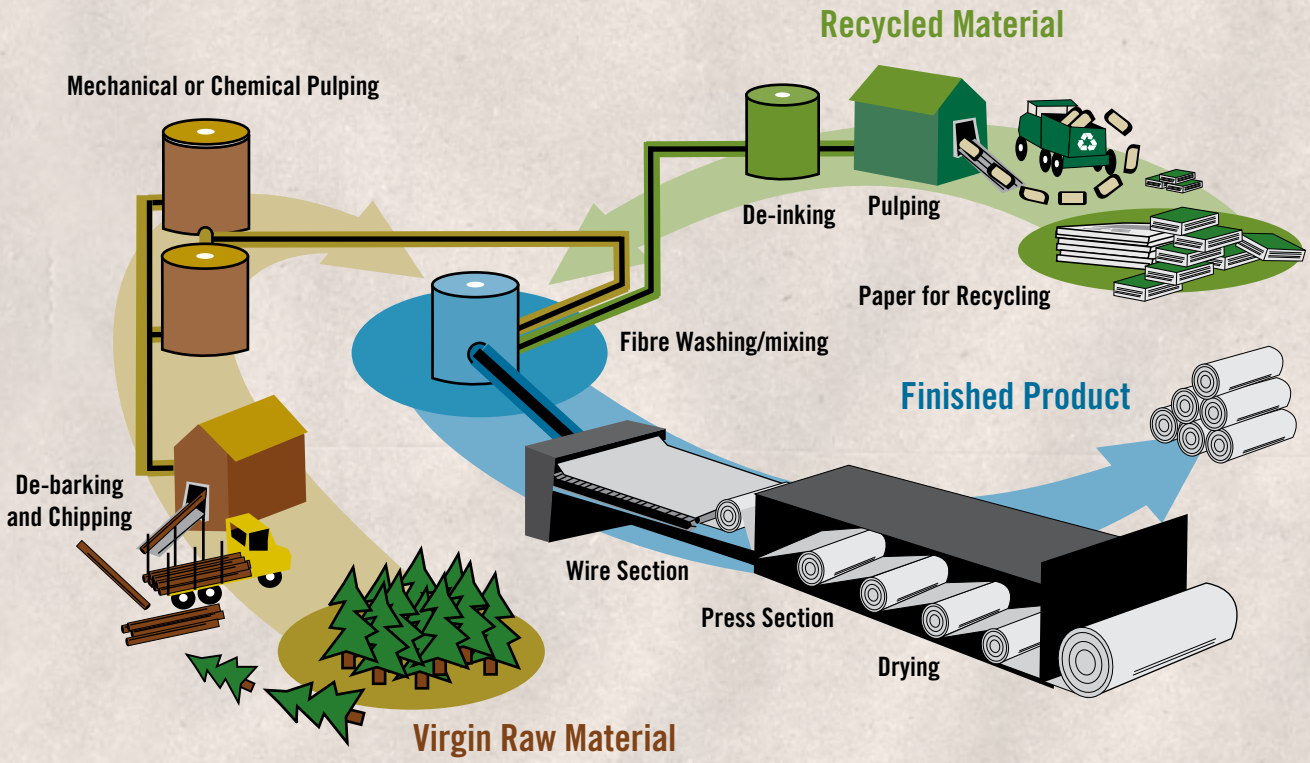
24. De la Madrid Cordero, E. 2009. *La situación de la industria de la celulosa y el papel en el mundo*. Department of Rural Finance. Government of Mexico.
25. Environment Canada. Forest Products and Fisheries Act Division (personal communication). US Bureau of Labor Statistics. 2013. Quarterly census of employment and wages. Table 2. Private industry by 6-digit NAICS industry and government by level of government, 2010 annual averages: Establishments, employment and wages, change from 2009. Online at: <www.bls.gov/cew/ew10table2.pdf> (accessed July 2013). National Council for Air and Stream Improvement, Inc. (NCASI-US). 2013. Personal communication, Nov. 2013. Instituto Nacional de Estadística y Geografía (INEGI). 2012. « Principales características de la industria manufacturera por sector, subsector, rama y clase de actividad. Resultados integrados, 2009–2010 ». *Encuesta Anual de la Industria Manufacturera 2009–2010, SCIAN 2007*. En ligne : <HYPERLINK "http://www.inegi.org.mx/prod_serv/contenidos/espanol/bvinegi/productos/encuestas/establecimientos/indus_manu/resumen_anual_09_10/EAIM09_10.pdf" www.inegi.org.mx/prod_serv/contenidos/espanol/bvinegi/productos/encuestas/establecimientos/indus_manu/resumen_anual_09_10/EAIM09_10.pdf>.
26. De la Madrid Cordero, E. 2009. *La situación de la industria de la celulosa y el papel en el mundo*. Financiera Rural. Department of Rural Finance. Government of Mexico.
27. RISI. 2013. Annual historical data: World pulp, 2010. Online at: <www.risiinfo.com/pages/product/pulp-paper/>.

It shows wood as the main resource used, but currently, recovered paper accounts for more than 37 percent of fiber used to make new paper products in the United States,[28] and in Canada about 87 per cent of the wood fiber used to make paper comes from a blend of sawmill residues (59 per cent) and recycled paper (28 per cent).[29] In Mexico, the pulp and paper industry uses between 85 percent and 88 percent secondary fibers, mainly recycled paper and cardboard (much of it imported).[30] Investment in new technologies has further enabled companies' use of recovered paper in their production. However, while used paper is recovered at a rate of nearly 70 percent, a significant percentage of paper product is not suitable for recovery because it is contaminated (e.g., certain tissue papers, or food wrappers), thus significantly reducing the utilization rate of this recovered fiber. Also, cellulose fibers become shorter each time they are recycled, which limits their useful lifespan for the production of paper.[31]

3.3.1 Pulp Mills

Pulp mills manufacture pulp from wood or other fibers, including recycled paper. Pulping facilities can include de-inking plants that process waste paper into pulp. To transform virgin wood into pulp, the cellulose fibers that are held together by a substance called lignin must be separated. Depending on the type and strength of paper desired, this can be done using mechanical or chemical processes. *Mechanical pulping* involves crushing logs that have been stripped of their bark with grinders and then soaking them with water. Generally speaking, mechanical pulps are used to manufacture short-lived products and those requiring less strength, such as newsprint. *Chemical pulping* involves cooking wood chips in huge vats, or digesters, with chemicals. The combination of heat and chemicals dissolves the lignin, releasing the long wood fibers without breaking them. Chemical pulp is therefore used to manufacture

Figure 29. Schematic of a Typical Pulp and Paper Mill



Source: Modified from European Paper & Packaging Industries. 2013. *Paper online.* Website, <www.paperonline.org>.

28. American Forest and Paper Association. 2013. Website, <www.afandpa.org> (accessed Aug. 2013).
29. Forest Products Association Canada. 2013. Website, <www.fpac.ca/index.php/en/> (accessed Aug. 2013).
30. De la Madrid Cordero, E. 2009. *La situación de la industria de la celulosa y el papel en el mundo*. Department of Rural Finance. Government of Mexico.
31. US EPA. 2013. Wastes/resource conservation / common wastes & materials/paper recycling. Online at: <www.epa.gov/osw/conserve/materials/paper/basics/papermaking.htm> (accessed June 2013). US EPA. 2002. *Profile of the pulp and paper industry*. 2nd Edition. Office of Compliance Sector Notebook Project. November 2002. Online at: <www.epa.gov/compliance/resources/publications/assistance/sectors/notebooks/pulppasn.pdf> (accessed June 2013).

Steffen Thoma

longer-lived products and those requiring greater strength, such as printing and writing papers. One common chemical pulping process is the "kraft" process, which uses a solution of sodium hydroxide and sodium sulfide to dissolve the non-fibrous materials, including lignin.[32]

Depending on the eventual use of the pulp, it can undergo a bleaching process. Bleaching is used to whiten paper products and to prevent them from becoming brittle and yellow with time. The bleaching chemicals, such as chlorine dioxide, are injected into the pulp to further dissolve the lignin and yield a whiter product. The impacts of pulp bleached with chlorinated compounds have been a subject of debate and regulations since the late 1980s, as discussed below.

3.3.2 Paper Mills

Paper mills manufacture paper and are sometimes also involved in producing pulp. After fillers and coloring materials have been added to the pulp (if desired), it is ready to be made into paper. The pulp is pumped onto wire screens that vibrate to allow water to drain out of the pulp and to help the fibers interlock into sheets. Different qualities and properties of paper can be produced by varying the amounts of pulp and additives used. The sheets then pass through a long series of rollers to remove remaining moisture, and are dried by heated drums. Finally, a process called calendaring can be used to further compress and polish the sheets. Large sheets of paper are wound onto rolls and can then be cut for a variety of paper products.

Paper mills can manufacture both newsprint and other types of paper. Newsprint is made from mechanical wood pulp containing all components of the wood. Other types of paper can include those for the construction industry (e.g., asphalt paper); paper stock for conversion into paper products; "fluff pulp" for use in personal hygiene products such as disposable diapers, facial tissues, sanitary napkins and tampons; fine paper stock and a variety of office papers (e.g., printer, photocopy, loose-leaf, and kraft paper); and treated, laminated or coated papers.

3.3.3 Paperboard Mills

Paperboard mills manufacture paperboard and, as in the case of paper mills, can also be involved in the production of pulp—whether from virgin or recycled feedstock.

32. Statistics Canada. 2007. North American Industry Classification System (NAICS). Online at: <http://stds.statcan.gc.ca/naics-scian/2007/cs-rc-eng.asp?criteria=3221> (accessed Aug. 2013). US EPA. 2013. Wastes/resource conservation / common wastes & materials/paper recycling. Online at: <www.epa.gov/osw/conserve/materials/paper/basics/papermaking.htm> (accessed June 2013). US EPA. 2002. *Profile of the pulp and paper industry*. 2nd Edition. Office of Compliance Sector Notebook Project. November 2002. Online at: <www.epa.gov/compliance/resources/publications/assistance/sectors/notebooks/pulppasn.pdf> (accessed June 2013).

3.4 Pollutants Associated with the Pulp and Paper Manufacturing Sector

There are a variety of attendant environmental issues in pulp and paper manufacturing. They include water consumption, energy use, sustainable forest management, chemical use, air and water releases (including thermal pollution), and disposal or beneficial use of manufacturing residuals. This section of the report focuses on the pollutants released to air and water by various stages of the production of pulp, paper and paperboard. These stages include wood preparation, mechanical and chemical pulping, washing, screening, and bleaching; papermaking and coating operations; fuel combustion for energy (the boiler); the recovery furnace (evaporation, concentration, and combustion of "spent pulping liquor"—the liquid resulting from chemical pulping—enabling re-use of chemicals for pulping); and the lime kiln (used for recovering lime from spent pulping liquor for use in chemical pulping).[33]

The majority of the pollutants released to air and water as a result of pulp and paper manufacturing are generated as follows:

- **Wastewater:** The vastly greater part of spent pulping liquor and soluble wood materials is usually recovered (for chemical pulp mills), but wastewater can include a small amount of "weak" spent pulping liquor and effluents from the bleaching process.
- **Air emissions:** While predominantly released from stationary combustion equipment such as boilers and recovery furnaces, they can be emitted from other operations at the mill (e.g., pulping digesters, lime kiln, bleach plant, and wastewater treatment). They can include reduced sulfur compounds; volatile organic compounds (VOCs); odor from sulfides in spent pulping liquor and condensates from the kraft process; sulfuric acid and hydrochloric acid; particulates; and, from combustion units, sulfur and nitrogen oxides.
- **Solid waste (manufacturing residuals):** This results from the pulp manufacturing process, wastewater treatment, and chemical recovery process.

The following are some of the pollutants typically generated from pulp and paper manufacturing processes. Additional information about these pollutants' industrial uses, chemical properties, and their potential to cause harm to human health or the environment is provided in Appendix 5**.** As mentioned earlier in this report, in the absence of other information such as route and length of exposure, it is difficult to determine the actual risk posed by a substance. Readers are encouraged to refer to the sources used in this report for additional information, including the US ATSDR (ToxFAQs), and the New Jersey *Right-to-Know Hazardous Substance Fact Sheets*.

Volatile Organic Compounds (VOCs) are a category of organic compounds that are gases at room temperature (e.g., solvent vapors). Methanol is one of the VOCs emitted in largest proportions during pulp and paper manufacturing (as an inadvertent by-product of wood pulping, chemical recovery, and pulp bleaching). Other VOCs resulting from pulp and paper manufacturing include acetaldehyde, propionaldehyde, methyl ethyl ketone, phenols, and terpenes.

Reduced Sulfur Compounds (e.g., hydrogen sulfide, carbonyl sulfide) are associated with the distinct rotten egg odor emitted at chemical pulp mills.

Chlorinated Compounds: Chlorine-based chemicals commonly used for bleaching pulp include chlorine dioxide and sodium hypochlorite.

Dioxins and Furans: The discovery that dioxins and furans (a group of PBTs) were incidentally produced during the chlorination stage of bleaching, and especially with the use of elemental chlorine (Cl_2), led to the phase-out of the use of elemental chlorine for bleaching in North American chemical pulp mills. In areas where pulp mills use wood from logs transported in salt water, combustion of wood residuals (called "salty hog fuel") can lead to low levels of dioxins released to the air.

Chloroform may be formed by the use of chlorine-based compounds for bleaching in pulp and paper manufacturing.

Mercury is released from the combustion of fossil fuels.

Other Heavy Metals, including lead, cadmium, chromium, arsenic, zinc and other metal compounds, can be found in small quantities in wood, and are also natural components of fuels (e.g., coal, oil) used to generate power and steam at pulp and paper mills. They may also be present in dyes used to add color or brightness to certain papers.

33. The information in this section is taken from: US EPA. 1997. *The pulp and paper industry, the pulping process, and pollutant releases to the environment*. Fact sheet. Online at: <http://water.epa.gov/scitech/wastetech/guide/pulppaper/upload/1997_11_14_guide_pulppaper_jd_fs2.pdf> (accessed June 2013). Environmental Paper Network (EPN). 2011. *The state of the paper industry 2011: Steps toward an environmental vision*. Available at: <http://environmentalpaper.org/> (accessed Aug. 2013). Ince, B.K., Z. Cetecioglu and O. Ince. 2011. Pollution prevention in the pulp and paper industries. In *Environmental management in practice*, ed. Elzbieta Broniewicz. Rijeka, Croatia: InTech. National Council for Air and Stream Improvement, Inc. (NCASI). 2013. Personal communication, Dec. 2013.

Suspended Solids are solid material suspended in mill effluent, and are measured as total suspended solids (TSS).

Adsorbable Organic Halogens (AOX) is a measure of the quantity of chlorinated organic compounds in chemical pulp mill effluent.

Nitrogen Compounds (e.g., nitrates, nitrites, ammonia) and **Phosphorus** are added during the wastewater treatment process to help remove dissolved organic material from the effluent.

Biochemical Oxygen Demand (BOD) is the amount of dissolved oxygen that is needed by the organisms living in water to break down organic material. It is affected by discharges of waste matter and is often used as an indicator of water quality.

Criteria Air Contaminants (CACs): Due to differences among the three countries in PRTR reporting requirements, data on releases of CACs are not included in this report. However, CACs are typically released from the combustion of fuel (often fossil-based, such as coal, oil and natural gas) for generation of energy used during pulp and paper manufacturing. Common CACs include the following:

- **Carbon monoxide** is produced by incomplete combustion of fossil fuels.
- **Nitrogen oxides (NO_x)** are products of the combustion of fuels.
- **Particulates** are small particles that are dispersed into the atmosphere from combustion. They can be fine or coarse, and be composed of wood or chemical compounds created with carbon, metallic oxides and salts, acids, oils, lime, etc.
- **Sulfur dioxide (SO_2)** is a chemical compound produced from the combustion of fuel containing sulfur (e.g., oil, coal).

Greenhouse Gases (GHGs), such as carbon dioxide: GHGs (mainly from the boilers that generate energy for the pulp and paper mill) are typically released by this sector. GHG emissions data are excluded from this report, due to differences in national PRTR reporting requirements for these pollutants.

3.5 Pollution Prevention and Control in the Pulp and Paper Manufacturing Sector

In terms of reducing the impacts of industrial processes on human health and the environment, as well as minimizing costs, pollution prevention is preferable over end-of-pipe solutions, such as treatment and final disposal. A number of technologies and processes have been implemented by pulp, paper and paperboard mills over the past two decades to either prevent or minimize the generation of waste and the release of pollutants to the environment. And, just as certain groups of pollutants can jointly result from pulp and paper manufacturing processes (e.g., metals, sulfur compounds, volatile organic compounds), implementing pollution prevention and control processes or technologies can address multiple pollutants simultaneously.

3.5.1 Substitution of Toxic Inputs

The debate over elemental chlorine, which was commonly used 20 years ago in the pulp bleaching process, has led to its replacement with less toxic, or non-toxic, substitutes and the use of alternative processes for both pulping and bleaching. Some of these processes are described below.

- **Elemental chlorine–free (ECF) pulp bleaching**: Mills have replaced elemental chlorine with other agents, such as chlorine dioxide and hydrogen peroxide, in their bleaching processes. ECF has become the industry standard, and studies show that dioxin levels in the tissue of fish downstream from pulp and paper mills have significantly declined. ECF bleaching also reduces a number of chlorophenols to non-detect levels, decreases chloroform formation, and decreases chlorinated organic compound formation (measured as AOX) formation by 90 percent.[34]
- **Totally chlorine-free (TCF) pulp bleaching**: TCF uses no chlorine compounds, but instead uses hydrogen peroxide and ozone to bleach the pulp. This type of bleaching does not result in the formation of dioxins and furans or AOX. However, it is not widely used by North American pulp and paper mills.

34. National Council for Air and Stream Improvement, Inc. (NCASI). 2003. *Pulp mill process closure: A review of global technology developments and mill experiences in the 1990s*. Technical Bulletin No. 860. Research Triangle Park, NC: National Council for Air and Stream Improvement, Inc.

- **Extended delignification:** This refers to the enhanced removal of lignin prior to the bleaching process, which can be achieved by extended cooking, oxygenation, ozonation, and/or addition of chemical catalysts. Given that extended delignification allows more lignin to be recovered and burned during pulping liquor recovery, these processes can have positive effects on the quality of the mill's final effluent, especially on parameters such as BOD, color and AOX.

3.5.2 Closed-loop Systems and Recycling

Closed loop systems involve chemical recovery and recycling, to prevent the release of pollutants into the environment. For example, the effluent from the kraft pulping process, known as black liquor, is captured, combusted, and ultimately reused in the manufacturing process while concurrently generating energy. Some mills also collect the steam produced during the cooking of the wood chips, which can be condensed in order to remove some of the liquid's pollutants before it is released. Closed-loop systems can also have important economic benefits, given the cost of certain chemicals and other inputs used in pulp and paper manufacturing; however, there are significant technical challenges to achieving complete system closure for chemical pulping mills.[35]

There has been an ongoing effort to increase paper and paperboard recycling in North America, Western Europe and Japan. Increasing the recycled content of paper may result in benefits such as:

- less energy use, depending on the paper grade being manufactured;
- lower greenhouse gas emissions, depending on the paper grade involved;
- somewhat lower water use;
- lower air emissions, where less energy is used; and
- lower emissions to water.

3.5.3 Pollutant Control Technologies

Air Pollutants: Technologies have been installed on boiler systems in pulp and paper mills, as in other industries that generate their own power through fuel combustion, to prevent pollutants from being released to the environment. They include end-of-pipe air pollution control technologies, such as scrubbers, particulate "baghouses," and electrostatic precipitators. These technologies remove pollutants (e.g., sulfur compounds, VOCs) by capturing them for treatment or disposal.

Sludges: Various technologies and methods are used for the management and reduction of solid residuals and wastewater treatment sludges generated by pulp and paper mills, including the following:

- *Composting*: This method is well-suited to residuals that contain a fraction of paper fiber and/or other organic materials. The wastes are stabilized via microorganisms and the end product can be used for agriculture.
- *Land application/farming*: This method is used in many areas, and consists of spreading sludge over the land and mixing with soil. Before the application, the sludge is dewatered in order to reduce volume.
- *Incineration or combustion*: A common solution to wastewater treatment sludge, particularly when combined with other materials such as bark or wood residue—although the water content and ash content of most sludges do not make them a very efficient energy source.

Wastewater: Installing or upgrading secondary wastewater treatment systems may result in reductions in releases of suspended solids, as well as reduction in biochemical oxygen demand, although there are practical limits in terms of the extent to which these reductions can be achieved for a given treatment system. In primary wastewater treatment systems, suspended solids such as organic materials (e.g., wood fiber, debris, coating materials) are removed from the effluent. Secondary treatment systems use bacteria to break down organic pollutants and reduce their concentrations.

3.5.4 Pollution Prevention and Reduction: Looking Forward

Since the 1990s, the pulp and paper industry has shifted the focus from addressing many of the "conventional" pollutants or issues (e.g., methanol and chlorine, along with BOD and TSS), to conducting research on the potential effects on fish of natural wood extracts that are released into the environment during the preparation of cellulose fibers prior to bleaching. Issues such as these, along with regulatory requirements, customer demand, and industry commitment to minimizing environmental impacts

35. Ibid.

are driving the development of minimum-impact mills. For instance, mills are weighing the use of non-toxic substitutes for the inputs and additives used in various processes, as in:

- improving pulping liquor recovery to minimize releases of potentially harmful substances that may be present in lignin;
- using alternative paper dye formulations;
- changing paper wet-strength additives; and
- altering the use of de-foaming agents (used to counter the bubbles created from substances liberated from lignin).[36]

The industry is therefore looking to "green chemistry" to solve some of its current-day pollution challenges. For example, recent research by EPA scientists has yielded some promise relative to the issue of methanol releases. As an alternative to incineration, methanol may be captured and converted into methyl formate, a commodity chemical and environmentally-friendly blowing agent and solvent, and a precursor to formic acid, which is used as a preservative and antibacterial agent. Studies have shown that the new technology could remove about 98 percent of the sulfur compounds responsible for the odor from pulp and paper mills, and about 90 percent of the methanol gas from the waste stream. This technology uses no toxic inputs, but converts the existing waste into useful product. At the moment, the research does not transfer to an industrial-scale use, but future large-scale use of this green chemistry could significantly decrease environmental releases from pulp and paper mills, reduce the amount of energy used to dispose of waste, and minimize odor—while possibly increasing mills' profits.[37]

In 2009, the Canadian government established the Pulp and Paper Green Transformation Program, which offered incentives to mills to improve their environmental performance. Eligible companies could earn credits for the "black liquor" (spent pulping liquor) produced at chemical pulping mills between January and May, 2009, and then invest those credits where doing so made the most environmental and economic sense for their mills. Projects had to be those that would achieve measurable environmental benefits through energy efficiency improvements, renewable energy production, emission reductions, and so on. The projects undertaken varied from boiler and turbine upgrades to the installation of energy-efficient motors and emission-control equipment.[38]

3.6 Pulp and Paper Manufacturing: Regulatory Environment

3.6.1 Canada

Two main pieces of federal environmental legislation regulate the Canadian pulp and paper sector. They are the Canadian Environment Protection Act (CEPA), and the Fisheries Act. In addition, the Clean Air Regulatory Agenda (CARA) was launched in 2006. It provides a framework to establish emission reduction targets for the major industrial sectors in Canada, including the pulp and paper sector, in order to improve air quality and decrease smog levels and acid deposition.[39]

In addition to federal legislation, pulp and paper mills are regulated by provincial pulp and paper regulations and/or site-specific operating permits.

In 1971, pulp and paper became the first regulated sector under the Fisheries Act. Under the Act, Pulp and Paper Effluent Regulations (PPER) were put in place to govern the discharge of deleterious substances (including acutely lethal effluent, BOD matter, and suspended solids) from pulp and paper mills and the deposit of limited quantities of those deleterious substances into waters frequented by fish. The PPER have the overall objective of protecting water quality in order to sustain fish, fish habitats and fisheries resources. The PPER were amended in 1992 to introduce enforceable effluent quality standards for all mills, based on standards achievable through the use of secondary wastewater treatment, in order to avoid effluent discharges that are acutely lethal to rainbow trout. The PPER were updated in 2004 and 2008 to improve their clarity while supporting compliance and enforcement, and to streamline requirements linked to environmental effects monitoring studies.[40] Most recently (in 2010), Environment Canada conducted a review of industry sectors to determine compliance with existing PPER and concluded that facilities had high rates of compliance.

36. National Council for Air and Stream Improvement, Inc. (NCASI). 2003. *Pulp mill process closure: A review of global technology developments and mill experiences in the 1990s*. Technical Bulletin No. 860. Research Triangle Park, NC: National Council for Air and Stream Improvement, Inc.
37. US EPA. 2011. Transforming paper mill pollution into commercial resource. *Science Matters* newsletter, June 2011. Online at: <www.epa.gov/sciencematters/june2011/papermill.htm> (accessed 7 Dec. 2012).
38. Natural Resources Canada. 2013. Pulp and Paper Green Transformation Program: Mission accomplished. Online at: <www.nrcan.gc.ca/forests/federal-programs/13141> (accessed Sept. 2013).
39. Environment Canada. 2013. *Backgrounder: Clean air regulatory agenda*. Online at: <www.ec.gc.ca/default.asp?lang=En&n=56D4043B-1&news=295B1964-9737-4F80-B064-B3088D9910BE> (accessed June 2013).
40. Environment Canada. 2012. *Status report on the pulp and paper effluent regulations*. June 2012. Online at: <www.ec.gc.ca/Publications/default.asp?lang=En&xml=A231D61D-E897-4257-9E4B-F65CF5A8B5AD> (accessed June 2013).

Under CEPA, the Pulp and Paper Mill Effluent Chlorinated Dioxins and Furans Regulations require mills that use chlorine bleaching to implement process changes to prevent the formation of dioxin and furans, and to monitor dioxin and furan concentrations. The Regulations prohibit the discharge of measurable concentrations of 2,3,7,8-tetrachlorodibenzo-para-dioxin (TCDD) and 2,3,7,8-tetrachlorodibenzofuran (TCDF) in pulp and paper mill effluents. The Pulp and Paper Mill Defoamer and Wood Chip Regulations, also under CEPA, place restrictions on de-foamers and the use of polychlorinated phenol-treated wood chips.

Provinces and territories may enter into an equivalency agreement, under section 10 of CEPA, or section 4.2 of the Fisheries Act, to eliminate the duplication of environmental regulations. Only one province, Alberta, has entered into an equivalency agreement with the federal government.[41] In addition to federal regulations, many provinces have also set standards limiting pollutants in pulp and paper mill discharges.

3.6.2 United States

In the United States, the pulp and paper sector is regulated by numerous pieces of legislation. One of these is Executive Order (EO) Number 127873, from 1993, relating to the purchase of environmentally preferable products by the federal government and specifying a minimum percentage of recycled fiber in certain types of papers for federal purchases. This EO has had an important impact on the US pulp and paper market because the federal government is a major consumer of paper products.

The Environmental Protection Agency (EPA)'s "Cluster Rule" (1998) was the first effort aimed at combining regulatory criteria for industry sectors into a coherent system intended to reflect the operating characteristics of each industry, in contrast with the historical pattern of separately specifying regulations for each environmental medium (e.g., air, water, soil). The Cluster Rule sets baseline limits for releases of toxics and nonconventional pollutants into the air and water and is primarily concerned with setting National Emission Standards for Hazardous Air Pollutants (NESHAPs) under the Clean Air Act, and Effluent Guideline Limitations under the Clean Water Act.[42]

The Cluster Rule establishes a sampling methodology for mills relative to 12 chlorinated phenolics and AOX, to ensure compliance with air emission and water discharge permit limits. Under the air section of the Rule, pulp and paper mills must meet air standards to reduce emissions of toxic air pollutants occurring at various points throughout the mills. Specifically, EPA requires mills to capture and treat toxic air pollutant emissions that occur during the cooking, washing, and bleaching stages of the pulp manufacturing process. A key concept introduced with the 1990 amendments to the Clean Air Act was the determination of "maximum achievable control technology" (MACT), designed to encourage achieving the emissions level of the best-performing similar facilities. These emissions levels set a baseline for the new standard. At a minimum, a MACT standard must achieve a level of emissions control that is at least equivalent to this baseline.

Under the water section of the Cluster Rule, new and existing facilities in the bleached paper-grade kraft and soda and sulfite subcategories must meet standards to reduce discharges of toxic and nonconventional pollutants. A key focus has been on the generation of toxic and bioaccumulative chlorinated organic compounds, including dioxins and furans (2,3,7,8-TCDD and other chlorinated dioxins and dibenzofurans), trihalomethanes such as chloroform, and other compounds. EPA set effluent limits for toxic pollutants in the wastewater discharged during the bleaching process and in the final discharge from the mills. These limits are based on substituting chlorine dioxide for chlorine in the bleaching process. In the final Cluster Rule, EPA established the substitution of chlorine dioxide for chlorine—the elemental chlorine-free (ECF) process—as best available technology. In addition, the regulation addresses adsorbable organic halides (AOX), as well as biological and chemical oxygen demand, and total suspended solids in water. Mills in the affected subcategories must also follow best management practices to prevent spills of black liquor into wastewater sewers.

Very recently, following a review of the New Source Performance Standards (NSPS), which control emissions of particulate matter and total reduced sulfur compounds from a number of points at kraft pulp mills, the US EPA proposed updates to the NSPS for these facilities. The proposed amendments would apply to newly-constructed or modified recovery furnaces, smelt dissolving tanks and lime kilns, and would involve changes to particulate matter (PM) emission limits to be consistent with the NESHAPs applying to these facilities; added testing, monitoring, and reporting requirements; and emission limits for periods of startup, shutdown and malfunction.[43]

41. Environment Canada. 2013. *Equivalency agreements*. Online at: <www.ec.gc.ca/lcpe-cepa/default.asp?lang=En&n=5CB02789-1> (accessed June 2013).
42. US EPA. 1997. EPA's final pulp, paper, and paperboard *"Cluster Rule"—Overview*. Fact sheet. EPA-821-F-97-010. United States Environmental Protection Agency, Office of Water. November 1997. Online at: <http://water.epa.gov/scitech/wastetech/guide/pulppaper/upload/1997_11_14_guide_pulppaper_jd_fs1.pdf> (accessed July 2013).
43. US EPA. 2013. New Source Performance Standards—Kraft pulp mills. Rule and implementation information for pulp and paper production. Online at: www.epa.gov/ttnatw01/pulp/pulppg.html (accessed July 2013).

3.6.3 Mexico

A number of pieces of legislation govern Mexico's pulp and paper manufacturing plants.[44] They fall under the umbrella of the General Law of Ecological Equilibrium and Environmental Protection (*Ley General del Equilibrio Ecológico y la Protección al Ambiente*—LGEEPA). Facilities are subject to maximum allowable limits established by official standards (*Normas Oficiales Mexicanas*, or NOMs) for emissions to air and water, and for solid waste and hazardous materials management and disposal.

Under Article 5 of the LGEEPA, the rule for environmental impact assessment (*Reglemento de la LGEEPA en Materia de Evaluación del Impacto Ambiental*), new pulp and paper manufacturing plants must acquire operating permits and are subject to maximum air emission levels set by article 111 of the LGEEPA, the rule for the prevention and control of air pollution (*Reglemento de la LGEEPA en Materia de Prevención y Control de la Contaminación de la Atmósfera*). Facilities under federal jurisdiction (such as pulp and paper mills) are obliged to report their emissions to the national registry and follow best practices regarding emissions monitoring (at the plant and in the vicinity), treatment, and control systems (including in cases of equipment failure or accidents that can potentially result in environmental contamination).

Waste generated by the pulp and paper sector is regulated by the General Law for the Prevention and Integrated Management of Wastes (*Ley General para la Prevención y Gestión Integral de los Residuos*—LGPGIR), which requires waste product characterization and assessment by type and risk level, and the development of waste management plans. Under the LGEEPA rule for hazardous activities (*Reglemento de la LGEEPA en Materia de Actividades Altamente Riesgosas*), pulp and paper plants are also required to undertake risk assessment studies and develop contingency plans and accident-prevention programs. Official standards that apply to these activities include:

- NOM-052-SEMARNAT-2005, which establishes the characteristics, procedures for identification, and classification and lists of dangerous substances; and
- NOM-133-SEMARNAT-2000, which establishes the environmental management specifications for polychlorinated biphenyls (PCBs).

Persistent organic pollutants (POPs), such as dibenzo-para-dioxins and polychlorinated dibenzofurans, hexachlorobenzene, and PCBs, are unintentional by-products that can be released as the result of incomplete thermal combustion of organic matter where chlorine is present, or through specific chemical reactions in cases where chlorine-based substances are used. The LGPGIR establishes the requirement for facilities that are sources of such pollutants to develop action plans (to be included in the National Stockholm Convention Implementation Plan) aimed at eliminating or reducing unintentional releases of POPs.[45]

3.7 Reported Releases to Air and Water from Pulp, Paper and Paperboard Mills in North America, 2005–2010

In 2010, there were over 500 active pulp, paper and paperboard mills across North America: approximately 90 in Canada, 370 in the United States, and 64 in Mexico. Of the total number of mills, between 352 and 429 reported to the North American PRTRs over the 2005–2010 period (see Table 28).

Table 28. Pulp, Paper and Paperboard Mills Reporting to the North American PRTRs, 2005–2010

Sector	Number of Reporting Facilities		Total Releases and Transfers (kg)			Releases to Air (kg)			Releases to Water (kg)		
	2005	2010	2005	2010	% Change 2005–2010	2005	2010	% Change 2005–2010	2005	2010	% Change 2005–2010
Pulp, Paper and Paperboard Mills (NAICS 3221)	429	352	144,571,800	124,141,452	-14	92,650,349	75,094,700	-19	16,599,055	15,683,803	-6
All Reporting Sectors	**25,519**	**22,612**	**4,833,498,433**	**5,530,710,253**	**14**	**807,172,052**	**514,173,851**	**-36**	**234,003,770**	**221,806,836**	**-5**
Rank of NAICS Sector 3221			**9**	**9**		**2**	**2**		**3**	**3**	

Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

44. The information on Mexican regulations is taken from: Semarnat. 2013. *Reglamento de la LGEEPA en Materia de Registro de Emisiones y Transferencia de Contaminantes.* Semarnat. 2013. *Reglamento de la LGEEPA en Materia de Actividades Altamente Riesgosas.* Semarnat. 2013. *Reglamento de la LGEEPA en Materia de Impacto Ambiental.* Semarnat. 2013. Reglamento de la LGEEPA en Materia de Prevención y Control de la Contaminación de la Atmósfera. Semarnat. 2003. NOM-105-SEMARNAT-1996 (antes NOM-105-ECOL-1996). Secretaría de Economía. 2010. Norma Mexicana NMX-N-107-SCFI-2010.
45. Arauco. 2005. Plan de manejo de residuos peligrosos. In *Informe final: Planta Licancel.* Arauco y Constitución, S.A. Semarnat. 2007. *Regulación de los residuos peligrosos en México. Colección Técnica y Estadística.* INE-SEMARNAT. 2007. *La responsabilidad jurídico-penal asociada al manejo inadecuado de los residuos peligrosos en México.* Online at: <www2.ine.gob.mx/publicaciones/libros/398/olvera.html> (accessed May 2013).

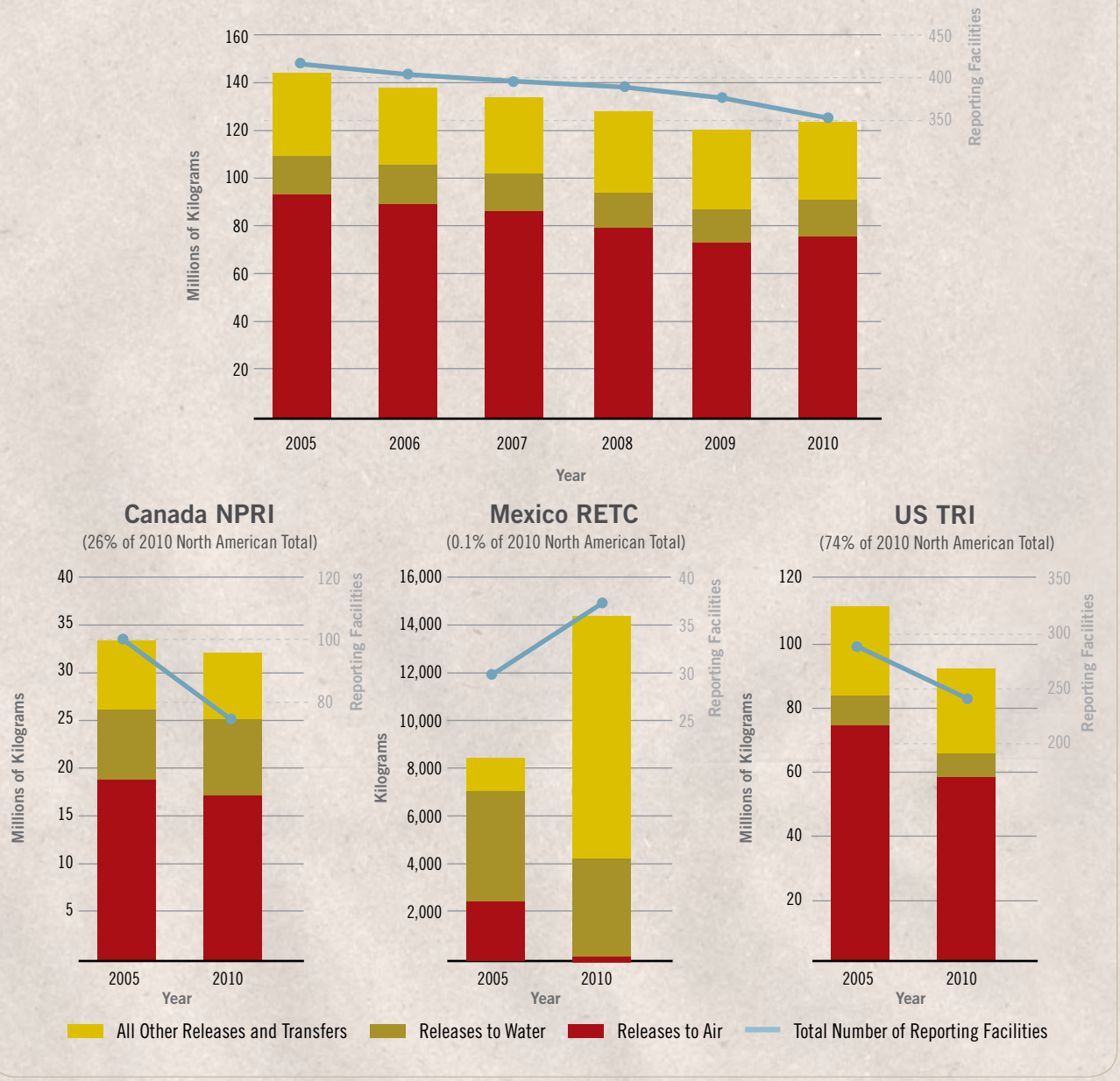
A facility might not report to its respective PRTR for a number of reasons, including the following:

- The facility does not meet PRTR reporting thresholds, for various reasons (e.g., due to a slow-down of operations during part of the year, or because it does not employ the minimum number of employees, in hours/year).
- It does not manufacture, process or otherwise use pollutants subject to PRTR reporting in that country.
- It is not in compliance with PRTR reporting requirements.

North American pulp and paper manufacturing facilities reported more than 144.5 million kilograms in total releases and transfers in 2005, and just over 124 million kilograms in 2010—a decrease of 14 percent. This industry sector ranked ninth among all reporting sectors in North America for total reported releases and transfers in both 2005 and 2010. It ranked second, after electric utilities, for releases to air in both years; and third for releases to water, after wastewater treatment plants and the animal slaughtering and processing sector. While the rank of the pulp and paper manufacturing sector relative to other industry sectors did not change between 2005 and 2010, releases to air reported by this sector decreased by 19 percent, and reported releases to water decreased by 6 percent.

However, there were differences among the three countries in reporting by this industry sector, as shown in Figure 30.

Figure 30. Releases and Transfers Reported by North American Pulp, Paper and Paperboard Mills, 2005–2010



Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

Figure 30 reveals that in 2005, the United States accounted for over 76 percent, Canada for 23 percent, and Mexico for less than 1 percent of total releases and transfers reported by this sector. By 2010, the US proportion had decreased to about 74 percent, Canada's had increased to 26 percent, and Mexico still accounted for less than 1 percent of the total. The overall decrease of 14 percent by this sector between 2005 and 2010 reflects reporting in Canada and the United States, but not Mexico, where total releases and transfers increased by 70 percent.

The main objective of this section of the report is to provide insight into possible reasons for decreases in reported releases to air and water from pulp, paper and paperboard mills between 2005 and 2010. A number of factors could have played a role in these decreases, including:

- a decline in the number of reporting facilities, due to a shutdown or slowdown in production;
- installation or implementation of pollution prevention or control technologies or processes;
- changes in the methodologies used to estimate releases;
- shifts in the way pollutants were handled (e.g., sending pollutants for disposal rather than releasing them to air); and
- changes in PRTR reporting requirements for facilities or pollutants, or in regulations for the industry sector.

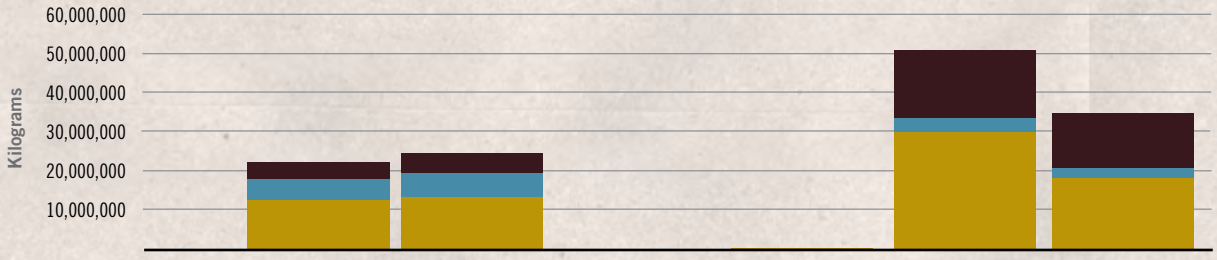
Some information relative to these factors can be obtained through facility PRTR reports. Additional information and insight were obtained through other sources, including:

- available facility-reported comments included with PRTR data reports, relative to pollution prevention or control efforts or reasons for year-to-year changes;
- a CEC survey of facilities in this sector; and
- pulp and paper industry associations in each of the three countries.

Figure 31 presents details of reporting from facilities in the three subsectors that make up the pulp, paper and paperboard mills sector, in each country. It shows that overall, paper mills made up the largest number of reporting facilities, in both 2005 and 2010, with this number decreasing in Canada

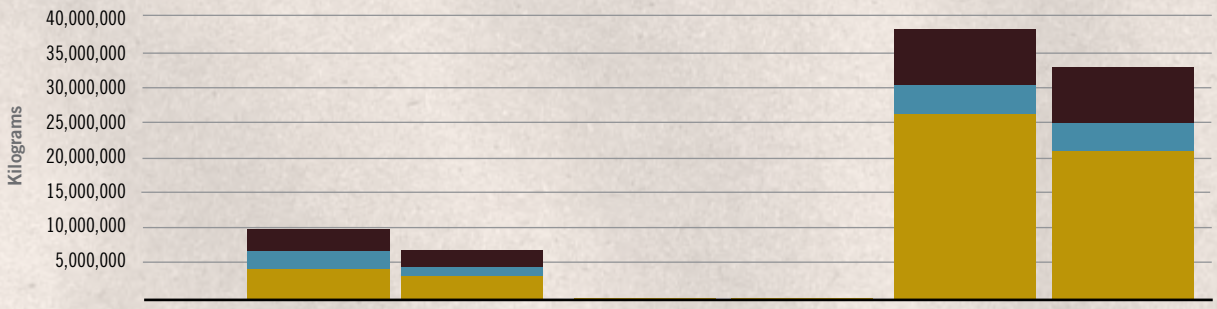
Figure 31. Releases to Air and Water Reported by Pulp, Paper and Paperboard Mills to the North American PRTRs, 2005-2010

Pulp Mills



	Canada NPRI		Mexico RETC		US TRI	
	2005 (45 Facilities)	2010 (36 Facilities)	2005 (2 Facilities)	2010 (2 Facilities)	2005 (55 Facilities)	2010 (39 Facilities)
All Other Releases and Transfers (kg)	4,213,596	4,857,766	0	0	17,445,972	14,308,916
Releases to Water (kg)	4,852,620	6,222,677	0	523	3,992,556	2,381,032
Releases to Air (kg)	12,994,068	13,311,558	0	0	29,554,705	18,071,896

Paper Mills



	Canada NPRI		Mexico RETC		US TRI	
	2005 (45 Facilities)	2010 (31 Facilities)	2005 (14 Facilities)	2010 (21 Facilities)	2005 (154 Facilities)	2010 (118 Facilities)
All Other Releases and Transfers (kg)	2,895,002	2,148,893	1,403	4,762	7,712,956	7,798,652
Releases to Water (kg)	2,441,652	1,659,178	2,781	2,554	3,994,114	3,906,194
Releases to Air (kg)	4,580,372	3,262,776	2,449	17	26,308,296	20,929,573

Paperboard Mills

	Canada NPRI		Mexico RETC		US TRI	
	2005 (10 Facilities)	2010 (7 Facilities)	2005 (14 Facilities)	2010 (14 Facilities)	2005 (90 Facilities)	2010 (84 Facilities)
All Other Releases and Transfers (kg)	169,616	45,012	0	5,060	2,883,850	4,193,889
Releases to Water (kg)	176,909	90,835	1,715	1,268	1,136,709	1,419,543
Releases to Air (kg)	1,267,710	623,136	20	74	17,942,729	18,895,669

Note: Of all reporting mills, 25 US facilities and five Canadian facilities are combination mills.
Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

and the United States, but increasing in Mexico. However, in terms of reported amounts, pulp mills accounted for the largest proportions of total releases and transfers, on average, in both years—including releases to air and water. This is to be expected, given the greater potential for the generation of pollutants from pulp manufacturing processes such as chemical pulping and bleaching, compared to papermaking. The exception is Mexico, where only two pulp mills reported (for a relatively small reported total).

3.7.1 Impacts of Fewer Reporting Facilities on the Decreases in Reported Amounts, 2005–2010

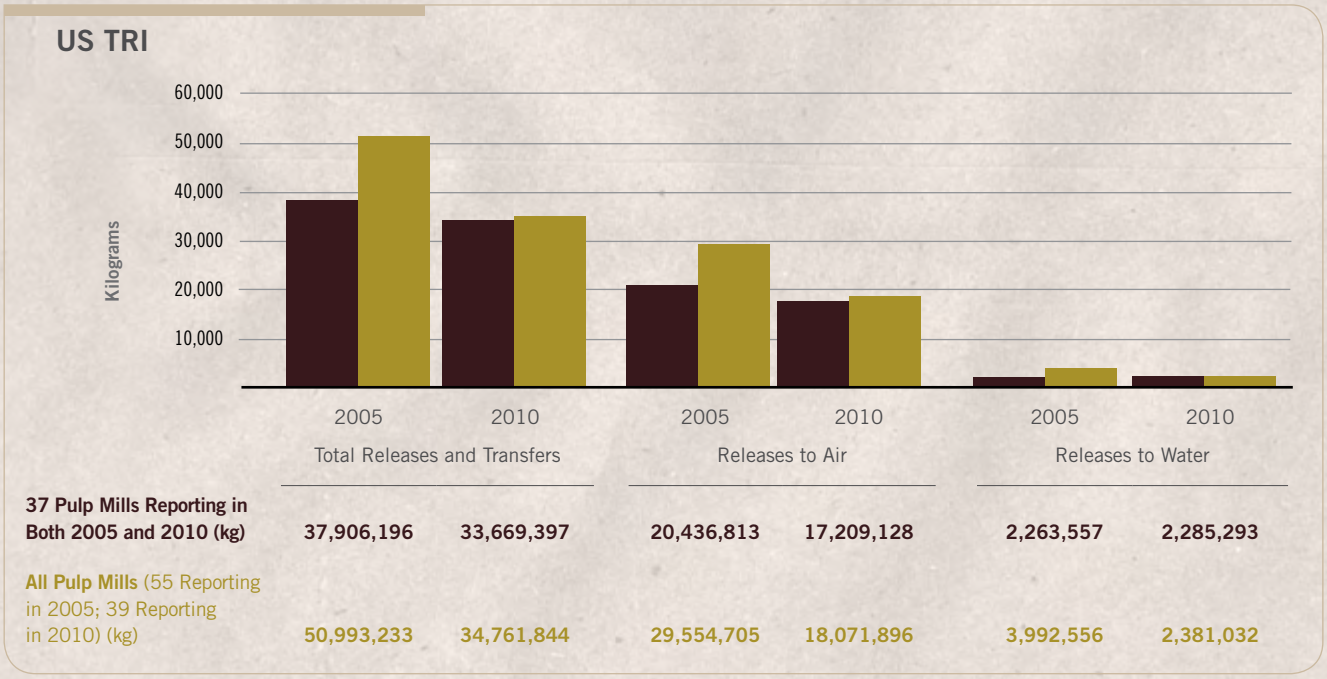
This section examines decreases in reported amounts between 2005 and 2010 for the subsectors shown in the following figures, in order to determine whether these decreases were driven by the decline in the number of reporting facilities. The data from consistently-reporting facilities (i.e., those reporting in both 2005 and 2010) are compared to the data from facilities reporting in 2005, but not 2010.

a) US Pulp Mills

Although the number of reporting pulp mills decreased in both Canada and the United States, the decrease in reported amounts between 2005 and 2010 was driven by US pulp mills (with this subsector reporting an increase in Canada). However, as shown in Figure 32, large proportions of the US decrease can be attributed to the decline in the number of reporting facilities, with the 16 fewer pulp mills accounting for about 80 percent (or 13 million kilograms) of the decrease in reported amounts from 2005 through 2010. In the case of releases to water, US pulp mills reporting in both years actually reported a modest increase over this period.

Of the US pulp mills that did not report in 2010, three did not report because of a shut-down in operations. These three mills accounted for almost 965,000 kilograms in total releases and transfers in 2005. The majority of the mills for which there are no pulp-related data for 2010 did in fact report—but the data were related to their paper or paperboard manufacturing operations (they are combination mills). These facilities reported a total of just over 12 million kilograms in releases and transfers from pulp-making operations in 2005, but none in 2010; however, that year they reported more than 5.7 million kilograms from paperboard manufacturing operations, and more than 2.3 million kilograms from papermaking operations. Therefore, while these data still reflect an overall decrease for pulp mills, about two-thirds of this decrease was in reality due to a shift in reporting to other production categories, resulting in increases in reporting from the other two subsectors.

Figure 32. Releases to Air and Water Reported by US Pulp Mills, 2005–2010

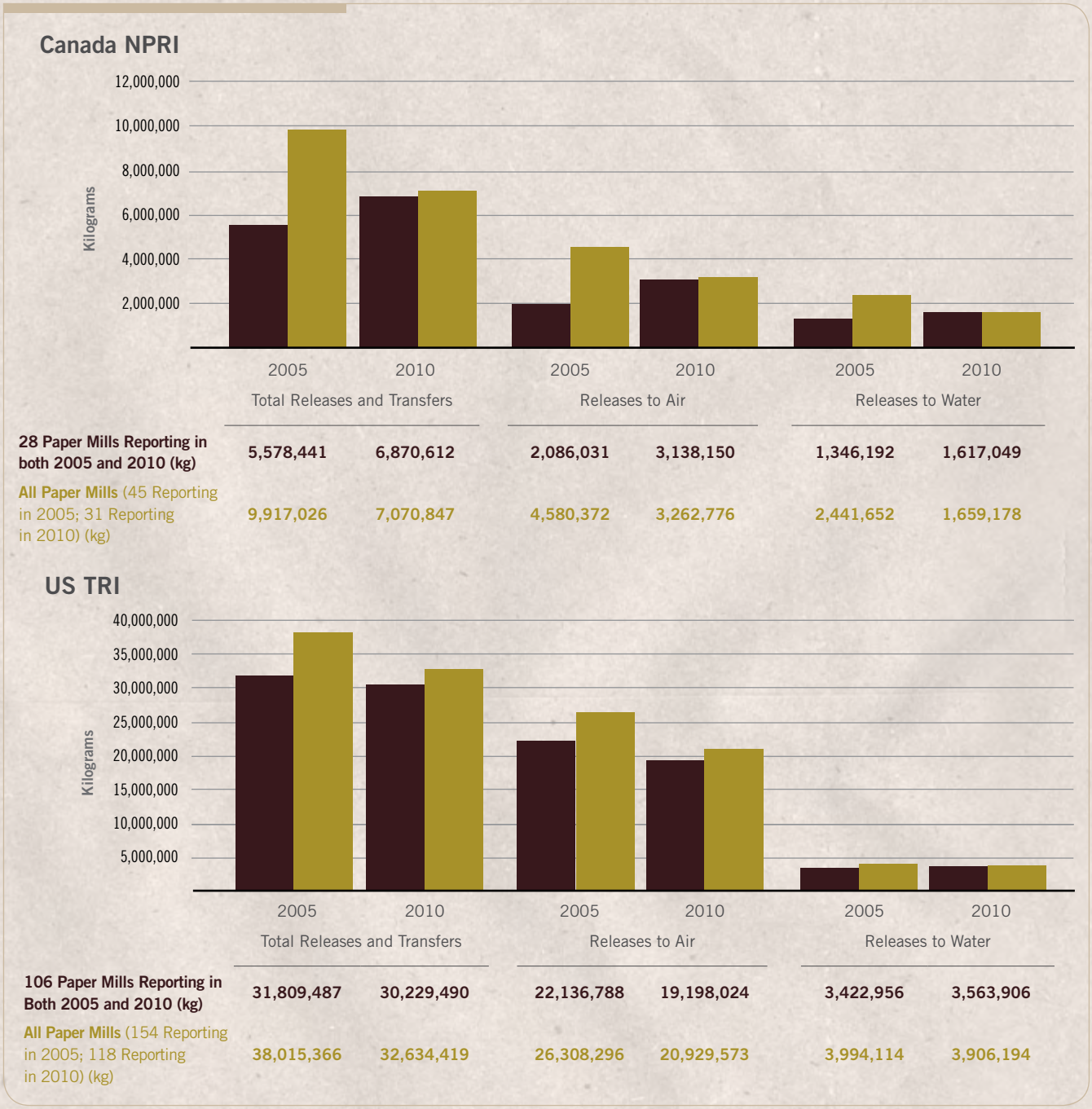


	Total Releases and Transfers		Releases to Air		Releases to Water	
	2005	2010	2005	2010	2005	2010
37 Pulp Mills Reporting in Both 2005 and 2010 (kg)	**37,906,196**	**33,669,397**	**20,436,813**	**17,209,128**	**2,263,557**	**2,285,293**
All Pulp Mills (55 Reporting in 2005; 39 Reporting in 2010) (kg)	**50,993,233**	**34,761,844**	**29,554,705**	**18,071,896**	**3,992,556**	**2,381,032**

b) Canadian and US Paper Mills

Figure 33 reveals that, as with US pulp mills, the decreases reported by the Canadian and US papermaking subsector were also driven in large part by the decline in the number of reporting facilities. In Canada, the paper mills reporting in both 2005 and 2010 actually reported increases in their total releases and transfers, as well as their releases to air and water. In the United States, relatively smaller decreases in total releases and transfers, as well as releases to air, were reported by facilities reporting in both years; however, these facilities reported an increase in releases to water over this period.

Figure 33. Releases to Air and Water Reported by Canadian and US Paper Mills, 2005–2010



	Total Releases and Transfers 2005	Total Releases and Transfers 2010	Releases to Air 2005	Releases to Air 2010	Releases to Water 2005	Releases to Water 2010
28 Paper Mills Reporting in both 2005 and 2010 (kg)	5,578,441	6,870,612	2,086,031	3,138,150	1,346,192	1,617,049
All Paper Mills (45 Reporting in 2005; 31 Reporting in 2010) (kg)	9,917,026	7,070,847	4,580,372	3,262,776	2,441,652	1,659,178

	Total Releases and Transfers 2005	Total Releases and Transfers 2010	Releases to Air 2005	Releases to Air 2010	Releases to Water 2005	Releases to Water 2010
106 Paper Mills Reporting in Both 2005 and 2010 (kg)	31,809,487	30,229,490	22,136,788	19,198,024	3,422,956	3,563,906
All Paper Mills (154 Reporting in 2005; 118 Reporting in 2010) (kg)	38,015,366	32,634,419	26,308,296	20,929,573	3,994,114	3,906,194

Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

Of the 36 US paper mills that had no data for 2010, seven did report that year, but the data related to their pulp or paperboard manufacturing activities. Similarly, two Canadian paper mills did not report data related to papermaking activities in 2010, but rather, on pulp-making or paperboard manufacturing. Of the approximately 40 remaining facilities in both countries that did not report in 2010, a number had shut down during this period, while others did not report for unknown reasons.

c) Canadian Paperboard Mills

Figure 34 reveals that the 2005–2010 decreases in releases to air and water reported by Canadian paperboard mills were also primarily driven by the decline in the number of reporting facilities in this subsector. Releases to air and water from the group of facilities that reported in both 2005 and 2010 increased over this period. Of the five Canadian paperboard mills that did not report in 2010, only one remained in full operation during this six-year period, with three having shut down.

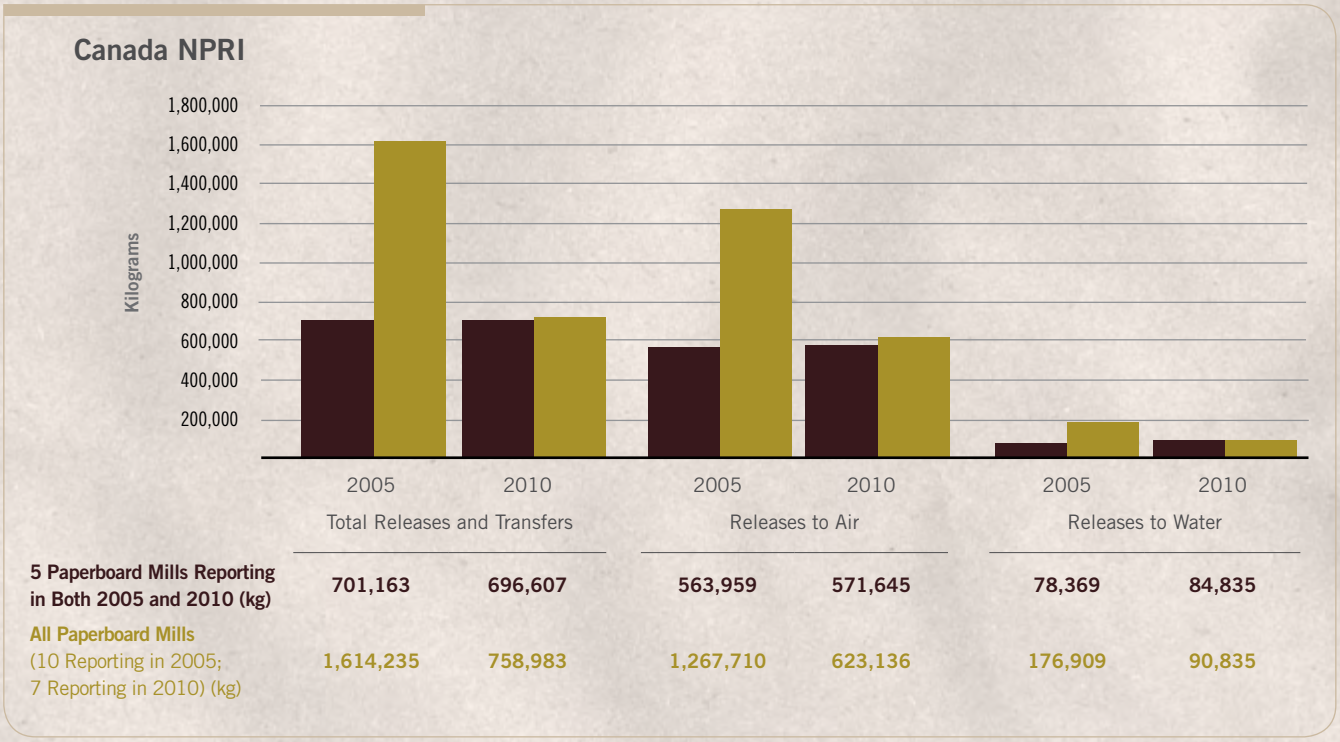
3.7.2 Pollutants Released to Air and Water from Pulp, Paper and Paperboard Mills, 2005–2010

In all, 109 pollutants were reported[46] by North American pulp, paper and paperboard mills from 2005 through 2010. Of these, 101 were reported released to air and 77 were released to water. Readers are reminded that releases of CAC and GHG are excluded from this analysis.

There were differences in the number of pollutants reported by mills in each of the three countries:

- In Canada, facilities in this sector reported 71 pollutants released to air and 51 released to water between 2005 and 2010.
- In Mexico, mills reported a total of 12 pollutants released to air, and 11 released to water.
- In the United States, 60 pollutants were reported released to air, and 47 to water.

Figure 34. Releases to Air and Water Reported by Canadian Paperboard Mills, 2005–2010



	Total Releases and Transfers		Releases to Air		Releases to Water	
	2005	2010	2005	2010	2005	2010
5 Paperboard Mills Reporting in Both 2005 and 2010 (kg)	**701,163**	**696,607**	**563,959**	**571,645**	**78,369**	**84,835**
All Paperboard Mills (10 Reporting in 2005; 7 Reporting in 2010) (kg)	**1,614,235**	**758,983**	**1,267,710**	**623,136**	**176,909**	**90,835**

46. "Reported" pollutants means those reported in amounts of at least 0.0001 kilograms.

The pollutants reported released to air and water in largest proportions by this sector, and the 2005–2010 changes in these releases, are shown in Tables 29a and 29b. Different factors can affect the amounts and types of pollutant reported by facilities, including the type and age of facilities, the fuels used, and the process technologies.

These tables reveal that the top six pollutants accounted for approximately 98 percent of all reported releases to air in both years, while for reported releases to water, the top five pollutants together accounted for 99 percent of the total each year. A majority of these substances saw decreases in releases over this period.

The data in these tables highlight the impacts of differences among the three countries in PRTR reporting requirements for pollutants. Of the top pollutants released to air and water, only four are subject to PRTR reporting in all three countries. In fact, of the 109 pollutants reported released to air and water by this sector, only 25 are common to the three PRTRs. Many of the substances that make up the typical pollutant profile of the pulp and paper manufacturing sector, and that were released to air and water in largest proportions (e.g., methanol to air, nitrates to water), are not subject to Mexico's RETC. However, even the pollutants that are subject to PRTR reporting in Mexico (e.g., acetaldehyde) were not reported by Mexican pulp and paper manufacturing facilities.

Of total reported releases to air by this sector, methanol alone accounted for 65 percent in 2005 and 62 percent in 2010. Reporting pulp mills, especially in the United States, accounted for the majority of these releases. Methanol is often emitted as a by-product in pulping and bleaching operations, as well as the pulping chemical recovery cycle. With respect to the latter, releases to air of methanol (and a number of other VOCs, as well as particulates, reduced sulfur compounds, and other pollutants) present ongoing challenges for pulp mills. The overall decrease of 23 percent in releases to air of this pollutant reflects decreases among US mills.

Tables 29a and 29b also reveal differences in the proportions of the top pollutants reported by Canadian and US mills. However, differences between the two countries in PRTR reporting requirements would not appear to be the reason since, with the exception of a few, the top reported pollutants are subject to both Canada's NPRI and the US TRI. Therefore, the data suggest the impact of other factors. These factors can include the choice of chemical inputs—for example, in the case of reported releases of chlorine dioxide, not all mills bleach their pulp and those that do might choose to use non-chlorinated compounds. Thus, the substances used, the industrial processes and the size of operations are some of the variables that can provide additional information about differences in facilities' reported releases to air and water.

Table 29a. Top Pollutants Released to Air by Pulp, Paper and Paperboard Mills in North America, 2005–2010

Pollutants	Releases to Air 2005 (kg)	Releases to Air 2010 (kg)	% Change 2005–2010	%, Canada NPRI, 2010	%, Mexico RETC, 2010	%, US TRI, 2010
Methanol (CA, US)	60,265,731	46,608,814	-23	19	–	81
Ammonia, Total (CA, US)	9,367,690	7,811,700	-17	20	–	80
Hydrochloric Acid (CA, US)	9,131,233	7,993,865	-12	22	–	78
Sulfuric Acid (CA, US)	4,162,369	2,464,961	-41	7	–	93
Acetaldehyde (CA, MX, US)	4,057,959	2,754,719	-32	14	0	86
Hydrogen Sulfide (CA, MX)	1,197,959	538,271	-55	100	0	–
Formaldehyde (CA, MX, US)	865,464	733,914	-15	12	0	88
Chlorine Dioxide (CA, MX, US)	709,806	568,532	-20	68	0	32
Phenol (CA, MX, US)	551,304	920,156	67	19	0	81
Cresols (CA, US)	403,762	577,938	43	0	–	100
Total Reduced Sulfur (TRS) (CA)	–	2,760,633	-13*	100	–	–
Total, 11 Pollutants	90,713,276	73,733,501				
Total, All Pollutants	92,650,349	75,094,700				
%, Top Pollutants, of All Pollutants	98	98				

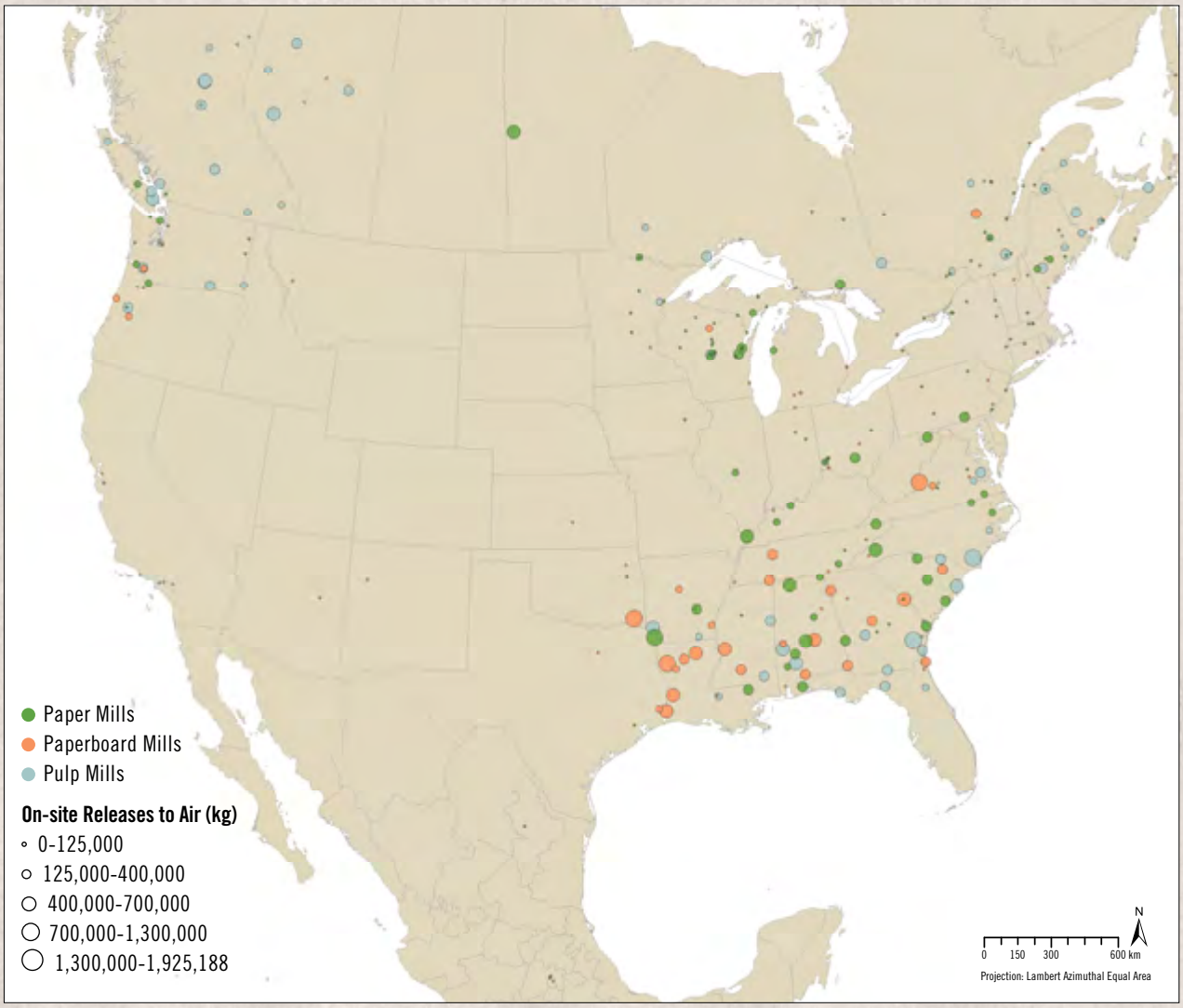
* Percentage change calculated from 2007 (first year of TRS reporting in Canada).
Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

Table 29b. Top Pollutants Released to Water by Pulp, Paper and Paperboard Mills in North America, 2005–2010

Pollutant	Releases to Water 2005 (kg)	Releases to Water 2010 (kg)	% Change 2005–2010	%, Canada NPRI, 2010	%, Mexico RETC, 2010	%, US TRI, 2010
Nitric Acid/Nitrate Compounds (CA, US)	4,940,424	4,629,247	-6	37	–	63
Manganese (and compounds) (CA, US)	3,243,694	2,952,440	-9	35	–	65
Methanol (CA, US)	2,745,486	1,799,779	-34	20	–	80
Ammonia, Total (CA, US)	2,601,349	4,105,726	58	83	–	17
Phosphorous, Total (CA)	2,045,909	1,063,191	-48	100	–	–
Zinc (and compounds) (CA, US)	220,144	183,632	-17	24	–	76
Formaldehyde (CA, MX, US)	180,691	104,142	-42	34	0	66
Acetaldehyde (CA, MX, US)	172,499	167,906	-3	8	0	92
Barium (and compounds) (US)	148,708	126,156	-15	–	–	100
Formic Acid (CA, US)	62,235	149,091	140	0	–	100
Total Reduced Sulfur (TRS) (CA)	–	193,919	113*	100	–	–
Total, Top 11 Pollutants	16,361,140	15,475,229				
Total, All Pollutants	16,599,055	15,683,803				
%, Top Pollutants, of All Pollutants	99	99				

* Percentage change calculated from 2007 (first year of TRS reporting in Canada).
Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

Figure 35. Distribution of Facilities Reporting Releases to Air to the North American PRTRs, 2010



Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

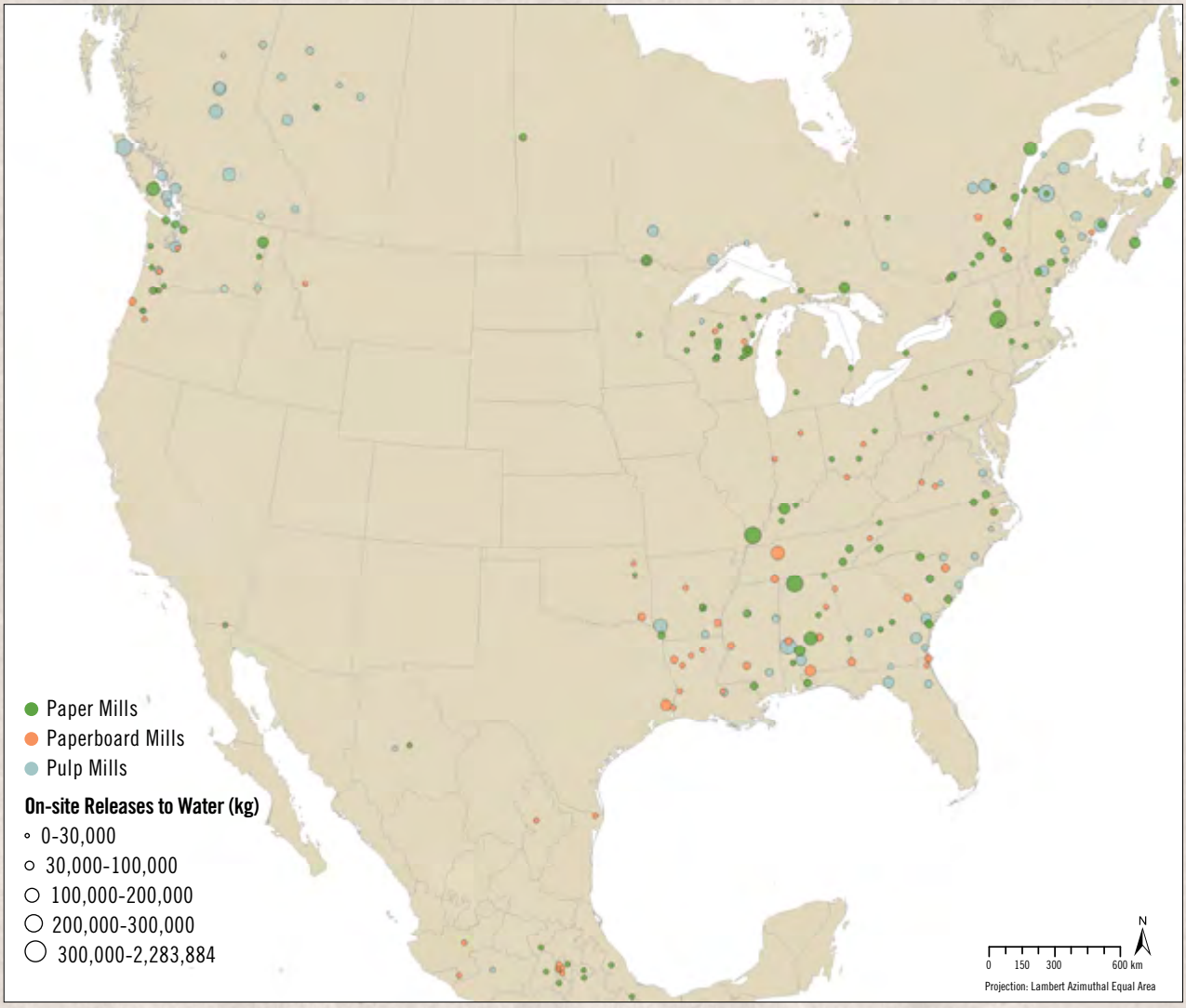
Figure 35 shows the locations of the pulp, paper and paperboard mills that reported releases to air to their respective PRTRs in 2010, while Table 30 presents the top facilities for reported releases to air in 2005 and 2010.

Table 30. Top Reporting Facilities in the Pulp, Paper and Paperboard Mills Sector: Releases to Air, 2005–2010

Facility Name	PRTR ID	City	State/Province/ Territory	Country	Industry Sector	Releases to Air 2005 (kg)	Releases to Air 2010 (kg)	% Change 2005–2010
Catalyst Paper Corporation - Crofton Division	1266	Crofton	British Columbia	Canada	Pulp Mills	951,729	978,791	3
AbiBow Canada Inc. - Thunder Bay Operations	930	Thunder Bay	Ontario	Canada	Pulp Mills	911,526	468,850	-49
Eurocan Pulp and Paper	3171	Kitimat	British Columbia	Canada	Paper Mills	742,398	0	–
Canfor Pulp - Prince George Pulp and Paper/Intercontinental Pulp	4063	Prince George	British Columbia	Canada	Pulp Mills	722,824	1,228,569	70
Howe Sound Pulp & Paper Corporation - Howe Sound Pulp & Paper	1419	Port Mellon	British Columbia	Canada	Pulp Mills	689,454	616,403	-11
Canfor Pulp Limited Partnership - Northwood Pulp Mill	1797	Prince George	British Columbia	Canada	Pulp Mills	683,369	1,010,964	48
Catalyst Paper - Elk Falls	333	Campbell River	British Columbia	Canada	Paper Mills	630,535	0	–
Terrace Bay Pulp Inc. - Terrace Bay Pulp	2607	Terrace Bay	Ontario	Canada	Pulp Mills	615,765	82,095	-87
Twin Rivers Paper Company - Edmundston Pulp Mill	1221	Edmundston	New Brunswick	Canada	Pulp Mills	585,107	591,361	1
Prince Albert Pulp Inc. - Prince Albert Pulp and Paper	3610	Prince Albert	Saskatchewan	Canada	Pulp Mills	549,935	0	–
					Total, Top 10 Mills, Canada NPRI	7,082,643	4,977,034	
					Total, All Reporting Mills, Canada NPRI	18,842,150	17,197,471	
					%, Top Mills, of All Reporting Mills, Canada NPRI	38	29	
Copamex Industrias, S.A. de C.V.	CIN561904611	San Nicolás de Los Garza	Nuevo León	Mexico	Paper Mills	2,424	0	-100
Smurfit Cartón y Papel de México - Div. Molino Los Reyes	SCP561510411	Tlalnepantla	Mexico Estado	Mexico	Paper Mills	25	17	-34
Papelera Iruña, S.A. de C.V.	PIR570900711	N/A	Distrito Federal	Mexico	Paperboard Mills	17	17	0
Smurfit Carton y Papel de Mexico, S.A. de C.V.	SCP561503311	Ecatepec	Mexico Estado	Mexico	Paperboard Mills	4	58	1,546
					Total, Top 4 Mills,* Mexico RETC	2,469	91	
					Total, All Reporting Mills, Mexico RETC	2,469	91	
					%, Top Mills, of All Reporting Mills, Mexico RETC	100	100	
International Paper Co. - Mansfield Mill	71052NTRNTHWY50	Mansfield	Louisiana	United States	Pulp and Paperboard Mills	2,206,027	1,842,790	-16
International Paper Co. Texarkana Mill	75504NTRNTPOBOX	Queen City	Texas	United States	Paper Mills	2,139,237	1,925,118	-10
International Paper Co. Riegelwood Mill	28456FDRLPRIEGE	Riegelwood	North Carolina	United States	Pulp Mills	2,103,977	1,781,085	-15
Rayonier Performance Fibers - Jesup Mill	31545TTRYNSAVAN	Jesup	Georgia	United States	Pulp Mills	1,907,041	1,526,722	-20
Evergreen Packaging	71611NTRNTFAIRF	Pine Bluff	Arkansas	United States	Pulp and Paper Mills	1,892,388	689,687	-64
Smurfit-Stone Container Corp.	29502STNCNOLDGE	Florence	South Carolina	United States	Paperboard Mills	1,805,624	548,182	-70
Meadwestvaco of Virginia - Covington Operations	24426WSTVCRIVER	Covington	Virginia	United States	Paperboard Mills	1,799,884	1,311,157	-27
Smurfit-Stone Container Enterprises Inc.	32034CNTNRNORTH	Fernandina Beach	Florida	United States	Pulp and Paperboard Mills	1,466,599	699,112	-52
International Paper Co. Franklin Mill	23851NNCMPHIGHW	Franklin	Virginia	United States	Paper Mills	1,438,627	163,944	-89
Wisconsin Rapids Pulp Mill	54494CNSLD950FO	Wisconsin Rapids	Wisconsin	United States	Pulp Mills	1,291,171	692,627	-46
					Total, Top 10 Mills, US TRI	18,050,575	11,180,425	
					Total, All Reporting Mills, US TRI	78,805,730	57,897,138	
					%, Top Mills, of All Reporting Mills, US TRI	23	19	

*Only four Mexican mills reported releases to air between 2005 and 2010.
Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

Figure 36. Distribution of Facilities Reporting Releases to Water to the North American PRTRs, 2010



Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

Figure 36 shows the locations of the pulp, paper and paperboard mills that reported releases to water to their respective PRTRs in 2010, while Table 31 presents the top facilities for reported releases to water in 2005 and 2010.

Table 31. Top Reporting Facilities in the Pulp, Paper and Paperboard Mills Sector: Releases to Water, 2005–2010

Facility Name	PRTR ID	City	State/Province/ Territory	Country	Industry Sector	Releases to Water 2005 (kg)	Releases to Water 2010 (kg)	% Change 2005–2010
Compagnie Abitibi Consolidated du Canada - Div. Alma	983	Alma	Québec	Canada	Pulp Mills	809,866	231,562	-71
Catalyst Paper Corporation - Powell River Division	723	Powell River	British Columbia	Canada	Pulp and Paper Mills	447,808	178,857	-60
Irving Pulp & Paper Ltd. - Irving Pulp & Paper	2604	Saint John	New Brunswick	Canada	Pulp Mills	369,377	280,401	-24
Domtar Inc. - Kamloops Mill (SFO)	2924	Kamloops	British Columbia	Canada	Pulp Mills	283,819	252,974	-11
Domtar Inc. - Cornwall Business Unit	1197	Cornwall	Ontario	Canada	Paper Mills	253,996	0	–
Cariboo Pulp and Paper Company	479	Quesnel	British Columbia	Canada	Pulp Mills	222,866	272,128	22
Western Pulp Limited - Squamish Operation	2872	New Westminster Dist.	British Columbia	Canada	Pulp Mills	205,029	0	–
West Fraser Mills Ltd. - Hinton Pulp	2991	Hinton	Alberta	Canada	Pulp Mills	193,895	180,784	-7
AbiBow Canada Inc. - Thunder Bay Operations	930	Thunder Bay	Ontario	Canada	Pulp Mills	187,454	117,927	-37
Domtar Inc. - Domtar Windsor Mill	1195	Windsor	Québec	Canada	Pulp Mills	181,927	96,889	-47
					Total, Top 10 Mills, Canada NPRI	3,156,038	1,611,521	
					Total, All Reporting Mills, Canada NPRI	7,471,181	7,972,689	
					%, Top Mills, of All Reporting Mills, Canada NPRI	42	20	
Kimberly Clark De Mexico, S.A. de C.V.	KCM562201621	San Cayetano	Querétaro	Mexico	Paper Mills	2,174	2,029	-7
Smurfit Carton y Papel de Mexico, S.A. de C.V.	SCP561503311	Ecatepec	Mexico Estado	Mexico	Paperboard Mills	961	882	-8
Empaques de Carton Titan, S.A. de C.V.	ECT571903912	Monterrey	Nuevo León	Mexico	Paperboard Mills	500	0	–
Smurfit Cartón y Papel de México - Div. Molino Los Reyes	SCP561510411	Tlalnepantla	Mexico Estado	Mexico	Paper Mills	203	0	–
Grupo Pipsamex, S.A. de C.V. Planta Veracruz	GPI563020711	Tres Valles	Veracruz	Mexico	Paper Mills	167	0	-100
Sonoco de Mexico, S.A de C.V.	SME561503311	Santa Clara Coatitla	Mexico Estado	Mexico	Paperboard Mills	133	10	-93
Industrias Centauro, S.A de C.V.	ICE561000511	Durango	Durango	Mexico	Paper Mills	102	0	–
Papeles Lozar, S.A de C.V.	PLO561503911	N/A	Mexico Estado	Mexico	Paper Mills	59	0	–
Papelera Iruña, S.A. de C.V.	PIR570900711	N/A	Distrito Federal	Mexico	Paperboard Mills	57	24	-57
Manufacturas Sonoco, S.A. de C.V.	MSO571501211	Atizapan de Zaragoza	Mexico Estado	Mexico	Paperboard Mills	40	323	702
					Total, Top 10 Mills, Mexico RETC	4,396	3,268	
					Total, All Reporting Mills, Mexico RETC	4,496	4,345	
					%, Top Mills, of All Reporting Mills, Mexico RETC	98	75	
Evergreen Pulp Enterprises	95564LSNPCLPDRI	Samoa	California	United States	Pulp Mills	691,465	0	–
Alabama River Cellulose LLC	36470LBMRVOFFHI	Perdue Hill	Alabama	United States	Pulp Mills	656,294	159,252	-76
Wausau Paper Corp. - Brokaw Mill	54417WSPPR2NDST	Brokaw	Wisconsin	United States	Paper Mills	373,054	52,979	-86
Georgia - Pacific Consumer Products LP	54307FRTHW1919S	Green Bay	Wisconsin	United States	Paper Mills	364,363	160,730	-56
Weyerhaeuser Pacific Veneer	98537WYRHS700EA	Aberdeen	Washington	United States	Pulp Mills	347,920	0	–
International Paper - Courtland Mill	35618CHMPNPOBOX	Courtland	Alabama	United States	Paper Mills	290,390	327,304	13
Temple-Inland	37134NLNDCCONAL	Waverly	Tennessee	United States	Pulp and Paperboard Mills	270,035	218,232	-19
Finch Paper LLC	12801FNCHP1GLEN	Glens Falls	New York	United States	Paper Mills	243,077	671,373	176
Domtar AW LLC - Ashdown Mill	71822NKSPPHIGHW	Ashdown	Arkansas	United States	Pulp Mills	218,499	202,928	-7
Meadwestvaco Texas LP	77656PLPPPOBOX	Evadale	Texas	United States	Paperboard Mills	203,944	160,663	-21
					Total, Top 10 Mills, US TRI	3,659,042	1,953,462	
					Total, All Reporting Mills, US TRI	9,123,378	7,706,768	
					%, Top Mills, of All Reporting Mills, US TRI	40	25	

Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

3.7.3 Releases to Air and Water of Known or Suspected Carcinogens, Developmental or Reproductive Toxicants, Metals and PBTs Reported by Pulp, Paper and Paperboard Mills, 2005–2010

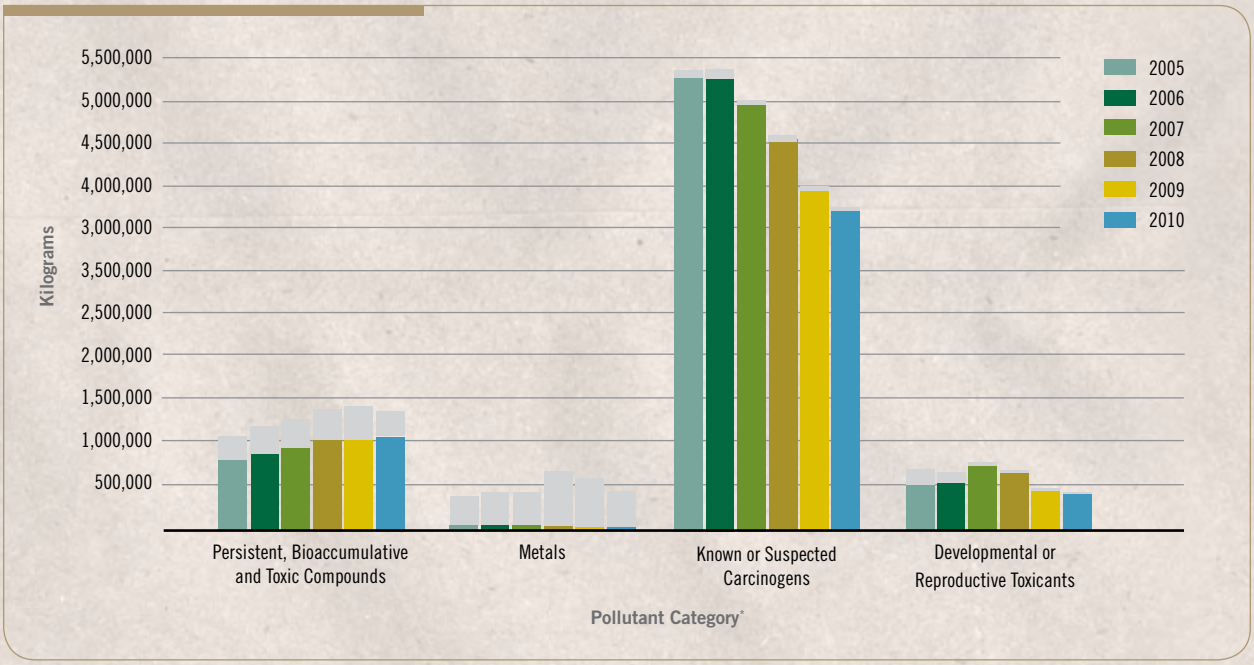
Many of the pollutants released directly to the environment every year by pulp, paper and paperboard mills belong to one or more of the following categories: known or suspected carcinogens; developmental or reproductive toxicants; PBTs, and metals. This section examines releases to air and water of such pollutants and especially those considered to be of special interest because of their significant potential risk to human health and the environment, even when released in relatively small amounts.

Figures 37 and 38 present the reported releases to air and water of pollutants in these four categories by North American pulp and paper mills, from 2005 through 2010. In 2010, facilities reported releases to air of 46 such pollutants, for a total of almost 5.3 million kilograms—a decrease of about 20 percent from 2005 levels. Facilities in this sector also reported releases to water of 35 pollutants in these categories, for a total of 3.6 million kilograms (a decrease of about 12 percent from 2005 levels).

The reported pollutants in these four categories that are common to the three PRTRs are represented by the colored portion of the bars in these graphs, while all reported pollutants in these categories are represented by the gray portion of the bars. Both of these figures reveal a notable difference in reported releases of common versus all metal compounds. Some of the metals released to water in largest proportions over this period include manganese and zinc and their compounds, which are subject to PRTR reporting in both Canada and the United States, but not Mexico; and barium and its compounds, which are subject to reporting only in the United States. In fact, of all the pollutants in these categories reported released to air or water by pulp, paper and paperboard mills, only 19 were common to the three PRTRs.

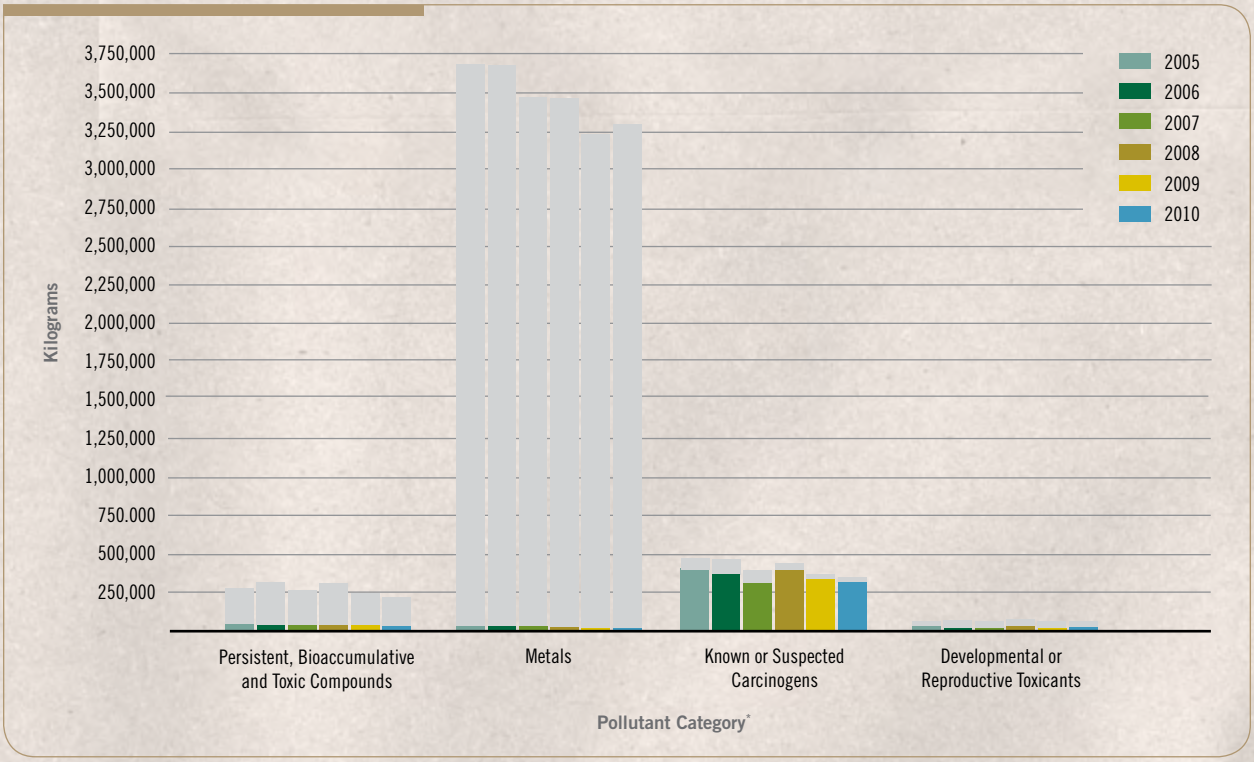
Table 32 presents the sector's reported releases to air of the top 10 pollutants belonging to at least one of these four categories and common to all three PRTRs. It compares the pollutants' release amounts (in kilograms) with their cancer and non-cancer risk (TEP) scores, to illustrate their potential toxicity when released to air. Reported releases to air of these pollutants declined notably between 2005 and 2010.

Figure 37. Reported Releases to Air of Known/Suspected Carcinogens, Developmental/Reproductive Toxicants, Metals and PBTs: Pulp, Paper and Paperboard Mills, 2005–2010



* Some pollutants belong to more than one category.
Note: Color columns refer to pollutants common to the 3 PRTRs; grey columns refer to pollutants in these categories subject to PRTR reporting in at least one country.
Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

Figure 38. Reported Releases to Water of Known/Suspected Carcinogens, Developmental/Reproductive Toxicants, Metals and PBTs: Pulp, Paper and Paperboard Mills, 2005–2010



* Some pollutants belong to more than one category.
Note: Color columns refer to pollutants common to the 3 PRTRs; grey columns refer to pollutants in these categories subject to PRTR reporting in at least one country.
Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

Table 32. Pulp, Paper and Paperboard Mills: Releases to Air of C, D, M, P Common to the Three PRTRs, 2005–2010

Pollutant	C	D	M	P*	Releases to Air 2005 (kg)	Releases to Air 2010 (kg)	% Change 2005–2010	Cancer Risk Score for Air (TEP) 2010	Non-cancer Risk Score for Air (TEP) 2010	%, Canada NPRI, 2010 (# facilities)	%, Mexico RETC, 2010 (# facilities)	%, US TRI, 2010 (# facilities)
Mercury (and compounds)	x	x	x	x	788	785	0	-	10,984,584,401	8.5 (19)	0.5 (3)	91 (113)
Lead (and compounds)	x	x	x	x	14,697	12,067	-18	337,870	6,998,741,796	11 (46)	1 (4)	88 (188)
Cadmium (and compounds)	x	x	x	x	322	242	-25	6,281,012	458,997,038	97 (53)	0 (3)	3 (1)
Arsenic (and compounds)	x	x	x	x	265	368	39	5,886,512	30,904,190	83 (32)	0 (2)	17 (2)
Acetaldehyde	x				4,057,959	2,754,719	-32	27,547	25,618,891	14 (25)	0	86 (106)
Chloromethane		x			215,384	233,236	8	153,935	13,294,429	18 (3)	0	82 (12)
Nickel (and compounds)	x	x	x	x	4,308	3,886	-10	10,881	12,434,871	0	0 (3)	100 (8)
Formaldehyde	x				865,464	733,914	-15	14,678	11,742,628	12 (17)	0 (3)	88 (93)
Chromium (and compounds)	x	x	x	x	731	1,400	91	182,001	4,340,028	14 (28)	0.1 (3)	86 (8)
Chloroform	x	x		x	214,935	112,626	-48	180,202	1,576,765	38 (2)	0	62 (6)
Total, Top 10 Pollutants Common to the 3 PRTRs					5,374,853	3,853,242		13,074,639	18,542,235,037			
Total, 19 Pollutants Common to the 3 PRTRs					6,020,064	4,805,996		15,640,322	20,415,413,273			

* C = Known/Suspected carcinogen; D = Developmental/Reproductive toxicant; M = Metal; P = Persistent, bioaccumulative, toxic substance.
Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

This table also reveals a notable absence of data from Mexican mills, with few facilities in that country reporting, and these reporting only very small proportions of releases to air of three common pollutants: mercury, lead and chromium and their compounds. The table shows that many of the pollutants were reported either mostly in Canada, or mostly in the United States, perhaps indicating differences between the two countries in the processes, fuels or other inputs used at pulp and paper mills.

For example, among the pollutants common to the three PRTRs, the large majority of total releases to air of mercury and its compounds in 2010 were reported by US mills. These releases remained virtually unchanged between 2005 and 2010. The high non-cancer risk (TEP) score for mercury provides a strong indication of its potential to cause harm when released to air. As mentioned earlier, mercury and other pollutants of special interest released by pulp and paper mills and other industrial sectors have been the subject of increased regulatory actions by North American environmental authorities.

The large majority of all releases to air of cadmium and its compounds in 2010 were reported by Canadian mills. Cadmium and other metals can be released to air through the combustion of sludge from the lime kiln and the spent liquor in chemical recovery furnaces, as well as from the boiler. A number of metals can also be found in the "alternative fuels" sometimes used for power at industrial facilities (most commonly, cement kilns). A review in 2010 of a proposal by the Corner Brook Pulp and Paper mill in Newfoundland, Canada, to use tire-derived fuel (TDF) to generate electricity for the plant raised concerns about the potential for releases of metals such as arsenic, zinc and their compounds.[47]

In terms of the common pollutants released to water, Table 33 shows that releases declined by about 24 percent (from about 399,000 kilograms in 2005 to 304,000 kilograms in 2010). For the top 10 common pollutants, the release amounts (in kilograms) are compared with their cancer and non-cancer risk (TEP) scores, resulting in a very different picture of these releases to water when the potential toxicity of the substances is considered.

Reported releases to water of mercury and its compounds by this sector increased notably between 2005 and 2010, from about 79 kilograms to almost 338 kilograms—relatively small volumes in comparison with other pollutants released by pulp and paper mills. However, the high TEP score for non-cancer effects puts mercury compounds in first place. In 2010, 77 US mills accounted for about 48 percent of total

Table 33. Pulp, Paper and Paperboard Mills: Releases to Water of C, D, M, P Common to the Three PRTRs, 2005–2010

Pollutant	C	D	M	P*	Releases to Water 2005 (kg)	Releases to Water 2010 (kg)	% Change 2005–2010	Cancer Risk Score for Water (TEP) 2010	Non-cancer Risk Score for Water (TEP) 2010	%, Canada NPRI, 2010 (# facilities)	%, Mexico RETC, 2010 (# facilities)	%, US TRI, 2010 (# facilities)
Mercury (and compounds)	x	x	x	x	79	338	326	--	4,392,487,263	24 (15)	28 (15)	48 (77)
Lead (and compounds)	x	x	x	x	16,156	14,520	-10	29,040	609,831,801	15 (40)	6 (15)	80 (129)
Cadmium (and compounds)	x	x	x	x	1,229	890	-28	1,691,650	124,647,871	79 (45)	21 (14)	0
Arsenic (and compounds)	x	x	x	x	3,726	3,139	-16	12,557,734	62,788,669	90 (28)	10 (14)	0
Chromium (and compounds)	x	x	x	x	2,921	3,297	13	--	1,450,723	27 (25)	27 (18)	46 (6)
Acetaldehyde	x				172,499	167,906	-3	1,058	856,320	8 (19)	0	92 (91)
Nickel (and compounds)	x	x	x	x	2,797	1,684	-40	--	43,773	0	47 (20)	53 (6)
Formaldehyde	x				180,691	104,142	-42	83	30,201	34 (13)	0	66 (80)
Chloroform	x	x		x	10,761	1,131	-89	1,696	18,095	4 (2)	0	96 (4)
Chloromethane		x			2	63	2,575	25	2,154	95 (2)	0	5 (4)
Total, Top 10 Pollutants Common to the 3 PRTRs					390,860	297,110		14,281,285	5,192,156,870			
Total, 19 Pollutants Common to the 3 PRTRs					399,202	304,222		14,579,531	5,403,839,254			

* C = Known/Suspected carcinogen; D = Developmental/Reproductive toxicant; M = Metal; P = Persistent, bioaccumulative, toxic substance.
Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

47. Government of Newfoundland and Labrador. Department of Environment and Conservation. 2010. Corner Brook Pulp & Paper Tire Derived Fuel (TDF) Co-Firing Trial Project. Summary of environmental assessment process. Online at: <www.env.gov.nl.ca/env/env_assessment/projects/Y2010/1539/index.html> (accessed Nov. 2013).

releases of mercury to water, 15 Mexican mills accounted for 28 percent of the total, and 15 Canadian mills accounted for 24 percent.

Compared with releases to air, where there was an absence of data from Mexico (Table 32), this table shows that Mexican mills reported releases to water of six metals—some of them in relatively large proportions, and from a majority of reporting facilities in this sector. For example, nickel and its compounds were reported by 20 mills in Mexico in 2010. Nickel compounds can be found in the fossil fuels used at pulp and paper mills. Nickel alloys are also used in mill equipment (e.g., black liquor digesters/heaters) because they can withstand highly corrosive environments better than other metals. However, wear and tear and corrosion do occur and nickel can be released to the environment.

3.7.4 Insights from North American Pulp, Paper and Paperboard Mills

In order to learn more about the reasons behind reported decreases in releases to air and water from this sector and especially, environmental sustainability initiatives, the CEC conducted a questionnaire survey of mills, to which a small number of facilities,[48] representing the three subsectors (i.e., pulp, paper and paperboard mills), responded. The objective of this survey was to obtain additional information from facilities about their activities, and was not intended to be a verification of their reported PRTR data. Anecdotal comments provided by some of the Canadian and US facilities in their NPRI and TRI reports, relative to their pollution prevention efforts or other reasons for year-to-year changes in reporting, were also consulted. Finally, pulp and paper manufacturing associations in the three countries were contacted for additional comments. The following information is drawn from these sources.

The five Canadian respondents included one facility from Alberta, one from Ontario, and three from Quebec. None was among the top reporting mills for releases to air or water, and their releases to air over the 2005–2010 period ranged from a few kilograms to approximately 23,000 kilograms. In terms of releases to water, reported amounts ranged from about 400 kilograms to 35,000 kilograms. Each of these facilities reported reductions in their releases to air and water between 2005 and 2010.

The Mexican mills for which responses were received were located in the states of Mexico, Michoacán, Jalisco, Oaxaca, Nuevo León, Querétaro, Veracruz and Sonora. Two of the facilities had reported releases to water in the 2005–2010 period: one of them reporting just under one kilogram, and only in 2010; and the other reporting a similar amount, and only in 2005. Thus, none of the respondents was among the top reporting facilities for releases to air and water.

Of the two US respondents, one was located in Michigan, the other from North Carolina. One mill reported releases to air of almost 100,000 kilograms in 2005, declining to approximately 60,000 kilograms in 2010; and releases to water of about 80 kilograms in 2010, down from 125 kilograms in 2005. The other mill reported releases to air of almost 750,000 kilograms in 2005, and about 400,000 in 2010; and releases to water of approximately 22,000 kilograms in 2005 and 11,000 kilograms in 2010. These two mills were therefore not among the top US reporters for releases to air and water over this period.

The respondents answered questions about their processes, fuels and material inputs, and their releases to air and water between 2005 and 2010, including the following:[49]

- What raw materials and fuels are used in the facility; and does the facility use technologies or processes to control air pollution, or for the treatment of water and waste water?
- What are the main environmental concerns of the facility, especially relative to air and water releases?
- Did the facility undertake pollution prevention initiatives between 2005 and 2010, and what were the aims and main drivers?
- Did the facility report decreases in air and water releases between 2005 and 2010, and what were the primary causes?

In terms of the raw materials used, facilities mentioned wood chips; recycled and post-industrial fiber (including old newspapers and coated paper); and purchased pulp, including softwood kraft (bleached) pulp. One US facility mentioned the use of eucalyptus fiber, a fast-growing plant that has become more common in papermaking (although there are some drawbacks, including the fact that it is not grown in most areas of North America). Respondents also mentioned a wide variety of fuels used to generate

48. In all, responses were submitted for seventeen mills, but two Mexican companies submitted responses on behalf of multiple mills. Therefore, there are eleven individual survey responses: five from Canada, two from the United States, and four from Mexico.
49. The survey questionnaire is provided in Appendix 6. With the exception of facilities that consented to have their names used, names of the responding facilities are not mentioned in this report.

electricity, including natural gas, fuel oil, coal, and landfill gas. A few paper and newsprint mills mentioned their de-inking processes, and one mentioned the use of sodium hydrosulfite for pulp bleaching.

Seven out of the 11 respondents indicated that they have an environmental management system (EMS) in place: four claimed an ISO 14001 system; one the Forest Care certification system; and two claimed individual, unregistered systems. Ten of these respondents said they had implemented specific changes between 2005 and 2010, with the objective of preventing or reducing pollution:

- 8 facilities cited improvements made toward energy efficiency, including the substitution of fuels (no details were provided);
- 5 listed the implementation of new processing technologies;
- 4 listed the renovation of existing technologies;
- 4 listed the substitution or reformulation of raw materials, but provided no details;
- 5 listed recycling, with one indicating it was researching alternate uses for some of its waste (a new product); and
- 1 stated that it had joined a clean industry program.

Four facilities also provided details of new pollution control technologies, which included the following:

- Water and wastewater:
  - use of sodium hypochlorite and a biocide for treating wastewater (via sand filtration);
  - use of ion exchange technology to separate residual color and chloride from wastewater;
  - clarifiers and activated sludge treatment, and primary and secondary wastewater treatment processes.
- Residual sludge: sent to landfill, both on- and off-site; applied to land; or sent off-site for composting.
- Air pollutants: facilities mentioned the use of an electrostatic precipitator (which removes small particles by passing the flue gas through an electrically-charged screen to then be able to separate the charged particles). They also mentioned the use of flue gas scrubbers to remove pollutants that are then converted into a sludge for disposal or other treatment.

When asked if these actions were taken to address specific environmental issues, five of the mills cited the need to reduce releases of criteria air contaminants (e.g., NO_x, particulate matter) and greenhouse gases. Two facilities mentioned management of solid waste, and one facility cited the prevention of fugitive dust, as objectives. None of the facilities listed releases of "other hazardous or toxic substances" as an objective. Nevertheless, the implementation of pollution control technologies aimed at reducing releases of specific substances (e.g., greenhouse gases) often results in reductions in releases of other pollutants contained in the same waste stream.

In terms of the main drivers for the initiatives undertaken at these facilities, the majority of respondents mentioned more than one, as follows:

- 7 facilities listed a corporate commitment to the environment;
- 6 facilities listed other economic benefits (e.g., fuel, energy and raw materials costs, and a reduction in cost associated with fuel substitution; as well as a new product from waste);
- 5 facilities cited the modernization of the facility;
- 5 facilities cited compliance with regulations;
- 3 facilities listed incentive programs;
- 2 facilities listed community relations, including customer demand; and
- 1 facility listed access to international markets.

The majority of respondents stated that multiple factors accounted for the changes implemented at their facilities between 2005 and 2010. These included the need to comply with regulations (e.g. facility permitting requirements, a reason invoked for facilities' use of PRTR data). Economic drivers (the price of raw materials and other economic benefits) appear to be among the strongest incentives for these facilities, and collectively were listed 10 times. The corporate commitment to the environment is significant (7 mentions), as well as the modernization of facilities (5 mentions), which in most cases can be understood to occur for non-environmental reasons. Community relations, customer demand, and access to international markets were mentioned less frequently, but remained part of the mix of drivers influencing the changes implemented within these mills.

In terms of PRTR reporting, there was not always a congruence between facility responses and the changes shown in the data for releases to air and water between 2005 and 2010 (i.e., some respondents mentioned decreases when the data show increases). This might be the result of respondents' inadvertently referring to releases that occurred before or after the 6-year time frame of this survey. Eight of the facilities cited a decrease in air and water releases from 2005 to 2010. For air releases, one facility mentioned a decrease in production (resulting from a boiler shutdown) as the reason for the change; another cited a change in emission

estimation techniques. For water releases, one facility cited improved effluent control as a reason for the decrease, and another facility cited fuel switching.

The Alberta Newsprint Company, located in Whitecourt, Alberta, described reductions in releases to water that mirror the 2005–2010 changes in its reported PRTR data. This facility did not report releases to air over this period, but reported releases to water of almost 9,000 kilograms in 2010, a reduction from about 11,110 kilograms reported in 2005. The majority of these releases were of total phosphorous. The facility stated that during this period, it implemented multiple pollution prevention activities, including the installation of pollution control equipment, new processing technology, reductions in the chemicals used for waste treatment, and renovation of existing technology. The mill also participated in a phosphorus reduction program, which explains the decreases in reported releases to water of this pollutant. The facility mentioned regulations, economic benefits, and incentive programs as the drivers of its pollution prevention initiatives.

During the process of conducting the questionnaire survey, certain errors in reporting by a small number of Mexican pulp and paper mills were identified, including errors in data estimations or calculations, and unit errors (e.g., reporting of tons instead of kilograms). The Mexican industry association, the *Cámara Nacional de las Industrias de la Celulosa y del Papel*, is reviewing the RETC data submitted by these member facilities and discussing possible corrections with Semarnat.

Table 34 presents comments included by some of the Canadian and US survey respondents in their PRTR reporting forms between 2005 and 2010—a useful source of information about the reasons for changes in reported releases to air and water over this period. While only a small percentage of facilities provide such comments (with comparable details not available through the RETC reporting form), the benefit of these comments is that they are submitted annually and are pollutant-specific. As such, they can provide a greater level of accuracy about changes in reported data.

The results of this questionnaire survey suggest that, despite a certain disconnection between facility responses and changes in their PRTR data, decreases in releases to air and water from participating pulp and paper facilities were directly related to changes in environmental management practices. Nevertheless, facility comments also indicate that other factors were partly responsible for these decreases, including economic considerations, data corrections or changes in estimation methodologies, or a slowdown in production.

A number of mills acknowledged that PRTR data are used in external communications with the public, with comments also indicating that customer demand played a role in their environmental management decisions, such as the choice of chemicals used at their facilities. This suggests that PRTR data have wider impacts and that they are a useful tool not only for industrial facilities, but for external stakeholders as well.

Table 34. Reasons for Changes in Reported Releases to Air and Water, 2005–2010: Canadian NPRI and US TRI

Reasons for Changes in reported PRTR data	Example Statement (statements have been edited for length and clarity)
Change in production	Due to downturn in the economy, there was significantly less production.
Changes in estimation techniques, calculation methods, or corrections of errors	Emissions testing in 2007 for phenol enabled more-precise quantification of the amount of phenol used, consumed, and emitted from the process. This testing indicated that, although based upon the best information available at the time, phenol emissions were significantly overestimated in previous years.
Customer/client demand	Customer demand has increased for the production of Bisphenol A–free products.
Process change/closure/change of ownership	Coating of silver halide–based photographic product was completed in December. Silver emissions were a result of wastewater treatment during shutdown of operations (related to silver halide products). As of 2007, no further operations utilizing silver are planned (focusing on thermal and inkjet media production).
Economic incentives	The facility can burn natural gas or #4 oil. In 2005, the facility shifted use to more oil and less gas, for economic reasons.
Change in medium of release or transfer for a particular pollutant	Scrap product that retains a small amount of this chemical is being diverted from the landfill to a recycler.
Facility surpasses (or no longer meets) reporting thresholds	Production grew during 2009 to the point where manufacturing of this aluminum fume exceeded the required reporting threshold of 25,000 pounds/year. This created the need for reporting.

Appendix 1

Using and Understanding *Taking Stock*

For those new to pollutant release and transfer registers or to *Taking Stock*, this appendix describes the characteristics of the three national PRTRs, including the features that are unique to the system of each country. It also describes the scope of this report and the methodology and terminology used in it.

Features of the Three North American PRTRs

Taking Stock is based on information provided by North America's three national PRTR programs:

- **Canada's NPRI** (<www.ec.gc.ca/pdb/npri/npri_online_data_e.cfm>)
- **Mexico's RETC** (<http://app1.semarnat.gob.mx/retc/index.php>)
- **The US TRI** (<www.epa.gov/triexplorer>).

Each country's PRTR has evolved with its own list of pollutants, sector coverage, and reporting requirements. Table A-1 compares features of the three PRTRs.

Overview of PRTR Reporting Requirements

Which Pollutants Must Be Reported?

The pollutants subject to national PRTR reporting requirements are listed because they meet certain criteria for chemical toxicity and the potential for risk to human health and the environment. Each PRTR system covers a specific list of substances: NPRI spans almost 350 pollutants, TRI approximately 600, and RETC 104.

Table A-1. Features of the Three North American PRTRs

	US Toxics Release Inventory (TRI)	Canada's National Pollutant Release Inventory (NPRI)	Mexico's *Registro de Emisiones y Transferencia de Contaminantes* (RETC)
First mandatory reporting year	**1987**	**1993**	**2004**
Industrial activities or sectors covered	Manufacturing and federal facilities, electric utilities (oil- and coal-fired), coal and metal mines, hazardous waste management and solvent recovery facilities, chemical wholesalers, and petroleum bulk terminals	Any facility manufacturing or using a listed chemical, except for exempted activities such as research, repair, retail sale, agriculture and forestry. Any facility releasing criteria air contaminants (CACs) to air in specified quantities	Facilities in 11 sectors under federal jurisdiction: petroleum, chemicals, paints and ink manufacturing, primary and fabricated metals, automotive, pulp and paper, cement/limestone, asbestos, glass, electric utilities, and hazardous waste management. Also, facilities undertaking specific activities subject to federal jurisdiction, such as handling hazardous wastes or discharging pollutants to national water bodies
Number of pollutants subject to reporting	593 individual pollutants and 30 pollutant categories	346 pollutants or pollutant groups	104 pollutants
Employee thresholds	10 or more full-time employees (or equivalent number of hours)	Generally 10 employees or more. For certain activities, such as waste incineration and wastewater treatment, the 10-employee threshold does not apply	No employee threshold
Substance "activity" (manufacture, process or otherwise use) thresholds, or "release" thresholds	"Activity" thresholds of 25,000 lbs, or 11,340 kg (with an "otherwise use" threshold of about 5,000 kg); lower thresholds for certain pollutants (e.g., persistent bioaccumulative and toxic [PBT] chemicals and dioxins and furans)	"Activity" thresholds of 10,000 kg for most chemicals. Lower thresholds for certain pollutants such as PBTs, polycyclic aromatic hydrocarbons, dioxins and furans, and criteria air contaminants	"Release" and "activity" thresholds for each pollutant (a facility must report if it meets or exceeds either threshold). Except for greenhouse gases, "release" thresholds range from 1 kg to 1,000 kg. "Activity" thresholds range from 5 kg to 5,000 kg. Any release of polychlorinated biphenyls (PCBs) and sulfur hexafluoride, and any release or activity involving dioxins and furans, is reportable
Types of releases and transfers covered	On-site releases to air, water, land, and underground injection; off-site releases to disposal; off-site transfers to recycling, energy recovery, treatment, or sewage	On-site releases to air, water, land, and disposal, including underground injection; transfers off-site for disposal; treatment prior to final disposal (including sewage); recycling and energy recovery	On-site releases to air, water and land; transfers off-site for disposal, recycling, re-utilization, energy recovery, treatment, co-processing (input from another production process) and sewage

As of April 2006, the Chemical Abstracts Service (CAS) listed more than 27 million chemical substances and identified more than 239,000 of them as regulated or covered by chemical inventories worldwide.

Facilities report the amounts of each pollutant they have released to the environment at their own location (on-site). They also report how much of the substance was sent off-site for disposal, or transferred for recycling or other waste management. Pollutant-based reporting thresholds exist, and certain pollutants have lower reporting thresholds due to their greater potential for risk to human health and the environment. In general, the PRTR pollutant thresholds are as follows:

- For Canada's NPRI and the US TRI, a facility must report if it manufactures, processes, or otherwise uses (e.g., in cleaning industrial equipment) 10,000 kilograms (NPRI) or 11,340 kilograms (TRI) of a listed pollutant.
- Mexico's RETC has both an "activity" threshold and a "release" threshold. A facility must report if it meets or exceeds either threshold. The RETC "activity" threshold is typically either 2,500 kilograms or 5,000 kilograms, depending on the substance; the typical "release" threshold is 1,000 kilograms.

For more information, see Appendix 2: Pollutants Common to at Least Two of the Three North American PRTRs.

Assessing potential harm to human health or the environment from particular releases of a pollutant is a complex task, because the potential of a substance to cause harm arises from various factors, including its inherent toxicity and the nature of the exposure to the substance (e.g., the potential risk posed by asbestos sent to a secure landfill is considered to be much lower than the risk posed by asbestos released to air). However, the reported data and information about a pollutant's chemical properties and toxicity can serve as a starting point for learning more about its potential impacts.

Ranking Pollutants by Toxic Equivalency Potential (TEP)

To put pollutant releases into context, *Taking Stock* includes a chemical ranking system that takes into account both a pollutant's toxicity and its potential for human exposure, using toxic equivalency potentials (TEPs). TEPs indicate the relative human health risk associated with a release of

Known or Suspected Carcinogens, Developmental or Reproductive Toxicants, Metals, and PBTs

In order to provide more information about PRTR pollutants, the *Taking Stock* report and *Taking Stock Online* database also categorize them as follows (with many of the pollutants reported to the North American PRTRs falling into one or more of these categories):

- **Known or suspected carcinogens**, based on the World Health Organization's International Agency for Research on Cancer (IARC) and California's Office of Environmental Health Hazard Assessment (OEHHA) Proposition 65 list.[50]
- **Developmental or reproductive toxicants**, based on California's Proposition 65 list. These substances adversely affect reproductive capabilities and/or the development of the fetus. Metals, solvents, and pesticides have been widely implicated in reproductive and/or developmental impacts. Endocrine disruptors have also been added to this category.
- **Persistent, bioaccumulative and toxic substances (PBTs).** These pollutants have properties that render them a long-term environmental and health threat, even in small quantities. When PBTs are released into the environment, they persist over long periods of time and do not break down easily into other compounds; they can be transported in the atmosphere over long distances, ending up far from the sources of their release; and they bioaccumulate in the food chain (increasing in concentration at higher levels). They are also toxic, often causing damage to humans, plants and wildlife.
- **Metals.** Metals occur naturally, but human activities such as mining and smelting increase the proportions of metals in the environment. The toxicity of certain metals and their compounds depends on the forms they take in the environment.

50. International Agency for Research on Cancer (IARC). 2013. Classification. Online at: <http://monographs.iarc.fr/ENG/Classification/index.php>. State of California. Office of Environmental Health Hazard Assessment (OEHHA). 2013. *Proposition 65* list. Online at: <www.oehha.org/prop65.html>.

Reporting of Criteria Air Contaminants and Greenhouse Gases

Data for releases of criteria air contaminants (CACs) and greenhouse gases (GHGs) are not included in *Taking Stock*, due to differences in national reporting requirements for these pollutants. CACs—including carbon monoxide, nitrogen oxides, particulate matter, sulfur oxides and volatile organic compounds—are a group of chemicals associated with environmental effects such as smog, acid rain and regional haze, and health effects such as respiratory illnesses. Major sources of CACs are the burning of fossil fuels, as well as natural resource extraction and a variety of manufacturing activities. GHGs contribute to climate change by trapping heat within the earth's atmosphere. They are the subject of the international Kyoto Protocol, which came into force in 2005. The major GHGs include carbon dioxide, methane, nitrous oxide and three groups of fluorinated gases. Some of the main anthropogenic sources of GHGs are the burning of fossil fuels, deforestation and agricultural activities. CACs are reported to Canada's NPRI and GHGs are reported to Mexico's RETC, but these pollutants are not subject to US TRI reporting. However, there are other sources of information on emissions of these pollutants in all three countries:

Criteria Air Contaminants:

- Canada's National Pollutant Release Inventory: <www.ec.gc.ca/inrp-npri/Default.asp?lang=En&n=4A577BB9-1>
- US National Emissions Inventory: <www.epa.gov/air/emissions/>
- *Inventario Nacional de Emisiones de México* (National Emissions Inventory of Mexico): <www.inecc.gob.mx/dica/547-calaire-inem>

Greenhouse Gases:

- Canada's Greenhouse Gas Reporting Program and National Inventory Report: <www.ec.gc.ca/ges-ghg/default.asp?lang=En&n=1357A041-1>
- US Greenhouse Gas Reporting Program: <http://www.epa.gov/ghgreporting/>
- US Greenhouse Gas Emissions website: <www.epa.gov/climatechange/ghgemissions/index.html>
- Mexico's RETC (facility-specific GHG data): <http://app1.semarnat.gob.mx/retc/index.html>

one unit of a pollutant, compared to the risk posed by the release of one unit of a reference substance. TEP weights are calculated using the CalTOX model developed by California regulatory agencies. TEPs are one of many different screening tools, each of which is based on a series of assumptions, thus yielding different results.

Readers should note that the TEP analysis is limited, in that a release does not directly correlate to actual exposures or levels of risk. In addition, not all of the substances have an assigned TEP (information on their toxicity or exposure potential may be missing). However, these pollutants should not be assumed to be without risk. Also, TEPs are available only for air and water releases and it should not be assumed that other types of pollutant releases (e.g., to land) present no risk.

The TEP reference chemical for carcinogens is benzene and the reference chemical for non-carcinogens is toluene. The TEP weights used in the *Taking Stock* report and online database have been taken from the Scorecard website (<http://scorecard.goodguide.com/env-releases/def/tep_gen.html>), June 2013. The TEP weight is multiplied by the amount of release, to provide a score for each pollutant.

Which Industries Report?

Each country requires PRTR reporting by facilities in specific industrial sectors or undertaking specific industrial activities.

- In Canada, all facilities that meet reporting thresholds and requirements report to the NPRI, with the exception of a few resource-based sectors and certain activities such as research laboratories.
- In Mexico, all industrial sectors regulated under federal law are required to report to the RETC, along with facilities in other sectors that engage in activities subject to federal regulation. These include facilities that handle hazardous wastes, or discharge pollutants into national water bodies.
- In the United States, TRI requires reporting by federal facilities, most manufacturing facilities and industries that service manufacturing facilities (e.g., electric utilities and hazardous waste management facilities). A few resource-based sectors, such as oil and gas extraction, are exempt from reporting.

North American Industry Classification System

NAICS code	Industry
11	Agriculture, Forestry, Fishing and Hunting
21	Mining, Quarrying and Oil and Gas Extraction
22	Utilities (Electricity, Water and Gas Distribution)
23	Construction
31/32/33	Manufacturing
41/42/43	Wholesale Trade
44/45/46	Retail Trade
48/49	Transportation and Warehousing
51	Information and Cultural Industries
52	Finance and Insurance
53	Real Estate and Rental and Leasing
54	Professional, Scientific and Technical Services
55	Management of Companies and Enterprises
56	Administrative and Support, Waste Management and Remediation Services
61	Educational Services
62	Health Care and Social Assistance
71	Arts, Entertainment and Recreation
72	Accommodation and Food Services
81	Other Services (except Public Administration)
91/92/93	Public Administration

North American Industry Classification System

Canada, Mexico and the United States have adopted the North American Industry Classification System (NAICS), whose codes are used to categorize the industrial activities of a facility. NAICS codes were established in 1997 and since 2006 they have been incorporated into PRTR reporting to replace the standard industrial classification (SIC) codes used by each country. Although there is some variation among the three countries in the subsector categorizations and codes used, the breakdown of industrial sectors into general categories is the same (see the text box). For more information about the implementation of the NAICS system in each country, see:

- Canada: <www.statcan.gc.ca/subjects-sujets/standard-norme/naics-scian/2007/list-liste-eng.htm>
- Mexico: <www.inegi.org.mx/est/contenidos/espanol/metodologias/censos/scian2007_1.pdf>
- United States: <www.census.gov/cgi-bin/sssd/naics/naicsrch?chart=2007>

PRTR reporting requirements are based in part on the industrial activity undertaken within a facility, and not only the industry code assigned to that facility. Therefore, not all facilities within a given sector might have to report. For example, within the economic sector that includes dry-cleaning, only those facilities undertaking the actual dry-cleaning process, and not clothing drop-off points, might be required to report. Another example is a food processing plant that is required to report because it has its own power plant to generate electricity.

Employee Thresholds

Both NPRI and TRI have an employee threshold, generally corresponding to the equivalent of 10 full-time employees (with some exceptions for pollutants or certain types of facilities). Mexico's RETC does not have an employee threshold. More information on reporting instructions is available on the NPRI, RETC and TRI websites (see above).

Taking Stock Terminology

Taking Stock uses the following categories for presenting information on pollutant releases and transfers (see Figure A-1).

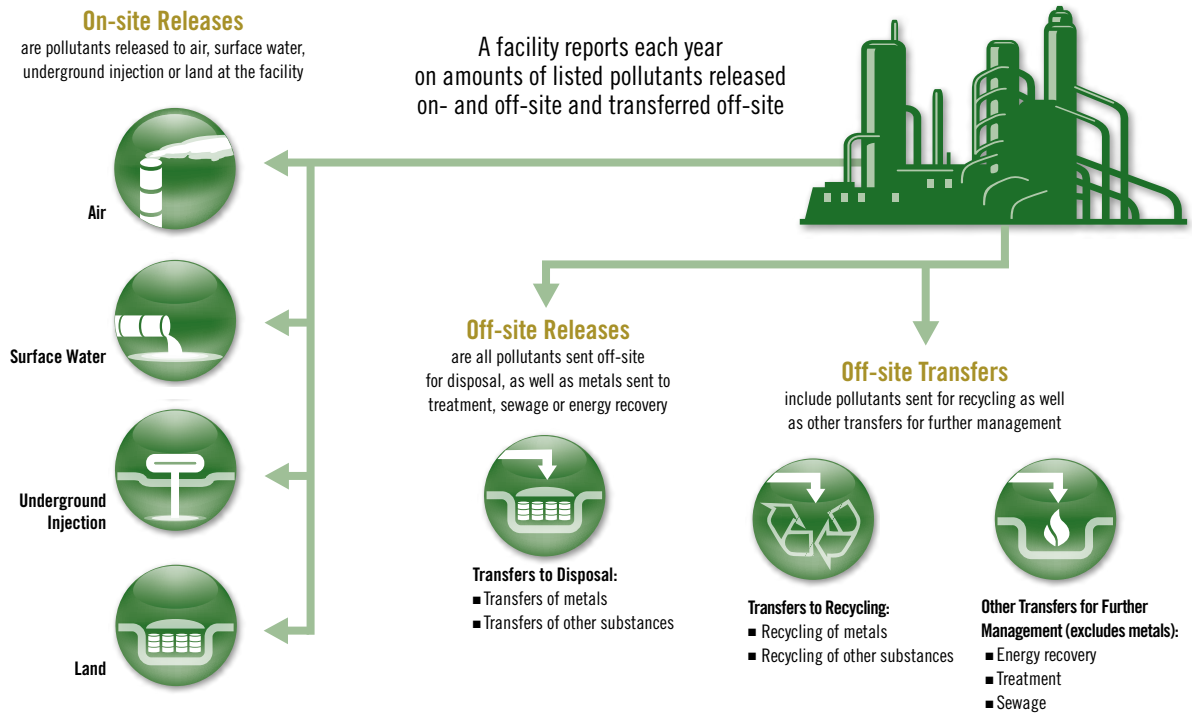
Releases

- ***On-site releases*** describes releases that occur at a facility—that is, pollutants that are released into the air or water, injected into underground wells, or put in landfills "inside the fence line."
- ***Off-site releases*** describes pollutants sent off-site for disposal. Waste sent off-site to another facility for disposal may be disposed of on land, in landfills or by underground injection. These methods are the same as on-site releases, but they occur at locations other than at the originating facility.

Transfers

- ***Transfers to recycling*** describes substances sent off-site for recycling.
- ***Transfers for further management*** describes pollutants (other than metals; see figure A-1) sent off-site for treatment, energy recovery, or to sewage.

Figure A-1. Pollutant Releases and Transfers in North America



Source: CEC. 2011. *Taking Stock: North American Pollutant Releases and Transfers 13*. Figure A-1. Montreal: Commission for Environmental Cooperation. Online at: <www3.cec.org/islandora/en/item/4303-taking-stock-13-north-american-pollutant-releases-and-transfers-en.pdf>.

*A note about metals: Metals sent off-site for disposal or to sewage, treatment, or energy recovery are included in the *off-site releases* category. This mirrors the US TRI practice of classifying all transfers of metals as "transfers to disposal," because metals sent to energy recovery, treatment or sewage treatment may be captured and removed from waste and disposed of in landfills or by other disposal methods. This approach recognizes the physical nature of metals, and acknowledges that metals sent to disposal, sewage, treatment or energy recovery are not likely to be destroyed, and therefore they may eventually enter the environment. Because this terminology is specific to *Taking Stock*, the terms *release* and *transfer* as defined here may differ from their use in NPRI, RETC and TRI.

Taking Stock Scope and Methodology

Data from the three countries' PRTRs were obtained by the CEC from the three governments or retrieved from their publicly accessible websites. For this edition of *Taking Stock*, the CEC received the latest dataset (from 2005 through 2010) from Canada and the United States in March 2012, and Mexico in October 2012.[51] With the exception of criteria air contaminants (CACs) and greenhouse gases (GHGs), all reported data from the three countries are accessible through the *Taking Stock Online* integrated North American PRTR database.

The methodology used in preparation of the annual *Taking Stock* report and online database includes the following:

- The PRTR data from each country are compiled for the *Taking Stock* integrated, North American PRTR database. This involves standardizing data fields used in the three countries—for example, aggregating reported off-site transfers to disposal (NPRI) into an "off-site releases" category (see *Taking Stock* Terminology, above or online).
- Certain individual reported substances, including many metals, are aggregated into pollutant groups or categories (e.g., lead and its compounds, xylene isomers). In these cases, no specific CAS number for the pollutant group is assigned.
- The data are submitted to a general review in order to identify inconsistencies or possible errors, which are then communicated to the national PRTR programs. Although the CEC cannot be responsible for erroneous reporting by facilities, the goal of the North American PRTR project is to use the best data possible.
- Data for each reporting year (going back to 2005) are refreshed at least annually—a fact readers are urged to remember, particularly when they attempt to use the data to analyze time trends. Users can visit the national websites to view changes to the data.

51. The data sets of the national PRTR systems are constantly evolving as facilities revise previous submissions to correct reporting errors or make other changes. To get the most recent data for specific facilities of interest, readers are encouraged to consult the national PRTR websites.

Limitations of PRTR Data

Because of national PRTR reporting requirements, including thresholds for pollutants and facilities, only a portion of all industrial pollution is being captured. Also, industrial facilities are not the only sources of pollution in North America. North American PRTR data do not provide information on the following:

- *All potentially harmful substances.* The data provide information only on the pollutants reported to each country's PRTR.
- *All sources of contaminants.* The report includes only those facilities in the countries' industrial sectors, or undertaking specific industrial activities, that are subject to reporting to each national PRTR program. The North American PRTRs do not include emissions from automobiles or other mobile sources, from natural sources such as forest fires, or from agricultural sources. For some pollutants, these mobile, natural and agricultural sources can be large contributors to the overall amounts.
- *Releases and transfers of all pollutants from a facility.* Only those pollutants for which reporting thresholds are met are included.
- *All facilities within required reporting sectors.* In Canada and the United States, only facilities with the equivalent of 10 full-time employees must report (with certain exceptions). Mexico has no employee threshold.
- *Environmental fate of or risks* from the pollutants released or transferred.
- *Levels of exposure* of human or ecological populations to the pollutants.
- *Legal limits* of a pollutant from a facility. The data do not indicate whether a facility is in compliance with permits and other regulations.

Substances released or transferred by industrial facilities have physical and chemical characteristics that influence their ultimate disposition and consequences for human and ecological health. Assessing the potential harm from particular releases of a pollutant to the environment is a complex task because the potential of a substance to cause harm arises from various factors, including its inherent toxicity and the nature of the exposure to the substance (e.g., the potential risk posed by asbestos sent to a secure landfill is considered to be much lower than the risk posed by asbestos released to air). PRTR data alone cannot provide enough information to assess the potential harm from a pollutant; however, the data in combination with other information about a pollutant can serve as a starting point for learning more about its potential impacts. Readers may wish to seek other sources for more information, such as:

- US Agency for Toxic Substances and Disease Registry, ToxFAQs,:<www.atsdr.cdc.gov/toxfaqs/index.asp>;
- State of New Jersey, Department of Health, *Right-to-Know Hazardous Substance Fact Sheets* (information also available in Spanish): <http://web.doh.state.nj.us/rtkhsfs/indexFs.aspx>.

Pollutants Common to at Least Two of the Three North American PRTRs

Table A-2. Pollutants Common to at Least Two of the Three North American PRTRs

Pollutant	CAS No.	NPRI Threshold (kilograms/year)	RETC Threshold (kilograms/year)		TRI Threshold (kilograms/year)	Reporting of Pollutant Mandatory		
		Manufacture, process, or otherwise use	Manufacture, process, or otherwise use	Emission	Manufacture, process, or otherwise use	NPRI	RETC	TRI
1,1,1,2-Tetrachloroethane	630-20-6	10,000			11,340	x		x
1,1,1-Trichloroethane	71-55-6		2,500	1,000	11,340		x	x
1,1,2,2-Tetrachloroethane	79-34-5	10,000	5,000	1,000	11,340	x	x	x
1,1,2-Trichloroethane	79-00-5	10,000	5,000	1,000	11,340	x	x	x
1,1,2-Trichlorotrifluoroethane (CFC-113)	76-13-1		2,500	1,000	11,340		x	x
1,1-Dichloro-1-fluoroethane (HCFC-141b)	1717-00-6	10,000	5,000	1,000	11,340	x	x	x
1,1-Methylenebis (4-isocyanatocyclohexane)	5124-30-1	10,000			11,340	x		x
1,2,4-Trichlorobenzene	120-82-1	10,000	5,000	1,000	11,340	x	x	x
1,2,4-Trimethylbenzene	95-63-6	10,000			11,340	x		x
1,2-Butylene oxide	106-88-7	10,000			11,340	x		x
1,2-Dichlorobenzene	95-50-1	10,000	5,000	1,000	11,340	x	x	x
1,2-Dichloroethane	107-06-2	10,000	5,000	1,000	11,340	x	x	x
1,2-Dichloropropane	78-87-5	10,000			11,340	x		x
1,3-Butadiene	106-99-0	10,000	5,000	100	11,340	x	x	x
1,3-Dichloro-1,2,2,3,3-pentafluoropropane (HCFC-225cb)	507-55-1		2,500	1,000	11,340		x	x
1,4-Dichlorobenzene	106-46-7	10,000	5,000	1,000	11,340	x	x	x
1,4-Dioxane	123-91-1	10,000	5,000	100	11,340	x	x	x
1-Chloro-1,1-difluoroethane (HCFC-142b)	75-68-3	10,000	5,000	1,000	11,340	x	x	x
2,2,4-Trimethylhexamethylene diisocyanate	16938-22-0	10,000			11,340	x		x
2,4,4-Trimethylhexamethylene diisocyanate	15646-96-5	10,000			11,340	x		x
2,4,5-Trichlorophenol	95-95-4		2,500	1,000	11,340		x	x
2,4,6-Trichlorophenol	88-06-2		2,500	1,000	11,340		x	x
2,4-Diaminotoluene	95-80-7	10,000			11,340	x		x
2,4-Dichlorophenol	120-83-2	10,000			11,340	x		x
2,4-Dichlorophenoxyacetic acid	94-75-7		2,500	100	11,340		x	x
2,4-Dinitrotoluene	121-14-2	10,000	5,000	1,000	11,340	x	x	x
2,6-Dinitrotoluene	606-20-2	10,000			11,340	x		x
2-Ethoxyethanol	110-80-5	10,000	2,500	100	11,340	x	x	x
2-Mercaptobenzothiazole	149-30-4	10,000			11,340	x		x
2-Methoxyethanol	109-86-4	10,000			11,340	x		x
2-Methylpyridine	109-06-8	10,000			11,340	x		x
2-Naphthylamine	91-59-8		50	100	11,340		x	x
2-Nitropropane	79-46-9	10,000	2,500	100	11,340	x	x	x
2-Phenylphenol	90-43-7	10,000			11,340	x		x
3,3-Dichloro-1,1,1,2,2-pentafluoropropane (HCFC-225ca)	422-56-0		2,500	1,000	11,340		x	x
3,3'-Dichlorobenzidine dihydrochloride	612-83-9	10,000			11,340	x		x
3-Chloro-2-methyl-1-propene	563-47-3	10,000			11,340	x		x
3-Chloropropionitrile	542-76-7	10,000			11,340	x		x

Table A-2. Pollutants Common to at Least Two of the Three North American PRTRs

Pollutant	CAS No.	NPRI Threshold (kilograms/year)	RETC Threshold (kilograms/year)		TRI Threshold (kilograms/year)	Reporting of Pollutant Mandatory		
		Manufacture, process, or otherwise use	Manufacture, process, or otherwise use	Emission	Manufacture, process, or otherwise use	NPRI	RETC	TRI
4,4'-Methylenebis(2-chloroaniline)	101-14-4	10,000			11,340	x		x
4,4'-Methylenedianiline	101-77-9	10,000			11,340	x		x
4,6-Dinitro-o-cresol	534-52-1	10,000	2,500	100	11,340	x	x	x
4-Aminobiphenyl	92-67-1		2,500	1,000	11,340		x	x
4-Nitrophenol	100-02-7	10,000			11,340	x		x
7H-Dibenzo(c,g)carbazole	194-59-2	50*			45*	x		x
Acetaldehyde	75-07-0	10,000	2,500	100	11,340	x	x	x
Acetonitrile	75-05-8	10,000			11,340	x		x
Acetophenone	98-86-2	10,000			11,340	x		x
Acrolein	107-02-8	10,000	2,500	100	11,340	x	x	x
Acrylamide	79-06-1	10,000	2,500	100	11,340	x	x	x
Acrylic acid	79-10-7	10,000			11,340	x		x
Acrylonitrile	107-13-1	10,000	2,500	100	11,340	x	x	x
Aldrin	309-00-2		50	100	45		x	x
Allyl alcohol	107-18-6	10,000			11,340	x		x
Allyl chloride	107-05-1	10,000			11,340	x		x
Aluminum (fume or dust)	7429-90-5	10,000			11,340	x		x
Aluminum oxide (fibrous forms)	1344-28-1	10,000			11,340	x		x
Ammonia	--	10,000			11,340	x		x
Aniline	62-53-3	10,000	5,000	1,000	11,340	x	x	x
Anthracene	120-12-7	10,000			11,340	x		x
Antimony (and compounds)	--	10,000			11,340	x		x
Arsenic (and compounds)	--	50	5	1	11,340	x	x	x
Asbestos (friable form)	1332-21-4	10,000	5	1	11,340	x	x	x
Benzene	71-43-2	10,000	5,000	1,000	11,340	x	x	x
Benzidine	92-87-5		5,000	1,000	11,340		x	x
Benzo(a)anthracene	56-55-3	50*			45*	x		x
Benzo(a)phenanthrene	218-01-9	50*			45*	x		x
Benzo(a)pyrene	50-32-8	50*			45*	x		x
Benzo(b)fluoranthene	205-99-2	50*			45*	x		x
Benzo(g,h,i)perylene	191-24-2	50*			45*	x		x
Benzo(j)fluoranthene	205-82-3	50*			45*	x		x
Benzo(k)fluoranthene	207-08-9	50*			45*	x		x
Benzoyl chloride	98-88-4	10,000			11,340	x		x
Benzoyl peroxide	94-36-0	10,000			11,340	x		x
Benzyl chloride	100-44-7	10,000			11,340	x		x
Biphenyl	92-52-4	10,000	5,000	1,000	11,340	x	x	x
Bis(chloromethyl) ether	542-88-1		2,500	1,000	11,340		x	x
Bisphenol A	80-05-7	10,000			11,340	x		x
Boron trifluoride	7637-07-2	10,000			11,340	x		x
Bromine	7726-95-6	10,000			11,340	x		x
Bromochlorodifluoromethane (Halon 1211)	353-59-3	10,000	5,000	1,000	11,340	x	x	x
Bromoform	75-25-2		2,500	1,000	11,340		x	x
Bromomethane	74-83-9	10,000	5,000	1,000	11,340	x	x	x

Table A-2. Pollutants Common to at Least Two of the Three North American PRTRs

Pollutant	CAS No.	NPRI Threshold (kilograms/year)	RETC Threshold (kilograms/year)		TRI Threshold (kilograms/year)	Reporting of Pollutant Mandatory		
		Manufacture, process, or otherwise use	Manufacture, process, or otherwise use	Emission	Manufacture, process, or otherwise use	NPRI	RETC	TRI
Bromotrifluoromethane (Halon 1301)	75-63-8	10,000	5,000	1,000	11,340	x	x	x
Butyl acrylate	141-32-2	10,000			11,340	x		x
Butyraldehyde	123-72-8	10,000			11,340	x		x
C.I. Acid Green 3	4680-78-8	10,000			11,340	x		x
C.I. Basic Green 4	569-64-2	10,000			11,340	x		x
C.I. Basic Red 1	989-38-8	10,000			11,340	x		x
C.I. DiRETC Blue 218	28407-37-6	10,000			11,340	x		x
C.I. Disperse Yellow 3	2832-40-8	10,000			11,340	x		x
C.I. Food Red 15	81-88-9	10,000			11,340	x		x
C.I. Solvent Orange 7	3118-97-6	10,000			11,340	x		x
C.I. Solvent Yellow 14	842-07-9	10,000			11,340	x		x
Cadmium (and compounds)	--	5	5	1	11,340	x	x	x
Calcium cyanamide	156-62-7	10,000			11,340	x		x
Carbon disulfide	75-15-0	10,000			11,340	x		x
Carbon tetrachloride	56-23-5	10,000	5,000	1,000	11,340	x	x	x
Carbonyl sulfide	463-58-1	10,000			11,340	x		x
Catechol	120-80-9	10,000			11,340	x		x
Chlordane	57-74-9		5	100	4.5		x	x
Chlorendic acid	115-28-6	10,000			11,340	x		x
Chlorine	7782-50-5	10,000			11,340	x		x
Chlorine dioxide	10049-04-4	10,000	5,000	100	11,340	x	x	x
Chloroacetic acid	79-11-8	10,000			11,340	x		x
Chlorobenzene	108-90-7	10,000	5,000	1,000	11,340	x	x	x
Chlorodifluoromethane (HCFC-22)	75-45-6	10,000	5,000	1,000	11,340	x	x	x
Chloroethane	75-00-3	10,000			11,340	x		x
Chloroform	67-66-3	10,000	5,000	1,000	11,340	x	x	x
Chloromethane	74-87-3	10,000	5,000	1,000	11,340	x	x	x
Chlorotrifluoromethane (CFC-13)	75-72-9	10,000	5,000	1,000	11,340	x	x	x
Chromium (and compounds)	--	10,000	5	1	11,340	x	x	x
Cobalt (and compounds)	--	10,000			11,340	x		x
Copper (and compounds)	--	10,000			11,340	x		x
Creosote	8001-58-9	10,000			11,340	x		x
Cresol (all isomers and their salts)	--	10,000			11,340	x		x
Crotonaldehyde	4170-30-3	10,000			11,340	x		x
Cumene	98-82-8	10,000			11,340	x		x
Cumene hydroperoxide	80-15-9	10,000			11,340	x		x
Cyanides	--	10,000	5,000	100	11,340	x	x	x
Cyclohexane	110-82-7	10,000			11,340	x		x
Cyclohexanol	108-93-0	10,000			11,340	x		x
Decabromodiphenyl oxide	1163-19-5	10,000			11,340	x		x
Di(2-ethylhexyl) phthalate	117-81-7	10,000			11,340	x		x
Dibenz(a,j)acridine	224-42-0	50*			45*	x		x
Dibenzo(a,h)anthracene	53-70-3	50*			45*	x		x
Dibenzo(a,i)pyrene	189-55-9	50*			45*	x		x

Table A-2. Pollutants Common to at Least Two of the Three North American PRTRs

Pollutant	CAS No.	NPRI Threshold (kilograms/year)	RETC Threshold (kilograms/year)		TRI Threshold (kilograms/year)	Reporting of Pollutant Mandatory		
		Manufacture, process, or otherwise use	Manufacture, process, or otherwise use	Emission	Manufacture, process, or otherwise use	NPRI	RETC	TRI
Dibutyl phthalate	84-74-2	10,000	5,000	100	11,340	x	x	x
Dichlorodifluoromethane (CFC-12)	75-71-8	10,000	5,000	1,000	11,340	x	x	x
Dichloromethane	75-09-2	10,000	5,000	1,000	11,340	x	x	x
Dichlorotetrafluoroethane (CFC-114)	76-14-2	10,000	5,000	1,000	11,340	x	x	x
Dicyclopentadiene	77-73-6	10,000			11,340	x		x
Diethanolamine	111-42-2	10,000			11,340	x		x
Diethyl sulfate	64-67-5	10,000			11,340	x		x
Dimethyl phthalate	131-11-3	10,000			11,340	x		x
Dimethyl sulfate	77-78-1	10,000			11,340	x		x
Dimethylamine	124-40-3	10,000			11,340	x		x
Dinitrotoluene (mixed isomers)	25321-14-6	10,000			11,340	x		x
Dioxins and furans	--	*	*	*	*	x	x	x
Diphenylamine	122-39-4	10,000			11,340	x		x
Epichlorohydrin	106-89-8	10,000	5,000	1,000	11,340	x	x	x
Ethyl acrylate	140-88-5	10,000			11,340	x		x
Ethyl chloroformate	541-41-3	10,000			11,340	x		x
Ethylbenzene	100-41-4	10,000			11,340	x		x
Ethylene	74-85-1	10,000			11,340	x		x
Ethylene glycol	107-21-1	10,000			11,340	x		x
Ethylene oxide	75-21-8	10,000			11,340	x		x
Ethylene thiourea	96-45-7	10,000			11,340	x		x
Fluoranthene	206-44-0	50*			45*	x		x
Fluorine	7782-41-4	10,000			11,340	x		x
Formaldehyde	50-00-0	10,000	5,000	100	11,340	x	x	x
Formic acid	64-18-6	10,000			11,340	x		x
Gamma-hexachlorocyclohexane (lindane)	58-89-9		5	100	11,340		x	x
HCFC 124 (and all isomers)	--	10,000	5,000	1,000	11,340	x	x	x
HCFC-123 (and all isomers)	--	10,000	5,000	1,000	11,340	x	x	x
Heptachlor	76-44-8		5	100	4.5		x	x
Hexachlorobenzene	118-74-1	*	*	*	*	x	x	x
Hexachlorobutadiene	87-68-3		2,500	1,000	11,340		x	x
Hexachlorocyclopentadiene	77-47-4	10,000	5,000	1,000	11,340	x	x	x
Hexachloroethane	67-72-1	10,000	5,000	1,000	11,340	x	x	x
Hexachlorophene	70-30-4	10,000			11,340	x		x
Hydrazine	302-01-2	10,000	5,000	100	11,340	x	x	x
Hydrochloric acid	7647-01-0	10,000			11,340	x		x
Hydrogen cyanide	74-90-8	10,000			11,340	x		x
Hydrogen fluoride	7664-39-3	10,000			11,340	x		x
Hydrogen sulfide	7783-06-4	10,000	5,000	1,000		x	x	
Hydroquinone	123-31-9	10,000			11,340	x		x
Indeno(1,2,3-c,d)pyrene	193-39-5	50*			45*	x		x
Iron pentacarbonyl	13463-40-6	10,000			11,340	x		x
Isobutyraldehyde	78-84-2	10,000			11,340	x		x
Isophorone diisocyanate	4098-71-9	10,000			11,340	x		x

Table A-2. Pollutants Common to at Least Two of the Three North American PRTRs

Pollutant	CAS No.	NPRI Threshold (kilograms/year)	RETC Threshold (kilograms/year)		TRI Threshold (kilograms/year)	Reporting of Pollutant Mandatory		
		Manufacture, process, or otherwise use	Manufacture, process, or otherwise use	Emission	Manufacture, process, or otherwise use	NPRI	RETC	TRI
Isopropyl alcohol	67-63-0	10,000			11,340	x		x
Isosafrole	120-58-1	10,000			11,340	x		x
Lead (and compounds)	--	50	5	1	45	x	x	x
Lithium carbonate	554-13-2	10,000			11,340	x		x
Maleic anhydride	108-31-6	10,000			11,340	x		x
Manganese (and compounds)	--	10,000			11,340	x		x
Mercury (and compounds)	--	5	5	1	4.5	x	x	x
Methanol	67-56-1	10,000			11,340	x		x
Methoxychlor	72-43-5		50	100	45		x	x
Methyl acrylate	96-33-3	10,000			11,340	x		x
Methyl iodide	74-88-4	10,000			11,340	x		x
Methyl isobutyl ketone	108-10-1	10,000			11,340	x		x
Methyl methacrylate	80-62-6	10,000			11,340	x		x
Methyl tert-butyl ether	1634-04-4	10,000			11,340	x		x
Methylenebis(phenylisocyanate)	101-68-8	10,000			11,340	x		x
Michler's ketone	90-94-8	10,000			11,340	x		x
Molybdenum trioxide	1313-27-5	10,000			11,340	x		x
Monochloropentafluoroethane (CFC-115)	76-15-3	10,000	5,000	1,000	11,340	x	x	x
Naphthalene	91-20-3	10,000			11,340	x		x
n-Butyl alcohol	71-36-3	10,000			11,340	x		x
n-Hexane	110-54-3	10,000			11,340	x		x
Nickel (and compounds)	--	10,000	5	1	11,340	x	x	x
Nitric acid and nitrate compounds	--	10,000			11,340	x		x
Nitrilotriacetic acid	139-13-9	10,000			11,340	x		x
Nitrobenzene	98-95-3	10,000			11,340	x		x
Nitroglycerin	55-63-0	10,000			11,340	x		x
N-methyl-2-pyrrolidone	872-50-4	10,000			11,340	x		x
N-methylolacrylamide	924-42-5	10,000			11,340	x		x
N,N-dimethylaniline	121-69-7	10,000			11,340	x		x
N,N-dimethylformamide	68-12-2	10,000			11,340	x		x
N-nitrosodimethylamine	62-75-9		2,500	100	11,340		x	x
N-nitrosodiphenylamine	86-30-6	10,000			11,340	x		x
Paraldehyde	123-63-7	10,000			11,340	x		x
Parathion methyl	298-00-0		5	100	11,340		x	x
PCBs (polychlorinated biphenyls)	1336-36-3		5		4.5		x	x
Pentachloroethane	76-01-7	10,000			11,340	x		x
Pentachlorophenol	87-86-5		2,500	1,000	11,340		x	x
Peracetic acid	79-21-0	10,000			11,340	x		x
Phenanthrene	85-01-8	50*			11,340	x		x
Phenol	108-95-2	10,000	5,000	1,000	11,340	x	x	x
Phosgene	75-44-5	10,000			11,340	x		x
Phosphorus (yellow or white)	7723-14-0	10,000			11,340	x		x
Phthalic anhydride	85-44-9	10,000			11,340	x		x
p-Nitroaniline	100-01-6	10,000			11,340	x		x

Table A-2. Pollutants Common to at Least Two of the Three North American PRTRs

Pollutant	CAS No.	NPRI Threshold (kilograms/year)	RETC Threshold (kilograms/year)		TRI Threshold (kilograms/year)	Reporting of Pollutant Mandatory		
		Manufacture, process, or otherwise use	Manufacture, process, or otherwise use	Emission	Manufacture, process, or otherwise use	NPRI	RETC	TRI
P-Nitrobiphenyl	92-93-3		2,500	1,000	11,340		x	x
Polychlorinated alkanes (C10-C13)	--	10,000			11,340	x		x
Polymeric diphenylmethane diisocyanate	9016-87-9	10,000			11,340	x		x
Potassium bromate	7758-01-2	10,000			11,340	x		x
p-Phenylenediamine	106-50-3	10,000			11,340	x		x
Propargyl alcohol	107-19-7	10,000			11,340	x		x
Propionaldehyde	123-38-6	10,000			11,340	x		x
Propylene	115-07-1	10,000			11,340	x		x
Propylene oxide	75-56-9	10,000			11,340	x		x
Pyridine	110-86-1	10,000	5,000	1,000	11,340	x	x	x
Quinoline	91-22-5	10,000			11,340	x		x
Quinone	106-51-4	10,000			11,340	x		x
Safrole	94-59-7	10,000			11,340	x		x
sec-Butyl alcohol	78-92-2	10,000			11,340	x		x
Selenium (and compounds)	--	10,000			11,340	x		x
Silver (and compounds)	--	10,000			11,340	x		x
Sodium nitrite	7632-00-0	10,000			11,340	x		x
Styrene	100-42-5	10,000	5,000	1,000	11,340	x	x	x
Styrene oxide	96-09-3	10,000			11,340	x		x
Sulfur hexafluoride	2551-62-4	10,000	5,000			x	x	
Sulfuric acid	7664-93-9	10,000			11,340	x		x
tert-Butyl alcohol	75-65-0	10,000			11,340	x		x
Tetrachloroethylene	127-18-4	10,000			11,340	x		x
Tetracycline hydrochloride	64-75-5	10,000			11,340	x		x
Thiourea	62-56-6	10,000			11,340	x		x
Thorium dioxide	1314-20-1	10,000			11,340	x		x
Titanium tetrachloride	7550-45-0	10,000			11,340	x		x
Toluene	108-88-3	10,000			11,340	x		x
Toluene-2,4-diisocyanate	584-84-9	10,000			11,340	x		x
Toluene-2,6-diisocyanate	91-08-7	10,000			11,340	x		x
Toluenediisocyanate (mixed isomers)	26471-62-5	10,000	5,000	1,000	11,340	x	x	x
Toxaphene	8001-35-2		5	100	4.5		x	x
Trichloroethylene	79-01-6	10,000	5,000	1,000	11,340	x	x	x
Trichlorofluoromethane (CFC-11)	75-69-4	10,000	5,000	1,000	11,340	x	x	x
Triethylamine	121-44-8	10,000			11,340	x		x
Vanadium (and compounds)	--	10,000			11,340	x		x
Vinyl acetate	108-05-4	10,000			11,340	x		x
Vinyl chloride	75-01-4	10,000	5,000	1,000	11,340	x	x	x
Vinylidene chloride	75-35-4	10,000			11,340	x		x
Warfarin	81-81-2		5	100	11,340		x	x
Xylene (all isomers)	--	10,000			11,340	x		x
Zinc (and compounds)	--	10,000			11,340	x		x

* See national PRTR websites for details.

Top Pollutants Released or Transferred by North American Facilities, 2005–2010

Table A-3. Top Pollutants Released or Transferred by North American Facilities, 2005–2010

Pollutant	Total Releases and Transfers			On-site Releases*		Off-site Releases to Disposal		Total Transfers**	
	2005 (kg)	2010 (kg)	% Change 2005–2010	2010 (kg)	% Change 2005–2010	2010 (kg)	% Change 2005–2010	2010 (kg)	% Change 2005–2010
Zinc (and compounds) (CA, US)	641,233,326	728,410,100	14	359,657,700	32	78,427,592	-42	290,216,625	25
Hydrogen Sulfide (CA, MX)	549,418,432	632,563,242	15	152,867,297	-49	479,650,431	91	41,241	13
Lead (and compounds) (CA, MX, US)	454,007,439	467,277,324	3	278,044,395	37	16,424,428	-72	172,808,501	-10
Copper (and compounds) (CA, US)	423,077,058	414,654,953	-2	130,518,101	73	12,715,615	5	271,417,257	-19
Nitric Acid/Nitrate Compounds (CA, US)	282,522,125	261,770,018	-7	186,440,364	-2	6,194,076	-40	69,133,880	-15
Hydrochloric Acid (CA, US)	278,784,924	106,476,066	-62	100,709,277	-62	618,974	25	5,141,870	-61
Methanol (CA, US)	235,980,973	181,871,475	-23	82,718,244	-23	8,602,919	42	90,392,584	-26
Manganese (and compounds) (CA, US)	201,483,436	520,948,260	159	390,269,583	424	36,360,643	-16	94,295,640	13
Ammonia, Total (CA, US)	168,634,168	166,025,660	-2	146,010,710	-3	5,197,391	1	14,800,877	17
Sulfuric Acid (CA, US)	167,319,200	137,997,148	-18	61,167,004	-26	1,751,106	-80	75,047,148	0
Toluene (CA, US)	117,578,961	81,953,570	-30	19,487,839	-36	1,374,087	-6	60,925,295	-29
Barium (and compounds) (US)	111,095,302	123,588,149	11	96,004,623	15	26,770,845	2	812,681	-38
Chromium (and compounds) (CA, MX, US)	105,716,301	132,763,501	26	37,497,942	138	12,814,868	-20	82,440,520	11
Xylenes (CA, US)	94,385,816	93,634,927	-1	13,960,096	-38	1,034,846	-6	78,607,070	11
Nickel (and compounds) (CA, MX, US)	94,384,820	124,507,807	32	48,832,141	310	9,371,894	9	66,300,180	-10
Arsenic (and compounds) (CA, MX, US)	93,957,936	121,258,405	29	118,589,939	42	1,862,287	-81	806,179	-14
Ethylene Glycol (CA, US)	64,959,022	59,641,334	-8	9,161,085	50	1,753,120	96	48,724,668	-16
Hydrogen Fluoride (CA, US)	40,908,356	26,139,364	-36	23,303,486	-39	518,487	128	2,317,386	-4
n-Hexane (CA, US)	38,793,968	33,702,311	-13	22,426,054	2	1,513,498	1,431	9,756,412	-42
Styrene (CA, MX, US)	38,442,671	19,915,865	-48	12,172,663	-54	1,113,266	-15	6,545,668	-39
Aluminum (fume or dust) (CA, US)	37,112,781	19,769,397	-47	5,462,040	-24	3,962,937	-77	10,316,986	-19
Vanadium (and compounds) (CA, US)	33,748,986	44,374,086	31	30,941,836	35	6,344,130	58	7,087,561	3
Dichloromethane (CA, MX, US)	31,275,542	13,317,896	-57	2,302,892	-29	152,119	11	10,861,007	-61
Phosphorous, Total (CA)	27,390,800	183,372,769	569	166,700,954	1,300	11,744,136	24	4,855,008	-20
Ethylene (CA, US)	24,197,018	22,737,718	-6	8,103,171	-28	24	-73	14,634,484	13
Certain Glycol Ethers (US)	21,407,701	16,253,775	-24	5,992,423	-33	759,793	-27	9,501,559	-17
n-Butyl Alcohol (CA, US)	20,177,537	12,452,743	-38	5,417,250	-38	121,980	257	6,912,065	-39
N-Methyl-2-Pyrrolidone (CA)	18,031,259	16,278,572	-10	2,047,373	-10	771,672	131	13,387,425	-13
Methyl Isobutyl Ketone (CA, US)	16,865,069	9,627,080	-43	1,873,483	-53	67,826	-4	7,682,767	-40
Acetonitrile (CA, US)	16,821,993	15,922,337	-5	8,848,026	9	32,921	155	7,040,715	-19
Total Reduced Sulfur (TRS) (CA)	--	270,113,955	170†	96,958,553	32†	173,146,179	551†	6,902	39†
Total, Top 31 Pollutants	**4,449,712,921**	**5,059,319,809**	**16**	**2,624,486,544**	**22**	**901,174,092**	**43**	**1,532,818,160**	**-8**
Total, All Pollutants	**4,833,498,433**	**5,530,710,253**	**14**	**2,879,335,208**	**24**	**930,493,737**	**42**	**1,719,727,915**	**-8**
%, Top 31 Pollutants, of All Pollutants	**92**	**91**		**91**		**97**		**89**	

*Sum of On-site Releases to Air, Water, Land, and Underground Injection. **Sum of Transfers to Recycling and Other Transfers.
† Percent change calculated from 2007 (first year of TRS reporting in Canada).
Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

Appendix 4

Top Reporting Sectors in North America, 2005–2010

Table A-4. Top Reporting Sectors in North America, 2005–2010

Industry Sector	NAICS-4 Code	Total Releases and Transfers 2005 (kg)	Total Releases and Transfers 2006 (kg)	Total Releases and Transfers 2007 (kg)	Total Releases and Transfers 2008 (kg)	Total Releases and Transfers 2009 (kg)	Total Releases and Transfers 2010 (kg)	% Change 2005–2010
Metal Ore Mining	2122	579,082,564	959,468,670	891,780,223	963,602,162	946,806,807	1,209,414,482	109
Electric Power Generation, Transmission, Distribution	2211	527,061,796	507,666,843	502,207,870	455,438,263	369,374,147	352,112,292	-33
Basic Chemical Manufacturing	3251	350,468,597	358,451,753	331,395,331	316,779,254	269,178,727	291,320,541	-17
Iron and Steel Mills and Ferroalloy Manufacturing	3311	312,281,935	326,250,943	335,333,978	324,699,283	234,061,306	307,514,746	-2
Oil and Gas Extraction	2111	299,959,066	352,648,093	425,045,364	519,514,573	521,838,245	975,143,329	225
Support Activities for Mining and Oil and Gas Extraction	2131	275,449,433	291,148,385	350,015,825	436,929,233	430,632,041	1,704,958	-99
Nonferrous Metal (except Aluminum) Product/Processing	3314	264,792,816	354,836,292	317,299,626	315,491,899	274,146,732	362,220,896	37
Waste Treatment and Disposal	5622	228,270,716	213,420,808	212,877,357	198,627,485	169,597,797	198,450,011	-13
Pulp, Paper, and Paperboard Mills	3221	144,571,800	137,973,131	133,797,656	127,707,178	119,378,035	124,141,452	-14
Water, Sewage and Other Systems	2213	129,606,665	126,646,951	130,512,863	137,716,716	132,559,661	131,651,071	2
Petroleum and Coal Products Manufacturing	3241	122,938,595	182,615,184	207,026,327	173,018,676	167,453,335	116,358,264	-5
Other Electrical Equipment/Component Manufacturing	3359	122,452,169	114,987,627	141,390,477	129,183,266	102,324,610	93,254,407	-24
Resin, Synthetic Rubber, Artificial Synthetic Fibers Mfg	3252	120,724,754	119,875,869	112,839,715	97,004,435	83,622,391	89,902,761	-26
Motor Vehicle Parts Manufacturing	3363	106,248,184	97,337,168	94,787,662	68,104,136	48,490,034	57,798,205	-46
Other Fabricated Metal Product Manufacturing	3329	95,730,498	89,333,824	71,248,549	69,230,151	54,314,912	59,522,147	-38
Pharmaceutical and Medicine Manufacturing	3254	88,424,517	71,287,337	61,227,976	49,624,927	43,958,251	44,115,336	-50
Steel Product Manufacturing from Purchased Steel	3312	72,027,290	84,274,730	68,703,611	59,678,512	40,817,553	46,045,099	-36
Pesticide, Fertilizer, Other Agricultural Chemical Mfg	3253	65,676,743	65,243,321	63,225,303	62,711,422	74,201,666	73,861,639	12
Coating, Engraving, Heat Treating, and Allied Activities	3328	58,030,203	56,579,812	54,093,324	56,789,219	48,562,023	38,182,911	-34
Forging and Stamping	3321	55,259,683	53,212,057	49,883,154	44,402,399	31,003,868	33,548,650	-39
Alumina and Aluminum Production and Processing	3313	53,468,689	58,790,872	47,046,778	35,937,612	26,438,091	30,087,047	-44
Foundries	3315	53,394,266	50,918,368	58,191,323	61,708,817	62,220,715	40,952,586	-23
Plastics Product Manufacturing	3261	52,246,929	48,176,705	46,002,835	43,499,883	31,852,148	48,149,766	-8
Other Chemical Product and Preparation Manufacturing	3259	44,850,740	46,150,913	45,345,418	40,657,296	32,752,590	32,727,558	-27
Motor Vehicle Manufacturing	3361	43,193,482	41,933,296	42,604,437	31,105,034	23,055,939	22,529,193	-48
Animal Slaughtering and Processing	3116	40,590,751	38,638,546	37,285,399	42,142,895	37,528,091	34,099,903	-16
Paint, Coating, and Adhesive Manufacturing	3255	39,067,257	39,456,209	33,078,507	27,783,805	22,378,428	22,508,492	-42
Semiconductor/Other Electronic Component Mfg	3344	34,190,962	32,216,401	27,239,386	26,471,328	19,961,990	22,560,601	-34
Grain and Oilseed Milling	3112	23,552,436	22,589,298	24,188,769	21,593,022	19,936,169	24,065,602	2
Machine Shops; Turned Product; Screw, Nut, & Bolt Mfg	3327	21,950,937	25,635,327	25,264,048	25,530,666	18,453,344	21,860,876	0
Total, Top 30 Sectors		**4,425,564,475**	**4,967,764,733**	**4,940,939,092**	**4,962,683,547**	**4,456,899,646**	**4,905,804,822**	**11**
Total, All Sectors		**4,833,498,433**	**5,458,622,690**	**5,439,460,679**	**5,392,090,187**	**4,829,435,749**	**5,530,710,253**	**14**
%, Top 30 Sectors, of All Sectors		**92**	**91**	**91**	**92**	**92**	**89**	

Note: Differences among the three countries in PRTR reporting requirements affect the North American picture of industrial pollution.

Appendix 5

Selected Pollutants: Industrial Sources, Uses and Chemical Properties

Information about the typical industrial uses or production of some of the pollutants mentioned in this report, as well as their chemical properties and potential to cause harm, is provided below. Readers are reminded that PRTR data alone cannot provide enough information to assess the potential harm from a pollutant; however, the data in combination with other information about a pollutant can serve as a starting point for learning more about its potential impacts. Readers may wish to consult other sources, including those used as a basis for the information below: ToxFAQs, developed by the US Agency for Toxic Substances and Disease Registry (ATSDR), and New Jersey's *Right-to-Know Hazardous Substance Fact Sheets*.

Arsenic is a naturally occurring metal found in the environment, especially as an impurity in metal ores. Arsenic compounds are commonly used to preserve wood; as metal alloys; and in pesticides. Humans may be exposed to this substance by ingesting small amounts in food and water, or breathing sawdust or smoke from wood treated with arsenic. Exposure may also result from work involving arsenic (e.g., copper or lead smelting, wood treating, pesticide application). Breathing high levels of arsenic can irritate the throat and lungs, while exposure to lower levels may cause nausea and damage to blood vessels. Arsenic in drinking water can cause bladder, lung, skin, kidney and liver cancer, and ingesting very high levels can result in death. There is evidence that long-term exposure to arsenic in children may result in lower IQ scores, and that exposure to arsenic in the womb and early childhood may increase mortality in young adults.

Cadmium is a natural element found in the earth's crust, usually in combination with other elements such as oxygen, chlorine, or sulfur. Most cadmium is extracted during the production of other metals such as zinc, lead, and copper. Cadmium does not corrode easily and has many uses, in batteries, pigments, metal coatings, and plastics. Cadmium enters the environment from mining, certain industrial processes, fuel combustion, and disposal of household wastes. It does not break down in the environment, but can change forms, and cadmium particles in air can travel long distances before being deposited. Some forms of cadmium dissolve in water, and cadmium binds to soil particles. Fish, plants, and animals take up cadmium from the environment and thus, people can be exposed to this pollutant by eating foods containing cadmium. Exposure can occur through breathing contaminated workplace air, or drinking contaminated water. Exposure to cadmium in air, food, or water can lead to damage of the lungs, digestive system, and kidneys.

Lead is a naturally occurring metal which does not break down, but can be transformed by sunlight, air and water. Activities such as mining and manufacturing, burning fossil fuels, and disposal of lead-containing material can release lead into the environment. Lead is found in vehicle batteries, pigments, plastics, glass, electronics, and jewelry and pottery. It is also used to shield X-rays, and in insecticides, rodenticides and ointments. Human exposure can occur through eating food or drinking water that contains lead, or from inhaling lead released from leaded paint in older homes. Water pipes in older homes may contain lead solder that leach lead into the water. Inorganic lead is considered a probable carcinogen and developmental or reproductive toxicant, and exposure to even small amounts can affect almost every organ in the body, especially the nervous system. High levels of exposure to lead during pregnancy may cause miscarriage, growth defects and mental impairment in offspring. Low levels of exposure can affect a child's development and because it is a PBT, lead is stored in the bones and accumulates over time.

Mercury is a naturally occurring metal that takes several forms. Metallic mercury is a shiny liquid that becomes a gas when heated. Mercury combines with other elements to form inorganic mercury compounds, and with carbon to make organic mercury compounds, including methylmercury. Mercury is used in thermometers, dental fillings and batteries. Anthropogenic sources of exposure are emissions from coal-fired power plants, mining, smelters, cement plants and the disposal of products containing mercury. The nervous system is very sensitive to all forms of mercury. Methylmercury and metallic mercury vapors are the most harmful, because more mercury in these forms reaches the brain. Exposure to high levels of mercury can permanently damage the brain, kidneys and the developing fetus, and very young children are especially sensitive. Mercury transported over long distances through the atmosphere is deposited in soils and in water. Because it is a PBT and bioaccumulates in fish, humans can be exposed when they consume fish, shellfish and marine mammals.

Hexachlorobenzene is a fungicide whose production and use are now prohibited internationally under the Stockholm Convention and the Protocol on Persistent Organic

Pollutants, under the United Nations' Convention on Long-Range Transboundary Air Pollution (LRTAP). However, small amounts are emitted as a result of its formation as a waste product during the manufacture of other chemicals, and through its release during combustion. This pollutant is very slow to break down in air and is subject to long-range transport in the atmosphere. It does not dissolve easily in water, but binds to sediments and settles to the bottom. It has a strong tendency to bioaccumulate in animals that live in hexachlorobenzene-contaminated water. Brief exposure to very high levels of hexachlorobenzene may cause effects on the nervous system such as weakness and convulsions; skin sores; and liver and thyroid effects. Long-term exposure can cause damage to the liver and reproductive system and can cause developmental effects. Hexachlorobenzene is also considered to be a human carcinogen.

Chromium is a naturally occurring element found in liquid, solid and gas forms. It can change form easily in water and soil. The most common forms are chromium(0), the metal, as well as chromium(III) and chromium(VI). The metal is used in making steel. Chromium(VI), also known as hexavalent chromium, and chromium(III) are used in chrome plating, dyes, leather tanning and wood preserving. Exposure to chromium can occur through eating food containing chromium(III), breathing contaminated air (e.g., during the manufacture of chrome-based products), skin contact, drinking contaminated well water, or living near uncontrolled waste sites containing chromium or near industries that use chromium. The hazards associated with chromium depend on its form. Breathing high levels of chromium(VI) can cause problems such as asthma and damage to the male reproductive system. Chromium(VI) compounds are also known carcinogens and inhalation has been linked with lung cancer.

Volatile Organic Compounds (VOCs) are a category of organic compounds that exist as gases at room temperature (e.g., solvent vapors). VOCs react with nitrogen oxides (NO_x) to form ground-level ozone, the major component of smog and a severe lung irritant. Methanol is one of the VOCs emitted in largest proportions during pulp and paper manufacturing (as an inadvertent by-product of wood pulping, chemical recovery, and pulp bleaching). It is a suspected developmental toxicant, neurotoxin, and a gastrointestinal or liver toxicant. Other VOCs resulting from pulp and paper manufacturing include acetaldehyde, propionaldehyde, methyl ethyl ketone, phenols, and terpenes.

Reduced Sulfur Compounds (e.g., hydrogen sulfide, carbonyl sulfide) are associated with the distinct rotten egg odor associated with some kraft pulp mills. Exposure to reduced sulfur emissions has been linked to symptoms that include headaches, watery eyes, nasal problems and breathing difficulties.

Chlorinated Compounds include chlorine dioxide and sodium hypochlorite, which are chlorine-based chemicals commonly used for bleaching pulp. Chlorine dioxide has the potential to be a severe acute and long-term respiratory irritant, and can lead to death at high-level exposures.

Dioxins and Furans are incidentally produced during the chlorination stage of bleaching pulp, especially when this involves elemental chlorine (Cl_2), and this discovery led to the phase-out of the use of elemental chlorine for bleaching in North American chemical pulp mills. Dioxins and furans are a group of PBTs. They are known human carcinogens and can cause immune system suppression and reproductive failure. In areas where pulp mills use wood from logs transported in salt water, combustion of wood residuals (called "salty hog fuel") can lead to low levels of dioxins released to the air.

Chloroform may be formed by the use of chlorine-based compounds for bleaching in pulp and paper manufacturing. It is a human carcinogen and suspected respiratory, cardiovascular, liver and kidney toxicant, and endocrine disruptor.

Total Suspended Solids (TSS) is a measure of solid material suspended in mill effluent, which material, if present in high amounts, can adversely affect bottom-living organisms upon settling in receiving waters.

Nitrogen Compounds (e.g., nitrates, nitrites, ammonia) and **Phosphorus** are added during the wastewater treatment process to help remove dissolved organic material from the effluent. In excess amounts, nitrogen and phosphorus can have adverse effects on the quality of receiving waters, by causing increases in aquatic plant growth and areas of depleted oxygen (called "dead zones"). Ammonia is also a precursor to fine particulate formation, and a lung irritant.

Biochemical Oxygen Demand (BOD) is the amount of dissolved oxygen that is needed by the organisms living in water to break down organic material. It is affected by discharges of waste matter and is often used as an indicator of water quality.

Criteria Air Contaminants (CACs) are typically released from the combustion of fuel (often fossil-based, such as coal, oil and natural gas) for generation of energy used during pulp and paper manufacturing. Due to differences among the three countries in PRTR reporting requirements, data on releases of CAC are not included in this report. Common CACs include the following:

- **Carbon monoxide** is produced by incomplete combustion of fossil fuels. Acute exposure to this air pollutant can lead to death, and high levels in the atmosphere can harm vegetation.
- **Nitrogen oxides (NO_x)** are products of the combustion of fuels. They combine with volatile organic compounds and sunlight in the lower atmosphere to form ozone, a key component of smog. In moist air, nitrogen oxides can also form nitric acid, which is precipitated as a component of acid rain. NO_2 is also an acute respiratory irritant.
- **Particulates** are small particles that are dispersed into the atmosphere from combustion. They can be fine or coarse, and be composed of wood ash or of chemical compounds created from carbon, metallic oxides and salts, acids, oils, lime, etc. The greatest health impact is felt from the particulate matter (PM) in the smallest size category—PM 2.5—which penetrates the lungs. Fine particulates are linked to serious health impacts, including chronic bronchitis, asthma, and premature deaths.
- **Sulfur dioxide (SO_2)** is a chemical compound produced from the combustion of fuel containing sulfur (e.g., oil, coal). Sulfur dioxide can cause haze and acid rain, which contributes to the acidification of lakes and streams, damage to forests, corrosion of buildings and machinery, and poor air quality, which in turn causes respiratory problems such as asthma and bronchitis.

Greenhouse Gases (GHGs), such as **carbon dioxide (CO_2)**, contribute to climate change and are typically released by this pulp and paper mill sector, mainly from the boilers that generate energy. GHG emissions data are excluded from this report, due to differences in national PRTR reporting requirements for these pollutants.

Appendix 6

Questionnaire Survey for Pulp, Paper and Paperboard Mills

A. Environmental Management

The questions in this section focus on facilities' environmental management activities from 2005 through 2010.

1. Does your company have a stated environmental policy?

☐ Yes If yes, is this information available to the public? ☐ Yes ☐ No
☐ No
☐ Do not know

2. Does your facility have an environmental management system (EMS)?

☐ Yes (e.g., ISO 14001, other) If yes, please specify: _____
☐ No
☐ Do not know

3. From 2005–2010, did your facility implement changes with the objective of preventing or reducing pollution?

☐ Yes ☐ No ☐ Do not know (If you answered "no" or "do not know", please go to question #6).

If yes, please check any of the following actions taken and indicate the year (or period) in which they were implemented:

☐ Installation of pollution control equipment Year(s): ____
☐ Implementation of new processing technology Year(s): ____
☐ Renovation of existing technology Year(s): ____
☐ Substitution or reformulation of raw materials Year(s): ____
☐ Fuel substitution Year(s): ____
☐ Recycling Year(s): ____
☐ Improvement in energy efficiency Year(s): ____
☐ Replacement of electricity generation or steam with external source Year(s): ____
☐ Other (please specify): Year(s): ____

_____
_____
_____

4. If you answered yes to question #3, were these actions taken to address one or more of the following environmental issues? Please check all that apply and if possible, describe briefly:

- ☐ Emissions to air of criteria air contaminants _____
- ☐ Emissions to air of other hazardous or toxic substances _____
- ☐ Emissions of greenhouse gases _____
- ☐ Discharges to water of toxic substances _____
- ☐ Discharges to water of other substances _____
- ☐ Management of solid waste _____
- ☐ Management of hazardous waste _____
- ☐ Other _____

5. If you answered yes to question #3, what was(were) the main driver(s) in the decision to make this(these) change(s) at the facility?

- ☐ Community relations
- ☐ Compliance with local, federal or international regulations. If possible, please provide name(s):

_____

_____

_____

- ☐ Corporate commitment to the environment
- ☐ Environmental management system
- ☐ Price of raw materials
- ☐ Access to international markets
- ☐ Client demand
- ☐ Modernization of the facility
- ☐ Other economic benefit (e.g., waste minimization) Please specify:
- ☐ Specific incentive programs (e.g., energy efficiency program). If possible, please provide name(s):

_____

- ☐ Other (please describe briefly)

_____

_____

- ☐ Do not know

6. To your knowledge, did your facility's reported pollutant releases to air decrease from 2005–2010?

☐ Yes ☐ No ☐ Do not know

If yes, was this decrease due to any of the following factors that are not part of a pollution prevention strategy? (please check all that apply):

- ☐ Changes in emission factors used, sampling or calculation methodology, or correction of past estimation errors
- ☐ Changes in PRTR guidance or regulations
- ☐ A decrease in production at the facility
- ☐ Other reason NOT related to a specific pollution prevention strategy (please specify):

_____

- ☐ Do not know

7. To your knowledge, did your facility's reported pollutant releases to water decrease from 2005–2010?

☐ Yes ☐ No ☐ Do not know

If yes, was this decrease due to any of the following factors that are not part of a pollution prevention strategy? (please check all that apply):

☐ Changes in emission factors used, sampling or calculation methodology, or correction of past estimation errors
☐ Changes in PRTR guidance or regulations
☐ A decrease in production at the facility
☐ Other reason NOT related to a specific pollution prevention strategy (please specify):

_____

_____

☐ Do not know

8. To your knowledge, how are your facility's reported PRTR data used? (Check all that apply):

☐ To inform or measure progress in your facility's (or company's) environmental objectives? (e.g., performance indicators)
☐ To comply with facility permitting requirements?
☐ To communicate with stakeholders and/or the public?
☐ Other (please describe briefly):

_____

_____

☐ Do not know

9. When reporting your facility's PRTR data, how are your facility's releases and transfers quantified? (Check all that apply):

☐ Direct measurement (e.g., monitoring)
☐ Engineering calculation or estimation
☐ Mass balance calculation
☐ Emission Factors
☐ Other (please describe)

_____

_____

☐ Do not know

10. To your knowledge, how does your facility verify the accuracy of the PRTR data reported?

_____

_____

_____

☐ Do not know

A. Company, Facility, and Job Position Characteristics *Please help us to validate and complete the following information:*

1. Please provide the full name and address of your facility (i.e., buildings that are on a contiguous site and under common control by a company):

Name of facility _____
Street name/number _____
City _____
State/province/territory _____
Postal code _____
Facility PRTR (NPRI, TRI or RETC) ID: _____

2. If you have a parent company, please provide its full name and location below:

Name of parent company _____
City _____
State _____
Country _____

3. Description of your facility's activities:

Industry sector name: _____
North American Industry Classification Sector (NAICS) code(s): _____
Year in which your facility started operations: _____

4. Please provide the following information:

☐ Raw materials used (e.g., solid wood, wood chips, recycled fiber) – please specify: _____

☐ Process (e.g., Kraft, mechanical pulping, de-inking, other) – please specify: _____

☐ Fuel used (boiler) – please specify: _____

☐ Air pollution control technologies (e.g., scrubbers, cyclones, bag houses) – please describe briefly: _____

☐ Raw water treatment – please describe briefly: _____

☐ Waste treatment (e.g., incinerators, sewage treatment, on- or off-site landfills, recycling) – please describe briefly:

☐ Other (please describe briefly): _____

5. Which of the following most closely reflects your job title? (Check only one):

- ☐ Environmental/EHS manager or specialist
- ☐ Regulatory compliance specialist
- ☐ Plant manager
- ☐ Human resources manager or specialist
- ☐ Consultant
- ☐ Other (please specify): _____

_____

6. How many years have you held this job within the facility? _____

7. To what extent is your work related to PRTR reporting?

- ☐ A great deal (50% or more)
- ☐ Some (20 % - 49%)
- ☐ A little (0% - 19%)

8. Including yourself, about how many full-time equivalent employees work at your facility? _____

9. Please provide any additional comments about PRTR reporting, or environmental management challenges at your facility that you would like us to know.

_____

_____

_____

_____

_____

10. In the next *Taking Stock* report, the CEC will make general reference to information about facilities' processes or environmental management practices obtained via this survey. In the event that your facility's environmental sustainability efforts could be used as an example of best practices, do you give the CEC permission to name your facility in the report? ☐ YES ☐ NO

We greatly appreciate your taking the time to respond to this questionnaire. Your participation in this survey will help to make our effort a success.

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