The High Costs of Cheap Power

Emissions from coal-fired electricity in Canada

Tim Weis • PJ Partington • Ben Thibault • Sachi Gibson • Kristi Anderson

June 2012

PEMBINA institute

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Foreword by Gideon Forman, Executive Director of Canadian Association of Physicians for the Environment

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The Pembina Institute
Box 7558
Drayton Valley, Alberta
Canada T7A 1S7
Phone: 780-542-6272
Email: info@pembina.org

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Foreword

Physicians across North America have long recognized that from start to finish, coal-fired power is a huge problem.[1,2,3]There are no two ways about it.

The fuel's harm begins with accidental deaths during exploration and extraction. A recent article in *Scientific American*, "The Human Cost of Energy", argues that for workers in developed nations coal is the "most hazardous" of all types of energy generation.

When the fuel is burned, it produces toxic by-products including lead and mercury (brain poisons), dioxin (an endocrine disruptor), chromium and arsenic (carcinogens), and sulphur dioxide and nitrogen oxide (causes of acid rain). Its contribution to air pollution — and therefore illness and health costs — is very significant indeed.

In 2008, the Canadian Medical Association released a landmark report quantifying the price of bad air — both financial and human — across the country. It estimated in that year poor air quality resulted in the death of 21,000 Canadians, over 92,000 emergency department visits, and more than 620,000 trips to a doctor's office.

The economic damages — including loss of life and healthcare costs — very significant as well, were pegged in 2008 at about $8 billion annually. Of course coal is not the only contributor to smog but it is a major one, and the longer we burn it, the greater the expense in terms of dollars and human suffering.

Coal facilities also release copious quantities of carbon dioxide. As the Pembina Institute's trenchant analysis shows, in 2010 "seven out of Canada's ten largest emitters of greenhouse gases were coal plants." It is therefore no wonder that Nobel Prize-winning economist Paul Krugman embraces the notion that globally, "most of the climate-change problem comes down to just one thing, burning coal…"[4]

Where do we go from here? From the perspective of the Canadian Association of Physicians for the Environment, Canada's coal policies are very mixed – with Ottawa contributing almost nothing useful and some provinces showing remarkable leadership. Most impressive of all is Ontario, which will be closing its coal plants entirely by 2014. Ontario's action on coal serves as an extraordinary example of what can be done when citizens, health professionals, and a receptive government collaborate for appropriate environmental regulation. This province shows

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[1] Physicians For Social Responsibility (2009) *Coal's Assault on Human Health*: www.psr.org/assets/pdfs/psr-coal-fullreport.pdf,

[2] Ontario Public Health Association (2002) Beyond coal: Power, Public Health and the Environment, www.opha.on.ca/resources/docs/coal.pdf

[3] Nurses, Doctors Release New Coal Death Statistics, (2010) http://www.cleanairalliance.org/node/827

[4] Paul Krugman, "Building a Green Economy" *New York Times,* April 7, 2010, online at: *http*://www.nytimes.com/2010/04/11/magazine/11Economy-t.html?pagewanted=all

that an advanced industrial economy can wean itself of the deadliest of fossil fuels while comfortably keeping on the lights.

Our job as citizens — and it cannot begin too soon — is to use good science to show decision-makers across Canada that coal use can, and must, be reduced to zero.

Gideon Forman
Executive Director
Canadian Association of Physicians for the Environment
www.cape.ca

The High Costs of Cheap Power

Pollution from coal-fired electricity in Canada

Contents

List of Figures

1. Introduction

1.1 Overview

When we flick on the light switch or run our appliances, most of us do not think of where our electricity comes from. Many Canadians think our electricity simply comes from hydroelectric generation. As such, we do not associate it with the images of smoke stacks and billowing plumes that we see south of our border or elsewhere in the world where coal-fired electricity gets more attention.

The reality is that the combination of electricity sources — and therefore the qualities and characteristics of the electricity system — depend on where we live in the country. Some provinces live up to the common conception of predominantly hydroelectric power, but six provinces still burn coal to generate electricity and three of these — Alberta, Saskatchewan, and Nova Scotia — rely more on coal than any other source of electricity combined.

Provinces that are heavily coal-power-reliant experience a range of social and environmental costs from its combustion. By direct comparison — kilowatt-hour for kilowatt-hour — coal power is the dirtiest major source of power in Canada. It is also the highest contributor to greenhouse gases (GHGs). These emissions come with serious environmental and health costs — costs that clearly undermine the view that coal power is "cheap." However, provincial leadership, particularly in Ontario, is proving that historical reliance on coal power can be traded in for cleaner, more reliable and more cost-effective alternative sources of electricity.

In light of the high GHG emissions from coal power, Environment Canada's proposed regulations begin to reduce GHG emissions from the coal sector. While this is a step in the right direction, important opportunities to improve the regulations could provide better results. Worryingly, there are indications that some industry players are asking that Environment Canada weaken the proposed regulations, asking for changes that would reduce the expected GHG reductions by more than half over the first 15 years after the regulations come into effect.

This report makes clear that, despite popular misconceptions, Canada's electricity is not, in all cases, "clean". Nor is coal power particularly "cheap" when considering its high social and environmental costs. By acknowledging the real costs of our current electricity grid, we can better identify the need for an energy transition within Canada's electricity sector. Alternatives are available today, and given the scale of the pollution caused by coal electricity highlighted in this report, that transition needs leadership now.

1.2 Scope

The focus of this report is the production of power from coal in Canada from the existing fleet of power plants. In addition to electricity generation, coal is used in Canada for coking in industrial processes. As well, Canada mines and exports coal to countries including China. While coking

and mining both have significant environmental concerns, the scope of this report is confined to coal-fired electricity generation.

There are new technologies such as gasification, air pollution controls (e.g. scrubbers), and carbon capture and storage, that can, to varying degrees, mitigate the primary environmental and health impacts of producing power from burning coal. These technologies add capital cost. As a consequence, experience shows that these technologies would not be implemented without stringent performance-based regulation, technology subsidies and credits. Current and proposed regulations would allow much of the existing coal fleet in Canada to operate as they are today, without retrofit or major upgrade, locking us on the current pollution trajectory for decades to come. This report synthesizes publicly available data to highlight the ongoing levels of pollution that result from existing coal plants in Canada. Without increased political action we are locked into that pollution for another generation.

Figure 1: Sundance coal electricity plant, Canada's single largest source of greenhouse gas emissions in 2010

Photo: David Dodge, the Pembina Institute

2. Coal power in Canada

2.1 Coal's contribution to electricity generation and greenhouse gas emissions

Canada burns coal, and lots of it. While many people may associate coal with the industrial revolution of the 1800s, coal is still burned in six of ten Canadian provinces to generate electricity. Currently, burning coal for electricity in this country results in more GHG emissions than the oilsands, though swelling oilsands emissions from escalating development means coal emissions will soon take second place. Nonetheless, coal-fired electricity generation remains a major source of both GHG emissions and persistent toxic pollutants, contributing significantly to environmental degradation and human health problems in Canada.

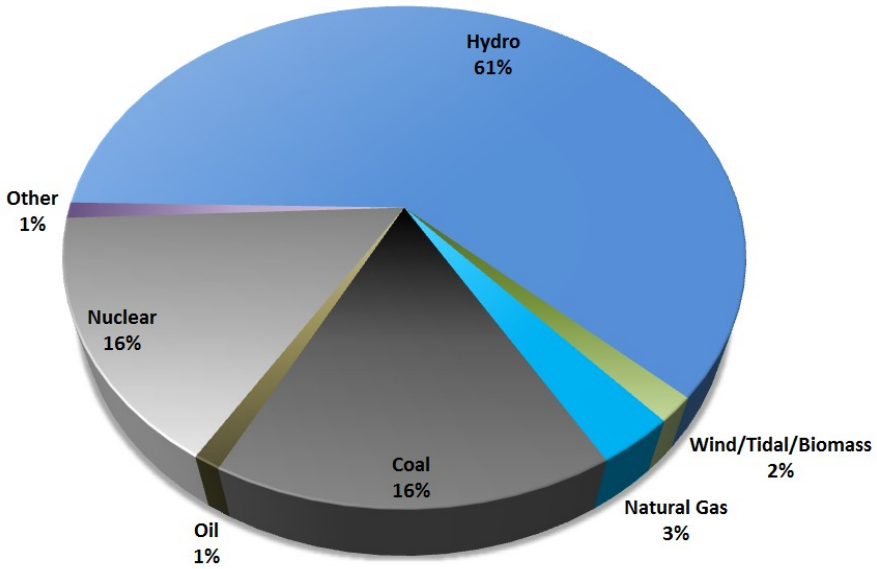

Figure 2: Electricity sources in Canada (2009)

Source: Environment Canada[5]

As Figure 2 shows, Canada used coal to generate approximately 16 per cent of all its electricity in 2009. However, coal use is also responsible for approximately 77 per cent of electricity sector GHG emissions in Canada, such that the electricity sector contributed to around 15 per cent of the country's total emissions in 2010.[6] This is because of coal's high GHG intensity, with over 1050 tonnes of CO_2 equivalent (CO_2e) GHG emissions for every gigawatt-hour (GWh) of electricity generated — more than twenty times the GHG intensity of the average of all other

[5] Environment Canada, *Reported Facility Greenhouse Gas Data* (2010). http://ec.gc.ca/ges-ghg/default.asp?lang=En&n=8044859A-1

[6] *Ibid.*

electricity sources in Canada.[7] Indeed, in 2010, seven out of Canada's ten largest emitters of GHGs were coal plants, as shown in Table 1.

Table 1. Largest sources of greenhouse gas emissions in Canada (2010)

Facility	Reporting company	City	Prov.	Mt CO_{2e}	Type
Sundance Generating Plant	TransAlta Partnership	Duffield	AB	15.8	Coal
Mildred Lake and Aurora North Plant Sites	Syncrude Canada	Fort McMurray	AB	12.7	Oil Sands
Genesee Generating Station	Capital Power Generation	Warburg	AB	9.1	Coal
Nanticoke Generating Station	Ontario Power Generation	Nanticoke	ON	8.6	Coal
Suncor Energy Inc. Oil Sands	Suncor Energy Oil Sands Partnership	Fort McMurray	AB	8.6	Oil Sands
Keephills Generating Plant	TransAlta Partnership	Duffield	AB	6.8	Coal
Boundary Dam Power Station	Sask. Power Corporation	Estevan	SK	6.7	Coal
Battle River Generating Station	Alberta Power (2000)	Forestburg	AB	5.0	Coal
Dofasco Hamilton	Arcelor Mittal Dofasco	Hamilton	ON	5.0	Steel
Sheerness Generating Station	Alberta Power (2000)	Hanna	AB	4.9	Coal

Source: Environment Canada[8]

The federal government has introduced GHG regulations on coal-fired generation, which are expected to come into force in 2015 to apply to new units, but will only apply to existing units when they come to their 45-year regulatory end-of-life. The regulations are as yet in their proposed, *Gazette* Part I form, so Environment Canada may make changes in advance of releasing their final form, which might weaken their effect.[9] In any case, the existing fleet of coal plants will continue to contribute considerably to GHG emissions, among other health-impacting air pollutants, particularly in provinces that continue to rely heavily on coal power for electricity generation.

2.2 Coal use is concentrated in a few provinces

Coal use for electricity generation varies considerably by province across Canada. As Figure 3 shows, four provinces (British Columbia, Quebec, Newfoundland and Labrador and Prince Edward Island) do not use coal at all. Of those that do use it, Ontario is the only province on track to phase it out completely by 2014 — a remarkable feat considering coal once generated upwards of 40 per cent of Canada's most populous province's electricity (see Section 0) — while

[7] Based on data from: Environment Canada, *Reported Facility Greenhouse Gas Data* (2010). http://ec.gc.ca/ges-ghg/default.asp?lang=En&n=8044859A-1; and Statistics Canada, "CANSIM," Table 127-0006, available at http://www5.statcan.gc.ca/cansim/ (accessed June 7, 2012).

[8] Environment Canada, *Reported Facility Greenhouse Gas Data* (2010). http://ec.gc.ca/ges-ghg/default.asp?lang=En&n=8044859A-1

[9] See Part 0, *infra*, for more information on the proposed regulations, their impact and the impacts of possible changes to the regulations.

Manitoba has only one very small coal plant that rarely operates and is scheduled for retirement by 2015.

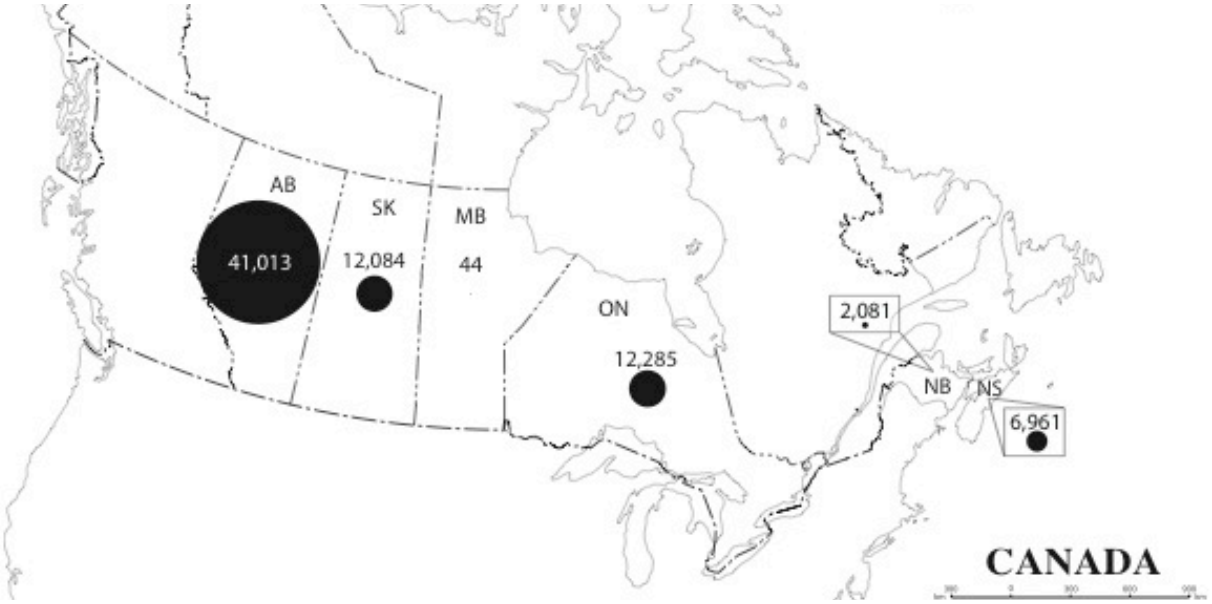

Figure 3. Electricity generation from coal in Canada in 2010 (GWh)

Source: Statistics Canada[10]

As such, when the federal regulations come into effect in 2015, only Alberta, Saskatchewan, New Brunswick and Nova Scotia will have coal-fired electricity generation. While New Brunswick has a single coal plant that generates about one-fifth of the province's electricity, in contrast, coal provided over 60 per cent of electricity generation in Saskatchewan and Nova Scotia, and almost 75 per cent in Alberta, in 2009.

These variations mean that electricity generation has different characteristics and carries different consequences depending on the province, with the GHG intensity of grid electricity varying in close association to the jurisdiction's reliance on coal generation, as Figure 4 illustrates.

[10] Statistics Canada, "CANSIM," Table 127-0006, available at http://www5.statcan.gc.ca/cansim/ (accessed June 7, 2012).

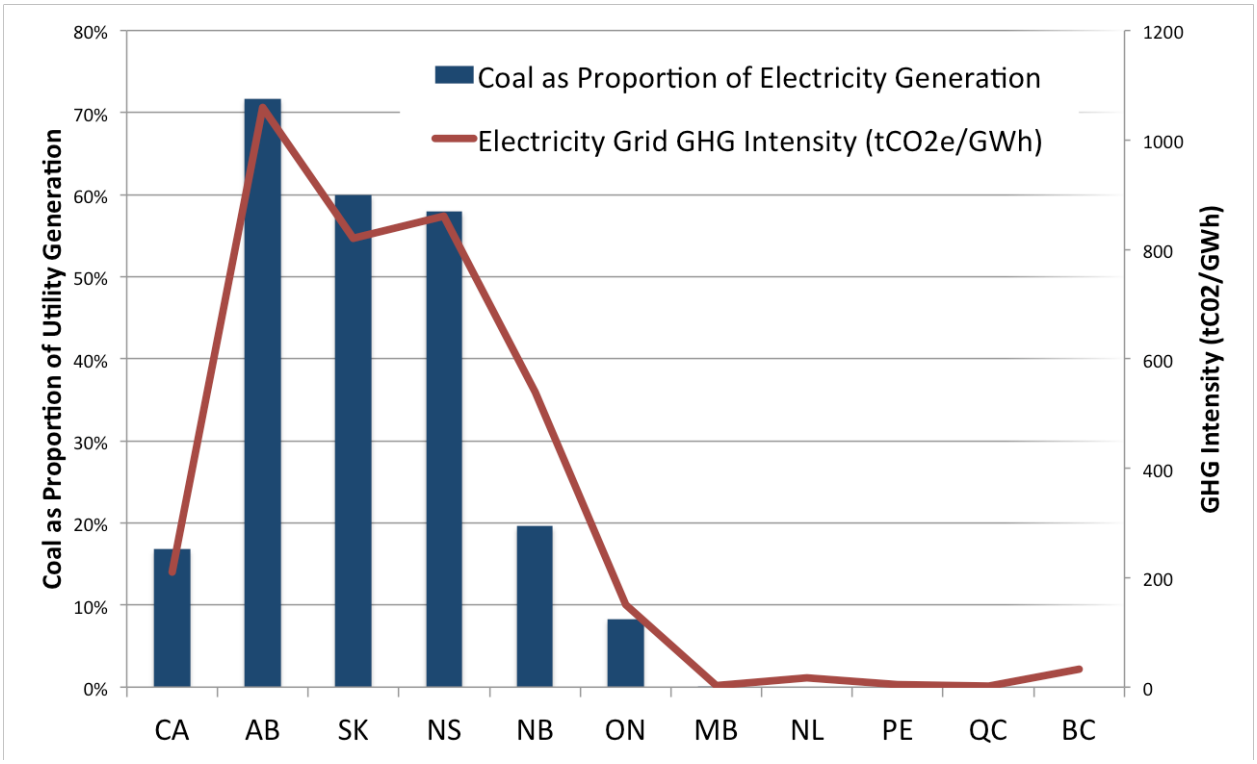

Figure 4: Provincial dependence on coal-fired electricity and electricity sector GHG intensity

Source: Statistics Canada, Environment Canada (2010)[11]

As a result, those provinces that rely heavily on coal power see substantial GHG contributions from their electricity sectors, as Figure 5illustrates. Whereas electricity generation produced 14 per cent of Canada's nation-wide emissions in 2009, its contribution to emissions in Alberta is 21 per cent and 20 per cent in Saskatchewan, which are significant absolute amounts given the high per capita and per GDP emissions in both of these provinces due to their energy-intensive industries. The proportional contributions are even higher for New Brunswick and Nova Scotia, at 38 and 47 per cent, respectively. In no other province does electricity generation even account for 10 per cent of provincial GHG emissions.

[11] Statistics Canada, "CANSIM," Table 127-0006, available at http://www5.statcan.gc.ca/cansim/ (accessed June 7, 2012); Environment Canada, *National Inventory Report: 1990-2010* (May 2012), Part 3, 36-48. http://www.ec.gc.ca/ges-ghg/default.asp?lang=En&n=83A34A7A-1

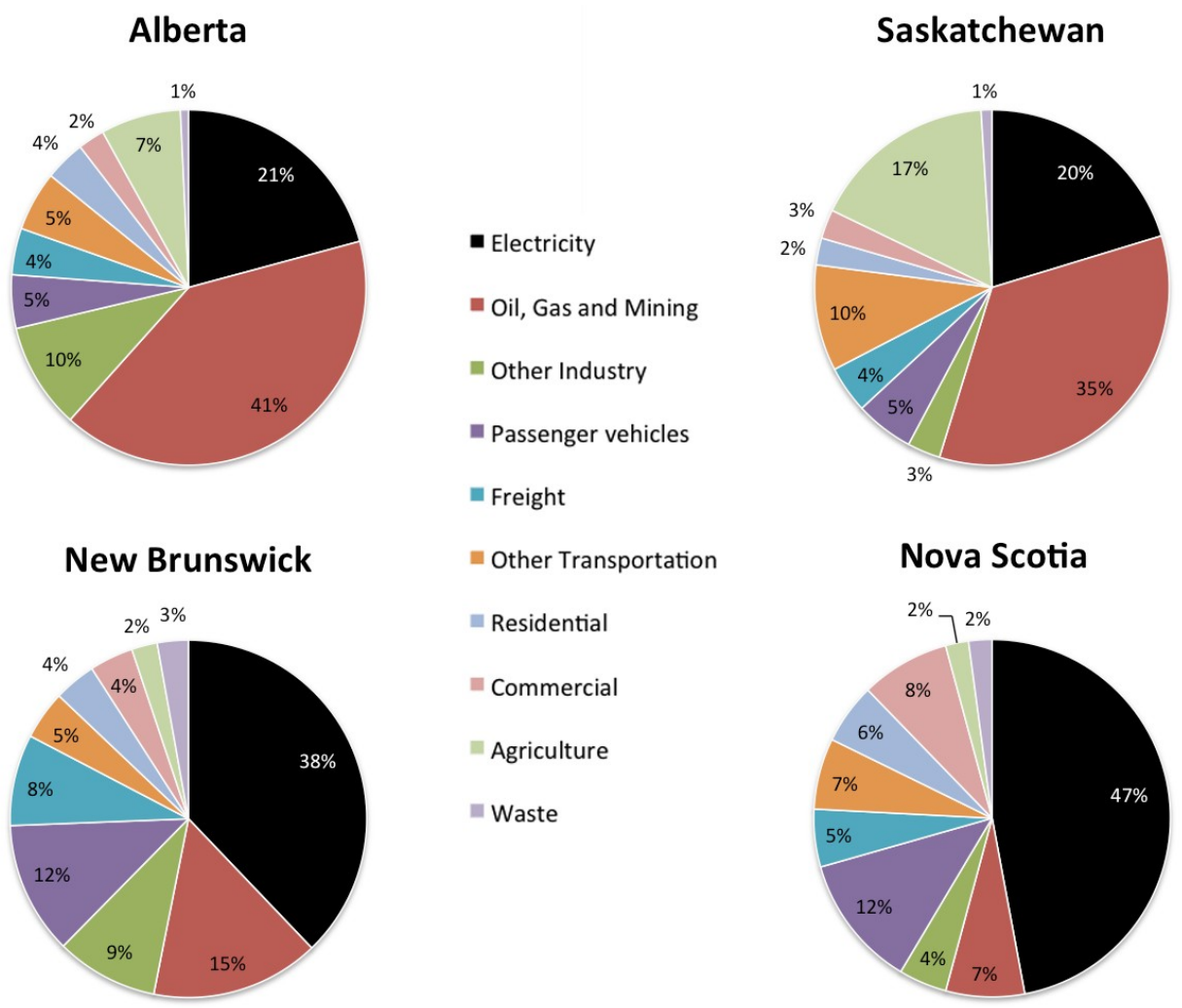

Figure 5: Greenhouse gas contributions by source in Alberta, Saskatchewan, New Brunswick and Nova Scotia

Source: Environment Canada (2009)[12]

Similarly, heavy reliance on coal power also contributes considerably to increased regional air pollution emissions, as detailed in Section 2.3, below. Figures 6 through 9 map the location of the existing coal plants that will be in operation when the federal regulations come into effect. The figures illustrate the capacity (in megawatts; MW) of each generating unit. Likewise, Table 2 through 5 show the age and capacity of these units, as well as the year in which they will meet their 45-year end-of-life trigger under the new federal regulations.

[12] Environment Canada, *National Inventory Report: 1990-2009* (May 2011), Part 3, 51-77. http://www.ec.gc.ca/ges-ghg/default.asp?lang=En&n=83A34A7A-1

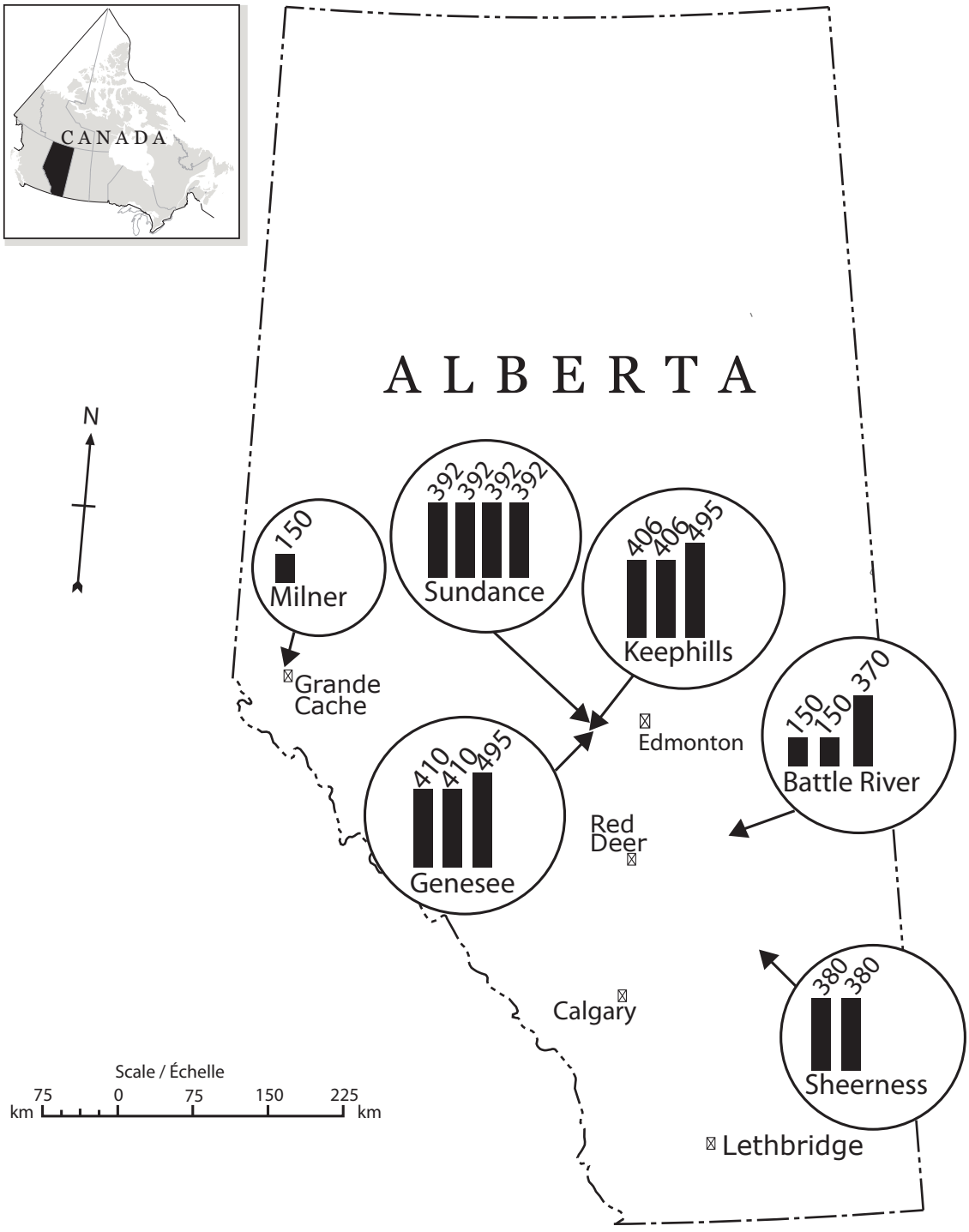

Figure 6: Coal-fired electricity generating units in Alberta (unit size in MW)

Source: Milner Power, Trans.AJta, Atco Power. Map adapted from Natural Resources Canada (The Atlas of Canada)[13]

[13] Milner Power Inc., *HR Milner Generating Station,* http://www.milnerpower.ca/; TransAlta, *Plants in Operation,* http://www.transalta.com/facilities/plants-operation; Atco Power, *Battle River Coal-Fired Generating Station,*

Table 2: Alberta coal units

Company	Unit Name	Commissioning Year	End of 45-year Life or PPA	Capacity (MW)	Notes
ATCO Power	Battle River 3	1969	2014	150	
ATCO Power	Battle River 4	1975	2020	150	
ATCO Power	Battle River 5	1981	2026	370	
ATCO Power	Sheerness 1	1986	2031	380	Unit co-owned by TransAlta
ATCO Power	Sheerness 2	1990	2035	380	Unit co-owned by TransAlta
Capital Power	Genesee 1	1989	2034	410	
Capital Power	Genesee 2	1994	2039	410	
Capital Power	Genesee 3	2005	2050	495	Unit co-owned by TransAlta
Maxim Power	HR Milner 1	1972	2017	150	
Maxim Power	HR Milner 2	2017	2062	500	Stalled pending final regulations
TransAlta	Keephills 1	1983	2028	406	
TransAlta	Keephills 2	1983	2028	406	
TransAlta	Keephills 3*	2011	2056	495	CCS pilot cancelled
TransAlta	Sundance 1	1970	n/a	280	Abrupt closure Feb 2011
TransAlta	Sundance 2	1973	n/a	280	Abrupt closure Feb 2011
TransAlta	Sundance 3	1976	2021	407	
TransAlta	Sundance 4	1977	2022	392	
TransAlta	Sundance 5	1978	2023	392	
TransAlta	Sundance 6	1980	2025	392	

Source: Milner Power, TransAlta, Atco Power.[14]

http://www.atcopower.com/Our+Facilities/North+America/Battle+River+%28AB%29/Battle_River_Coal_Fired_Generating_Station.htm.

[14] *Ibid*.

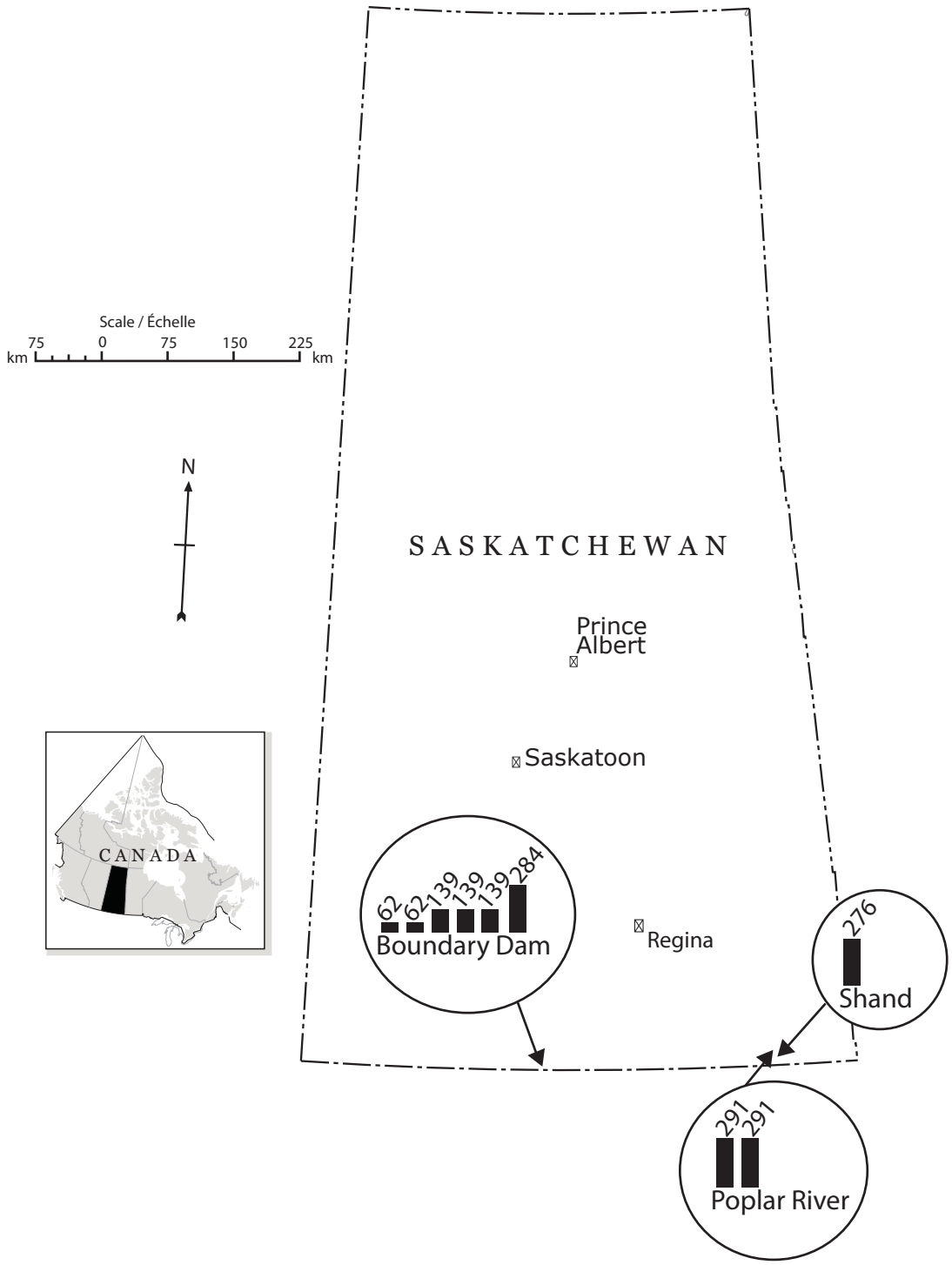

Figure 7: Coal-fired electricity generating units in Saskatchewan (unit size in MW)

Source: SaskPower. Map adapted from Natural Resources Canada (The Atlas of Canada)[15]

[15] SaskPower, *Coal-Fired Stations,* http://www.saskpower.com/about_us/generation_transmission_distribution/coal_fired_stations.shtml

Table 3: Saskatchewan coal units

Company	Unit Name	Commissioning Year	End of 45-year Life or PPA	Capacity (MW)	Notes
SaskPower	Boundary Dam 1	1959	2004	62	
SaskPower	Boundary Dam 2	1960	2005	61	
SaskPower	Boundary Dam 3	1969	2014	139	Plans to convert 100 MW CCS
SaskPower	Boundary Dam 4	1970	2015	139	
SaskPower	Boundary Dam 5	1973	2018	139	
SaskPower	Boundary Dam 6	1978	2023	284	
SaskPower	Poplar River 1	1983	2028	291	
SaskPower	Poplar River 2	1980	2025	291	
SaskPower	Shand 1	1992	2037	276	

Source: SaskPower[16]

Once Ontario has completed its coal phase out by 2014, Alberta and Saskatchewan will comprise over 85 per cent of Canada's coal-fired electricity generation. Nonetheless, significant volumes of electricity are still generated by coal in both New Brunswick and Nova Scotia. Proportionally, Nova Scotia relied on coal more heavily than any other province, that is, until it recently began to reduce its coal use while developing policies for alternatives.

[16] *Ibid*.

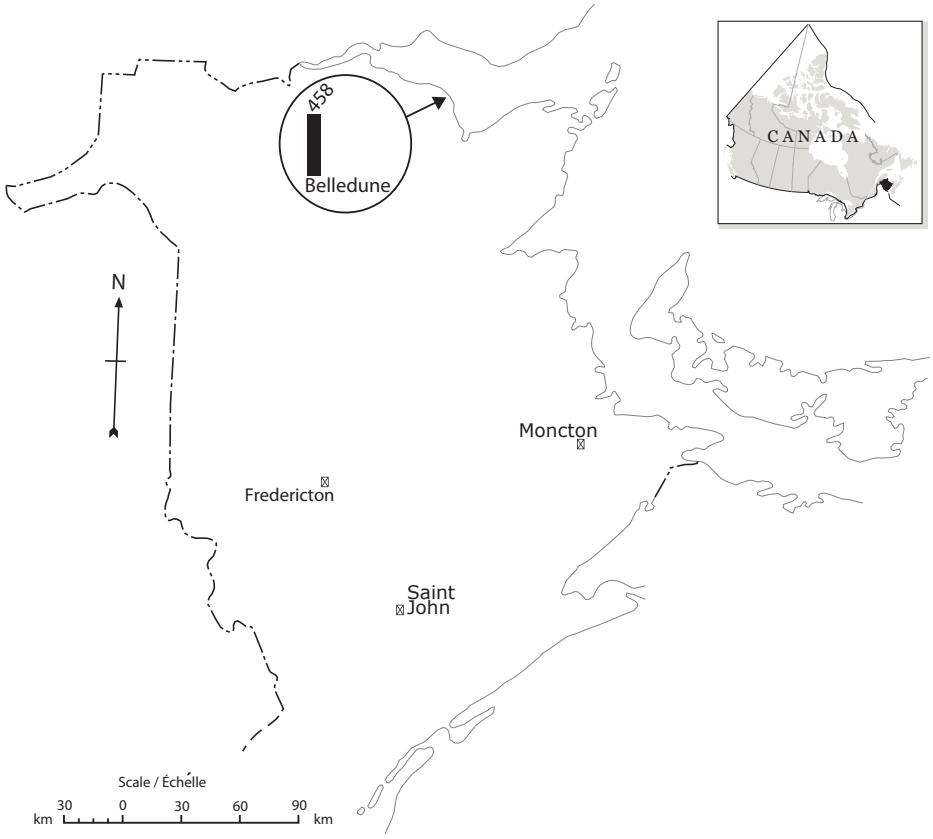

Figure 8: Coal-fired electricity generating units in New Brunswick (unit size in MW)

Source: NB Power. Map adapted from Natural Resources Canada (The Atlas of Canada)[17]

Table 4: New Brunswick coal unit

Company	Unit Name	Commissioning Year	End of 45-year Life or PPA	Capacity (MW)	Notes
NB Power	Belledune 1	1993	2038	458	

Source: NB Power[18]

[17] NB Power, *Thermal Tour*, http://www.nbpower.com/html/en/safety_learning/learning/electricity_generated/thermal/thermal_tour.html

[18] *Ibid*.

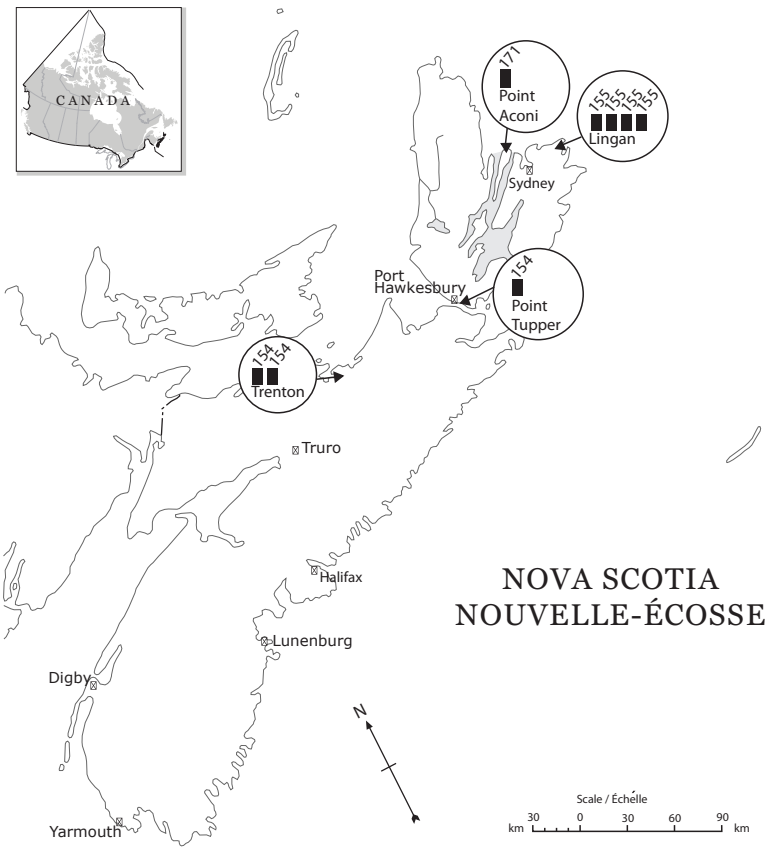

Figure 9: Coal-fired electricity generating units in Nova Scotia (unit size in MW)
Source: Nova Scotia Power. Map adapted from Natural Resources Canada (The Atlas of Canada)[19]

Table 5: Nova Scotia coal units

Company	Unit Name	Commissioning Year	End of 45-year Life or PPA	Capacity (MW)	Notes
NS Power	Lingan 1	1979	2024	155	As of 2012, two Lignan units to be shut down seasonally
NS Power	Lingan 2	1980	2025	155	
NS Power	Lingan 3	1983	2028	155	
NS Power	Lingan 4	1984	2029	155	
NS Power	Point Aconi 1	1994	2039	171	
NS Power	Point Tupper 1	1973	2018	154	
NS Power	Trenton 5	1969	2014	154	
NS Power	Trenton 6	1991	2036	154	

Source: Nova Scotia Power[20]

[19] Nova Scotia Power, *Thermal Generating Stations*, http://www.nspower.ca/en/home/aboutnspi/bringingelectricitytoyou/ourgeneratingfacilities/thermal.aspx.

[20] *Ibid.*

2.3 Coal pollution impacts on human health

Burning coal takes an expensive toll on public health. Coal plants emit air pollutants that, in high enough concentrations, can damage respiratory and cardiovascular systems, and release toxins that accumulate in the food we eat.

Coal pollutants are linked to an increased risk of developing a range of illnesses, as well as exacerbating existing conditions. Particulate matter can trigger asthmas attacks and cause or worsen chronic bronchitis and chest disease in children[21], chronic obstructive pulmonary disease (COPD), cardiovascular disease, and lung cancer.[22] Nitrogen dioxide is a precursor to ground-level ozone, which can exacerbate asthma attacks. Sulphur dioxide (SO_2) is a known cause of bronchoconstriction and worsened asthma symptoms as it can react with other substances in the air to create particulate matter.[23]

Air pollutants are of particular concern to children's health because their respiratory and immune systems are still developing. Young people also tend to spend more time outside, increasing their exposure to air pollution.[24] High levels of particulate matter have also been linked with elevated levels of infant mortality.[25]

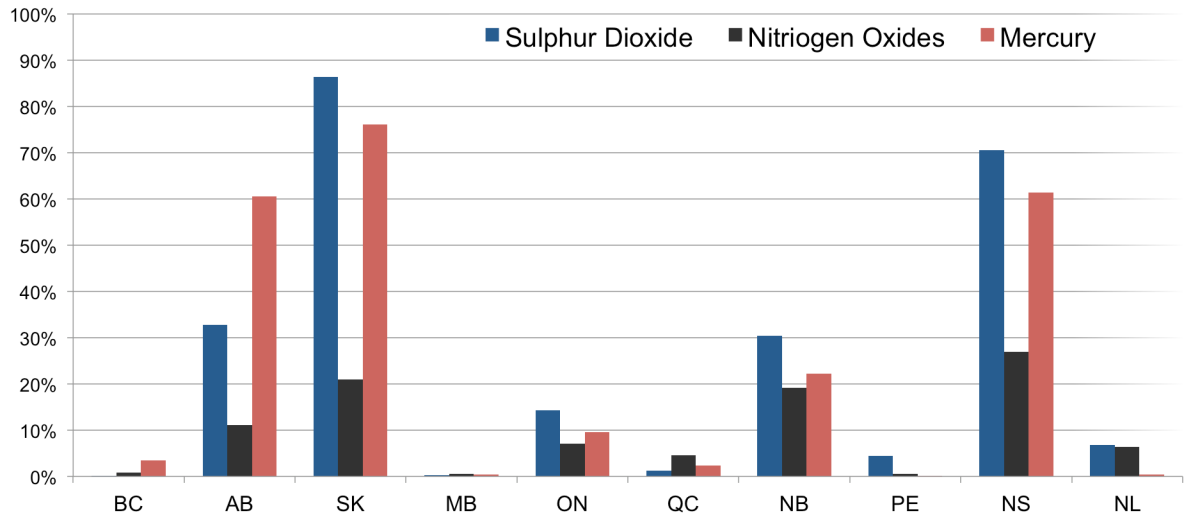

Figure 10: Proportion of total provincial emissions that are from electric power generation in 2010

Source: Environment Canada[26]

[21] Joel Schwartz, "Air pollution and children's health," *Pediatrics* 113, no. supplement 3 (April 1, 2004), 1037-43.

[22] Alan Lockwood, Kristen Welker-Hood, Molly Rauch and Barbara Gottlieb, *Coal's Assault on Human Health,* (Physicians for Social Responsibility, 2009). http://www.psr.org/assets/pdfs/psr-coal-fullreport.pdf

[23] United States Environmental Protection Agency, "Sulphur dioxide [and] Health." http://www.epa.gov/air/sulfurdioxide/health.html (accessed June 7, 2012)

[24] Joel Schwartz, "Air pollution and children's health," *Pediatrics* 113, no. supplement 3 (April 1, 2004), 1037-43.

[25] T.J. Woodruff, J. Grillo and K.C. Schoendorf, "The relationship between selected causes of postneonatal infant mortality and particulate air pollution in the United States," *Environmental Health Perspectives* 105 (1997), 608-12.

[26] Environment Canada, National Pollution Release Inventory – 2010 NPRI Reviewed Facility Data, available at http://www.ec.gc.ca/pdb/websol/querysite/query_e.cfm

Coal plants also emit airborne mercury, a known neurotoxin. Mercury from coal plants becomes a health problem when we absorb it from the food we eat, often in the form of contaminated fish.

Mercury pollution often ends up in lakes and rivers resulting in its bioaccumulation in fish, working its way up the food chain as it persists in the bodies of the predators that consume contaminated fish and other seafood. Even low levels of mercury can pose a risk to the developing cardiovascular and immune systems of children, while fetal exposure to mercury can negatively affect cognitive development, including learning ability and muscle coordination.[27]

In coal-fired Canadian provinces, electricity generation is major cause of air pollution, particularly mercury and SO_2, and to a lesser extent nitrogen oxides (NO_X), as Figure 10 illustrates.

For example, the electricity sector in Alberta and Saskatchewan, where coal dependence remains high, is responsible for around 60 per cent and 75 per cent of mercury emissions, respectively. In both provinces, coal is responsible for over 99 per cent of those electricity sector emissions.[28]

Figure 11 shows the high emissions of mercury for each unit of electricity generation from coal facilities in Alberta, relative to the national average of electricity generation. Indeed, across Canada, coal power is responsible for around 95 per cent of the electricity sector's mercury emissions.

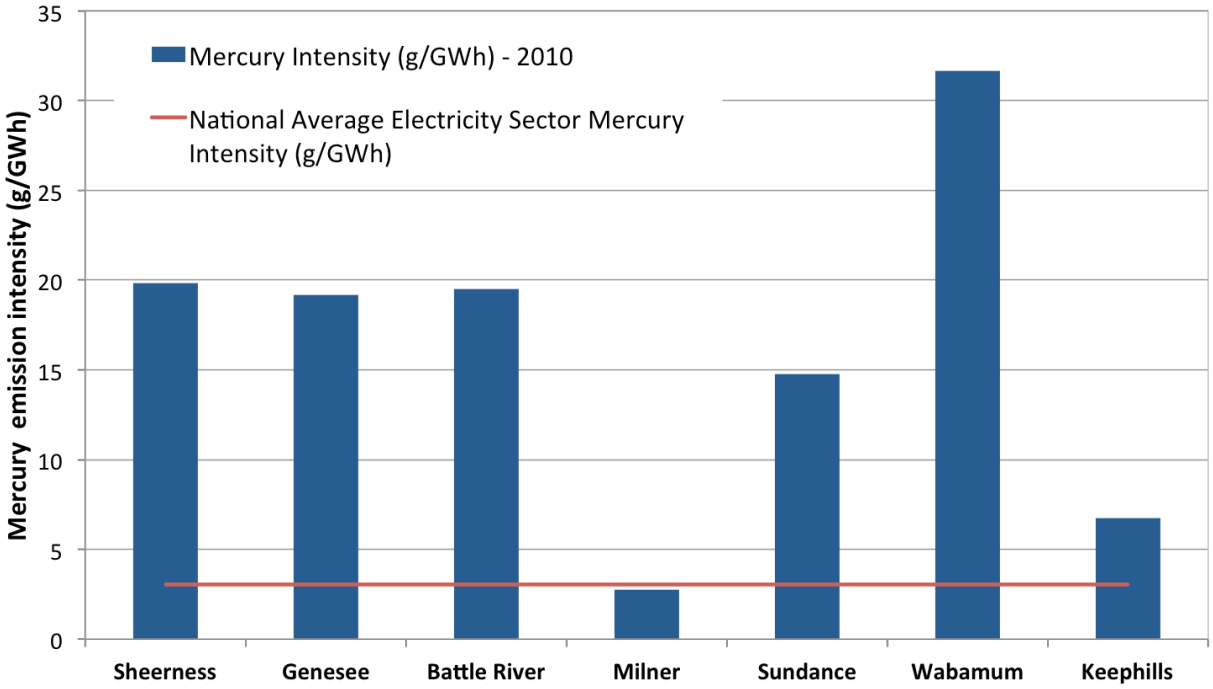

Figure 11: Mercury emissions intensities of coal-fired facilities in Alberta in 2010

Source: Alberta Environment and Sustainable Resource Development, Environment Canada[29]

[27] Environment Canada, "Mercury Fever", *EnviroZine* 17, February 21, 2002. http://www.ec.gc.ca/EnviroZine/english/issues/17/home_e.cfm

[28] *Ibid*.

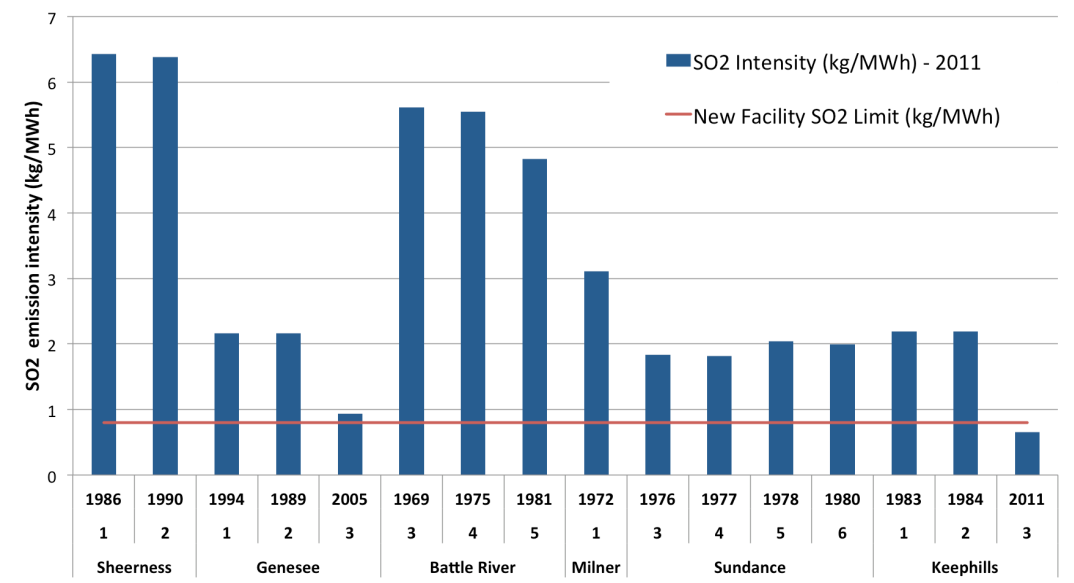

Figure 12: Sulphur dioxide (SO2) emission intensities of Alberta's coal power units in 2011 (with year of commissioning for each unit) relative to the regulated intensity standard

Source: Alberta Environment and Sustainable Resource Development[30]

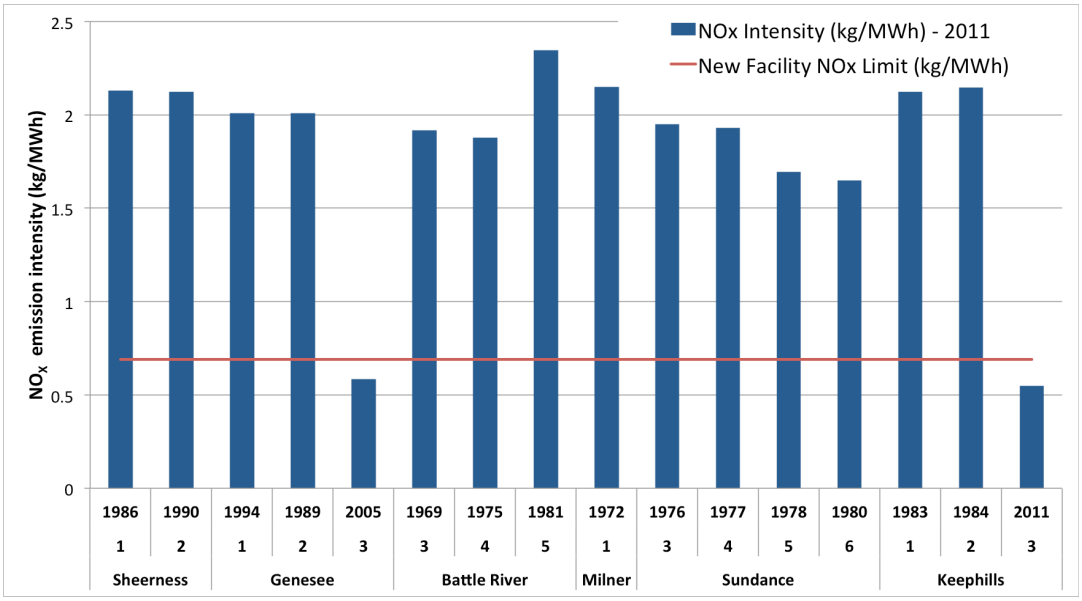

Figure 13: Nitrogen oxide (NOx) emission intensities of Alberta's coal power units in 2011 (with year of commissioning for each unit) relative to the regulated intensity standard

Source: Alberta Environment and Sustainable Resource Development[31]

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[29] Alberta Environment and Sustainable Resource Development, *Annual Reports: Section 55, Emissions Trading Regulation – Summary of Annual Reports Compiled by Alberta Environment*, available at http://www.environment.alberta.ca/apps/etr/GetDocument.aspx?ID=69; Environment Canada, *National Pollution Release Inventory – 2010 NPRI Reviewed Facility Data*, available at http://www.ec.gc.ca/pdb/websol/querysite/query_e.cfm

[30] Alberta Environment and Sustainable Resource Development, *Annual Reports: Section 55, Emissions Trading Regulation – Summary of Annual Reports.*

New pollution control technology and government regulation can reduce the amount of pollution emitted by coal plants, but many plants, particularly older plants, still emit significant amounts of pollution. For example, in Alberta, the provincial government has standards for SO_2 and NO_x emissions for new facilities, but almost all existing facilities still emit those pollutants at levels well above the standard, as shown in Figure 12 and Figure 13.

2.4 The hidden costs of coal

The health and environmental impacts of these emissions, as well as social and economic effects therefrom, carry real costs. These relatively high costs undermine the defence that coal power supplies a cheap source of power for some provinces and their economies.

Where it is plentiful, coal has traditionally been a relatively cheap source of energy. However, new pollution control requirements, including scrubbers to reduce emissions of mercury, sulphur dioxide (SO_2), nitrogen oxides (NO_x) and particulate matter mean that the financial cost of electricity from newly built coal plants is much higher than it has been traditionally. The U.S. Energy Information Agency expects that in 2020, new coal plants will have levelized costs of approximately 11 cents per kilowatt-hour (kWh).[32] Costs will be even higher if carbon capture and storage (CCS) technology is deployed to reduce carbon dioxide (CO_2) emissions.

Coal has other costs that are very real, but are not reflected in the prices on our utility bills. Coal-fired electricity adds social costs, such as illnesses related to coal pollution and the costs for cleaning up environmental damage. The Environmental Integrity Project estimated the social costs of premature deaths – omitting other health and environmental costs – from 51 coal plants in the United States.[33] The analysis found that between 18 and 38 plants had higher premature-death related costs than the estimated market value of their electricity The Brookings Institution found that the environmental and social costs of coal-fired power in the United States are about 5.3 cents per kWh.[34]

These estimates do not include the cost of GHG emissions. Existing coal power in Canada emits over 1050 tonnes of CO_2 for every GWh produced — more than twenty times the GHG intensity of the average of all other electricity sources in Canada. As such, any reasonable price signal on carbon, or estimate of the social cost of carbon, would increase the cost of coal power relative to other electricity generation considerably.

A study completed in 2005 for the Ontario Ministry of Energy estimated that the levelized full cost of continuing with coal-fired generation in Ontario would be 16.4 cents per kWh. That includes 3.7 cents per kWh in financial costs, plus 11.3 cents per kWh in health costs and 1.4

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[31] *Ibid*.

[32] US EIA Annual Energy Outlook 2011.

[33] Environmental Integrity Project, *Net Loss: Comparing the Cost of Pollution vs. the Value of Electricity from 51 Coal-Fired Plants* (2012). http://www.environmentalintegrity.org/news_reports/documents/PowerPlantReport_2012.6.6.Final.pdf

[34] Michael Greenstone and Adam Looney, *A Strategy for America's Energy Future: Illuminating Energy's Full Costs*, (The Brookings Institution, 2011). http://www.brookings.edu/papers/2011/05_energy_greenstone_looney.aspx

cents per kWh in environmental costs.[35] The same report estimates that over 650 premature deaths and as much as $3-billion in annual health care costs could be saved by phasing out coal-fired electricity.

[35] DSS Management Consultants, *Cost Benefit Analysis: Replacing Ontario's Coal-Fired Electricity Generation*, Prepared for the Ontario Ministry of Energy (2005).

3. Provincial efforts to reduce coal use

3.1 Ontario's ongoing effort to phase out coal

Ontario provides an example of a successful transition away from dependence on coal-fired electricity. In 2007, the Ontario Government committed to shutting down the province's coal plants by 2014, a critical part of its plan to reduce GHG emissions.

Since then, in 2010 and 2011, the province phased out six of the 15 coal power units that it had in 2007, representing over 45 per cent of the province's 2007 coal power generating capacity. To meet its commitment, the remaining nine plants will be shut down or converted to cleaner fuel sources by 2014. In accomplishing this commitment, no plant in the province will have operated for more than 45 years, and the average lifespan for the stock of coal plants that Ontario held in 2007 will be 38 years.[36] This accelerated phase out of coal power in Ontario is considerably more ambitious than the application of the proposed federal regulations would be alone, even with the 45-year end-of-life definition, as demonstrated in Figure 14.

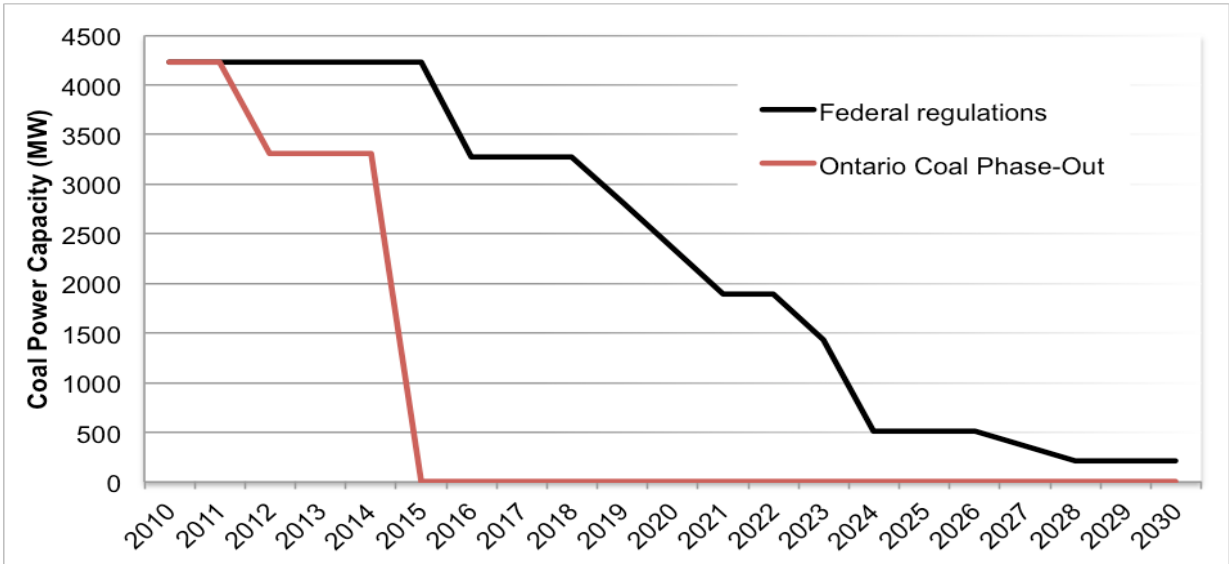

Figure 14: Coal-fired generating capacity in Ontario under Ontario's coal phase out plans versus the federal regulations (without the phase out plan)

Source: Data synthesized from Environment Canada, Ontario Power Generation[37]

[36] This is a weighted average of the age at closure of the 15 units that Ontario held in 2007, weighted according to the amount of capacity of each unit.

[37] Environment Canada, personal communication; Ontario Power Generation, Thermal Power, accessed June 8, 2012. http://www.opg.com/power/thermal/

At the same time, Ontario has also reduced its use of the coal power units that continue to operate. At the beginning of the century, around 26 per cent of electricity generation in Ontario was supplied from coal-fired power plants, dropping to 19 per cent by 2007 with a wave of important end-of-life closures in 2005.[38] By 2010, coal represented 8.3 per cent of electricity output.[39] Although most of the emissions information in this report represents the 2010 data currently available, the phase out has since continued to reduce Ontario's dependence on coal power for its overall generation and has likewise reduced the concomitant emissions. In 2011, coal power provided 2.7 per cent of electricity output, a third of the previous year.

Ontario's achievement in this regard has brought important benefits for human and environmental health in Ontario. In 2003, coal-fired electricity generation emitted 478 kg of mercury, which fell almost 80 per cent to 100 kg in 2010. The result is that in 2010, only 8 per cent of mercury emissions in Ontario came from coal power and, with the ongoing phase out, this proportion continues to fall. If 2003 coal-power mercury emissions were held steady, total mercury emissions in Ontario in 2010 would have been approximately 30 per cent higher.[40]

Similarly, between 2005 and 2011, GHG emissions from coal-fired power fell over 80 per cent, as shown in Figure 15.

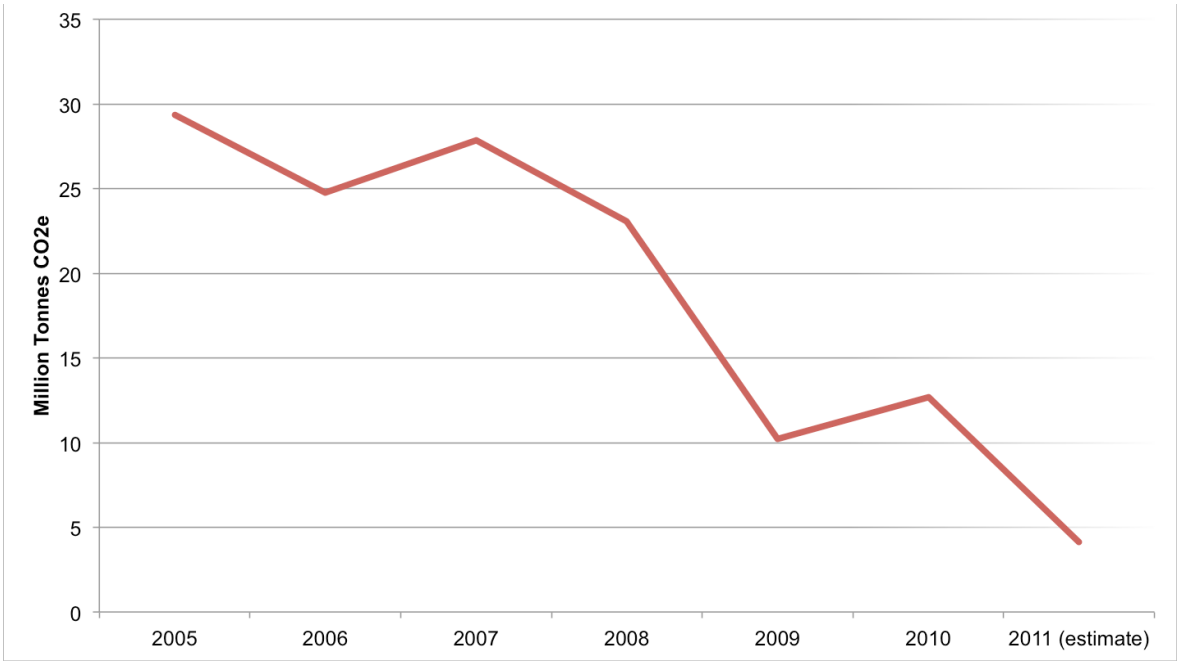

Figure 15: GHG emissions from coal power in Ontario.

Source: Environment Canada, Independent Electricity System Operator[41]

[38] Environment Canada, *National Inventory Report: 1990-2009* (May 2011), Part 3, 50. http://www.ec.gc.ca/ges-ghg/default.asp?lang=En&n=83A34A7A-1

[39] Independent Electricity System Operator (IESO), *Composition of Ontario's Electricity Supply Mix Continues to Change: Consumer Response Supports Reliability* (January 6, 2012). http://www.ieso.ca/imoweb/media/md_newsitem.asp?newsID=5930.

[40] Environment Canada, *National Pollutant Release Inventory.* http://www.ec.gc.ca/inrp-npri/

[41] Environment Canada, *Reported Facility Greenhouse Gas Data* (2010). http://ec.gc.ca/ges-ghg/default.asp?lang=En&n=8044859A-1; Independent Electricity System Operator (IESO), *Composition of Ontario's Electricity*

Ontario is managing this transition away from coal with a combination of measures to reduce electricity consumption, particularly at peak demand, and by increasing generation from lower and non-emitting sources of electricity.[42] While coal-fired generation decreased by 82 per cent from 2008 to 2011, nuclear has held relatively constant; hydro has fallen; electricity from natural gas has doubled; and wind power generated nearly three-times as much electricity in 2011 as in 2008, while overall electricity generation has also fallen slightly.[43] Ontario provides an example of how to reliably meet electricity demand at reasonable cost while phasing out coal power completely, and doing so faster than the proposed federal regulations require.

3.2 Progress in Nova Scotia

Despite long-standing reliance on coal-fired electricity, in recent years Nova Scotia has taken strides away from coal and towards renewables. In 2006, coal plants generated approximately 80 per cent of Nova Scotia's electricity. By 2011, coal-fired electricity was down to 57.5 per cent, as shown in Table 6. Nova Scotia still relies heavily on coal, but the province has used a combination of policy tools, including emission caps on GHG emissions from the electricity sector, legislated targets for renewables and investment in efficiency, to start the transition away from coal.

Table 6: Electricity generation in Nova Scotia by fuel source

Year	Owned by Nova Scotia Power				Purchased Power	
	Coal and Petcoke	Gas	Oil	Renewables	Renewables (IPP)[44]	Imports
2011	6,848 GWh	2,430 GWh	35 GWh	1,335 GWh	743 GWh	526 GWh
	57.5 %	20.4 %	0.2 %	11.2 %	6.2 %	4.4 %
2010	7,839 GWh	2,275 GWh	36 GWh	1,017 GWh	526 GWh	471 GWh
	63.0 %	20.0 %	0.3 %	8.4 %	4.3 %	3.9%

Source: Nova Scotia Power[45]

There are currently four coal plants in Nova Scotia: four units at the Lingan Generating Station, one unit each at Point Aconi and Point Tupper, and two units at Trenton. All four are owned and operated by Nova Scotia Power. In 2012, two of the units at Lingan will be scaled down to seasonal operation only, shutting down during warmer months of the year.

In 2009, approximately 50 per cent of Nova Scotia's GHG emissions came from electricity generation. Absolute emissions caps for GHG and air pollution were implemented for the entire electricity sector. The GHG caps require that Nova Scotia Power gradually reduce emissions to

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Supply Mix Continues to Change: Consumer Response Supports Reliability (January 6, 2012). http://www.ieso.ca/imoweb/media/md_newsitem.asp?newsID=5930

[42] Independent Electricity System Operator (IESO), *Composition of Ontario's Electricity Supply Mix Continues to Change: Consumer Response Supports Reliability* (January 6, 2012). http://www.ieso.ca/imoweb/media/md_newsitem.asp?newsID=5930

[43] *Ibid.*

[44] IPPs are independent power producers in Nova Scotia.

[45] Robin McAdam, "Q&A: Fuel Mix Update," *A Cleaner Megawatt*, March 15, 2012. http://cleaner.nspower.ca/post/QA-Fuel-Mix-Update.aspx

stay below declining thresholds set in regulation. Between 2010 and 2020, the regulations will result in a 25 per cent decline in GHG emissions from electricity generation, from approximately 10 megatonnes (MT) of CO_2e in 2009 to 7.5 MT in 2020. In 2011, electricity-sector GHGs in Nova Scotia were 8.6 MT. The GHG caps are applied across the electricity sector, but given Nova Scotia's reliance on coal, much of the reductions will come from reducing the use of coal to generate electricity, and switching to cleaner sources.

Some flexibility is built into the regulations: two- and three-year compliance periods allow Nova Scotia Power to emit slightly above the caps' downward trajectory in one year if they emit below that trajectory in the next year. The compliance periods are outlined in Table 7. If by 2020 the utility exceeds the cumulative emissions cap by a maximum of 2.6 MT (less than 3 per cent of the allowed emissions from 2010-2019), it can still comply with the regulations by paying a transmission incentive that began at $15/tonne in 2010 and steadily increases to $60/tonne by 2020.

Table 7: Nova Scotia electricity sector emissions reduction schedule

Year[46]	Annual sector GHG cap (million tonnes of CO_2e)	Compliance period limit cap (million tonnes of CO_2e)
2010	9.7	19.22
2011	9.52	
2012	9.34	18.5
2013	9.17	
2014	8.98	26.32
2015	8.8	
2016	8.54	
2017	8.28	24.06
2018	8.02	
2019	7.76	
2020	7.5	7.5

Source: Nova Scotia Environment[47]

The utility can meet GHG caps by closing down coal plants or reducing the use of coal and other fossil fuels in other ways, as long as additional legislative requirements to invest in renewable energy and efficiency are also met. Nova Scotia legislation requires that 25 per cent of electricity be from renewable sources by 2015 and 40 per cent by 2020. In 2011, 17 per cent of electricity in Nova Scotia came from renewables. New renewable generation can be owned by Nova Scotia Power, procured from independent power producers, imported and procured through the Community Feed-in-Tariff program, which incentivizes small-scale community-owned renewable power. Legislation in 2010 also created Efficiency Nova Scotia, a third-party organization that uses funds raised by an efficiency levy to achieve demand-side management targets laid out in electricity efficiency and conservation plans.

[46] Nova Scotia Power Inc.'s GHG emissions were approximately 10.15 MT in 2007.

[47] Nova Scotia Environment, *An Approach to Regulating Electricity Sector Greenhouse Gas and Air Pollutant Emissions in Nova Scotia: A Discussion Paper*, February 2009.

Nova Scotia has taken a different approach to reduce the use of coal to generate electricity compared to Ontario's efforts to close coal plants entirely. A combination of absolute caps on GHG emissions from the electricity sector and required investment in renewables and efficiency have resulted in coal use declining by 28 per cent in the past five years, with expectations that it will continue to decline in the years ahead. As of June 2012, Nova Scotia has indicated an interest to negotiate an equivalency agreement with the federal government to continue with Nova Scotia's provincial regulatory approach, if the GHG reductions from the provincial approach are the same or better than the reductions expected from the proposed federal regulations.

4. Regulating greenhouse gas emissions

4.1 Summary of the proposed federal coal regulations

In June 2010, then-Environment-Minister Jim Prentice announced that the federal government would introduce regulations to gradually phase out conventional coal power. Minister Prentice presented the proposed approach for coal power as part of Canada's commitment to reduce GHG emissions and become a "clean energy superpower."[48]

This was not the first time that the current government had promised to crack down on high emissions from conventional coal power. The *Turning the Corner* regulatory framework, introduced in 2007 and updated in 2008, would have imposed emissions requirements on all coal facilities (along with the rest of heavy industry). Units commissioned prior to 2004 would have been required to reduce their emissions intensity (CO_2 emissions per unit of electricity generated) by 18 per cent in 2010 and a further two per cent each year thereafter. Units commissioned in 2004 or later would have been required to reduce their emissions intensity by two per cent per year below the level of a new supercritical facility, following an initial three-year grace period. Units commissioned in 2012 or later would have been required to meet a standard based on CCS by 2018.[49] As Prime Minister Harper announced in 2008, "this effectively means that after 2012, no new dirty coal-fired electrical plants can come online in Canada."[50]

While the coal regulations announced by Minister Prentice in 2010 were another in a series of promises to tackle emissions from the sector, they were the first in the government's newly announced approach of regulating industrial emissions one sector at a time. *Turning the Corner* had been abandoned in favour of this new approach and coal power, in going first, would set expectations for the sectors to follow.

The government tabled the draft coal regulations in August 2011, more than a year after they were first announced by Minister Prentice. The approach taken by the draft regulations is consistent with his announcement.

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[48] Jim Prentice, "Announcement – Canada shows leadership on climate change and the environment," speech, Ottawa, Ont. (June 23, 2010). http://www.ec.gc.ca/default.asp?lang=En&n=6F2DE1CA-1&news=BB5AC3DC-837A-406E-AD28-B92ED80F5A81.

[49] Environment Canada, *Turning the Corner: Regulatory Framework for Industrial Greenhouse Gas Emissions* (Government of Canada, 2008). http://www.ec.gc.ca/Publications/default.asp?lang=En&xml=C16DAFD9-E250-46DC-8B26-53F0DF2E7A75

[50] Stephen Harper, "Prime Minister Harper addresses the Canada-U.K. Chamber of Commerce in London," speech, London, Ont. (May 29, 2008). http://www.pm.gc.ca/eng/media.asp?id=2131.

Beginning in July 2015, any coal units entering operation would be required to limit their emissions to 375 tonnes of CO_2 per GWh generated (t CO_2/GWh) — a level consistent with combined-cycle natural-gas-fired generation. This performance standard also applies to existing units after they have operated for their full "useful life," defined by the regulation as 45 years.

Several flexibilities were also proposed, including a deferral of the standard until 2025 for any unit built CCS-ready and adhering to specific construction milestones.

At the end of a unit's life it must either refit to meet the standard (likely through application of CCS), switch to an unregulated fuel (likely natural gas), or close down. Offsets and trading are not permitted, although there are several flexibilities that allow utilities to shift end-of-life dates within a province or transfer credits for early application of CCS.

While the regulations will prevent new conventional coal units from being built after mid-2015,[51] the impact on existing units will be spread out over nearly a half century. This is because these units are allowed operate without emissions limits until they are 45 years old, with no incentives to pollute less or close earlier.

Such an approach is inconsistent with the urgency of cutting Canada's GHG emissions. Without an accelerated retirement of Canada's coal-fired capacity or significant additional investment to reduce emissions from existing units, the environmental impact of these regulations is severely constrained.

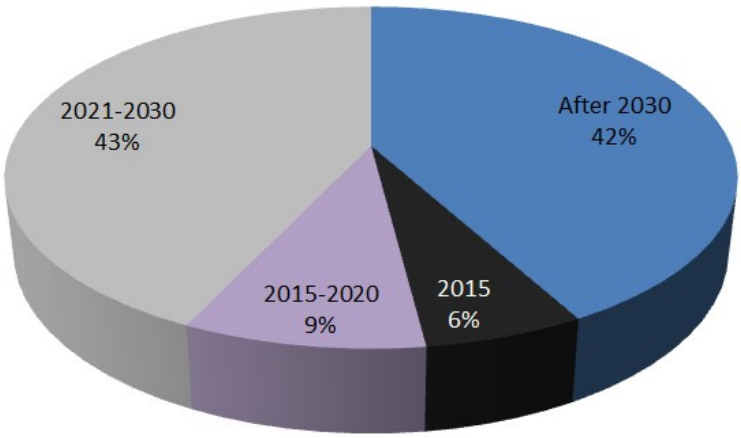

Figure 16: Timing of draft regulation's impact on national coal-fired generating capacity (excluding Ontario, and not accounting for potential flexibilities)

Source: The Pembina Institute

As shown in Figure 16, defining the useful life of a coal-burning unit as 45 years means that only about 14 per cent of national conventional coal capacity (excluding Ontario) will be subject to the federal regulations before the end of 2020. A further 42 per cent of capacity will not be

[51] It is worth noting, however, that the deferral of the performance standard until 2025 for units built CCS-ready would apply to any new plant (as CCS would be necessary to meet the standard), meaning they could operate as a conventional unit until 2025 (though 30 per cent capture would be required in 2024). This means that if a 500 MW "CCS-ready" supercritical baseload coal unit were built in the second half of 2015, the deferral would permit additional emissions of approximately 1.5 Mt CO_2 per year for eight years, plus an additional 0.5 Mt in 2024, totaling roughly 12.5 Mt over the period of deferral.

affected until after 2030, spreading the emission reduction impact of the regulations over a very long time period. This is shown at a provincial scale in Figure 17.

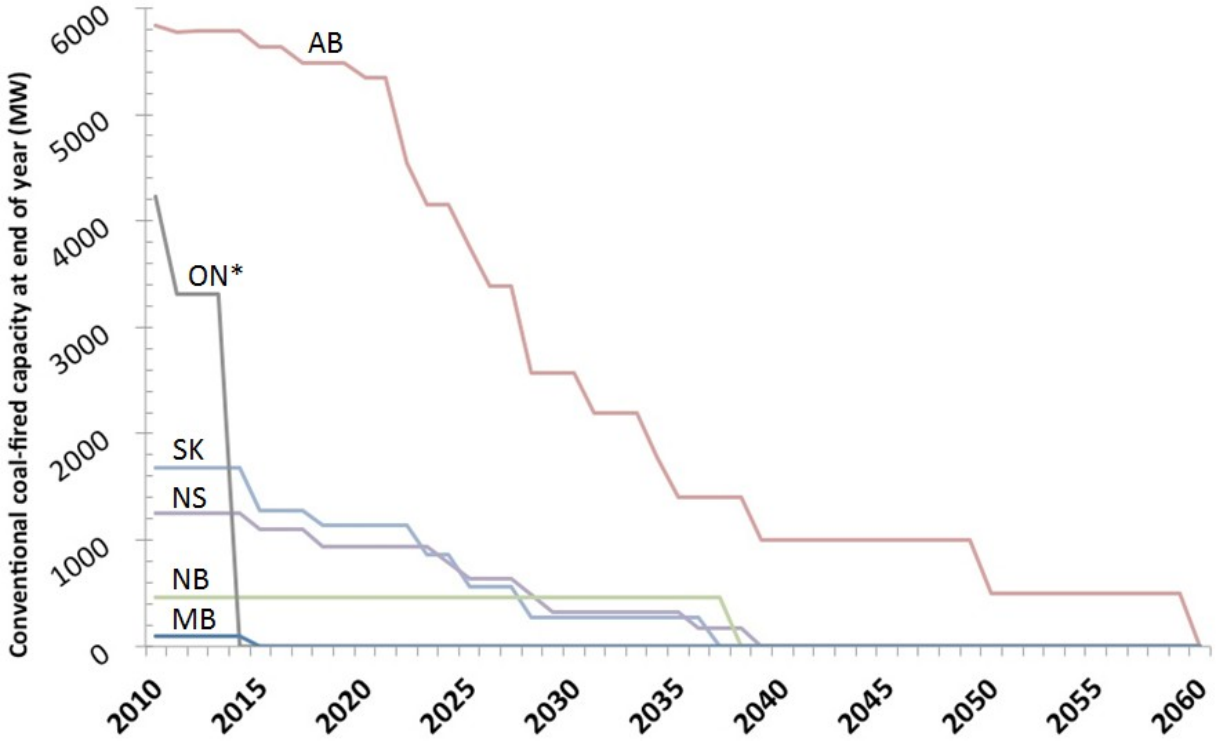

Figure 17: Provincial conventional coal-fired generating capacity under the proposed regulations

Source: The Pembina Institute

4.2 Contribution of federal coal regulations to Canada's climate goals

The Government of Canada has committed to reducing GHG emissions to 17 per cent below the 2005 level (in other words, to 607 Mt) by 2020.[52] They have not yet outlined a clear set of policies to get there, however, and without further action Canada is on track to miss the target by a wide margin. Under current federal and provincial policies — including the draft coal regulations — Environment Canada projects that national emissions will grow to 785 Mt by 2020, nearly 30 per cent above the target.

With the inclusion of the draft coal regulations, can we say that that the electricity sector is doing its fair share of the effort to meet the national target? We cannot assess this directly without a clear understanding of what future regulations will ask of other sectors. However, by looking at the projected outcomes of a well-designed climate policy package we can get a sense of what a cost-effective outcome for the sector would look like. In the Pembina Institute's view, a well-

[52] Environment Canada, *Planning for a Sustainable Future: A Federal Sustainable Development Strategy for Canada* (Government of Canada, 2010), 20. http://www.ec.gc.ca/dd-sd/F93CD795-0035-4DAF-86D1-53099BD303F9/FSDS_v4_EN.pdf.

designed policy package would be centered on a robust economy-wide carbon price. Because this policy would drive reductions where they are most affordable, regulations for the electricity sector should seek to achieve comparable outcomes. If the electricity sector does not generate the same level of reductions under a regulatory approach as it would under a carbon price, these reductions will need to come from other sectors, where they will be relatively more expensive.

According to Environment Canada's modelling, the draft federal coal regulations are anticipated to reduce CO_2 emissions by 5.3 Mt in 2020.[53]This represents just three per cent of the total reductions required to fill the gap between the emissions level anticipated under current policies (excluding the coal regulations) and Canada's 2020 emissions target.[54]

Provincial actions — notably Ontario's coal phase out — account for a much larger share of projected reductions from the electricity sector to 2020. With provincial and federal efforts taken together, Environment Canada projects the electricity sector will emit 95 Mt CO_2e in 2020, 25 per cent less than in 2005.[55]

In a well-designed climate policy package, the electricity sector is projected to play a significant role in national emissions reductions, since it offers many affordable opportunities to cut emissions. Under a robust climate policy package consistent with achieving the federal government's 2020 emissions target,[56] emissions from the sector are projected to fall by 37 per cent (40.2 Mt) from business as usual (BAU), to a level of 68.3 Mt in 2020.[57] About half of the electricity sector's reductions are projected to occur in Alberta, suggesting a significant reduction in coal power as well as some application of CCS.

This level is significantly below the 95 Mt projected for the electricity sector under current policies, including the proposed federal coal regulations. Future regulations for natural-gas-fired electricity generation (and potentially refined petroleum products; RPP) should contribute to additional reductions in the electricity sector, but are unlikely to fill the 27 Mt gap. Gas-fired generators are currently projected to emit 24 Mt in 2010 and 33 Mt in 2020.[58] Therefore, if the proposed rules for coal-fired electricity are finalized, achieving the same outcome as the

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[53] Environment Canada, *Reduction of Carbon Dioxide from Coal-fired Generation of Electricity Regulations*, Regulatory Impact Analysis Statement (Government of Canada, 2011), 8.2. http://www.gazette.gc.ca/rp-pr/p1/2011/2011-08-27/html/reg1-eng.html.

[54] To put this into further perspective, under current policies (including Alberta's Specified Gas Emitters regulation), oilsands growth is projected to *increase* annual emissions by 62 Mt — nearly 12 times as much — between 2005 and 2020, to a total of 92 Mt CO_2e. Without swift action to control GHGs in this and other industrial sectors, the impact of efforts to reduce emissions from coal power will be significantly diminished. See: Environment Canada, *Canada's Emissions Trends*, (Government of Canada, 2011), 25. http://www.ec.gc.ca/Publications/default.asp?lang=En&xml=E197D5E7-1AE3-4A06-B4FC-CB74EAAAA60F

[55] *Ibid.,* 28.

[56] Matthew Bramley and Pierre Sadik, *Climate Leadership, Economic Prosperity: Final Report on an Economic Study of Greenhouse Gas Targets and Policies for Canada* (Pembina Institute and David Suzuki Foundation, 2009). http://www.pembina.org/pub/1909. This report modeled a slightly stronger 2020 target of 20 per cent below the 2006 level instead of the current 17 per cent below the 2005 level. While the two targets are different, the resulting carbon price — reaching $100/t in 2020 — would likely be of the same order of magnitude.

[57] Mark Jaccard and Associates Inc., *Exploration of two Canadian greenhouse gas emissions targets: 25% below 1990 and 20% below 2006 levels by 2020 – Final Report* (Pembina Institute and David Suzuki Foundation, 2009), Table 40. http://www.pembina.org/pub/1910

[58] Ibid.

application of a robust carbon price would require reductions from the rest of the electricity sector on the order of 68 per cent from BAU by 2020, or from gas-fired generation alone on the order of 80 per cent.

Table 8: Projected 2020 emissions outcomes in the electricity sector

	Well-designed climate package	Current policies
Source of data	*Climate Leadership, Economic Prosperity*	*Canada's Emissions Trends*
Reference emissions, including ON coal phase out (Mt CO_2e)	109	100
Emissions w/ policies fully implemented (Mt CO_2e)	68	95
Generation (TWh)	749	734

Source: Pembina Institute and David Suzuki Foundation[59]

4.3 Effect of federal regulations on increasing non-emitting electricity generation

The proposed regulations will make virtually no contribution towards achieving the federal government's target of 90 per cent non-emitting electricity generation by 2020. Environment Canada's modelling finds the proposed regulations will have "a negligible impact on non-emitting generation," even in 2030.[60] With a projected increase of 0.3 terawatt-hours (TWh), non-emitting sources account for an insignificant 0.2 per cent of total increased generation in the regulatory scenario to 2030. The remaining approximately 99.8 per cent comes from gas-fired units.[61]

It is clear that the proposed regulations are not stringent enough to drive the required transition to low-carbon electricity generation. Environment Canada's modelling shows that the federal government's goal of generating 90 per cent of Canada's electricity from non-emitting sources will not be achieved under current regulations. Even in 2030 — a decade late — non-emitting sources will provide only 83 per cent of Canada's electricity generation.[62]

4.4 Equivalency agreements

Under the Canadian Environmental Protection Act (CEPA 1999), a province or territory can negotiate for a federal regulation to stand down if they have policies in place that achieve the

[59] Matthew Bramley and Pierre Sadik, *Climate Leadership, Economic Prosperity: Final Report on an Economic Study of Greenhouse Gas Targets and Policies for Canada* (Pembina Institute and David Suzuki Foundation, 2009). http://www.pembina.org/pub/1909.

[60] Environment Canada, *RIAS*, 8.3.

[61] Ibid, Table 10.

[62] Ibid, Table 9.

same environmental outcome. These formal agreements, known as equivalency agreements (EAs), are intended "to avoid duplication among the various orders of government and to enable the best-positioned jurisdiction to provide the highest environmental quality for Canadians."[63]

Agreements last for five years at a time, and can be suspended early by either party with three months' notice. To date, Alberta is the only province with an EA under CEPA.[64]

The primary objective of any EA should be to ensure that emissions reductions meet or exceed the federal requirements. Thus, any agreement should be based on implemented provincial regulations that will reduce global warming pollution from coal-fired electricity generation at least as much as projected under the federal regulations. These should also be backstopped by federal regulation in the case that the provincial rules are weakened or do not perform as expected. Performance should be assessed through annual reporting.

The federal and Nova Scotia governments have recently committed to reach an EA for the coal regulations.[65] Nova Scotia has taken important steps to reduce GHG emissions in the electricity sector. A legislated cap requires an absolute emissions reduction from the sector of roughly 20 per cent this decade, from 9.6 Mt to 7.5 Mt.[66] In parallel, the province's renewable energy target could reduce coal's role in the energy mix from roughly 75 per cent of generation in 2010 to 40 per cent in 2020.[67] In working towards a formal EA, Nova Scotia has agreed to extend its hard caps to 2030, to ensure continued reductions that match or exceed the requirements of the federal regulations.

Assessed against the criteria outlined above, a Nova Scotia equivalency agreement could provide a model that other provinces considering EAs should follow. It adheres to key principles including regular reporting as well as having provincially legislated targets that are backstopped by the Federal limits. Crucially, if Nova Scotia follows their current plan and extends the regulations to 2030, we expect the province will reduce more emissions and in a more cost effective manner than would occur under the currently proposed federal regulations.

4.5 Efforts to further weaken the federal regulations

There are indications that the federal government is being pressured to weaken the coal regulations in their final version. If they are weakened in the ways proposed, they risk becoming less than half as effective as the draft version. As noted earlier, the draft regulations do not go far enough given the commitments Canada has made to reduce GHG emissions. Weakening them

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[63] Environment Canada, *Equivalency Agreements under the* Canadian Environmental Protection Act*, 1999*, fact sheet, 1. http://www.ec.gc.ca/lcpe-cepa/default.asp?lang=En&n=DCDEC51D-1

[64] CEPA Environmental Registry, "Equivalency Agreements," (2005). http://www.ec.gc.ca/lcpe-cepa/default.asp?lang=En&n=5CB02789-1 (accessed February 10, 2012). For the full text of the agreement, see: http://laws-lois.justice.gc.ca/eng/regulations/SOR-94-752/FullText.html.

[65] Environment Canada, "Canada and Nova Scotia Working Together to Reduce Greenhouse Gas Emissions," news release (March 19, 2012). http://www.ec.gc.ca/default.asp?lang=En&n=714D9AAE-1&news=C57FE6E9-8B0D-487E-8B31-58B3FE776DBC

[66] Government of Nova Scotia, *Greenhouse Gas Emissions Regulations*, Reg. 260/2009, Section 4. http://www.gov.ns.ca/JUST/REGULATIONS/regs/envgreenhouse.htm

[67] Nova Scotia Department of Energy, *Renewable Electricity Plan* (Government of Nova Scotia, 2010), 17.

further would be a very significant setback to Canada's climate action and a troubling precedent for future GHG regulations in other industrial sectors.

The two most serious ways the regulations could be weakened are:

1. The definition of useful life could be extended from 45 to 50 years.

Emissions limits only apply to existing units at the end of their useful life. Recent information suggests that the age threshold could be increased from 45 to 50 years in the final version of the regulations. The 5-year extension would be on top of a 2009 concession that extended the lifetime from 40 to 45 years — a concession made at the request of electricity sector CEOs according to an Access to Information request. Older plants are often significantly less efficient than newer ones, meaning the most polluting plants would be allowed to continue to operate until they are half of a century old.

The 40-year timeline has a strong precedent in that Alberta's Air Emissions Management Framework commits coal-fired units to reduce their criteria air contaminants (such as nitrogen oxides and sulphur dioxide) to the equivalent of a new coal plant at the latest of 40-years, or when their Power Purchase Agreement (PPA) expires.[68] The current 45-year end-of-life already creates a disconnect between the Alberta industry obligations for CACs and GHGs.[69] Stretching the end-of-life in the federal GHG regulations to 50 years would significantly exacerbate this disconnect.

2. The performance standard could be loosened from 375 to 425 t CO_2/GWh.

The performance standard represents the maximum allowable emissions rate once the regulations apply to a unit. The draft regulations fix the performance standard at 375 t CO_2/GWh. However, recent information suggests this will be weakened to 425 t CO_2/GWh in the final version, allowing regulated units to emit more.

This concession is being sought in an effort to make future coal emissions congruent with existing technology for combined-cycle natural gas plants. There is no limiting technical reason why coal with CCS could not perform at a much lower level, in fact SaskPower is planning on capturing up to 90 per cent of its emissions on its Boundary Dam 3 project, which would be on the order of 100 t CO_2/GWh.[70] Setting such a standard implies that no improvements over what is already commercially available will be sought for combined cycle natural gas in any future regulations.

[68] The last PPA expires in the year 2020.

[69] Alberta's coal units can operate beyond 40-years or PPA only if they use NOx and SO_2 emission credits that have been created through emission reductions elsewhere in the Alberta coal-unit fleet. Current estimates indicate that there will be inadequate NOx and SO_2 credits available in that system to enable these units to life extend to 45-years, let alone 50-years.

[70] Power Engineering, *Emissions Reduction - Boundary Dam 3*. Available online at: http://www.power-eng.com/news/2012/06/07/emissions-reduction-boundary-dam-3.html

4.6 Implications of weakening the regulations

Changing the end-of-life definition from 45 to 50 years and the performance standard from 375 to 425 t CO_2/GWh means the regulations would allow an additional 105 million tonnes of emissions between 2015 and 2030. This would represent more than half (60 per cent) of the reductions Environment Canada expects from the draft regulations over that period (175 Mt).

To put the 105 million tonnes in context, it would have the same GHG implications as putting 1.4 million cars on the road over the same time period. Maxim Power's H.R. Milner expansion, discussed below in Section 4.7, also provides a useful comparison given the controversy that surrounded the company's plan to build the coal-fired unit before the regulations come into force. If they are successful, they would be emitting roughly 22 million more tonnes between 2015 and 2030 than if the plant had emissions limits. The GHG implications of weakening the draft regulations' end-of-life age and performance standard would be nearly five times larger.

Table 9 and Figure 18, below, presents the implications for each of the potential changes. The estimated impact of weakening the performance standard assumes existing units meet the performance standard at end-of-life. This is a reasonable assumption if the provinces negotiate equivalency agreements that are based on fleet-wide approaches (such as the agreement Nova Scotia recently announced).

Table 9: Implications of weakened regulations (cumulative from 2015-2030)

	Projected emissions reductions from draft regulations[71]	Projected increase in emissions relative to draft regulations[72]		
		Extending life to 50 years	Changing standard to 425 t CO_2/GWh	Extending life and changing standard
Alberta	112 Mt	60 Mt	8 Mt	63 Mt
Saskatchewan	41 Mt	22 Mt	4 Mt	24 Mt
New Brunswick[73]	0 Mt	0 Mt	0 Mt	0 Mt
Nova Scotia[74]	22 Mt	16 Mt	2 Mt	17 Mt
National	175 Mt	98 Mt	15 Mt	105 Mt

Source: Pembina Institute[75]

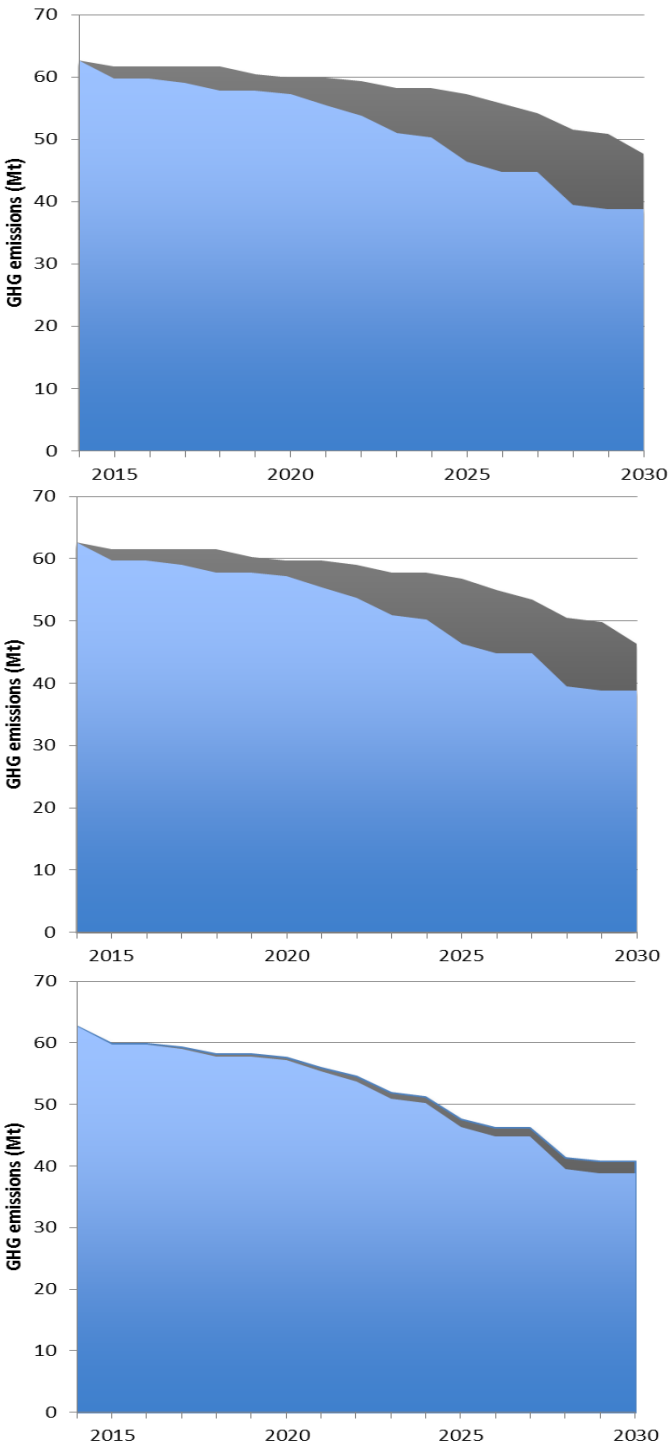
[71] Environment Canada, *Regulatory Impact Analysis Statement*, Table 16.

[72] The following assumptions were used to derive these estimates: capacity factor (75 per cent), emissions rate (1000 t CO_2/GWh). Moving from 40 to 45 years reduced the draft regulations' effectiveness by approximately 105 Mt over 2015-2030.

[73] New Brunswick's only coal plant will not reach 45 years of age until 2038.

[74] Nova Scotia has legislated hard emissions caps until 2020 which exceed the reductions listed above. Nova Scotia has negotiated a draft equivalency agreement with the Federal government, which could preserve the benefits of the draft regulations. The numbers in the table show a scenario where Nova Scotia only meets the requirements of the weakened final regulations when it extends its emissions cap to 2030, a requirement of the agreement.

[75] Matt Horne, Tim Weis and PJ Partington, Weakening regulations could reduce their effectiveness by more than half, available online at: www.pembina.org/pub/2329



CO_2 emissions with the draft regulations (blue) and a scenario with a 50-year end-of life and 425 tCO_2/GWh standard (grey)

CO_2 emissions with the draft regulations (blue) and a scenario with a 50-year end-of life and 375 tCO_2/GWh standard (grey)

CO_2 emissions with the draft regulations (blue) and a scenario with a 45-year end-of life and 425 tCO_2/GWh standard (grey)

Figure 18: Implications of weakened regulations for Canadian coal emissions

Source: The Pembina Institute[76]

[76] Matt Horne, Tim Weis and PJ Partington, Weakening regulations could reduce their effectiveness by more than half, available online at: www.pembina.org/pub/2329

4.7 Attempt to subvert regulations

In light of the high environmental and health costs of conventional coal combustion and the long lifespan of capital-intensive coal plants, it is critical to put a stop to new conventional coal power development in Canada immediately. Given the proposed 45-year exemption for existing coal power units under the Gazette I proposed regulations, any new builds would lock large capital investments into high emissions electricity until 2060 or later.

Building further conventional coal-fired power plants would undermine the latitude of the next two generations of Canadian decision-makers to transition to cleaner electricity and lower national emissions. That said, the proposed regulations would consider newly built plants that are operational before July 1, 2015, as "existing" so as to qualify for the 45-year exemption from application of the regulations. This creates a rush-to-build loophole that could allow a coal plant developer to avoid Environment Canada's performance standard and allow it to sell high-emissions-intensity electricity clear through 2060 and perhaps beyond.

For Alberta's carbon-intensive electricity grid, this is not a mere hypothetical. Maxim Power Corp. (Maxim) plans to build a new 500-MW supercritical coal generator at its existing 145 MW Milner coal plant near Grande Cache. If it is constructed, this Milner expansion, or Milner 2, will emit three million tonnes of GHGs per year, equivalent to adding nearly 600,000 new vehicles to the road. By obtaining an exemption, Maxim plans to get a free pass to generate electricity at approximately twice the emissions intensity of the program standard until it applies at the economic end-of-life for the new plant in the 2060s.[77] When seeking expedited provincial regulatory approval for the plant, Maxim's lawyers reported in a letter that, "Maxim has consulted with the [federal] Minister [of Environment] on this new legislation and understands that the Milner expansion will be considered an Existing Plant if it is commissioned by July 1, 2015."[78]

In September 2011, federal Environment Minister Peter Kent made a clear statement opposing exploitation of the 2015 loophole, stating, "It was never the intention to create a loophole for short-cutters to get in and get a half-century licence to emit greenhouse gases or to put other toxins into the air which have serious impacts on Canadians living downwind".[79] In March 2012, Minister Kent reiterated that "The July, 2015, coming-into-effect deadline wasn't posted as a loophole for people to be getting under the wire and enjoying a 50-year, regulation-free run."[80]

As time has progressed, Maxim can no longer build a plant in time for the 2015 deadline and would need a further exemption from the federal regulations. In March 2012, Maxim CEO, John

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[77] Maxim Power Corp., *Application to Alberta Utilities Commission for HR Milner Expansion*, (January 30, 2009), 62, Appendix E. According to Maxim's expected annual generation and GHG emissions from the plant, its emissions intensity will be 850 tonnes CO_2e per MWh. This intensity would be over twice the allowable emissions intensity under the currently proposed 375 tonnes/MWh performance standard.

[78] John E. Lowe, letter to Alberta Utilities Commission, "re: Application No. 1604766 – Proceeding 203, Maxim Power Corp. HR Milner Power Plant Expansion," (June 7, 2011). http://www.pembina.org/docs/maxim-letter-to-auc.pdf

[79] The Canadian Press, "Ottawa warns pending emissions rules will be enforced," *CTV News*, September 9, 2011. http://www.ctv.ca/CTVNews/Canada/20110909/peter-kent-emissions-110909/

[80] Shawn McCarthy, "N.S. wins right to manage own emissions," *The Globe and Mail*, March 19, 2012. http://www.theglobeandmail.com/report-on-business/industry-news/energy-and-resources/ns-wins-right-to-manage-own-emissions/article2374240/

Bobenic, acknowledged that "it would be impossible to commission [Milner 2] by 2015," and it would likely commission, instead, in 2017.[81] Instead, Maxim is "hopeful" that "they are going to stick to the underlying principles of the regs, which were that they would give industry a five-year window to adjust to new regulations," so that with the regulations finalized this year, Maxim hopes "to have five years during which we can complete the balance of commercial arrangements and the construction of the plant."[82]

In other words, Maxim says that it can no longer commission Milner 2 in time to gain an exemption under the 2015 "grace period" that Minister Kent indicated was not intended to allow a generator to "get under the wire" of the regulations. Instead, it is hoping for a further exemption that would allow industry a "five-year window to adjust," presumably to ensure that the regulations do not strand capital.

However, Maxim cannot claim that it had an expectation for a return-on-investment with conventional coal. Conventional coal's high GHG emissions intensity in the face of Canada's 20-year-old international obligations to limit emissions of GHGs[83] and Canada's 2009 commitment to reduce GHG emissions to 17 per cent below 2005 levels by 2020, makes government action to reduce coal use a likely eventuality.[84] Expectations of unconstrained coal developments were more specifically and clearly prevented when former Environment Minister Jim Prentice announced in June 2010 that, with respect to the adoption of a grace period, Environment Canada "will guard against any rush to build non-compliant coal plants in the interim."[85] The proposed regulations' 2015 in-force date would come more than five years after Kent's statement.

Maxim's recent actions and public statements indicate that it continues to intend to build the new Milner 2 coal unit.[86] Despite Maxim's inability to commission by 2015 and the federal government's indications that a new unit at Milner would be contrary to its regulatory intent in any case, Maxim hopes to gain an extended exemptionout to 2017. If this new plant is built, it would further entrench Alberta's heavy reliance on conventional coal power by locking in a long-lasting and very large capital investment in this highly emitting electricity generation. Yet, considering the clear federal government pronouncements that unmitigated coal emissions must be curbed, Maxim has had no reasonable expectation for a loophole that would allow it to operate — it has invested no capital with a reasonable expectation of a return. As such, the rationale of preventing capital from being stranded does not apply. The Milner plant expansion is one of the first tests of the power of the proposed federal coal regulations' ability to curb emissions from coal in the near term.

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[81] *Q4 2011 Maxim Power Corp. Earnings Conference Call – Final*, FD (Fair Disclosure) Wire, (March 26, 2012).

[82] *Ibid.*

[83] United Nations Framework Convention on Climate Change, Article 4(2)(a).

[84] Government of Canada, *Canada's Greenhouse Gas Target and Emissions Projections*, (January 2011). http://www.climatechange.gc.ca/default.asp?lang=En&n=DC025A76-1

[85] Jim Prentice, "Announcement – Canada shows leadership on climate change and the environment," speech, Ottawa, Ont. (June 23, 2010). http://www.ec.gc.ca/default.asp?lang=En&n=6F2DE1CA-1&news=BB5AC3DC-837A-406E-AD28-B92ED80F5A81.

[86] Shawn McCarthy, "N.S. wins right to manage own emissions", *The Globe and Mail*, March 19, 2012. http://www.theglobeandmail.com/report-on-business/industry-news/energy-and-resources/ns-wins-right-to-manage-own-emissions/article2374240/.

5. Conclusion

Coal-fired electricity is one of the largest sources of air pollution and the most carbon-intensive source of electricity, yet it remains a dominant component of several provincial electricity systems in Canada. The continued use of conventional coal power in Canada is concentrated in Alberta, Saskatchewan and Nova Scotia, where it constitutes one of the largest sources of GHG emissions in each province. Despite action in Ontario to phase out its coal plants by 2014, and efforts in Nova Scotia to reduce its dependence on coal, Canada is still home to a large fleet of conventional coal plants that, if left unaddressed, will continue emitting air pollutants and GHGs for decades.

The federal government has issued draft regulations on coal-fired electricity generation that will make some contribution towards Canada's 2020 climate change targets but little to no contribution towards the federal government's goal of 90 per cent non-emitting electricity by 2020. That said, the moderate ambitions of the draft regulations are at risk of being further weakened by pressure to stretch the economic life of a coal unit from 45 to 50 years — extending the amount of time it has before needing to comply with the performance standard — and to loosen the performance standard from 375 to 425 t CO_2/GWh. Taken together, these changes would reduce the effectiveness of the proposed regulations by more than half in their first 15 years. Meanwhile, efforts like the proposed Milner coal plant expansion in western Alberta try to circumvent the regulations before they are applied, by racing to build a new conventional coal unit before the regulations come into effect, and be unfettered by GHG emissions restrictions for 45 to 50 years into the future.

Reducing conventional coal plants from Canada's electricity supply will lessen the high costs of coal pollution to human and environmental health, and capitalize on one of Canada's most cost-effective ways to reduce GHGs. Weak requirements for coal plants would mean missing some of the most effective GHG reduction opportunities presented by the many feasible alternatives to coal-fired electricity and would require other sectors of the economy to make greater GHG reductions if Canada is to meet its international climate change commitments. Ontario's coal phase out has shown that a coal-burning jurisdiction can switch to cleaner alternatives and keep the lights on. Ontario's example, and the promise of action from the federal government, presents an opportunity to take decisive action to reduce the harm caused by Canada's remaining fleet of conventional coal plants.