Background Information
Nuclear Power in Canada: Key Environmental Impacts

Solid and Liquid Wastes

Uranium mining and milling

- An estimated 575,000 tonnes of tailings per year, of which 90–100,000 tonnes can be attributed to uranium production for domestic energy purposes. Uranium mill tailings are acidic or potentially acid generating, and contain a range of long-lived radionuclides, heavy metals and other contaminants. Tailings generation would increase proportionally with the use of lower grade uranium ores, as larger amounts of ore would have to be processed to produce the same amount of uranium concentrate.
- Up to 18 million tonnes of waste rock, which may also contain radionuclides, heavy metals, and be acid generating. Of this total, up to 2.9 million tonnes can be attributed to uranium mining for domestic energy purposes.
- It is estimated that there are more than 213 million tonnes of uranium mine tailings in storage facilities in Canada, and 109 million tonnes of waste rock.

Refining and conversion operations

- It is estimated that nearly 1,000 tonnes of solid wastes and 9,000 m3 of liquid wastes are produced per year as a result of uranium refining, conversion and fuel production for domestic energy generation purposes. Information on the precise character and fate of these wastes could not be obtained.

Power plant operation

- Approximately 85,000 waste fuel bundles are generated by Canadian nuclear reactors each year. As of 2003, 1.7 million bundles were in storage at reactor sites. It is estimated that these wastes will have to be secured for approximately one million years for safety, environmental and security reasons.
- Approximately 6,000 tonnes of lower level radioactive wastes are generated each year in Ontario as a result of power plant operations, maintenance, and refurbishment.
- Power plant maintenance and refurbishment also result in the generation of substantial amounts of additional hazardous wastes, including heavy metals and asbestos.

- Very large amounts of low, intermediate and high-level radioactive wastes will be produced as a result of the eventual decommissioning of refining, conversion and fabrication facilities as well as power plants.

Water

- Severe contamination of surface water and groundwater with radionuclides, heavy metals and other pollutants has arisen from uranium mine tailing management facilities and mine and mill operations. Discharges to surface waters from uranium mines and mills in Canada in 2003 included over 1,500 kg of uranium, 860 kg of molybdenum, 70 kg of arsenic, 185 kg of nickel, 40 kg of selenium, and 10 tonnes of ammonia.
- Effluent from uranium mines and mills was found by Health Canada and Environment Canada to be 'toxic' for the purposes of the *Canadian Environmental Protection Act* in 2004.
- Routine and accidental releases of radionuclides to surface waters occur in the course of power plant operations, with tritium oxide and carbon-14 being key radioactive pollutants of concern. Groundwater contamination with tritium has occurred at the Pickering generating facility in Ontario.
- Ontario's nuclear power plants are found to be the leading source of discharges of hydrazine, an extremely hazardous pollutant, to surface waters in Canada. Nuclear generating facilities have also been sources of discharges of metals (copper, zinc, and chromium) and ammonia to surface waters.
- Nuclear power is a major consumer of water. Uranium mining operations involve extensive dewatering, in the range of at least 16–17 billion litres per year, with the implication of impacts on groundwater and surface water storage and flows.
- Generating facilities require large amounts of cooling water. The Darlington and Pickering facilities in Ontario are alone estimated to use approximately 8.9 trillion litres of water for cooling purposes per year — more than 19 times the annual water consumption of the City of Toronto. Adverse thermal impacts of cooling water discharges on fish populations in the vicinity of nuclear power plants have been observed.

Air

- Atmospheric releases of a range of radionuclides occur at all stages of nuclear power production. Atmospheric releases of radon gas result from mining and milling operations and from tailings management facilities. Windblown dust from mine sites and tailings management facilities (TMFs) contains a range of radionuclides. Atmospheric releases (principally uranium) also arise from refining and conversion activities.
- Routine and accidental releases of radiation and radionuclides occur from power plant operations, including tritium oxide, carbon-14, noble gases, iodine-131, radioactive particulate and elemental tritium.

- The incineration of low and intermediate-level radioactive wastes from power plant operations and maintenance in Ontario has resulted in further atmospheric releases of radionuclides, particularly tritium. A wide range of hazardous air pollutants have been released by the Bruce Western Waste Management facility. A new incinerator installed in 2003, has reduced emissions of hazardous, but not of radiological, pollutants
- Windblown dust from mine sites and TMFs contains a range of heavy metals. In addition, releases of a number of hazardous air pollutants, including dioxins and furans, hexachlorobenzene, heavy metals (principally lead) ammonia and hydrogen fluoride arise from uranium refining and conversion operations.
- Ontario nuclear power plants are the only National Pollutant Release Inventory reported source of releases of hydrazine to the air in Canada.
- Uranium mining and milling operations are found to be significant sources of releases of sulphur dioxide (SO2), volatile organic compounds (VOCs) and nitrogen oxides (NOx). Releases of NOx, particulate matter (PM) and sulphuric acid arise from refining and conversion activities.
- The road transportation of uranium from mill sites in northern Saskatchewan to the Blind River refinery in Northern Ontario and then on to the Port Hope conversion facility in Southern Ontario produces additional releases of NOx and PM. Further transportation related releases of criteria air pollutants would arise from the long-term management of waste nuclear fuel and other radioactive wastes arising from facility operations, maintenance and decommissioning, particularly if the management strategies for these materials require the movement of wastes from reactor sites to centralized facilities.

Climate

- Total greenhouse gas (GHG) emissions associated with uranium mining, milling, refining, conversion and fuel fabrication in Canada are estimated at between 240,000 and 366,000 tonnes of CO2 per year.
- Total emissions associated with the sector, including the emissions associated with power plant construction, are in the range of 468,000 and 594,000 tonnes of CO2 per year, equivalent to the emissions of between 134,000 and 170,000 cars per year.
- Total annual GHG emissions associated with domestic power production alone are estimated at between 267,000 and 289,000 tonnes of CO2 per year. Other recent estimates suggest total GHG emissions associated with nuclear power in Canada are in the range of at least 840,000 tonnes per year.