



Canada

Emission control instruments are established by the Federal Government under the authority of the Canadian Environmental Protection Act, 1999. Control instruments can take many forms: federal regulations, guidelines, codes of practice and the authority to enter into environmental agreements with provinces. For example, in January 2003, the *New source emission guidelines for thermal electricity generation* were published in Canada Gazette Part 1, 137(1), 3-8 (4 Jan 2003) and are available at <http://publications.gc.ca/gazette/archives/p1/2003/2003-01-04/pdf/g1-13701.pdf>. These guidelines provide limits for the emission of SO₂, NO_x and particulate matter from new fossil fuel-fired steam-cycle power units. The *National emission guideline for stationary combustion turbines* (available at http://www.ccme.ca/files/Resources/air/emissions/pn_1072_e.pdf), published in December 1992, cover SO₂ and NO_x emissions from existing combustion turbines. The *Reduction of carbon dioxide emissions from coal-fired generation of electricity regulations* were published in Canada Gazette Part II, 146(19), 1951-2091 (12 Sep 2012) and set a performance standard for CO₂ emissions from end-of-life and new coal-fired units. The regulations came into effect on 1 July 2015 and are available at <http://www.gazette.gc.ca/rp-pr/p2/2012/2012-09-12/pdf/g2-14619.pdf>. Finally, a different approach has been taken for mercury in that *Canada-wide standards* have been implemented (see http://www.ccme.ca/files/Resources/air/mercury/hg_epg_cws_w_annex.pdf). The standards were endorsed by the Canadian Council of Ministers of the Environment in October 2006.

New source emission guidelines for thermal electricity generation

The annexed *New source emission guidelines for thermal electricity generation* (the Guidelines) are a revised version of the former *Thermal power generation emissions - national guidelines for new stationary sources*, which were issued on 15 May 1993. The annexed Guidelines indicate the quantities and concentrations above which nitrogen oxides, particulate matter and sulphur dioxide should not be emitted from fossil fuel-fired steam-driven electricity generating units, operated for the purpose of the sale of electricity to industry, commerce, or the public. The Guidelines are intended for new generating units only. However, it is recognised that opportunities to reduce emissions may arise during major alterations to an existing generating unit. The Guidelines therefore recommend that an assessment of the feasibility of emission reduction measures should be completed before the alterations are started. The assessment should be undertaken by the owner of the unit in close consultation with the appropriate regulatory authority, and improved emission control measures should be implemented wherever feasible. The Guidelines are part of continuing efforts to reduce emissions of air-polluting discharges to the atmosphere, and will contribute to that end by restricting such discharges from future additions to electric generating system capacity. The recommended emission limits are achievable using control methods that were available to the industry since the Guidelines inception in 2003.

Emission guideline for sulphur dioxide (SO₂)

The hourly mean rate of discharge of sulphur dioxide emitted into the ambient air from a new generating unit, as determined over successive 720 hour rolling average periods, should not exceed any one of the following sets of final sulphur dioxide emission rates:

- 4.24 kg/MWh net energy output and 8% of the uncontrolled emission rate; or
- 2.65 kg/MWh net energy output and 25% of the uncontrolled emission rate; or
- 0.53 kg/MWh net energy output.

The uncontrolled emission rate of sulphur dioxide from the generating unit in kg per megawatt-hour net energy output (kg/MWh) is calculated using the formula:

$$(A/B) \times C \times (1000 \text{ MJ}/1 \text{ GJ}) \times D$$

where:

A is the sulphur concentration in fuel expressed in the decimal form of a percentage, on a dry basis;

B is the higher heating value of fuel in megajoules per kilogram (MJ/kg);

C is a constant equal to 2, representing the ratio of molecular weight of sulphur dioxide to molecular weight of sulphur; and

D is a constant equal to 10.6 GJ/MWh, representing the reference net plant heat rate in gigajoules per megawatt-hour.

Emission guideline for nitrogen oxides (NO_x)

The hourly mean rate of discharge of nitrogen oxides, expressed as NO₂, emitted into the ambient air from a new generating unit when determined over successive 720 hour rolling average periods should not exceed the emission rate of 0.69 kg/MWh net energy output.

Emission guideline for particulate matter

The hourly mean rate of discharge of particulate matter emitted into the ambient air from a new generating unit when determined over successive 720 hour rolling average periods should not exceed 0.095 kg/MWh net energy output.

Notes

‘gross energy output’ means the gross useful work performed by the steam generated. For units generating only electricity, the gross useful work performed is the gross electrical output from the turbine/generator set. For cogeneration units, site-specific provisions to account for any useful thermal energy output supplied by the plant may be specified by the appropriate regulatory authority.

‘net energy output’ means gross energy output minus unit service power requirements.

National emission guidelines for stationary combustion turbines

These Guidelines were established as part of the Canadian NO_x/VOC Management Plan issued in May 1991 by the Canadian Council of Ministers of the Environment (CCME), and were published in December 1992. The objective of the Guidelines is to encourage reductions in NO_x emission, while minimising collateral emissions, such as SO₂ and CO, from new stationary combustion turbines. The Guidelines become applicable within Canada if they are adopted in part or whole under the regulatory requirements of a jurisdiction (provincial, territorial or federal).

The Guidelines apply to turbines used in electric power production and for other industrial purposes, and are not intended to apply to the following cases:

- combustion turbines used for emergency or stand-by duty;
- combustion turbines used in research, development, and field demonstration; and
- combustion turbines under repair or being tested.

Emission guideline for nitrogen oxides (NO_x)

The emission limit values are determined by calculating the allowable mass of NO_x (grams) per unit output of shaft or electrical energy (gigajoules), as well as an allowance for an additional quantity of

NO_x emitted if useful energy is demonstrated to be recovered from the facility's exhaust thermal energy during normal operation. Allowable emissions over the relevant time period equal:

$$(\text{Power Output} \times A) + (\text{Heat Output} \times B) = \text{grams of NO}_2 \text{ equivalent}$$

where:

- Power Output is the total electricity and shaft power produced expressed in gigajoules (GJ) (3.6 GJ/MWh);
- Heat Output is the total useful heat energy recovered from the combustion turbine facility;
- A and B are the allowable emission rates, expressed in grams per gigajoule (g/GJ), for the facility's power and heat recovery components respectively, as given below.

Power Output Allowance A for solid-derived fuels: 500 g/GJ

Heat Recovery Allowance B for solid-derived fuels: 120 g/GJ

The value of 'A', set at 500 g/GJ for solid-derived fuels, recognises that the competing alternative technology option is a conventional coal-burning steam electric power plant.

Emission guideline for sulphur dioxide (SO₂)

SO₂ emissions should not exceed 770 g/GJ of output from combustion turbines using solid-derived fuels whose uncontrolled SO₂ emissions, based on fuel sulphur content, would be between 770 and 7700 g/GJ of output, or a minimum of 90% sulphur capture for those solid-derived fuels whose uncontrolled SO₂ emissions, based on fuel sulphur content, would be greater than 7700 g/GJ of output.

Note

A solid-derived fuel is a fuel derived from biomass or by some process such as gasification or liquefaction of coal.

Reduction of carbon dioxide emissions from coal-fired generation of electricity regulations

These Regulations, which came into effect on 1 July 2015, establish a regime for the reduction of carbon dioxide (CO₂) emissions that result from the production of electricity by means of thermal energy using coal as a fuel, on its own or in conjunction with other fuels. The Regulations apply a performance standard to new units, and to old units that have reached the end of their useful life but continue to produce electricity.

A new unit is one that starts producing electricity commercially on or after 1 July 2015. In general, an end-of-life coal unit is one that is 50 years of age. The end-of-useful-life date of a unit is determined according to the following principles:

- units commissioned before 1975 will reach their end-of-useful-life on 31 December 2019 or on 31 December of the 50th year that follows their commissioning date, whichever comes first;
- units commissioned after 1974 but before 1986 will reach their end-of-useful-life on 31 December 2029 or on 31 December of the 50th year that follows their commissioning date, whichever comes first;
- units commissioned in or after 1986 will reach their end-of-useful-life on 31 December of the 50th year that follows their commissioning date.

CO₂ limit

A new or old unit must not, on average, emit more than 420 tonnes of CO₂ from the combustion of fossil fuels for each GWh of electricity produced by the unit during a calendar year (420 tCO₂/GWh).

The quantity of electricity is determined in accordance with the following formula:

$$G_{\text{gross}} - G_{\text{aux}}$$

where:

G_{gross} is the gross quantity of electricity that is produced by the unit during the calendar year, expressed in GWh, and measured at the electrical terminals of the generators of the unit using meters that comply with the requirements of the Electricity and Gas Inspection Act and the Electricity and Gas Inspection Regulations; and

G_{aux} is the quantity of electricity that is used by the power plant in which the unit is located during the calendar year to operate infrastructure and equipment that is attributed to the unit for electricity generation and for separation, but not for pressurisation, of CO₂, expressed in GWh, determined in accordance with an appropriate method of attribution, based on data collected using meters that comply with the requirements of the Electricity and Gas Inspection Act and the Electricity and Gas Inspection Regulations.

The quantity of emissions is determined by using:

- a continuous emission monitoring system (CEMS) as specified in the Regulations document; or
- a fuel-based method, based on the quantity of carbon in the fossil fuel fed for combustion, in accordance with the methods specified in the Regulations document.

CO₂ emissions released from the use of sorbent to control the emissions of sulphur dioxide from a unit are included as CO₂ emissions from the combustion of fossil fuels.

Emissions from a gasification system that produces synthetic gas derived from coal or petroleum coke that is used as a fuel to produce electricity from a unit are included as emissions from that unit.

CO₂ emissions from a unit do not include emissions that are captured in accordance with the laws of Canada or a province that regulates the capture, and that are transported and stored in accordance with the laws of Canada or a province, or of the United States or one of its states, that regulate the transportation or storage.

Canada-wide standards for mercury emissions from coal-fired electric power generation plants

Canada-wide Standards (CWS) are intergovernmental agreements developed under the Canadian Council of Ministers of the Environment (CCME) Canada-wide Environmental Standards Sub-Agreement. CWS come from a political commitment by federal, provincial and territorial Ministers to address key environmental protection and health risk issues that require concerted action across Canada. The power generation sector is the largest single remaining man-made source of mercury emissions in Canada. Therefore, CCME has set mercury CWS for this sector, with the goal of reducing mercury emissions from existing plants and ensuring new plants achieve emission levels based on best available technologies economically achievable. The *Canada-wide standards for mercury emissions from coal-fired electric power generation plants* were endorsed by CCME on 11 October 2006. A *Monitoring protocol in support of the Canada-wide standards for mercury emissions from coal-fired electric power generation plants* (available at



http://www.ccme.ca/files/Resources/air/mercury/hg_monitoring_protocol_e.pdf) has also been published.

The *Canada-wide standards for mercury emissions from coal-fired electric power generation plants* consist of two sets of targets:

- provincial caps (kg/y) on mercury emissions from existing coal-fired electric power generation plants to be achieved by 2010; and
- capture rates or emission limits for new plants, based on best available technology economically achievable since the CWS inception in 2006.

The provincial caps represent 60% national capture of mercury from coal burned. A second phase of the CWS may explore the capture of 80% or more of mercury from coal burned for 2018 and beyond.

Existing facilities

Existing coal-fired electric power generation plants will meet the following provincial caps for annual mercury emissions:

Province	Estimated emissions ¹ , kg/y	2010 cap, kg/y
Alberta	1180 ²	590
Manitoba	20	20
New Brunswick	140	25
Nova Scotia	150	65 ³
Ontario	495	not set ⁴
Saskatchewan	710	430
Total	2695	1130

¹ based on 2002 to 2004 utility monitoring programme.

² Alberta's commitment is through the implementation of the Clean Air Strategic Alliance Electricity Project Team recommendations. Alberta emissions are based on a 90% capacity factor.

³ Nova Scotia's cap for 2010 was changed in provincial regulations to 110 kg/y.

⁴ Ontario will help meet the national CWS of 60% capture of mercury by 2010, and help exceed it in the near future with its ultimate goal of zero mercury emissions from coal-fired power generation. Ontario is committed to phasing out the use of coal in its power plants.

⁵ Saskatchewan's early actions, between 2004 and 2009, will be used to meet its provincial caps for the years 2010 to 2013.

New facilities

Mercury emissions from new coal-fired electric power generation units are not included in the provincial caps. A new unit will need to achieve a mercury capture rate from coal burned of no less than the value specified below or an average annual mercury emission rate no greater than that specified below:



Coal type	Percent capture in coal burned ¹ , %	Emission rate ¹ , kg/TWh
bituminous coal	85	3
subbituminous coal	75	8
lignite	75	15
blends	85	3

¹ these rates are based on best available technologies economically achievable

This paper reflects the IEA CCC understanding of the relevant legislation and is not a substitute for the official version. The IEA CCC does not guarantee the accuracy of the data included in this paper and accepts no responsibility for any consequences of their use.

UPDATED: 7 July 2015