

## Understanding mercury



Activities to address mercury in the environment have increased dramatically in response to concerns over its impact on human health. These efforts are focused on improving our understanding of both human and natural sources of mercury releases, mercury movement through the environment, its effects on human health and the best ways to minimise these impacts.

The coal-fired electricity generation industry is one of the largest point sources of mercury emissions. The industry is working with governments, researchers, and other stakeholders to vigorously address the issue. The electricity-generation sector is committed to addressing mercury emissions and is engaged in many initiatives to achieve that goal.

### Why is mercury an issue?

Mercury is a toxic natural element that enters the food chain from both natural and human sources. Although concentrations of mercury in air are usually low and of little direct concern, mercury in water, having entered directly from soil or with precipitation, can be converted by micro-organisms into its most toxic, organic form. This compound, methyl mercury, accumulates in fish tissue and becomes more concentrated as it moves up the food chain.

Human exposure to mercury occurs primarily through eating contaminated fish. In sufficient doses, methyl mercury can damage the nervous system, especially in developing fetuses and young children. The magnitude of exposure depends on the amount of mercury in the fish consumed and the amount of fish consumed.

In U.S. regulatory decision-making around mercury, it was noted that there is a "plausible" link between releases from human sources to the atmosphere and methyl mercury in fish. It is considered "plausible" because science has established neither the relative contributions of human versus natural sources, nor the pathways mercury follows from source to receptor.

### Mercury in our environment

#### *Where it is found:*

**Products & equipment such as thermometers, dental fillings, electrical equipment, and light fixtures and in the natural environment.**

#### *Releases into the environment:*

- From natural sources such as soils, oceans and volcanoes
- From human products and equipment
- Through processes such as coal combustion, creation of new reservoirs, incineration of municipal, medical and hazardous waste, and precious and base metal smelting

**Some mercury can move into the atmosphere and be transported long distances before being deposited on earth. Mercury emitted in one country can therefore be transported and deposited in another.**



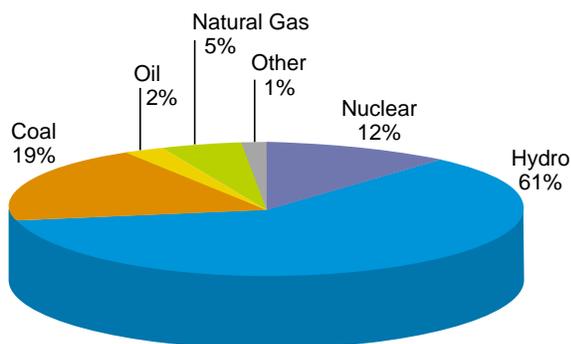
## Understanding mercury (continued)

### The coal-fired electricity generation sector and mercury

Canada has a rich diversity of resources for producing electricity. Although the majority of electricity is produced with hydropower, approximately 19% of electricity in Canada is produced by burning coal. Coal is an important component of the resource mix; it is an abundant resource and an inexpensive option for producing electricity.

#### NET ELECTRICITY GENERATION IN CANADA, 2000

Total = 582 TW.h



SOURCE: 1) Energy Statistics Handbook, 57-601 UPB, July 2001, Statistics Canada, 2001 2) Quarterly Report on Energy Supply & Demand in Canada, 57-003 XPB, 2000 4th Quarter, Statistics Canada, 2001

Coal contains trace amounts of mercury, which can be released when it is burned. It is estimated that Canadian coal-fired power plants emitted 2.0 tonnes of mercury to the atmosphere in 2000, about 25% of Canada's total<sup>1</sup>. In the United States, coal-burning utilities release about 39 tonnes of mercury every year. Since 2000, Canadian utilities have been required to report their annual mercury emissions under the National Pollutant Release Inventory (NPRI).

### What is being done to manage mercury?

Mercury has been characterized as toxic under the Canadian Environmental Protection Act (CEPA). This requires a management program for emissions from human activities. The Canadian Council of Ministers of Environment (CCME) is establishing standards for a number of emission sources, including coal-fired electricity generation.

Eastern provinces are signatories to a Mercury Action Plan to reduce mercury emissions under the Conference of New England Governors and Eastern Canadian Premiers. Canada is a signatory to a North American Regional Action

Plan (NARAP) under the Commission for Environmental Co-operation. The United States Environmental Protection Agency must propose a Draft Rule for control of mercury emissions from coal-fired power plants by December 2003, with the final form being completed and circulated to stakeholders in December 2004.

### Making progress in mercury management

Setting emission standards for this sector, developing implementation plans and measuring their efficacy is impeded by continuing uncertainties in key areas of mercury management: emissions measurement, availability of technologies for removing mercury and the variability in the presence of mercury in coal and in its behaviour in the combustion process.

The electric power generation sector is engaged in a number of activities to try to reduce these uncertainties.

#### Improving emission measurements

For a number of years, companies have been working to improve emission estimates. This requires an understanding of the mercury content in coal and what happens to that mercury when the coal is burned. Activities to improve this understanding have been confounded by the variability in the levels of mercury found in coal and its complex chemistry.

The coal mercury content can vary dramatically across coal types and within a single coal seam. Likewise, the chemical form in which mercury is emitted can be highly variable, depending on coal and ash characteristics, especially the sulphur and chlorine content, as well as operating conditions.

Mercury emissions can occur in three forms – particulate mercury, oxidized or reactive (ionic) mercury, and elemental mercury. The particulate mercury is a very small fraction of the total mercury. The ratio of ionic mercury to elemental mercury depends upon the factors noted above. The form of the emissions is a key factor in determining viable management options.

Mercury is difficult to measure in coal-fired electricity generation stack gases because its concentrations are so low – near the minimum level for detection. For much the same reason, laboratory analyses for mercury in coal or ash samples frequently produce inconsistent results.

The Ontario Hydro Method for measuring mercury emissions in combustion gases ("stacks") has been recommended by regulators across North America, but it is relatively expensive to be considered as a long-term measurement tool. Because

<sup>1</sup> Canadian National Pollutant Release Inventory, 2000.

## Mercury in coals burned in Canada.

**As the mercury content in coals burned varies widely across Canada, so do the mercury emissions. Canadian utilities use medium and low sulphur sub-bituminous, high- and medium-sulphur bituminous coals, and lignite. The low sulphur sub-bituminous and lignite coals used frequently in Alberta and Saskatchewan respectively, and in some other regions in the country, tend to produce emissions high in elemental mercury, which are difficult to control. There are more options available for the management of emissions where coals producing higher ionic mercury emissions are used.**

of the low mercury concentrations variable results are produced during repeated tests, and present only a single point value ("snapshot") as opposed to continuous measurements. Coal-fired utilities in Canada continue to invest substantial resources in measuring stack gases.

Continuous Emissions Monitoring systems (CEMs) are available, but their long-term reliability has not been demonstrated for the low mercury concentrations produced by coal-fired plants.

Companies have been investing in research to address these measurement issues, testing coal, ash and stack gases. Activities in these areas will increase significantly with the launch of an intensive three-year CEA member mercury program.

### **Reducing mercury emissions**

Electric utilities have been actively taking steps to reduce mercury emissions as part of ongoing integrated air emission management programs. Many of the pollution control devices installed to capture other emissions (e.g. sulphur dioxide, nitrogen oxides, particulate matter and carbon dioxide) do capture some particulate and ionic mercury. It has been estimated that 40 percent of the mercury in coal is removed from coal-fired boilers in Canada in this fashion.<sup>2</sup> However, a recent U.S. modeling study regarding the four most significant air pollutants from electric power generation has shown that "a mercury reduction strategy by itself

would not significantly reduce emissions of the other three pollutants"<sup>3</sup>.

The technology receiving the most attention for mercury removal is Activated Carbon Injection (ACI). It is still under study in various programs in Canada, the U.S. and elsewhere: some final test results on commercial volume emissions are expected in late 2003. Installing ACI technology or adjusting air pollution control systems can be effective in capturing mercury in its ionic form. Neither of these options, however, is as effective at capturing elemental mercury.

Regional differences in the mercury content of coals used in Canada and the lack of technical solutions for reduction in elemental mercury emissions mean there is currently no commercially demonstrated technology that can achieve uniform reductions in mercury emissions from all coal-fired boilers.<sup>4</sup>

## CEA Mercury Program

**Building on significant efforts over the past few years, coal-fired electric generation companies are jointly embarking on a three-year program, in cooperation with governments, to reduce mercury management uncertainties. The program will:**

- **Strengthen laboratory analytical capabilities through analysis and quality assurance programs;**
- **Improve the emission inventories and the development of management options through an intensive two year coal, ash and stack sampling program;**
- **Promote effective stack testing through the development of guidance material and the support of on-site training on the Ontario Hydro Method;**
- **Create and maintain an information clearing house to ensure that all parties can keep informed on global mercury research and development activities.**

**The program will be implemented under agreements with governments, with regular, publicly available, reporting of results. The findings of this program will provide critical information for establishing and reviewing a mercury standard, and finding cost-effective and efficient management options for mercury emissions over the long-term.**

<sup>2</sup> Smith, Ian in *Record of the Meeting of the Multi-Stakeholder Advisory Group and the Mercury CWS Development Committee*, June 4-5, 2001.

<sup>3</sup> U.S. EPA, *Analysis of Emissions Reduction Options for the Electric for the Electric Power Industry*, March 1999.

<sup>4</sup> U.S. EPA Notice of Regulatory Finding

## Understanding mercury (continued)

CEA members are monitoring and investing in a variety of mercury research programs including U.S. developed control technologies and their application to Canadian plants. The U.S. government is spending many millions of dollars on mercury research, including pilot programs for a variety of mercury capture technology options. Important commercial demonstration projects will be completed in 2003.

### ***Reducing mercury in the global pool***

Because of the nature of mercury emissions and the variety of sources, there are opportunities to invest in reducing mercury emissions in other sectors. For instance, Ontario Power Generation has partnered with Pollution Probe and others in a pilot initiative aimed at extracting mercury-containing switches from older motor vehicles in Ontario prior to destruction. Elemental mercury is a global pollutant, so a mercury trading system would enhance the potential for reducing these emissions.

### ***Understanding mercury behaviour in the environment***

The sources and pathways of certain chemicals released into the environment can be varied and complex. Mercury is exceptionally difficult to trace because of its wide use in society, its abundance in the natural environment and its ability to cycle in the environment by moving from air to water environments and back. Research continues to probe the pathways between natural and human sources of mercury and people who may be exposed to the substance. CEA members are engaged in a number of studies investigating this area including the Canadian Metals in the Environment and the Collaborative Mercury Research Network (COMERN) programs.

CEA members are integrating mercury into their overall emission management strategies. The choice of a management option is critical to ensuring the delivery of safe, reliable power, while maintaining fuel diversity, and avoiding shorter-term solutions that will preclude investment in the newer technologies and other options over the longer-term.

### **For more information on mercury**

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## Some projects we are engaged in...

**SaskPower** is taking a lead role in a research consortium led by the University of North Dakota Energy and Environmental Research Centre to test the potential for reducing mercury emissions from plants burning lignite with several activated carbon technologies.

**Ontario Power Generation (OPG)** has joined with several U.S. utilities and the U.S. Department of Energy to fund a program evaluating the effectiveness of carbon based sorbent injection for mercury control. The program includes full-scale field demonstrations that will provide valuable operational information.

**ATCO Power, EPCOR, OPG, Nova Scotia Power, TransAlta, and SaskPower** are all members of the recently formed *Canadian Clean Power Coalition*. They are proposing the construction and operation of a full-scale demonstration project by 2007, which will assess the potential for new technologies to remove all types of air emissions, including mercury, from an existing coal-fired plant.

**EPCOR** will be conducting a regional Mercury Assessment Program, consistent with Alberta Government requirements, in relation to the advanced technology of the Genesee plant expansion and is also sponsoring a research chair at the University of Alberta on mercury removal technology.

## Resources:

**Council of Ministers for the Environment:**

**Canada Wide Standards for Mercury:** [www.ccme.ca](http://www.ccme.ca)

**Environment Canada:** [www.ec.gc.ca](http://www.ec.gc.ca)

**U.S. Environmental Protection Agency:** [www.epa.gov/](http://www.epa.gov/)

**Canadian Clean Power Coalition:**

[www.canadiancleanpowercoalition.com](http://www.canadiancleanpowercoalition.com)

