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Energy Brief

Coal-Fired Power Generation – An Overview

Coal-fired power generation is an important source of electricity in a number of Canadian provinces. In 2006, about 13 per cent of Canada's generation capacity used coal. While coal-fired power is relatively inexpensive, environmental concerns could create some uncertainty about the future use of this type of generation. This Energy Brief provides some perspective on the status of coal in the Canadian generation mix and addresses the factors governing the outlook based on the National Energy Board's most recent *Energy Futures Report*, released in November 2007.

Burning Coal to Produce Electricity - Benefits and Concerns

The abundance of coal reserves in North America tends to keep pricing fairly stable, unlike other resources such as gas or oil, which are more susceptible to geopolitical uncertainties. Canada's energy reserves contain roughly equivalent amounts of coal and oil, and three times more coal than gas. Another advantage, particularly in western Canada, is that most power plants are located in close proximity to coal deposits, resulting in secure and long-term fuel supply arrangements with relatively low transportation costs.

The greatest concerns about burning coal to produce electricity are environmental. Even with access to new technology and low sulphur coal, a coal fired power plant produces about twice the amount of green house gas (GHG) emissions as a modern gas-fired generation plant. The uncertainty about future environmental regulations certainly impacts the consideration of coal-fired generation as a viable investment.

Latest Technological Developments in Coal-Fired Generation

Supercritical-Pressure Pulverized Coal Combustion Technology

Generating electricity using this combustion technology requires the use of a boiler to heat and pressurize steam to supercritical levels. The benefits of this method include a reduction in fuel consumption by approximately 18 per cent and as a by-product GHGs would also decrease.

The most recent coal-fired generation plant built with this technology is Genessee 3 near Edmonton, which has been in operation since March 2005.

Integrated Gasification Combined Cycle (IGCC)

An IGCC power plant uses a partial combustion process that converts coal into syngas, a mixture of carbon monoxide and hydrogen, which is then used to fire the combustion turbine in a combined-cycle power plant.

Along with improved efficiency in power production, and a decrease in the production of GHGs, the benefits of IGCC include the ability to scrub pollutants like sulphur and heavy metals from the fuel before it is burned. IGCC can produce a concentrated carbon dioxide (CO_2) stream which can make CO_2 storage more economical.

As the technology matures, IGCC has the potential to become the preferred method to generate electricity from coal.

Carbon Capture and Storage (CCS)

There are a number of technologies developing to capture and store carbon for power plants, either scrubbing CO_2 from the exhaust stream after combustion or removing it from the fuel before power is generated.

Post-combustion scrubbing is less efficient, but it allows the plant to operate as a conventional facility in the event of technical difficulties with the CO_2 scrubbers. Pre-combustion scrubbing in an IGCC plant typically involves capturing the CO_2 during the gasification process. While this process may be more efficient, it also makes the operation of the plant dependent of the reliability on the equipment used to capture CO_2.

Once the CO_2 has been collected, it can then be shipped by pipeline to an area where it can be stored in geological formations such as active or depleted oil and gas reservoirs, or deep saline aquifers. In Canada, Alberta's geology appears to provide the required infrastructure, which could be leveraged for CO_2 transportation and injection.

Coal Generation Trends in Canada

Compared to other Canadian provinces and territories, Alberta relies the most heavily on coal-fired power generation. With a capacity of 6 217 MW, coal fired generation represents 53 per cent of the province's total capacity. While Ontario may have more installed capacity with 6 329 MW, coal-fired generation only represents 19 per cent of its total generation capacity.

Coal-fired generation capacity in Canada's overall energy mix (2006)

Province or Territory	Total (MW)	Coal (MW)	Percentage of coal fired capacity
Canada	123792	16272	13
British Columbia	14828	0	0
Alberta	11736	6217	53
Saskatchewan	3879	1800	46
Manitoba	5629	98	2
Ontario	32521	6329	19
Quebec	40219	0	0
New Brunswick	4549	541	12
Nova Scotia	2463	1288	52
PEI	171	0	0
Newfoundland and Labrador	7494	0	0
Nunavut	54	0	0
Northwest Territories	142	0	0
Yukon	108	0	0
Sources: Statistics Canada			

Alberta is currently the most active province in the development of new coal-fired generation. One new plant is already in operation, *Genessee 3*, and another, *Keephills 3*, has an in service date of early 2011. Capacity increases are also being planned at a number of existing plants.

The province plans to retire over the next 15 years a number of older coal plants whose current generation capacity amounts to 2 500 MW. It's expected that these units will be replaced by a combination of coal (mainly IGCC) and oil sands cogeneration plants, which will likely be powered by natural gas or bitumen.

A research and development project funded by the federal and provincial governments is providing EPCOR Utilities Incorporated and the Canadian Clean Power Coalition with a $33 million dollar grant that, if successful, could see a 500 MW IGCC plant in service as early as 2015.

Saskatchewan – Cost uncertainty and a demand growing faster than anticipated has lead the province to reconsider the coal-fired generation option and to instead opt for the natural-gas combustion turbine route for power generation.

However, earlier this year, SaskPower announced plans to refurbish and retrofit the existing Boundary Dam Unit 3 coal-fired plant to incorporate CO_2 capture technology. The refurbished unit will produce 100 MW as early as 2015.

Ontario – Concerns over coal's environmental effects are among the main reasons why the province has announced plans to retire by 2015, over 6 000 MW of coal-fired generation, which is the equivalent of approximately 20 per cent of its current generating capacity. To compensate for the loss of coal-fired power, the province is considering a number of options such as the return to service of a number of nuclear units at the Bruce generating station; the construction of a new natural gas-fired generation plant; an increase in energy from renewable sources; and the introduction of a "Conservation Culture" to mitigate future demand growth. Some coal-fired facilities, especially those fitted with scrubbers, could remain in service past the 2015 timeline as a back-up in case of potential delays in the in service date of the alternative power generation sources.

Nova Scotia and New Brunswick – Clean coal technologies can also be expected to play a role in New Brunswick and Nova Scotia over the next 20 years.

Observations and Implications

Coal-fired generation will remain a significant component of Canada's power production mix for years to come. On the other hand, coal faces challenges due to concerns about air quality, uncertainty about future GHG regulations, and competition from other sources of generation such as renewables, natural gas and nuclear.

Any forecast will be subject to considerable uncertainty until more is known about the direction of future GHG regulations, and the cost and reliability of new coal technologies. If carbon sequestration and storage proves practical, it would address a major concern about coal-fired generation and tend to promote the construction of new coal-fired power plants and associated CO_2 pipelines.