Canadian Energy Up-Date

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New U.S. National Energy Policy Report

On May 17, 2001 President Bush released a report of 163 pages prepared by the National Energy Policy Development Group (NEPD). This Group, chaired by the Vice–President, Richard B. Cheney, was established only two weeks after the new Administration had assumed office. It met formally eight times over 90 days and consulted some 400 experts and 150 organizations interested in energy matters. Nevertheless, the policy team was criticized by many as tight-lipped and secretive in its work, and it was clear that some groups were consulted more than others. The President announced that the new document with its 105 specific proposals was an 'action plan' stating that 'the goals of this strategy are clear; to ensure a steady supply of affordable energy for America's homes and businesses and industries.' The Policy Report is thus supply-oriented and the success of the course chosen will go a long way to define the future of the new Administration. The subsequent change in control of the Senate to the Democratic Party on June 6, 2001 has, however, affected its prospects, particularly the proposal to allow drilling in the Arctic National Wildlife Refuge in Alaska.

Chapter Five entitled 'Energy for a New Century - Increasing Energy Supplies' is the centrepiece of the document. The Report projects that net U.S. imports of oil will increase from the present just over one-half to two-thirds the total consumed unless there is a change in policy. The important objective is seen to increase U.S. domestic production as much as possible. It is interesting that the recent resource assessments of the U.S. Geological Survey are implicitly accepted, a stance not

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characteristic of earlier such policy reports, and it is acknowledged that U.S. oil production will decline over the next two decades. The Policy Report deals with the remaining domestic opportunities at some length with extensive and interesting illustrations of advanced petroleum discovery and production techniques that reveal as much about the authors of the report as the sections are informative.

As far as natural gas is concerned, the future needs are closely tied to the generation of electricity. The Policy Report indicates the U.S. will have to build between 1,300 and 1,900 new power plants to meet the need for 393 GW of new generating capacity by 2020 which is equivalent to one new such facility per week - a very large number indeed over time although, in fact, three to four such plants are being built each week now. Most are to be based upon natural gas. There are few references to other options for the electrical network system such as the emerging field of distributed generation – the network is seen to continue in its present structure. That there is an inconsistency between the expected need to fuel this growth in centralized electrical generation based nearly 90% on natural gas and the available gas supply is not acknowledged directly. Nevertheless, a careful reading of the coal section makes it evident this is the reason for keeping the solid fuel share of electrical generation at its present level of 52% (2000). U.S. production of the only fuel now produced in surplus to American requirements is now about one billion metric tonnes a year. To protect this market by increasing the environmental acceptability of the coal-to-electricity option, it is proposed to spend $2 billion over ten years to perfect the clean coal technologies of one kind or another. Nevertheless, there is a surprising lack of emphasis on the possibilities for Coal Bed Methane which source currently supplies 5-7 % of U.S. gas production. The impression left of the sections dealing with greenhouse gases is that this Administration has yet to come to terms with this far-reaching problem. The Policy Report takes little note of developments elsewhere on this issue.

Though Chapter Five was focused on the fossil fuels, it included a surprising proposal in the field of nuclear energy. The recommendations to revive the nuclear industry were for the most part directed to institutional changes to improve the pace and effectiveness of the regulatory regime with particular emphasis on extending the life span of the existing 103 reactors now on the U.S. operating roster. However, the suggestion was made in the text, but expressed in only more general terms in the Recommendations, that the reprocessing of nuclear waste should be re-considered and linked to a new technology known as accelerator transmutation to reduce the quantity and toxicity of the material to be handled. The Administration also intends to pursue the underground storage of nuclear waste materials at the Yucca Mountain site in the Nevada desert that has already cost some seven billion dollars over the last fourteen years of evaluation despite growing local opposition. This option is now less likely with the change in control of the Senate.

Chapter Three deals with 'Protecting America's Environment' and Chapter Four 'Using Energy Wisely: Increasing Energy Conservation and Efficiency.' It is here that the Policy Report seems the weakest. For example, the lead recommendation for Chapter Four reads 'The NEPD Group recommends that the President direct the Office of Science and Technology Policy and the President's Council of Advisors on Science and Technology to review and make recommendations on using the nation's energy resources more efficiently.' Nevertheless, considerable support is recommended for such measures as the encouragement of the introduction of hybrid and fuel cell-equipped vehicles mainly through an efficiency-based income tax credit between 2002 and 2007. The difficult problem with vehicles was highlighted by the coincidental appearance of a report from the Department of Transportation in which it was found that the overall fuel economy of new cars and trucks has fallen to the lowest levels since 1980, due mainly to the advent of sports utility vehicles. On the environmental side, the dilemma is best illustrated by the pressure to reduce the requirements to be met by the oil industry in two quite different ways: to allow more flexibility in the supply of specially-formulated

gasoline to certain smog-affected regions, and to relieve the burden of meeting air emission standards by refineries which are now operating effectively at capacity. At least half of the 152 oil refineries in the U.S. are believed to be currently violating air-pollution regulations in one way or another.

From an institutional viewpoint, the Policy Report was notable for its direct assignment of specifically identified proposals to existing Department and Agencies. It did not, however, deal with the question as to whether the present institutional arrangements are adequate to deal with the emerging situation in the energy field. Some commentators perceived this absence of such measures a missed opportunity.

Canadians will be especially interested in Chapter Eight 'Strengthening Global Alliances' with its many opportunities for the energy industry here. The Policy Report notes that Canada was the largest single supplier of oil to the U.S. at 1,686,000 barrels per day in 2000, followed closely by Saudi Arabia and then Venezuela. It does not add the qualification that, unlike the other two countries, Canada is a substantial importer of oil itself thus leading a non-specialist reader to a wrong impression of the potential supply from this country. More subtle problems such as that Canadian oil exports tend to be heavy and require specialized transportation and refinery treatment are not explored. As far as natural gas is concerned, Canada is reported as supplying 14% of the U.S. supply of gas in 2000 and, by implication, this rising trend is expected to continue. There is no reference to the supply and demand studies of the National Energy Board (the most recent released in 1999) that indicate conventional gas supply in Canada is likely to peak in another decade of two. The Policy Report supports additional supply of gas from the north to exploit the known reserves in Alaska but does not take a position on which of the two current pipeline proposals are favoured. More generally, the Report is supportive of an oil diplomacy option aimed at opening opportunities for investment by the industry in other countries around the world under conditions of greater transparency. There is specifically stated support for the proposed new pipeline to Ceyhan on the Mediterranean Coast in Turkey to serve the new fields in the Caspian region. Unlike some earlier U.S. official studies, the OPEC countries are treated carefully but there is surprising little emphasis on the work of the International Energy Agency which, after all, was established at the behest of an earlier Republican Administration. The careful reader might assume that the Report's authors chose not to comment on several important international government actions over the last few years.

The Policy Report was met with considerable commentary. Some energy economists took the view that an important opportunity had been missed. This group held that the most important step that should have been taken, especially to cope with the emerging difficulties with the electrical system, was to `get the prices right' and to generally increase transparency. One well-known expert in this field decried the absence of bold measures such as undertaking an immediate deregulation of the electrical system combined with a balancing imposition of the windfall-profits tax. Opinion from conservation and renewable energy circles was generally negative though most approved the specific initiatives that were proposed. There was much opposition from naturalists to opening the Arctic wildlife regions and other protected federal areas to oil and gas development. There was also some surprisingly strong opposition to the federal assumption of powers to obtain right-of-ways for new electrical lines from defenders of the rights of private property. As a Policy Report oriented to the longer term that eschewed short-term measures, it was surprising to some resource experts that little reference was made to the current disputes over the extent of the world's petroleum resources. Criticism from the general public generally concentrated on the lack of immediate measures to deal with short-term price and supply difficulties mainly for gasoline and electricity. That the Administration is sensitive to these more immediate issues was underlined by separate announcements at the time of the release of the Report calling for agencies to conduct investigations into gasoline pricing.

Copies of the National Energy Policy Report may be downloaded on the Web in whole or in sections from www.whitehouse.gov in .pdf form. The document contains many useful graphs and several large coloured illustrations including a full page devoted to a pipeline connection being welded at the Canada-U.S. border with flags flying. Canadians with knowledge of the history of energy policy in their own country will appreciate the irony of the Policy Report's initials.

Clean Development Mechanism and Joint Implementation Office

A Clean Development Mechanism and Joint Implementation Office has been established in the Department of Foreign Affairs and International Trade as part of the measures arising from the Kyoto Protocol negotiated in 1997 under the UN Framework Convention on Climate Change. This agreement divided the world into two different camps: the developed countries with legally-binding agreements to reduce six greenhouse gases and developing countries who committed to at least aim to stabilize these emissions.

The Protocol included three mechanisms to provide countries with flexibility in achieving reduction targets in a cost-effective manner. The Clean Development Mechanism (CDM) is a project-based approach which allows credit to be earned from emission reduction projects in developing countries (those with no binding targets as yet). The criteria under negotiation are expected to require that these projects must contribute to the sustainable development of the host country; result in emissions reductions that would not have otherwise occurred; generate real, measurable and long-term climate change mitigation benefits, and that they must be approved by the parties involved.

Joint Implementation (JI) allows for projects to be undertaken among countries that have committed to reductions in the emissions of greenhouse gases including OECD and countries with Economies in Transition. These projects also must result in emissions reductions that would not otherwise have occurred. The projects are implemented bilaterally after approval of the countries involved and credits can be earned.

International Emissions Trading allow parties with binding commitments to trade reduction credits internationally so that those capable of reducing emissions at lower cost can sell their surplus credits to another country with binding targets. The role of the Office is to act as a focal point for the government, to facilitate participation, to evaluate project proposals, to assist with project registration, and to pursue cooperation agreements. The benefits for the host country include improved energy efficiency, improved air quality, access to climate-friendly technology, investment in priority sectors, enhanced infrastructure, reduced dependence upon imported fuel, and socio-economic benefits. Companies are interested because they may offset their emissions and so avoid new regulations, earn trade credits, and add value to projects.

The current pilot phase was launched in 1995 and refers to projects as Activities Implemented Jointly (AIJ). These were initiated mainly with the objective of gaining experience and do not generate emission reduction credits as yet. Nevertheless, it is intended that these early projects can be converted into CDM or JI Projects in the future. Examples include biomass power generation in Belize, rural solar electrification in Bolivia, a hydroelectric plant in Costa Rica, fuel switching in district heating installations in the Czech Republic, reforestation and fugitive gas capture in Russia, and improvements to forestry practices in Indonesia.

Opportunities in the energy sector include energy efficiency improvements, fuel switching, electricity generation and transmission, renewable energy sources, demand-side management, and in the oil and gas field. There are also opportunities in other sectors such as in transportation, waste management, construction, forestry, and agriculture. Particular attention is paid to improving the efficiency with which energy is consumed in the light of current market trends to removal of subsidies, restructuring and privatization, demand-side management, construction of new facilities and buildings, and to meeting environmental concerns.

With the withdrawal of the U.S. from the Kyoto negotiation process on March 28, 2001, it is unclear at present whether the outstanding issues will be agreed by the time of the forthcoming COP 7 meeting. These matters centre on issues with developing countries, compliance, mechanisms, and the role of sinks for greenhouse gases. Nevertheless, it is precisely these issues that the U.S. has emphasized in the past.

The Department has produced a brochure in the field of the Clean Development Mechanism and Joint Implementation activities which may be obtained by contacting the Office. (E-Mail: cdm.ji@dfait-maeci.gc.ca; Fax: (613) 944-0064; Web: www.dfait-maeci.gc.ca/cdm-ji/).

New Reports

Newsletter of the International Association for Energy Economics

The Newsletter of the International Association for Energy Economics for the First Quarter of 2001 contains a number of articles of general interest. Fritz van Oostvoorn of the Netherlands Energy Research Foundation has contributed an extensive paper on 'Gas Market Liberalisation in Europe: Outlook for Gas Prices and Trade'; Fereidoon P. Sioshansi adds to his series on 'California's Electricity Crisis Continues'; Adam Rose writes on 'A Critical Issue in Electricity Reliability: Minimizing Regional Economic Losses in the Short Run'; Karen Schneider and Matthew Saunders on 'Removing Energy Subsidies in Developing and Transition Economies'; Leonard S. Hyman on 'From Ratebase to Revenue: The Roles of Technology and Investment in Ten Short Points'; and Pieter Vander Meiren on 'European Energy Policy and Energy Policy in Europe'. There is also a report of a Workshop in Prague dealing with the electrical situation in the Czech Republic.

The Newsletter may be obtained from the IAEE at 28790 Chagrin Boulevard, Suite 350, Cleveland, Ohio, 44122 (Fax (216) 464-5365; E-Mail: IAEE@IAEE.org; Web - http://www.IAEE.org.

New Reports from the Oxford Institute for Energy Studies

Two new publications have appeared from the Oxford Institute for Energy Studies. In 'The Governance of International Oil: The Changing Rules of the Game', Bernard Mommer (ISBN 1-901795-16-0) sets out the relevant set of rules as made up of the following four elements: the licensing regime; the fiscal regime; issues of sovereign taxation, and methods of dispute settlement. The author summarizes the evolution of these rules through the early period of the controlling oil companies, the subsequent formation of OPEC, and the later emergence of the intervention of the governments of the consuming countries that established the International Energy Agency.

The new book 'The Mediterranean Basin in the World Petroleum Market' by Paul Horsnell (ISBN 0-19-730021-9) addresses both upstream and downstream issues in a region at the confluence of four of the world's major current and prospective production areas. These publications may be obtained from the Institute at 57 Woodstock Road, Oxford, OX2 6FA, U.K. (Fax: +44 (0) 1865 310527; E-Mail: energy@sable.ox.ac.uk)
Web – http://associnst.ox.ac.uk/energy/.

Annual Report of the National Energy Board for 2000

In 2000, the energy industry accounted for just over six percent of Canada's GDP and employed approximately 290,000 people. Demand for domestic energy increased by about 2.5% following a similar increase in 1999. Energy export revenues accounted for 12% of all exports, up from 8% in 1999. During an active 2000, the National Energy Board monitored the construction of major new pipeline facilities including the completion of the Alliance Pipeline from north-eastern B.C. to the Chicago district and the construction of the Maritimes and Northeast Pipeline Management Ltd. laterals to Halifax and St. John in the east. The Board also received more applications for approvals of exploration and development

activity north of the 60th parallel than in any other year of the past decade. No major hearings were held for new pipelines but applications are expected for northern lines possibly later this year.

Canadian production of crude oil and equivalent averaged 345,000 cubic metres (2.2 million barrels) per day in 2000, up more that three percent from the 1999 level, reflecting increases in bitumen and conventional heavy oil production in western Canada and an increase in conventional light production in eastern Canada. Conventional light crude oil production fell by almost four percent in western Canada due mainly to the continuing natural decline of the reservoirs in the Western Canada Sedimentary Basin. Conventional oil reserves increased by eight percent to 702 cubic metres (4.4 billion barrels) (1999 data) with the inclusion of the Terra Nova field offshore Newfoundland. All other regions of Canada experienced reductions in reserves except for a small increase in B.C. On a cumulative basis from 1995 to 1999, additions to established reserves of conventional light and heavy crude oil have replaced 107% of production, again due mainly to the Terra Nova field. Total crude oil exports, including pentanes plus and synthetic oil, are placed at 221,700 cubic metres (1.4 million barrels) per day, up 11% from 1999. Crude oil imports were 146,100 cubic metres (920,400 barrels) per day and represented over 53% of total refinery feedstocks in Canada compared with 50% in1999. With Line 9 of Enbridge Pipelines Inc. reversed to move oil from Montreal to Sarnia in 1999, Ontario refiners received about 31% of their feedstock requirements from imports as compared to 26% the previous year.

Record prices were experienced for natural gas in 2000. Production reached a new high of 174.5 billion cubic metres (6.2 trillion cubic feet) that represents an increase of two percent on the year mainly due to the first full year of production from the Sable Island field offshore Nova Scotia. PanCanadian Ltd. announced a major natural gas discovery in the deep Panuke field in the same region containing of the order of one trillion cubic feet that is expected to be in production in early 2005 starting at 400 million cubic feet per day. Despite exploration successes in the Liard region of the Northwest Territories and offshore Nova Scotia, the Board estimates remaining established reserves of marketable natural gas as of year-end 1999 at 1,629 billion cubic metres (58 Tcf). The volume of reserves declined by one percent from 1998 as production continued to outpace reserve additions. Gas exports reached a record 100 billion cubic metres (3.5 Tcf) in 2000 which accounted for about 57% of total Canadian production.

Electricity generation rose by just over three percent in 2000 with the increase coming mainly from hydroelectric sources. Exports accounted for an estimated nine percent of generation and, at 50 terawatt hours (TW.h), were 16% higher than in 1999. This was a new record for exports whose value increased 111% by $2.1 billion. This sharp increase in value was due to extraordinary conditions in the U.S. market which benefited all the Canadian suppliers and particularly B.C. Hydro.

In May of 2001, the Board also released another report in its Energy Market Assessment Series. 'Canadian Electricity Trends and Issues' (ISBN 0-662-29865-9) examines electricity demand and generation on a province-by-province basis with a detailed analysis of trade, regulatory and restructuring initiatives, and prices. The highly diverse nature of the electrical system is noted. Only Alberta, first in deregulation, has experienced unstable electrical prices. The value of exports has risen sharply in recent years. This report is notable for its useful glossary of terms applicable to deregulation as this important industry to Canada enters a complex transformation.

In proceedings related to the expansion of the pipeline system, the Board accepted as reasonable projections of crude oil and equivalent supply from western Canada from an average rate of 316,800 cubic metres per day (1,992,400 barrels per day) in 1999 to 437,000 cubic metres per day (2,748,600 barrels per day) in 2010 given certain price assumptions including workable price differentials between the heavier and lighter grades of oil. Much of this increase will be accounted for by additional synthetic crude oil production from the oil sands and heavy, un-upgraded hydrocarbons

which will require increasing quantities of diluent to reduce viscosity sufficiently to permit pipeline transportation.

Copies of these reports may be downloaded from the Web at www. neb-one.gc.ca or obtained from the Board at 444 Seventh Avenue S.W., Calgary, Alberta, T2P 0X8 (Fax: (403) 292-5576).

Carbon Dioxide Climate Reports

The Winter 2001 issue of the 'Carbon Dioxide Climate Report of Environment Canada' is devoted to three useful assessments of recently published papers of interest in this field. The 'IPCC Special Report on Land Use, Land Use Change and Forestry' provides an in depth analysis of the science relevant to the discussion of sources and sinks of carbon from forest and soil management within the context of the negotiations leading to the Kyoto Protocol. The 'IPCC Special Report on Emissions Scenarios' is of relevance because future emissions used in climate models were projected by means of these scenarios. The Scenarios reflect the most recent trends in the forces driving emissions: population projections, economic development, and structural and technological change. The third assessment considers the controversial paper by James Hansen and his colleagues at the NASA Goddard Institute for Space Studies in August of 2000 entitled 'Global Warming in the 21st Century: An Alternative Scenario' and published in the Proceedings of the National Academy of Science. Hansen et al emphasize a climate change mitigation option that focuses on all greenhouse gases and their interrelationships which is nevertheless broadly consistent with other mitigation approaches in that a substantial reduction in carbon dioxide emissions are still required that go far beyond the requirements of the Kyoto Protocol.

The Spring 2001 issue of the 'Carbon Dioxide Climate Report' provides a synthesis of about 350 scientific papers and reports relevant to climate change that have appeared in the international peer-reviewed literature in 1999. These studies are classified under the following headings: Changes in Atmospheric Composition, Radiative Forcing, Climate Modelling, Climate Trends, Impacts and Adaptation, and Policy.

Copies of the 'Carbon Dioxide Climate Report' including recent issues may be obtained on the Web at: http://www.msc-smc.ec.gc.ca/saib/climate/ccsci_e.cfm from the Science Assessment and Integration Branch of Environment Canada or at 4905 Dufferin Street, Downsview, Ontario, M3H 5T4 (Tel: (416) 739-4432)

2000 Carbon Dioxide Fact Sheet

The 2000 issue of the *Carbon Dioxide Fact Sheet* follows the same format employed in previous years. Energy consumption data for the world and its principal regions and nations is taken from the BP Statistical Review of World Energy and converted to emissions of carbon dioxide using standard factors. This well-accepted source of energy statistics is mounted on the World Wide Web at (http://www.bp.com/worldenergy/). *The Review* is published in the latter part of the June following the year under review and thus provides a means of estimating emissions of carbon dioxide arising from the fossil fuels on a consistent basis throughout the world as early as six months after the relevant year-end. Population data for the July 1, 2000 base date was taken from the CIA World Factbook.

The conversion of one million tonnes of oil equivalent (MTOE), the basic energy unit employed in the *Review*, was taken here as 41.868 petajoules and the specific factors applied to the three fossil fuels were for oil - 19.9 million tonnes of carbon (not the dioxide) per exajoule (MTC/EJ); for natural gas -13.8 MTC/EJ; and for coal -24.1 MTC/EJ, all calculated on the basis of the higher heating value. Should it be desired to express emissions in terms of carbon dioxide rather than the carbon convention used in this note, the factor is 3.67. The limitations on the use of energy consumption data for the estimation of carbon dioxide emissions have been noted previously. (Walsh, J.H. (1993) *1992 Carbon Dioxide Sheet*, Energy Studies Review, **5**:2, p.131-5). The data in the following Table should be

considered useful for making relative comparisons between this year and last, and among nations and regions. Absolute values have to await detailed 'bottom-up' assessments.

Commentary

World

In 2000, world emissions of carbon dioxide from the three fossil fuels increased + 1.79% after falling marginally for two years in a row. The total primary energy consumption (excluding biomass and non-commercial forms of energy as is the practice in the *Review*) rose +2.1%, in contrast with the decrease in -0.64% in emissions and increase of +0.2% in primary energy consumption reported in 1999. The fossil fuels again accounted for 89.7% of the world's total energy consumption in 2000.

Canada and other Industrialized Countries

Canadian emissions increased +3.13% and accounted for 2.2% of the world's total. Sixty- four per cent of this increase was due to the greater consumption of natural gas and the remainder to coal whose consumption has risen in part due to the continued closure of some nuclear reactors in Ontario. Economic growth continued robust during the year at +4.1% on the revised `chain Fisher volume index basis' now used to calculate real values of GDP as of May 31, 2001. Primary energy consumption increased +3.2%. Canada's per capita emissions of 4.45 tonnes C/person/year were narrowly exceeded by Australia (4.72) but per capita emissions in both countries were less than those from the U.S.A. which were valued at 6.01.

Emissions also rose in Eastern Europe (a category here that includes all the former members of the old Soviet Union) at +0.96% after several years of decline reflecting the improved economic performance of that still depressed region. Primary energy consumption rose +2.4% in the Russian Federation. Emissions also rose +0.92% in the fifteen nations of the European Union after experiencing a small decrease of -0.46% in 1999.

Though a member of the EU, France was listed separately because of the importance of nuclear power in that country (about 78% of total generation) which ranks behind only tiny Lithuania. Nuclear energy accounted for 41.6% of France's primary energy supply in 2000 (computed on the equivalent fuel-input basis) and emissions decreased slightly -0.26%. In Canada and France, natural gas was a larger source of carbon dioxide than coal. In Eastern Europe and the countries of the Former Soviet Union taken together, emissions from this fuel were greater than from either oil or coal. The United States remains the largest contributor to carbon dioxide emissions accounting for 26.0% of the world's total in 2000.

Developing Countries

Emissions in the large developing countries of Brazil and India returned to higher rates of growth at +3.19% and +4.69% respectively though per capita emissions remained low. Emissions in China fell for the third year in a row by -2.10% in 2000 though less than the remarkable fall of –12.02% in 1999 due to much reduced consumption of coal. Emissions from oil and natural gas continued to rise. There was a decrease in per capita emissions to 0.54 tonnes C per person from 0.56 t/p the previous year despite the very low absolute value of this index in the world's most populous country. Emissions rose +3.32% in the rather heterogeneous Rest-of-World category which accounted for 39.3% of the world's population but per capita emissions stayed low at 0.57 tonnes C/person/year.

2000 Carbon Dioxide Fact Sheet

Country Region	Oil MTC%	Nat. Gas MTC%	Coal MTC%	Total MTC%	% Increase	% of World	Per Capita T C/p.c.
World	2919 45.8%	1251 19.6%	2206 34.6%	6376 100%	+1.79%	100%	1.05
Canada	69.1 49.6%	40.5 29.1%	29.6 21.3%	139.2 100%	+3.13%	2.2%	4.45
U.S.A.	747.7 45.1%	340.3 20.5%	569.2 34.4%	1657.2 100%	+2.51%	26.0%	6.01
E.U. (15	525.3 56.3%	196.2 21.0%	211.5 22.7%	933.0 100%	+0.92%	14.6%	2.47
E.Eur +FSU	201.0 25.0%	316.8 39.3%	287.3 35.7%	805.1 100%	+0.96%	12.6%	1.96
Australia	32.2 35.7%	11.0 12.2%	4731 52.1%	90.3 100%	+2.90%	1.4%	4.72
Brazil	70.3 80.3%	4.9 5.6%	12.3 14.0%	87.5 100%	+3.19%	1.4%	0.51
China	189.1 27.5%	12.9 1.9%	484.4 70.6%	686.4 100%	-2.10%	10.8%	0.54
France	79.2 69.6%	20.6 18.1%	14.1 12.3%	113.9 100%	-0.26%	1.8%	1.92
India	81.3 31.4%	13.0 5.0%	164.9 63.6%	259.2 100%	+4.69%	4.1%	0.26
Japan	211.2 60.2%	39.6 5.0%	99.8 28.5%	350.6 100%	+1.50%	5.5%	2.77
Rest-of-World	792.0 58.0%	275.2 20.1%	299.6 21.9%	1366.8 100%	+3.32%	21.4%	0.57

Canadian and International Developments in Climate Change

At the *third Conference of the Parties* (COP 3) to the United nations Framework Convention on Climate Change held in Kyoto December 1 - 10, 1997, Canada committed itself to reduce combined CO_2 CH_4 and N_20 emissions by 6% below 1990 levels and comined HFC, PFC and SF_6 emissions by 6% below 1995 levels between 2008 and 2012. Because of economic and population growth expected in the intervening period, Canada needs, in effect, to reduce its emissions some 20 - 25% below what they would be otherwise in 2010. The federal Government established the Climate Change Secretariat in late 1997 to deal with this problem (Web: www.nccp.ca/) through the development of the Government of Canada Action Plan 2000 on Climate Change, (Web: www.climatechange.gc.ca/english/whats_new/action_plan.shtml).

The Third Assessment Report of the Intergovernmental Panel on Climate Change appeared in early 2001. (Web: www.ipcc.ch/pub) the main findings may be summarized in the following sentence that state greenhouse gases resulting from the burning of the fossil fuels have "contributed substantially to an observed warming over the last 50 years". This stronger statement may be contrasted with

the "balance of the evidence suggests a discernible human influence on global climate" which summarized the *Second Assessment Report* of 1995.

The international negotiations in the field of climate change have been affected by the decision of the U.S. to withdraw from the Kyoto process on March 28, 2001. The government has announced, however, that Canada will continue its efforts to meet its Kyoto goals. These measures include the establishment of a Clean Development Mechanism and Joint Implementation Office in the Department of Foreign Affairs and International that will also be involved in coordinating Canadian interests in international emissions trading. (Web: www.dfait-maeci.gc.ca/cdm-ji)

Further information on world emissions of greenhouse gases may be obtained from the Carbon Dioxide Information Analysis Center of Oak Ridge National Laboratory (Web: cdaic.esd.ornl.gov/).

National Radiological Protection Board (UK) Report on 'Power Frequency Electromagnetic Fields and the Risk of Cancer'

The British National Radiological Protection Board has accepted the advice of its Advisory Group on Non-Ionising Radiation, which is Chaired by Sir Richard Doll, the well-known epidemiologist famous for his work on tobacco, that the evidence indicates a slightly elevated risk of cancer, normally leukemia, to those living downwind from power lines. The mechanism is thought to be the reaction of ions emitted from the power lines with oxygen and nitrogen in the air to form charged molecules that may be inhaled.

Brief information concerning the conclusions of this report, released on March 6, 2001 may be found on the Web at www.nrpb.org.uk and the report itself (Doc. NRPB 12 (1), 3-179 (2001); ISBN 0-85951-456-0) is on sale at the NRPB Information Office (Fax: +44 (0) 1235-822746; E-Mail information@nrpb.org.uk.

Electricity Consumption by The High Technology Industry

A new report prepared by the End-Use Energy Forecasting Group of the Environmental Energy Technologies Division of Lawrence Berkeley Laboratories 'Electricity Use by Office Equipment and Network Equipment in the U.S.' has led to substantially lower numbers than previous such studies. About 74 TeraWatt-hours (TWh) is consumed for this purpose per year or about two percent of the total electrical energy consumed in the U.S. Of this, about 70% is used by office equipment in the commercial sector. This analysis is relevant to the current crisis in electrical supply in California which may be due less to the rapid expansion in the high technology industry than previously thought. Faulty methodology is given as the reason for the largedifferences with earlier studies. Copies of relevant studies may be downloaded at Website http://enduse.lbl.gov/Projects/InfoTech.html.

Researchers from this group have established a Network for Energy, Environment, and the Information Economy which may be found on the Web at http://n4e/lbl/gov. Collaborators are welcome.

Short Notes

- In his paper 'Electricity Deregulation: Doubts Brought On by the California Debacle', which appeared in the IEEE Canadian Review – Spring 2002 Web - http://www.ieee.ca, Maurice Huneault of Hydro-Quebec has written an interesting paper on this subject from the point of view of an electrical engineer. He provides a history of this policy option and the experience of successes and failures in a number of countries around the world to date (including in Alberta and Ontario) as well as an extensive discussion of the current difficult electrical situation in California. (A detailed history of the crisis may be found on the Web at http://www.stoft.com.) He notes that electricity markets are quite different from other commodity markets in that consumers generally have little choice but to accept the price offered and that there is no inventory possible to smooth the swings in prices. The consequence is this market works well only when competing forces are balanced at all times because otherwise, marginal pricing leads to sellers with market power maximizing their profits by exploiting

scarcity. Congested transmission lines (as in California) result in different marginal prices at every node of the network. He concludes by listing a number of recommendations for aiding deregulation for a given implementation.

- The Ontario Government announced on April 23, 2001 that it would open the province's electricity market to competition by May 2002. It had originally been intended to take this step by November of 2000 but a moratorium was imposed involving the fossil-fuel plants. It was subsequently announced that Ontario Power Generation would sell the Lakeview coal-fired plant in Mississauga (likely to be converted to natural gas) and the Lennox gas and oil-fired plant near Kingston. Together with the lease of the Bruce nuclear generating plant already held by British Energy, the sale of two coal-fired plants in Thunder Bay and Atikokan in Northern Ontario, and four hydro plants on the Mississagi River near Sault Ste. Marie, the successor generating company to Ontario Hydro would likely meet the immediate objective of reducing its share of the market sufficiently to encourage others to enter this field. Ten years after opening the market, Ontario Power Generation expects to supply no more than 35% of the market.

- The Federal government introduced Bill C-27 into Parliament whose prime purpose is to form the Waste Management Organization (WMO) to deal with the vexing problem of high-level radioactive wastes produced primarily in nuclear generation. Passage is expected in 2002. The Bill proposes three options to be investigated: deep geological repositories in the Canadian Shield; perpetual storage at nuclear reactor sites, and centralized storage whether on the surface or below ground. Three years are allowed for study whereupon the government will choose which of the options developed by the WMO it prefers. Fines are provided for slowness in making this recommendation. A Trust Fund is also to be established to meet the operating costs of the WMO. An earlier Commission had studied this issue and found there was no public or aboriginal support for the favoured deep geological disposal option. In the meantime, these wastes are held at nuclear generating sites, first in pools and then in dry storage containers.

- The Russian Parliament approved legislation proposed by President Vladimir P. Putin on June 6, 2001 to establish the largest international repository for radioactive nuclear wastes operated on a commercial basis. Russia estimates that $21 billion may be earned over the next two decades by accepting 20,000 tonnes from 15 countries that are free of contractual obligations (mainly with the U.S.) to do otherwise. The fee is said to be $1,600 per kilogram to hold this material in perpetuity, but Russia reserves the right to re-process and resell it for further nuclear power generation. An installation that could hold the first 3,000 tonnes is nearing completion in the closed nuclear city of Krasnoyarsk-26 in central Siberia. (from the NewYork Times)

- Recent statistics gleaned from nuclear industry sources in the U.S. reveal strong gains in the performance of that country's 103 operating nuclear reactors. Averaged over the last three years, the top 25% of these plants were in service 92.4% of the time with direct production costs (operations and maintenance) of 1.5 U.S. cents per kWH with the average of all operating reactors at 1.8 U.S. cents per kWH.

- The first new power reactor since Soviet times went on line in Russia in Rostov-on-Don on February 23, 2001.

- Two papers in the 24 May 2001 issue of 'Nature' (Vol. 411 No. 6836) by W.H. Schlesinger and J. Lichter, and by R.Oren et al have raised doubts about the quantity of carbon that may be sequestered in forest ecosystems.

- Japanese researchers have reported in the March 1, 2001 issue of the U.K. journal Nature Web - www.nature.com (Vol. 410 No. 6824) that the simple chemical compound, magnesium diboride, has good superconducting properties. The onset of these properties at 39 degrees Kelvin is some 16.1 degrees higher than other known compounds of this class. Though lower than the temperatures achieved in some special copper-based oxides, the discovery has led to active efforts in a number of laboratories around the world because of the higher current densities possible and because it appears possible to work this material into usable configurations more easily. One possible application would be for less expensive Magnetic Resonance Imaging in the health field.

- An arbitration panel has ruled in favour of Newfoundland in an off-shore boundary dispute with Nova Scotia. The disputed area involves a large geological region of 60,000 square kilometres of the ocean floor known as the Laurentian sub-basin which is considered prospective for oil and gas. The finally boundary is yet to be set but this decision is expected to encourage exploration activity.

- The first experimental production well and two observation wells will be drilled this coming winter into methane clathrate hydrate formations in the Mackenzie Delta. The resource base of this class of resource is large around the world and represents an unexploited opportunity. Methane is a strong greenhouse gas and it is important to understand the behaviour of the unstable clathrate resource at a time of pronounced Arctic warming. The Geological Survey of Canada will direct the ten million dollar project with participation from Germany, Japan, and the U.S.

- Syncrude Canada, the world's largest producer of synthetic oil, reported record average production of 237,000 barrels per day in the first quarter of 2001. This oil was produced at a reported cost of $C20.08/barrel, substantially higher than the initial target of $C13/barrel for the year. It is expected that costs will average about $C17/barrel for this year. Some three-quarters of the increase in costs were attributed to higher prices for natural gas.

- The Chad-Cameroon oil pipeline, extending some 1073 km. (665 miles) to the Atlantic Coast from the Lake Chad region, is now expected to be in service in 2003 with a throughput of 36,000 cubic metres (225,000 barrels) per day. This new line, costing $US3.7 billion, is receiving support from development agencies. West Africa will be a growing source of oil over the next decades.

- The Hon. Ralph Goodale, Minister of Natural Resources, announced the formation of the Canada Foundation for Sustainable Development Technology. This Foundation will be managed at arms length from the Government by a fifteen-person Board of Directors chosen for expertise in the relevant technologies and will report to Parliament. The Chair and a minority of the directors and members will be appointed by the Governor-in-Council. In the energy field, funding will be available on a project-by-project basis for technologies such alternative energy production, geological sequestration of carbon dioxide, fuel cells, advanced materials, and methods of reducing emissions of volatile organic compounds and nitrogen oxides to the air. The Foundation has broad powers and it is envisioned that it will lever its efforts by entering into collaborative projects and partnerships to encourage innovative solutions. The Sustainable Development Technology Fund, announced in the year 2000 federal budget with an initial allocation of $100 million, will be the source of the government funds. In February 2001, twenty-eight Departments and Agencies presented their sustainable development strategies to Parliament.

Notes on Electric Vehicles

Hydro-Quebec has joined with the Kerr-McGee Chemical Company of Oklahoma to form the Avestor Corporation which will build a $340 facility in Boucherville, Quebec, to produce the lithium-metal-polymer batteries developed by the utility. Initially this plant will produce back-up batteries for the communications industry but it is anticipated this technology will be of interest in time to power electric vehicles. Operating life for this class of battery is stated as up to 10 years.

The June 2001 issue of the IEEE Journal 'Spectrum' (Vol. 38, No. 6) contains an article reviewing current developments in the field of metal (normally aluminum or zinc)/air fuel cells that includes a reference to the work of Aluminum-Power Inc. of Toronto. The first major application of such cells for transportation purposes may be to power electric scooters.

An article published in the March issue (Vol.38 No. 3) entitled 'Are Hybrid Vehicles Worth It?' by Lester B. Lave of Carnegie-Mellon University and Heather L. MacLean of the University of Toronto concluded: 'HEVs are unlikely to sell themselves in terms of fuel economy and lower emissions alone. Rather, they will have to attract buyers by offering features that are not available on conventional vehicles - applications requiring a large electrical supply, for example.' These authors were also not enthusiastic about the possibilities for fuel cells for car propulsion. This conclusion

has provoked an extensive vigorous and contrary commentary in the May issue (Vol. 38 No.5) which, together with the Author's Response, is a useful contribution to this debate.

Ballard Power Systems of Burnaby, B.C. will supply its new Mark 900 series of fuel cells and related services to the Honda Motor Company of Japan through 2002. The first delivery of fuel cells under this agreement was already made in February of 2001. The company has also announced an agreement with the DaimlerChrysler Company to provide hydrogen-based fuel cells for 30 buses in Europe beginning in 2002 which will be the first so equipped to enter regular transit service.

The EPS Company of Shipton, Quebec, has developed an electric bicycle that offers a pre-set power assist from a direct-drive motor mounted on the rear axle. This motor is a brushless dc device rated at 180 watts of continuous power but capable of delivering 450 watts for short bursts. There are three battery options offered: conventional lead-acid, nickel-cadmium and nickel-metal hydride. There are several U.S. companies in this field but, so far, none markets more than 15,000 units per year.

Some solid inorganic acid compounds, such as $CsHSO_4$ and $Rb_3 H(SeO_4)_2$ possess high proton conductivities and could become the basis of future fuel cells. A paper in the U.K. journal 'Nature' Web - http://www.nature.com by Sossina M. Hale and colleagues in the April 19, 2001 issue (Vol. 410, 910-913, 2001) note the advantages of these compounds which are stable up to 250 degrees C.

General Motors Corporation together with Argonne National Laboratory and energy partners BP, ExxonMobil and Shell have participated in a study of the best way to fuel vehicles in the near-term future to meet both lower greenhouse gas emission and practicality objectives. Of the 75 pathways and 15 vehicles considered, 27 were chosen for complete analysis with fuels ranging from low-sulphur gasoline, low-sulphur diesel fuel, methanol, liquid hydrogen and gaseous hydrogen produced from non-North American natural gas. There were two major findings in terms of lower carbon dioxide emissions and greater efficiency: a gasoline-based reforming approach was found to be the best bridging strategy to an hydrogen economy for vehicles equipped for fuel cells; and diesel-hybrid electric vehicles using reformulated diesel fuels ranked high among the non-fuel cell options. Renewable fuels, such as ethanol derived from cellulose, led by a wide margin to the lowest greenhouse gas emissions. The company intends to continue its efforts leading to the gasoline-based fuel cell option. It is also the intention to extend this study to other emissions such as NOX, hydrocarbons and particulates. Further information on the GM and Partners Study may be found at www.gm.com/company/gmability/environment

An Israeli company, Medis Technologies Inc., is developing a fuel cell that accepts methanol directly as the fuel. A proprietary liquid electrolyte is mixed with the methanol in the presence of a proprietary catalyst. The electrolyte performs the same function as the solid polymer membrane employed in other fuel cells in that it allows the transfer of hydrogen ions from anode to cathode while preventing the transfer of electrons. The company expects some 45% of the electrolyte can be methanol - much higher than the level reported for other direct methanol cells of this kind. The first applications are expected to be small units for powering portable computers and other electronic devices.

Energy Venture International, a company developing methanol-based fuel cells in cooperation with the National Research Council in Ottawa and the Alberta Research Council in Calgary, has announced that its first small prototype commercial cell should be ready by the Spring of 2002 with marketing to follow.

A new book on the history of electric vehicles has created interest. 'The Electric Vehicle and the Burden of History' by David A. Kirsch (Rutgers University Press, Piscataway N.J. 2000, ISBN 0-8135-2808-9, 256 pp.) according to Victor Wouk, a reviewer, posits that 'electric vehicles failed in the 1900s for other than technical reasons and this unfortunate history is haunting the efforts to promote EVs today.'