# Update

## Clean Coal Technology Program in the United States

The United States Congress is presently considering legislation to improve the quality of the air in that country. With the passage of a new act likely later this year, the US President announced at his meeting with the Canadian Prime Minister in Toronto, April 10, that an accord on air quality will be negotiated between their two countries as soon as possible. The standards and procedures finally agreed upon in the US legislation will be of great importance to Canada since about half the emissions leading to acid precipitation come across the border from our southern neighbour. Furthermore, the standards agreed upon for cars and trucks in the US will greatly influence regulatory decisions to be made here.

The steady progress made in the Clean Coal Technology Program of the US Department of Energy was an important element underpinning the new legislation. There is an important difference between the US and Canada with respect to sulphur emissions. In the US the leading source of sulphur emissions is coal combustion, while in Canada it is the smelting processes of the non-ferrous metals industry. In both countries the generation of electricity is the leading market for coal, accounting for over 80% of total consumption. Provinces such as Alberta rely on coal for much of their electricity (83.7% of all generation in 1988) as do Saskatchewan (76.2%) and Nova Scotia (67.8%), and coal is used for this purpose in Ontario (24.5%) and New Brunswick (11.7%). But there is also a major difference between the two countries in this domain: coal provided about 56% of electrical energy in the US in 1989 while the corresponding number for Canada was only 18%.

The original recommendation for a multi-billion dollar clean coal program came from the US and Canadian Special Envoys on Acid Rain. US envoy Drew Lewis and Canadian envoy William Davis, a former Premier of Ontario, were appointed in 1985 to study ways of resolving concerns between the two nations over the trans-boundary problem of acid rain. Among their recommendations was a call for a five-year $5 billion program to be funded by government and industry (shared approximately 50:50) in the US to demonstrate, at commercial scale, innovative clean coal technologies that were beginning to emerge from research programs both in the US and around the world. In March 1986 President Reagan endorsed the Special Envoys' recommendations and launched the $5 billion demonstration program, which built upon previous activities in the Department of Energy.

Rather than offering the $2.5 billion federal government share all at once, a sequence of competitions has been organized to administer the program. By conducting several rounds of competition, the US government hopes to attract the newest and best technologies that will become available as the program proceeds. President Bush, shortly after assuming office, confirmed the Clean Coal Technology Program's five-year schedule.

The Clean Air Act of 1970, as amended in 1977, in effect created two major categories of coal-burning power plants in the US: (1) those built before 1978, which typically have little pollution control equipment other than electrostatic filters and the like to control particulates, and (2) those built after 1978, which are equipped with flue gas desulphurization processes capable of removing 70-90% of the sulphur in the coal. Though much was achieved under these laws, ways were found to extend the lives of older stations longer than expected and it was never certain that such command directives were the

cheapest or most effective way of dealing with the problem.

The introduction of clean coal technology changes the picture in that, in many cases, emission reductions and cost improvements can be achieved simultaneously. The legislation currently before Congress permits the trading of emissions rights among utilities and others. Thus, rather than spend money on conversion or closure of an old plant with limited remaining useful life, utilities may opt to purchase emission rights from those willing to install new, highly-efficient facilities. The new technologies successfully address most emissions problems arising from the combustion of coal, with the exception of carbon dioxide. However, with improvements in conversion efficiency, less carbon dioxide will be emitted per unit of energy produced from coal. In contrast, the older add-on technologies involving flue gas desulphurization reduce station efficiencies, resulting in higher specific emissions of carbon dioxide. In the case of fluidized combustion, however, some additional carbon dioxide is released due to decomposition of the limestone used to capture sulphur in the coal.

The technologies assessed under the Clean Coal Program cover the whole field, ranging from such measures as cleaning the coal before combustion, capturing the sulphur during combustion or removing it after combustion, to the conversion of coal to a clean gas or liquid such that the direct combustion process is bypassed altogether. The main technologies under study include improved burners to reduce sulphur and $NO_x$ emissions, different classes of fluidized bed combustion and integrated-combined cycle power generation.

It remains to be seen how quickly new technologies will be adopted by the utility industry. However, the existing generating facilities are aging, no new nuclear plants have been ordered for 17 years and the demand for electricity is now rising. Some of the new coal technologies will be ready for deployment in time for another round of utility expansion expected in the mid-90s.

In Canada, Ontario Hydro has decided to install flue gas desulphurization equipment at some of its coal-based generating stations and, along with TransAlta Utilities Corporation of Alberta and the Coal Association of Canada, is studying combined-cycle generation (see item below: "Renewed Interest in IGCC Generation"). Several utilities have studied improved burners. Nova Scotia Power Corporation has announced its intention to build a circulating fluidized bed combustor of 165 MW(e) capacity at Point Aconi in Cape Breton, at a cost of $436 million, following a 20 MW(e) demonstration of this technology conducted at Chatham, NB in facilities of the New Brunswick Electric Power Commission. This new facility, now to be the subject of an environmental review, will be the first major application of the advanced coal-to-electricity processes in Canada.

## Ontario Hydro Receives Surprisingly Strong Response to Proposals for Non-Utility Generation

In its report, *Providing the Balance of Power*, released in December 1989, Ontario Hydro has estimated it could obtain 1600 MW of power from private sources by 2014, as compared to the 70 MW the utility presently purchases from over 30 private sources across the province. In response to a call for proposals, firm bids have been received from private developers for more than 6500 MW — much more than had been estimated and over twice the output of the new $12 billion Darlington nuclear station. The predominant fuel source chosen by the private operators is natural gas, though some rely upon landfill gas, peat and municipal waste together with other biomass sources. Many are applications that involve cogeneration, in which heat in the exhaust of gas turbines is recovered for heating and industrial uses. In this mode of operation, the recovery of fuel energy can be very high: as much as 80% in favourable cases, as opposed to the 30-40% recovered in conventional generation.

Though not all the proposals will prove feasible, it is clear that more energy can be obtained from these sources than previously expected and it may thereby be possible to delay to some extent the proposed new round of nuclear plant construction. Natural gas prices are likely to increase over the coming decade, but this effect may be somewhat cushioned by the higher efficiency of total energy use in these operations. Considerable quantities of natural gas will be consumed — possibly as much as an additional 200 billion $ft^3$/year. This market thus offers a new domestic opportunity for natural gas, in addition to the growing exports to the US often directed to the same application. The surprising response to this call for proposals suggests that Ontario is entering a new era in electrical generation.

## First Regular Oil Production Planned from Offshore Nova Scotia

Petroleum exploration off Nova Scotia has been underway since 1967. With 125 wells drilled, there have been significant discoveries of natural gas and more limited quantities of oil. A development plan has now been filed to bring two of these oil pools — Cohasset and Panuke — into production by the summer of 1992, from two rigs at a maximum rate of 30,000 barrels/day. Thirty-five million barrels of oil are expected to be recovered over the six-year life of the two fields, and will be delivered to shore in shuttle tankers.

Also, over four trillion $ft^3$ of natural gas have been discovered in the Sable Island region and, though development has often been delayed, there is now renewed interest in this potentially important source of energy for the province. In the meantime, discussions are continuing between industry and governments with the aim of bringing the larger fields off Newfoundland, especially Hibernia, into production in the mid-1990s. These latter negotiations are now expected to be completed during the summer of 1990.

## National Energy Board Drops Use of Benefit-Cost Analysis

On March 15, 1990, the National Energy Board announced its decision to stop using benefit-cost analysis as a factor in determining whether proposed natural gas exports are in the public interest. Benefit-cost analysis was one of the tools used by the Board in its Market-Based Procedure for licensing gas exports.

Three categories of factors are examined by the Board in public hearings in order to determine whether to grant a licence for the export of gas. The first two categories — the Complaints Procedure and the Export Impact Assessment — will continue to be used to assist the Board in determining whether the exports are surplus to Canadian needs. The third category — called public interest determination — is intended to include all other factors considered relevant by the Board. The Board will continue to examine export contracts to assure itself that they have commercial substance and are likely to be durable over their term. The Board emphasized in its decision that the benefit-cost analysis was not related to the determination of quantities of gas that are surplus to reasonably foreseeable requirements for use in Canada as specified under Section 118 of the NEB Act.

In 1989, several proposals to export gas, mainly to fuel cogeneration facilities to be located in the eastern US, were denied on the grounds that they were not of benefit to Canada. These decisions were challenged by both the producing industry and the Province of Alberta as interference in the recovery of the industry and not in the spirit of the Free Trade Agreement.

In a related matter, the Board is considering a major proposal by TransCanada Pipeline Company to expand its facilities to transport these export volumes to the eastern US. The question at issue is how the costs of this expansion will be reflected in the toll structure. The original intention was to roll these costs into the present rate base. This proposal has been challenged on the grounds that Canadian consumers of gas in the east will be in part underwriting these additional exports.

Whatever the Board does will now be highly controversial. By approving exports previously denied as failing the benefit-cost test, critics can claim gas will be exported without any real gain to Canada. No matter how the pipeline toll structure is defined, there will be those who will claim rate increases to Canadians are due to the increased exports.

It is noteworthy that no explicit estimate of the quantity of natural gas required in Canada over-and-above present projections has yet been made for dealing with restrictions on the consumption of the fossil fuels due to the 'greenhouse effect.' It is also not clear that the additional gas required for non-utility generation in Ontario (now greater than previously thought) has been explicitly considered by the Board.

## New Commission and New Data from the World Energy Council

The World Energy Council, with 90 member countries the main non-governmental international body active in the energy field, has established a new Commission, 'Energy for Tomorrow's World.' It is to identify strategies and make recommendations on how adequate, sustainable energy can be supplied optimally worldwide, while achieving an appropriate reconciliation between the needs for environmental protection and global economic development. This Commission aims to

complement the work of the United Nations World Commission on Environment and Development, to indicate how the legitimate aspirations for economic growth and their related energy demands throughout the world can best be met, given local, regional and global restraints. The report of the Commission will contain balanced objective facts drawn from energy operatives and international experts in the fields of environmental protection, energy conservation, energy technology, finance and economics. It is expected that Canadians will be active in this study.

The Council has now published the first edition of its composite *International Energy Data Report,* which includes the National Energy Data Profiles from some 50 WEC Member Countries. This authoritative edition of the *Report* encapsulates in brief and convenient form the energy structures of these countries, from local and imported primary energy production, to secondary energy production and total national consumption and, finally, to energy exports. Copies may be obtained from the CANWEC Office, Suite 305, 130 Albert St, Ottawa, Ont, Canada K1P 5G4 ($40).

## Renewed Interest in IGCC Generation of Electricity from Coal

The Canadian Electrical Association, in cooperation with Energy, Mines and Resources' CANMET group and Environment Canada, held a meeting in Montreal March 29-30 on 'Canadian Perspectives on IGCC.' (IGCC stands for 'integrated-gasification combined-cycle.') Sixteen papers were presented at the meeting, attended by 109 people interested in this emerging technology. Copies of the Proceedings may be obtained from the Association's offices in Montreal.

In IGCC technology, coal (and sometimes other fossil fuels) are first gasified, then the purified coal gas is used to fire a gas turbine. In one of the more important cycles, the heat left in the exhaust gas of the turbine after expansion is recovered to supply energy to a steam cycle. Two factors of major importance in supporting this technology are that (1) impurities such as sulphur are generally easier to remove under reducing conditions (as opposed to the oxidizing conditions obtaining in combustion processes), and (2) there has been steady improvement in the size, reliability and efficiency (via high allowable entry temperatures) of modern gas turbines.

In IGCC processes, typically about one-half the energy is generated by the gas turbines and the other half in the steam cycle. Although gas turbines have been increasing in size (typically 50-200 MWe, with the largest about 150 MWe), they are still small enough to be installed rapidly (in about three years) to allow growing but unpredictable loads to be met in incremental steps.

The complete facility can also be built in stages. It is possible to start with a turbine fuelled by natural gas for peak load and emergency service, to which a heat-recovery steam cycle could be fitted later. As electrical loads grow and the price of natural gas increases, the more costly coal gasification equipment could then be installed. This flexible aspect, along with the higher conversion efficiency and lower emissions of both acid and greenhouse gases as compared to many other options, make IGCC technology a prime candidate for the clean production of electricity from coal within this decade.

All the utilities that now use or may use coal for the generation of electricity in Canada are carefully monitoring developments in this field. Major studies of the idea are underway, by TransAlta Utilities Corporation of Alberta and The Coal Association of Canada, as it applies to the plentiful low-cost surface mineable coals of the west. Ontario Hydro, in its recent report, *Providing the Balance of Power,* foresees a place for this technology in Ontario.

The main issues to consider revolve around the choice of gasifier (there are several competing designs), whether to use air or the more expensive oxygen, and the rate of progress in turbine design, the limits of which set the overall efficiency possible in the process. Ultimately, it is anticipated that methods will be found to clean the coal gas without the necessity of an intermediate cooling stage to improve further the economy of the system.

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