Canadian Electricity and the

environment

Electricity and Climate Change ●

Towards a Sustainable Future

February 2002
Canadian Electricity Association

Contact: Ann Perelmiter, 613-230-9263
perelmiter@canelect.ca

This paper was prepared by the Canadian Electricity Association with the assistance of Ellen Battle of Ellen Battle Consulting Inc. and Michael Margolick of Global Change Strategies International Inc.

Canadian Electricity Association
Association canadienne de l'électricité

Introduction

Following completion of the details of the Kyoto Protocol in Marrakech in November 2001, Canada will likely move in 2002 to consider the Protocol's ratification and possible implementation. In a letter to the Joint Ministers of Energy and Environment in September 2001, the CEA urged Ministers to move expeditiously on consultations to allow a full and careful evaluation of the potential consequences of Canada's pursuit of its Kyoto commitment in advance of a decision on ratification.

The Kyoto target to reduce national Greenhouse Gas (GHG) emissions by an average of 6 percent below 1990 levels during 2008-12 remains a difficult challenge for Canada. With just six years until the beginning of the first commitment period, Canada is still on a GHG emissions path that exceeds the target by more than 25 percent. Moreover, the withdrawal of the United States from the Protocol means that domestic action would place Canada at a cost disadvantage relative to its major trading partner.

In this paper, CEA frames the issues for electricity in the Kyoto ratification debate. The purpose is to enhance understanding of the costs of measures to reduce electricity GHG emissions, the size of emission reductions that can be achieved within the Kyoto timeframe, and the impacts on Canadian consumers and the economy.

In addition, this paper presents CEA's proposed framework to move Canada toward a low emission electricity future.

The discussion draws on several sources, including work by the Analysis and Modelling Group (AMG) for the National Climate Change Process (NCCP), updated industry-government modelling under the auspices of the Electricity Covenant Group, and various CEA reports. The latter group includes a comprehensive Bird's-Eye View of Electricity Supply and Demand to 2020 ("BEV") (GCSI 2001a) that builds on forecasts by Natural Resources Canada for the AMG (CEOU 1999), by the National Energy Board (NEB 1999), and by the independent consultant HALOA, Inc. (HALOA 2000).

Summary

The prevailing analysis from the NCCP suggests that the electricity sector could achieve significant low cost emission reductions, far exceeding those of any other sector of the economy. However, this analysis does not take into account important political, financial, physical and technological constraints under which the industry operates. Because of these constraints, the availability of actual low cost reductions in the Kyoto time frame is very limited. A policy that seeks to force substantial near term reductions risks creating significant costs to Canada, especially if the US does not take a comparable level of action.

A more economically and politically affordable approach would combine a long-term framework with both near and long term action. CEA and its members are committed to working with governments to develop, refine and implement a long-term policy for a sustainable electricity future. Such a policy should encompass all fuels and technologies, it should take account of the full range of environmental issues, and it should address issues of regional equity. The policy should include a framework for the practical turnover of capital stock and steadily improving emissions performance. It should also be supported by measures to encourage the accelerated development and deployment of low emission technologies, investment in transmission facilities, and increased energy efficiency.

Electricity, the Economy, and the Kyoto Protocol

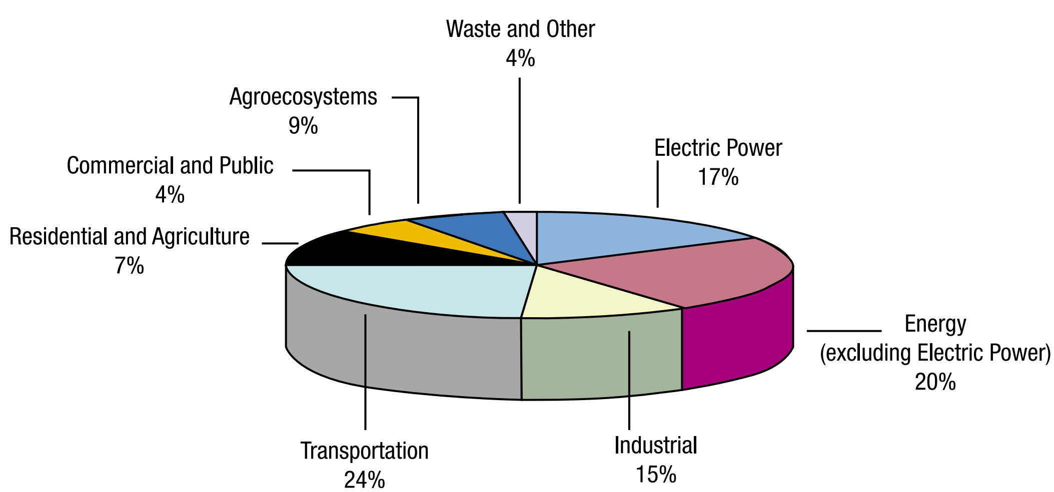
Electricity and Kyoto

The electricity sector is a significant contributor to GHG emissions (Fig. 1). Electricity production currently accounts for about 17 percent of human-induced GHG emissions in Canada (Environment Canada 2001). In comparison, it makes up approximately 34 percent of total US emissions (US DoE 2001). This difference reflects Canada's relatively low GHG-emitting generation mix, which includes substantial hydroelectric and nuclear power. Nevertheless, electricity, together with transportation and other energy industries, is one of Canada's fastest-growing emission sources.

The industry has both taken and proposed significant action to limit GHG emissions growth. Canadian electricity generators have already made gains in areas such as low-emission technologies, energy efficiency, emerging renewable power, and emission offsets. CEA and its members continue to work closely with federal and provincial agencies to implement other measures outlined in *Canada's First National Climate Change Business Plan* (Joint Ministers 2000). For example, CEA has pursued joint efforts with government on consumer education and emerging renewable technologies. CEA supports the initiative of several of its members, who, through the Canadian Clean Power Coalition (CCPC) have proposed an industry-government partnership to research, develop and demonstrate commercially viable clean coal technology including the capture and storage of CO_2. In Manitoba and Quebec, important progress has been made towards achieving aboriginal partnerships supporting the development of new hydro. Despite these efforts, continuing economic growth generates emissions growth, so that achieving substantial further gains in GHG emission reduction during 2008-12 will be a difficult challenge.

The results from the AMG modelling for the NCCP point to a heavy reliance on the electricity sector to meet Canada's GHG reduction target under the Kyoto Protocol. Both the modeling completed in 2000 and more recent AMG presentations suggest that in an economy-wide, least-cost response to reaching the Kyoto target, based on domestic action alone, the electricity sector would be expected to

Figure 1:
1999 Canadian GHG Emissions by Sector
Total - 700 Megatonnes of CO_2 equivalent



Source: Canada’s GHG Emissions 1990-1999, The Green Lane, Environment Canada contribute the largest absolute and proportional emission reductions – between 40 and 60 percent of the total required to meet the target. In the lower (40%) case, electricity emissions would reduce by approximately 80 Mt from Business as Usual (BaU), or about 50 percent below 1990 levels. In the modelling, these reductions are anticipated to occur largely from retirement of coal-fired plants and their replacement by natural gas, new hydro and increased inter provincial electricity trade and CO_2 capture and storage in the Prairies.

In reality, political, financial, physical and technological factors constrain the amount of domestic emission reduction that electricity producers can achieve within the Kyoto timeframe.

- According to AMG model runs, coal-fired generation could fall by up to 75 percent, with typical declines in the 50 percent range (HALOA 2000, Jaccard 2000)[1]. Such a result would need to come from significantly accelerated retirement of existing capital stock. This would result in stranded investment costs to be borne by customers and shareholders, and disruption of still fragile, emerging competitive markets. Further, it would imply that Western Canadians, in particular, would deny themselves use of by far the most competitive generation option available.
- Model runs indicate that hydroelectric generation could increase by about five percent, or the equivalent of 3,500 to 4,000 MW at typical plant capacity factors (AMG 2000). While such levels are consistent with current utility planning, it is by no means clear that all such developments will be realized in the Kyoto timeframe or that they will displace Canadian GHG emitting generation. Political issues and long planning and construction periods currently hinder the development of both large hydro projects and related transmission support. In the absence of the construction of substantial new east-west transmission capacity, much of the new power will serve export markets.
- Various model runs show CO_2 capture and storage of between 27 and 43 Mt, representing approximately 45 percent of the electricity sector's total emission reduction. While capture and storage remains a key option for the longer term, technology for the capture of CO_2 from commercial operations and its subsequent storage are yet unproven. Critical parts of the technology must still be demonstrated on a large scale and estimated costs are relatively high at $35-50 per tonne of CO_2 captured. (Reeve 2000) at the current stage of development. In short, although full scale testing is scheduled to occur in the 2008-2012 time frame, full commercial operation across the industry – and therefore significant emission reductions – is not practicable in the Kyoto timeframe.

Electricity in the Economy

Electricity generators must consider multiple challenges when framing any climate change response. These challenges include demand growth, industry restructuring, the fundamental role of reliable, affordable electricity, long lead times for capital replacement and technology development, diverse regional circumstances, and growing integration with the US economy.

Substantial new electricity supplies will be required to meet demand growth and replace retiring plants, so that GHG emissions could be much higher than 1990 levels by 2010. The CEA report, BEV, indicates that electricity demand will continue to grow faster than population, but slower than the economy averaging 1 to 1.5 percent per year

[1] The 75% decline is from HALOA, Inc. (HALOA 2000), Table 6-27, Path 3 compared to 2010 BAU. The 50% range is from HALOA, Inc. (HALOA 2000), Table 6-27 and Jaccard and Associates (Jaccard 2000), Tables 5-7 and 5-8.

through 2010 and beyond (GCSI 2001b). Further energy efficiency gains are achievable, but will be difficult to realize. Even significant demand-side efforts might hold demand growth only toward the lower end of the 1 to 1.5 percent range.

In total, an estimated 200 Terawatt hours (TWh) of energy generation, or 35 percent of existing supply, will need to be added between 2000 and 2020. Of this, approximately half would be new supply to meet new domestic demand. Any export growth would be over and above this estimate.

According to the three forecasts discussed in the BEV, electricity's GHG emissions could exceed 1990 levels by 20 to 30 percent by the end of the decade[2]. More recent analysis (HALOA 2001) suggests that the sector's GHG emissions in 2010 could be as high as 44 percent above 1990 levels, because of the favourable economics of coal plant life extension and of new coal capacity.

Electricity is fast becoming a business like any other, competing in open markets for customers and capital. By mid-2002, two provinces, representing half of Canadian consumers, will have full retail competition; several other provinces have acted to separate generation and transmission and to introduce competition in wholesale markets. While electric utilities have traditionally recovered costs through regulated rates, the move to increased competition means that the pass through of costs is more difficult. In such an environment, producers will be compelled to remain cost competitive if they are to survive. Among other effects, competitive markets will create hurdles for low GHG options, like hydro, nuclear, and wind power that are also capital-intensive.

At the same time, secure, reliable electricity supplies are increasingly important. Canadians continue to expect reliable, reasonably-priced, electric power to drive both the "new" and resource based economies. Because electricity costs directly influence the competitiveness of other industries – particularly the electricity-intensive industries that are the foundation of Canada's export sector – the electricity sector remains an important underpinning of the Canadian economy. The "new" economy, with its emphasis on information and communications, is increasingly dependent on both reliable electricity and the integrity of the electrical infrastructure. For these reasons, security of supply, reliability, and power quality are gaining in priority.

A transformation of the electricity sector to significantly reduce GHG emissions is a long game, requiring 20 years or more. The electricity industry is characterized by a very long-lived capital stock, with extended lead times required to bring into service some forms of new generation and associated new transmission lines. Low-emission options, like hydro and nuclear generation, may take up to a decade to plan and build. The same is true for high-voltage transmission lines.

Costs for small-scale distributed generation and options, like wind energy, continue to decline, but substantial market penetration will take time. As well, such options have their own inherent limitations. Wind will be limited by both its intermittent character and high transmission costs. Distributed generation faces technical and management hurdles and, in any event, does not entirely avoid GHG emissions.

Rapid changes that run ahead of emerging technology development and the economic capital stock replacement cycle would have large and divergent regional impacts. Given the diversity of supply and demand across Canada, regional equity issues are more pronounced for electricity than for any other sector. Part of this regional diversity reflects variations in electricity industry ownership and other institutional factors that can be altered, but most is due to fixed natural resource endowments. The difficulties within the electricity sector of meeting Kyoto

[2] This range is taken from: a MARKAL model run dated April 3, 2001 (Table 1, CEOU 1999); and a National Energy Board Report (NEB 1999, p. 99 (average of Cases 1 and 2).

targets on a national basis are greatly magnified in several regions.

In the integrated North American marketplace, an unequal environmental burden on Canadian competitors could lead to emissions, as well as economic, displacement. An uneven playing field between jurisdictions can result in "environmental arbitrage", where generation seeks the least-restrictive jurisdiction, thereby penalizing more restrictive ones with economic losses. While electricity has not traditionally faced external competition, this is rapidly changing with the move to open markets. If Canada, under the Kyoto Protocol, were to take stronger action on climate change, then emissions and economic benefits might be simply displaced to the US.

Shaping a Long-Term Response

The Context for a Sustainable Policy

To recap, for electricity to contribute substantially to a Canadian Kyoto commitment:

- It would require expensive early turnover of capital stock and a high reliance on natural gas, with the attendant increased risk from price volatility.
- It would require the development of low-GHG sources, including conventional large hydro and related transmission facilities at a faster pace than can be reasonably assured, given the financial and regulatory hurdles currently limiting such development.
- It would require the development of commercially viable CO_2 capture and storage technologies both sooner and on a larger scale than the current knowledge can ensure.

In short, even if immediate action were taken to alleviate the barriers to new capacity and to speed up the introduction of new technologies, the relatively short time to the Kyoto commitment period precludes large, practicably achievable, physical emission reductions from electricity. Forcing the change that may be achievable would entail both near term and long term costs, which merit careful reflection before any action is taken.

Offsets are an important element of an emission reduction strategy in the short- and medium-term, and one that has been embraced by the electricity industry, however, despite Canada's considerable success in the negotiations at Marrakech, offsets cannot be regarded as a panacea. Most Canadian utilities have adopted mitigative strategies that encompass both technological change and the use of offsets including use of credits and trading as support to the financing of technology development and capital stock renewal. However, there is great uncertainty surrounding the use of offsets, leaving potential investors at considerable risk.

Domestically, the absence of government policies on credits and emissions trading creates a disincentive to the development of effective offset strategies and the emergence of an effective and efficient credit market. Internationally, there remain great uncertainties about what will qualify as a legitimate offset, about the availability of offset tonnes and about their costs, including transaction costs. At this stage the most prudent assessment (see Reinstein 2001) would suggest that Russia will exercise its considerable market power in credit markets, drive hard bargains and maintain costs at a relatively high level. The availability of CDM credits will have limited mitigating effect because of their high transaction costs. If relatively high-cost offsets must be purchased to make up the bulk of the required emission reductions, then the opportunity costs of offsets (such as foregone investment in new technology development) may be excessive

In summary, a short term response to Kyoto carries substantial economic and political costs that could be significantly mitigated in the longer run as technology development and capital stock replacement increasingly

assist the effort.
The following are key principles and elements of a policy for a long-term sustainable electricity future, as envisaged by CEA and its members.

Principles of a Sustainable Electricity Policy

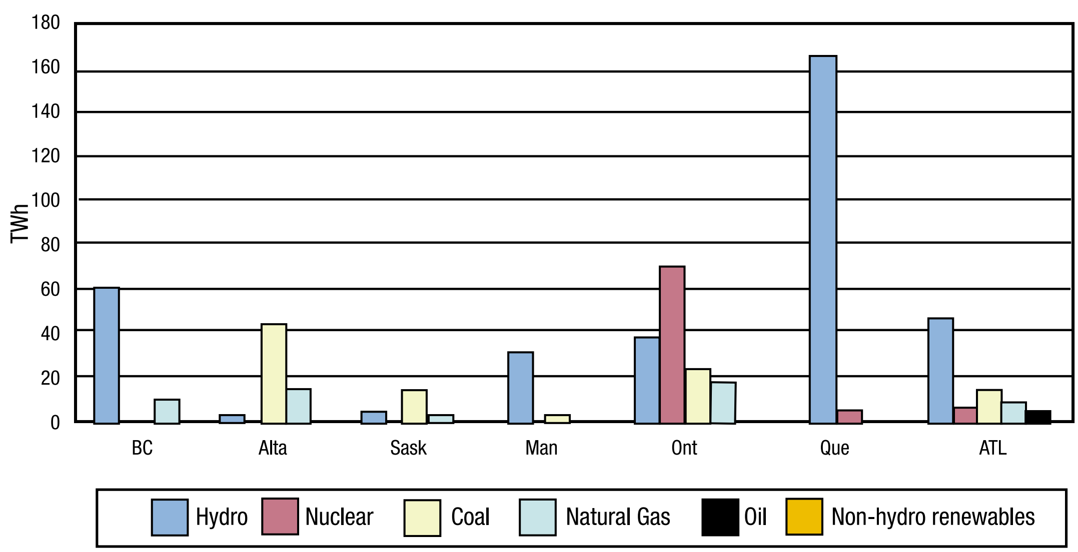
No fuel or technology can be overlooked in a plan for a sustainable electricity future. Canada will need to call on the full range of options – traditional, emerging, and future new, technologies – in the coming decades. The focus should be not on the merits and faults of different fuels and technologies, but on ways to continually improve the GHG and other environmental performance of all of them.

For example, in any scenario involving a very low carbon future globally, it is not possible to exclude nuclear power. Likewise, coal is too abundant, cost-effective, and secure, to be eliminated on a global basis. A sound strategy would strive for a low-emission coal future, rather than trying to force it out of the market.

As a corollary, no single technology or fuel offers a panacea for new supply and emission reduction. For example, a large-scale shift to natural gas would expose Canadians to increased fuel price volatility. While wind is becoming an increasingly economic option, several factors such as intermittency and constraints on location will limit it to only a modest percentage of the overall mix. Fuel price variations, environmental issues, regional diversity, and other considerations, combine to make a multi fuel, multi technology strategy most prudent.

A diverse generation mix that is grounded in regional resources and opportunities, and backed by robust transmission and distribution systems, will best serve the needs of Canadians in all regions for reliable, affordable low environmental-impact electricity. There is a great variety in the regional distribution of Canada's electricity resources, with a diverse mix in Ontario and the Atlantic provinces, dependence on low-cost coal in Alberta and Saskatchewan, and on hydro in British Columbia, Manitoba, and Quebec (Figure 2). These historical strengths should remain as foundations for the future.

Figure 2: Canada's Generation Mix in 2000



Source: The *BEV* Report (GCSI 2001)

Regional equity and efficiency must be carefully considered, not only in distributing the burden of a GHG target, but also in determining the timing and path of emission reductions. The ability of emitters in individual provinces to meet an allocated emission target will depend on available resources, economic growth, the age of GHG-intensive plant, and other factors, like investment barriers and access to lower emission supplies from elsewhere. For GHG policy that is cost-effective and politically viable, regional diversity should be taken into account in the timing and trajectory of emission reductions, as well as in the allocation of obligations.

The policy should also adopt a comprehensive, multi-pollutant approach to emission reductions. The electricity sector will reduce NO_x, SO_2, PM and mercury emissions consistent with regulatory targets and timetables. To the extent that these regulatory policies can be coordinated with each other and with a climate change response, both costs and investment risks can be reduced.

Elements of a Sustainable Electricity Policy

Emissions Performance Equivalence Standard

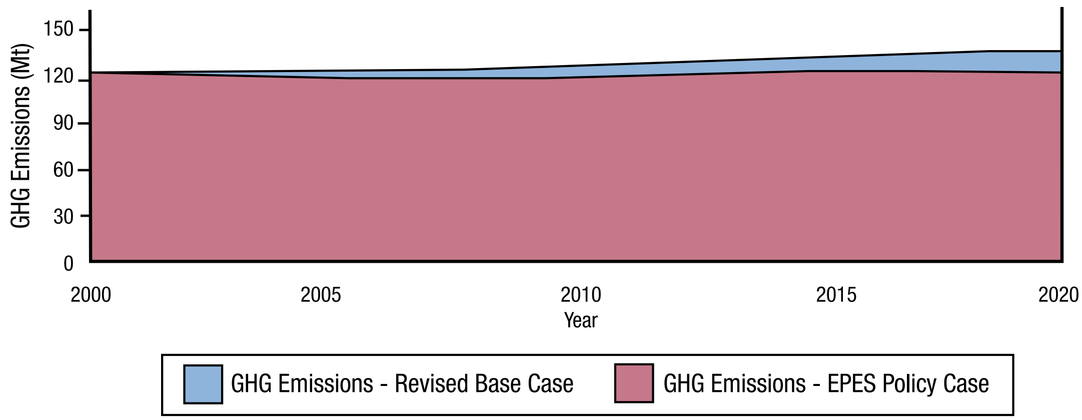
The electricity industry and governments are investigating the opportunities for basing climate change actions on a negotiated agreement or covenant between governments and the electricity sector (CEA 2001a). Federal and provincial governments identified sector agreements and performance standards as a potential action in Phase 1 of Canada's First National Climate Change Business Plan (Joint Ministers 2000). Industry covenants have been used extensively in Europe, Japan, and other jurisdictions to develop negotiated, yet binding, environmental commitments in lieu of regulation. The Pew Center for Global Climate Change has suggested, as part of a domestic US response, agreements under which industry would commit to significant reductions over a 20-year period. This "would allow companies to move forward with substantial capital investments". (PCGCC 2001)

In this context, CEA and most of its member utilities have proposed an "Emissions Performance Equivalence Standard" (EPES). Under the CEA's proposal, starting in 2008, all participating utilities would reduce to a specific standard (or better), their net emission rates from oil and coal-fired thermal units that have reached their 40 year anniversary (of commercial start up). The standard is currently defined to be that of a combined cycle natural gas turbine (CCGT). This performance standard would be achieved by investing in capital equipment or purchasing offsets. Net emission rates from all new generation would have to meet the same standard and new generation exceeding the standard would earn emission credits. Ahead of 2008, expansion plans for Alberta's Genesee and Keephills coal plants are consistent with EPES, since both projects are committing to offset the respective emissions to CCGT equivalence. Applying the "40 year anniversary rule" of EPES produces electricity generation GHG emissions that are always less, over the modelled period, than the emissions from the Base Case (revised to include the option of Coal Life Extension). The difference between the EPES Policy Case and the Base Case (revised) increases with time beyond the first Kyoto commitment period (Figure 3)[3].

CEA views such a negotiated arrangement, based on the principles of a performance

[3] The addition of the Coal Life Extension Technology (LET) option revises GHG emissions upwards from the AMG baseline, since LET becomes the least cost option for generation when a plant reaches its 40th anniversary. Under EPES, GHG emissions are reduced as existing plants are replaced by natural gas systems or offset to the CCGT emissions standard at their 40th anniversaries (Figure 3). The difference increases with time as a greater production shift to gas and other low GHG options occurs under the EPES Policy Case.

Figure 3: GHG Emissions 2000 - 2020



standard and the link to the life of capital stock as essential foundations for the proposed policy framework. Other policy components would provide support as outlined below. These include stronger efforts in investment policy, technology development, and energy efficiency.

Policies to Promote Investment

Policy action is required to encourage investment in new generation, transmission, and distribution as well as emission offsets. The BEV report indicated that, unless there is significant new investment in both generation and transmission, already tight supply-demand balances in several regions will worsen, and more comfortable margins elsewhere will disappear. The following are the key areas for action:

Tax structures must be continually examined to ensure that they reflect economic lives of assets, environmental requirements, and competitive conditions between Canada and the US. Although crown corporations are still the dominant form in Canada's electricity industry, under restructured markets, more and more capital will come from private investors, who require returns that are competitive with alternative investment opportunities. In this respect, tax treatment will be an important issue in a deregulated environment, especially where Canadian generators compete directly with US producers. Improvements to the tax system could include capital cost allowances that better reflect the useful economic lives of plant, and increased incentives for emerging technologies. The US electricity industry is calling for similar provisions for enhanced accelerated depreciation and other modifications to the tax code (EEI 2001).

Incentive rates of return are required to cover higher transmission risks in today's marketplace. Market restructuring has exacerbated the challenges of transmission planning by severing organizational links between generation and transmission. It can take as much as 6 to 10 years to design and construct a major transmission line and less than two years to bring a new generator, like a CCGT, into service. This, in turn, has created higher risk for transmission planners and operators, which is not captured in the current rates allowed by regulators. Transmission systems are either already constrained, or soon expected to be so, in several regions of the country (GCSI 2001c).

Governments also need to work together to streamline regulatory approvals, including those for cross-border transmission in order to ease existing bottlenecks. Complex, lengthy approval processes and inter jurisdictional issues hinder investment in new hydro and nuclear resources, and in major new transmission systems. Such large-scale projects typically involve protracted discussions and negotiations with communities affected by them. There are particularly complex issues at play related to First Nations claims and to environmental impacts. These issues must be appropriately managed so they will not restrict the development of more efficient, and lower-emitting, generating capacity and the attendant transmission infrastructure.

Irrespective of the ultimate decision on Kyoto, Canada is in a position to develop a comprehensive program of market mechanisms under rules compatible with those of our international partners including forestry and agricultural sinks, other offsets and emissions trading. Such a program could be readily reconciled with the framework of a negotiated covenant described earlier. Several Canadian utilities are leaders in the field of offsets and trading and CEA members seek opportunities to contribute to the formulation of the program.

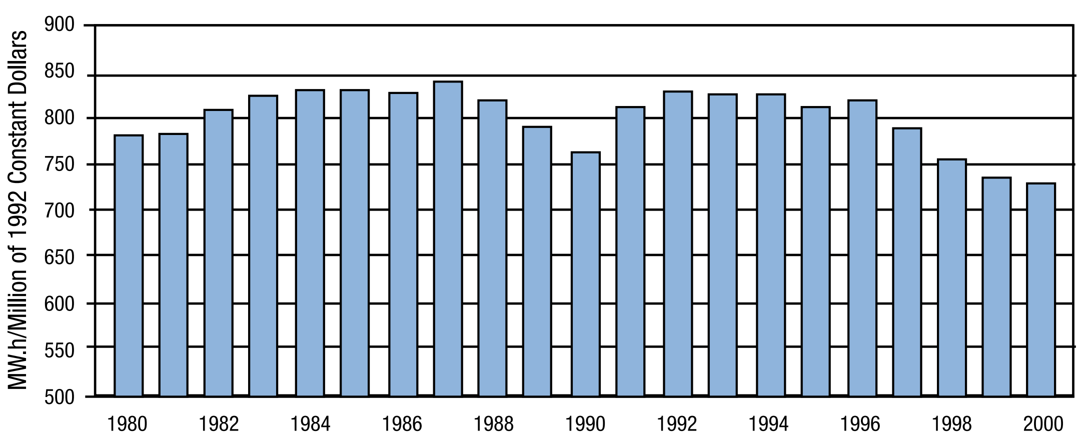
New Technology Development

The development and deployment of new, lower GHG technologies must be supported in a systematic and coordinated way in both the near- and long-term. A policy for a sustainable electricity future will hinge not only on rationally transforming the capital stock, but also on developing and implementing technologies that, over time, can substantially reduce the sector's GHG intensity. Concerted effort on technology development built around public/private collaboration is necessary immediately to obtain the payoff in 15 to 20 years.

The electricity sector needs affordable technology, which will require a large investment in research, development, and demonstration (RD&D), as well as time to develop and deploy the technology in the normal capital turnover cycle. Technology investments should focus on energy efficiency, emerging low-GHG generation sources, clean coal, and ongoing improvements to the environmental performance of all technologies.

A number of promising technologies have potential for cost-effective GHG reduction. Wind costs are approaching economic levels. Costs are also falling for small-scale, distributed generation (e.g., fuel cells), which could eventually reduce transmission and distribution requirements. New semiconductor technology can increase effective transmission capacity without the

Figure 4: Canadian Electricity Consumption per GDP, 1980 to 2000



Source: The *BEV* Report (GCSI 2001)

need for new lines. In addition, there is active research underway in clean coal technology, including the extraction and geological storage of CO_2.

Increased Energy Efficiency

Electric utilities and governments should partner to augment the effectiveness of their energy efficiency programs. Utility demand-side management (DSM) and government energy efficiency programs have contributed to the slow reduction in the electricity intensity of the Canadian economy over the past decade (Figure 4). While the limitations of promoting energy efficiency in the absence of a strong price signal cannot be ignored, economic opportunities remain, which can be achieved through reducing institutional barriers and transaction costs.

Although utility activity in DSM has diminished under market restructuring, retailers have niche market opportunities to sell energy management services, along with electricity. Government efforts on energy efficiency standards, information programs, and incentives could be complemented by stronger government/ industry partnerships.

Conclusion

The challenge for Canada's electricity sector is to manage GHG emissions efficiently and equitably, while providing affordable, reliable electricity to Canadians. Any fundamental transformation of the electricity sector, in other words, any sustainable transformation, must rest on the long-term nature of capital stock and technological change and will occur well beyond the Kyoto commitment period. Electricity has made major strides over several decades in the improvement of its environmental performance through constant incremental change – all the while also meeting the economic and social needs of Canadians.

This paper has outlined a framework for a flexible, comprehensive, and long-term response to climate change by the electricity sector that is consistent with this track record.

- It is founded on a realistic assessment of the political, financial, and technological constraints binding on the sector.
- It puts a focus on longer-term GHG emission reductions while still achieving near-term gains.
- It ensures objective consideration of all fuels and technologies and regional equity issues.

The framework entails action both now and over the long run:

- It proposes an emissions performance standard for the practical turnover of capital stock, combined with an emissions trading incentive for low emission generation development.
- It outlines taxation and regulatory policies to encourage new investment, development of low emissions technology, and targeted measures to enhance

References and Support

AMG 2000. *An Assessment of the Economic and Environmental Implications for Canada of the Kyoto Protocol.* Analysis and Modelling Group, National Climate Change Process. Ottawa. (November). p. 34 http://www.nccp.ca/NCCP/pdf/AMG_finalreport_eng.pdf

CEA 1999. *Emissions Performance Equivalent Standard: A Proposal by the Canadian Electricity Association.* Ottawa: CEA, October.

CEA 2001a. *Electricity Covenant Group Report.* Canadian Electricity Association. Ottawa. (September)

CEA 2001b. *Investing in Canada's Energy Future: Brief to the Council of Energy Ministers*. CEA, September.

CEA 2001c. *Canadian Electricity and the Economy; Developing a North American Energy Perspective.* Ottawa: CEA, May.

CEOU 1999. *Canada's Emissions Outlook: An Update. Analysis and Modelling Group, National Climate Change Process.* Ottawa. (December) http://nrcan.gc.ca/es/ceo/update.htm

EEI 2001. *National Energy Policy: Let's get it right.* Edison Electric Institute. Washington, DC. (September) http://wwweei.org/issues/comp_reg/nep/NEP_brochure.pdf

Environment Canada 2001. *Canada's Greenhouse Gas Emissions 1990-1999.* The Green Lane. Environment Canada. Ottawa. (July) http://www.ec.gc.ca/press/2001/010711_xsl_e.htm

EPRI 2000. *Energy-Environment Policy Integration and Co-ordination Study.* Electric Power Research Institute. Palo Alto, CA. Report 1000097. (December)

GCSI 2001a. *A Bird's-Eye View of Electricity Supply and Demand to 2020.* Global Climate Strategies International, Inc., Report Prepared for the Canadian Electricity Association. Vancouver. (July)

GCSI 2001b. *ibid*., p. 11

GCSI 2001c. *ibid*., p. 19

GCSI/HALOA 2000. *Estimating the Effect of the Emissions Performance Equivalence Standard (EPES) using the MARKAL model.* Global Climate Strategies International, Inc. (Ottawa) and HALOA, Inc. (Montreal). (September)

HALOA 2001. *MARKAL Modelling: Baseline Results Summary.* HALOA, Inc. Report Prepared for Natural Resources Canada. Montreal. (December (Revised)). Table 1

HALOA 2000. *Integrated Analysis of Options for GHG Emission Reduction Using MARKAL*. HALOA, Inc. Final Report for the Analysis and Modelling Group of the Canadian National Climate Change Implementation Process. Ottawa. (May 12) http://www.nccp.ca/NCCP/pdf/AMG_markalreport_eng.pdf

Harrison 2001. *Fueling Electricity Growth for a Growing Economy*. David Harrison, Jr. and Todd Schatzki. National Economic Research Associates (NERA). Report Prepared for the Edison Electric Institute. Washington, DC. (January) http://www.eei.org/future/fuel_diversity/nera_book.pdf

Jaccard 2000. *Integration of GHG Emission Reduction Options using CIMS.* Report Prepared for the Analysis and Modelling Group, Climate Change National Implementation Process. M.K. Jaccard and Associates/Energy Research Group. Vancouver. (June 3) http://www.nccp.ca/NCCP/pdf/AMG_cims_eng.pdf

Joint Ministers 2000. *Canada's First National Climate Change Business Plan.* Joint Ministers of Energy and Environment (except Ontario). National Climate Change Process. Ottawa. (October) http://www.nccp.ca/NCCP/pdf/media/FNBP2_eng.pdf

NCCP 1999. *Electricity Industry Issues Table Options Paper.* Electricity Industry Issues Table. National Climate Change Process. Ottawa. Cat. No. M22-132/5 - 1999E. ISBN 0-662-28926-9. (November) http://www.nccp.ca/html/tables/pdf/options/finalEpaper.pdf

NEB 1999. *Canadian Energy - Supply and Demand to 2025.* National Energy Board. (Update: June 30). Ottawa. (Cat. No. NE 23-1S/199E; ISBN 0-662-27950-6). http://www.neb-one.gc.ca/energy/sd99/sd99.pdf

PCGCC 2001. *Innovative Policy Solutions to Global Climate Change: The U.S. Domestic Response to Climate Change; Key Elements of a Prospective Program.* Pew Center on Global Climate Change. Arlington, VA. (August) http://www.pewclimate.org/policy/policy_inbrief_1.pdf

Reeve 2000. *The Capture and Storage of Carbon Dioxide Emissions - A significant opportunity to help Canada meet its Kyoto targets.* D. A. Reeve. Global Change Strategies International, Inc. Report Prepared for the Office of Energy Research and Development, Natural Resources Canada (NRCan Contract File No. NRCan 00-0195). Ottawa. Cat. No. M92-211/2001E. ISBN 0-662-05586-9. (October) http://nrn1.rncan.gc.ca/es/oerd/publications/publications/CO2%20Capture%20&%20Storage_e.PDF

Reinstein 2001. *The Outlook for International GHG Credits.* Robert A. Reinstein. Reinstein & Associates International. Washington, DC.

U.S. DoE 2001. *Emissions of Greenhouse Gases in the United States 2000.* Energy Information Administration, Office of Integrated Analysis and Forecasting, Energy Information Administration, U.S. Department of Energy. Washington, DC. DOE/EIA-0573(2000). (November) http://www.eia.doe.gov/pub/oiaf/1605/cdrom/pdf/ggrpt/057300.pdf