UPDATE

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Northern Natural Gas Pipeline Plans

With the rapid increase in natural gas prices over the last year, attention is now returning to the known reserves and potential for more natural gas in the western Arctic of Canada and Alaska. The Northern Pipeline Agency will be re-constituted. The U.S. Department of Energy forecasts that the demand for gas in that country will rise some 40% to 31.5 trillion cubic feet (TCF) per year by 2020, spurred in part by the environmental advantages of this fuel. Ninety percent of new power plants either under construction or planned in the U.S. are presently based upon gas as fuel. Presently some gas is exported in liquefied form from fields in the Cook Inlet region in the south of Alaska but large reserves are known in the existing oil production region at Prudhoe Bay in the north on the Arctic Coast. Some gas is already being supplied from fields in the Fort Liard region of the Northwest Territories to the Continental grid. Local production began in 1999 to supply the town of Inuvik in the Mackenzie River delta.

There are two main options which may prove not mutually exclusive. There is already partial regulatory approval for a pipeline that would parallel the Alaska highway. New discoveries have been made in the Yukon which could be serviced by this line. A branch could be built to serve the resources in the Mackenzie delta. Such a pipeline would travel some 2740 km (1,700 miles) from Prudhoe Bay and cost an estimated $US 8 billion. The second option involves the construction of a line along the Mackenzie River valley which could be extended some 484 km (300 miles) west to Prudhoe Bay. This latter section of the line would be laid some 4.6 meters (15 feet) below the water surface of the Arctic Ocean to avoid disturbing a sensitive environmental region. The cost of this route is placed at $US 3 billion. A feasibility study is expected to be completed by March of 2001.

There is a major difference from the previous northern pipeline proposals of two decades ago in that there is now widespread support among aboriginal peoples for the Mackenzie line. There is also support across all segments of society for a line across the Yukon and it may only be a question of which line will be built first. There appear to be no plans at present to develop the oil reserves of the Mackenzie delta.

New Reports

Third Assessment Report of the Intergovernmental Panel on Climate Change

The Third Assessment Report (TAR) of the Intergovernmental Panel on Climate Change was formally released in Geneva on February 19, 2001 after extensive prior consultative meetings. The key sentence is that greenhouse gases resulting from the burning of the fossil fuels have `contributed substantially to an observed warming over the last 50 years.' This statement is to be contrasted with `the balance of evidence suggests a discernible human influence on global climate' which summarized the Second Assessment Report (SAR) of 1995. One of the more important findings of the TAR is its conclusion that the upper range of warming over the next 100 years could be even higher that was estimated in 1995 due primarily to cleaner air containing fewer fine particulates as a result of the adoption of clean air policies around the world. The globally averaged surface air temperature is projected to warm 1.4 to 5.8 degrees Centigrade by 2100 relative to 1990, and globally averaged sea level is expected to rise 0.09 to 0.88 meters by that time.

Some statements taken from the Summary for Policymakers of the TAR on the impact of climate change follow: `Available observational evidence indicates that regional changes in climate, particularly increases in temperature, have already affected a diverse set of physical and biological systems in many parts of the world'; `It is well-established that the geographical extent of the damage or loss, and the number of [natural] systems affected, will increase with the magnitude and rate of climate change'; `A general reduction in potential crop yields in most tropical and sub-tropical regions for most projected increases in temperature [with] a general reduction, with some variation in potential crops in most regions in mid-latitudes for increases in annual-temperature of more than a few degrees'; `Some extreme events are projected to increase in frequency and/or severity during the 21st century due to changes in the mean and/or variability in climate'; `Projected climate changes during the 21st century have the potential to lead to large-scale and possibly irreversible changes in Earth systems resulting in impacts at continental and global scales'; `Adaptation has the potential to reduce adverse impacts of climate change and to enhance beneficial impacts, but will incur costs and will not prevent all damages'; `More people are projected to be harmed than benefited by climate change, even for global mean temperature increases of less than a few degrees'; `The effects of climate change are expected to be greatest in developing countries in terms of loss of life and relative effects on investment and the economy'; `Policies that lessen pressures on resources, improve management of environmental risks, and increase the welfare of the poorest members of society can simultaneously advance sustainable development and equity, enhance adaptive capacity, and reduce vulnerability to climate and other stresses'; `One-third of the world's population, approximately 1.7 billion people, presently lives in countries that are water-stressed ... Population growth and increased water withdrawals are projected to increase this number to around 5 billion by 2025, depending upon the rate of population growth. Projected climate change would further decrease the available water in many of these water-stressed countries'; `Most studies indicate that global mean annual temperature increases of a few degrees C or greater would prompt food prices to increase due to a slowing in the expansion of global food supply relative to growth in global food demand. [These changes] would worsen food security in Africa'; `The adverse health impacts of climate change will be greatest in vulnerable lower-income populations, predominately within tropical/subtropical countries'; `Model-based projections of the mean annual number of people who would be flooded by coastal storm surges increase several fold (by 75 to 200 million people depending upon adaptive responses) for mid-range scenarios of 40 cm sea level rise by 2080s relative to scenarios with no sea level rise'; and `The effects of

climate change are expected to be greatest in the developing world, especially in countries reliant on primary production as a major source of income.'

The full report of 1000 pages will be published by Cambridge University Press later this year. The report was written by 183 Coordinating Lead Authors and Lead Authors, and 243 Contributing Authors including Canadians. It was reviewed by 440 government and expert reviewers, and 33 Review Editors oversaw the review process. Sections of the TAR may be found on the Web at www.ipcc.ch/pub.

Publications from The National Energy Board

The National Energy Board has released a report in its Market Assessment Series entitled `Short-term Natural Gas Deliverability from the Western Canada Sedimentary Basin' which is of interest at a time of high natural gas prices. The report notes that two key trends have been identified. First, recently drilled wells start producing at lower rates than wells drilled more than five years ago and, second, production from these new wells is declining more quickly than was the experience with the older wells. In the Board's view, given sufficient drilling, gas deliverability from the Western Canada Sedimentary Basin (WCSB) will increase by 30 million cubic metres (1.1 billion cubic feet) per day by 2002. Production from the WCSB averaged about 465 million cubic metres (16.4 billion cubic feet) per day in 1999, a two per cent increase over the previous year. A production increase of 6.5% is thus anticipated in 2002 over 1999 but this will require the drilling of 8,700 wells in 2001 and 8,900 wells in 2002.

The Board has released three other reports of interest. The `Canadian Natural Gas Market - Dynamics and Pricing' (ISBN 0-662-29556-0) is in its regular series of *Energy Market Assessment Reports* prepared as part of the monitoring component of the Board's Market-Based Procedure. Dated November 2000, this report of 58 pages plus Glossary surveys the main developments in the natural gas market to the present time. The integration of the North American market for this convenient fuel is now well advanced and Canada now supplies one-quarter of the total Continental requirements including 15% of the gas demand in the U.S. There is a growing call for this fuel for electrical generation. Though prices have increased markedly recently, the Board finds that the natural gas market has been functioning so that Canadian requirements for natural gas have been satisfied at fair market prices. The report contains many figures and maps of the main pipeline facilities. There is also a useful chapter devoted to the analysis of regional natural gas dynamics and pricing.

The second report dated October 2000 is a timely survey of 92 pages dealing with `Canada's Oil Sands: A Supply and Market Outlook to 2015' (ISBN 0-662-29467-X). Based on publicly announced development plans covering the period 1996 to 2010, nearly $14 billion worth of projects are planned to expand petroleum production from the oil sands, with about $7 billion spent to date. Sections of the report deal with the early history of oil sands development, a review of oil sands resources and technology, supply costs, oil pipelines and environmental impacts. Based upon current technology, about 12% of the resource base, or 49 billion cubic metres (308 billion barrels) of crude equivalent, is estimated to be ultimately recoverable. For context, this quantity of oil is approximately equal to a little over one-third the present published world reserves of conventional oil. The report is intended to be of interest to both technical and non-technical readers and includes many figures and maps.

The third report is entitled `Northeast British Columbia Natural Gas Resource Assessment 1992-1997' which provides a five-year update to the previous 1994 report on the same subject. The main objective is to assess the effectiveness of drilling activity in developing new sources of gas supply within this region.

The Board has also announced the availability of a book entitled `Forty-Years in the Public Interest: A History of the National Energy Board' which deals with the challenges this agency has faced in the four decades of its history. It may be obtained from booksellers in Calgary (Pages on Kensington) and Ottawa (Shirley Leishman Books and Place Bell Book Store). For further information, contact the Board at 444 Seventh Avenue S.W., Calgary, Alberta, T2P 0X8 (Tel: (403) 299-2717; Web: www.neb.gc.ca).

Recent Newsletters from the Energy Technology Systems Analysis Project (ETSAP) of the International Energy Agency

The ETSAP News (Web: www.ecn.nl/unit_bs/etsap) for December 2000 (Vol. 7 No.4) contains two articles of special interest. In the first, there is a review of the recent suggestion of James Hansen of the Goddard Institute of Space Studies that the emphasis on reducing greenhouse gases should be placed on other greenhouse gases, such as methane, rather than carbon dioxide over the next fifty years because the effect of the latter gas is partly off-set by aerosols, such as sulphates and carbon particles, that are also by-products of the burning of the fossil fuels (Hansen, J, M. Sato, R. Ruedy, A. Klacis and V. Oinas, 'Global Warming in the Twenty-first Century: an Alternative Scenario', Proceedings of the National Academy of Sciences, Vol. 97 No. 18 (August 29, 2000), pp. 9875-9880). This view is contrasted with that of Manne and Richels who argue that the goal of climate policy should be a maximum allowable increase in global temperature, and calculate the importance of the non-CO_2 gases by the incremental value of their emissions rights - or price - relative to that of CO_2 (Manne, A.S. and R.G. Richels, 'A Multigas Approach to Climate Policy - with and without GWPs', Energy Modelling Forum, EMF - 19, Washington, DC. March 22-23, 2000). This short article provides a useful synopsis of the two arguments.

The second article, 'How Will Greenhouse Gas Emissions Reductions be Shared Domestically', is a summary of a major study conducted in Canada by R. Loulou, A. Kanudia, M. Labriet, M. Margolick and K. Vaillancourt prepared for the Analysis and Modelling Group of the Canadian National Climate Change Implementation Process (HALOA Inc. dated May 12, 2000). The MARKAL Model is used to show how incremental costs of emission reductions will be distributed among energy sectors either through demand or price effects.

The previous September 2000 issue (Vol.7 No.3) of the *News* provides a comprehensive listing of reports prepared by ETSAP participants and others using the MARKAL family of energy technology systems analysis models. Summaries of these papers are given together with information on how copies may be obtained. The reports are grouped by subject matter namely: emissions trading, Kyoto Protocol, learning curves, local energy planning, materials management, methodology, policy analysis and technology assessment.

Mr. H. Labib is now Executive Member for Canada in the ETSAP Activity. Copies of the *ETSAP News* may be obtained by contacting the Operating Agent, the Netherlands Energy Research Foundation, P.O. Box 37154, 1030 AD Amsterdam, The Netherlands (E-Mail: etsap@ecn.nl; Fax: +31 20 4922812).

Newsletter of the International Association for Energy Economics

The *Newsletter* of the International Association for Energy Economics for the Fourth Quarter of 2000 contains a number of papers or summaries of articles of general interest as usual. Paul Tempest provides an interesting article entitled 'Distortion, Illusion and Confusion: How to Improve Global Oil Market Data'; Fereidoon P. Sioshansi makes a long contribution in his series on 'California's Flawed Market: What Went Wrong and How to Fix It'; Reza Fathollahzadeh and Mohammad Mazraat write on 'The Structure of Energy Subsidies in Iran'; V. Kreslinsh, K. Brinkis, V. Zebergs and N. Zeltinsh discuss 'From National to Regional Electricity Market in the Baltic States and Northern Europe', and Reza Fathollahzadeh writes again on 'Renewable Energies and Sustainable Development in Iran'.

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: www.IAEE.org.)

Short Notes

- Former Senator Spencer Abraham is the new U.S. Secretary of Energy in the Bush administration.
- The Third Assessment Report (TAR) of the Intergovernmental Panel on Climate Change was formally adopted at a meeting in Shanghai held in January 2001. The key sentence is that greenhouse gases resulting from the burning of the fossil fuels have 'contributed substantially to an observed warming over the last 50 years.' This statement is to be contrasted with 'the

balance of evidence suggests a discernible human influence on global climate' which summarized the Second Assessment Report (SAR) of 1995. One of the more important findings of the TAR is its conclusion that the upper range of warming over the next 100 years could be even higher that was estimated in 1995 due primarily to cleaner air with less fine particulates as a result of the adoption of clean air policies around the world. In the worst case, the global temperature could be 6.1 degrees higher then than it was in 1990.

- The Chevron Company has announced that the first oil from the Tengiz field in Kazakhstan will begin flowing in July through a new pipeline (cost $US 2.5 billion) through the Russian port of Novorosslysk on the Black Sea. The initial deliveries will be 28 million tonnes per year. Turkish authorities are concerned with excessive tanker traffic through the Bosporus particularly if production increases. They support the construction of another pipeline which goes directly to the eastern Mediterranean port of Ceyhan.
- The World Meteorological Organization has announced that the Earth's temperature in 2000 was the fifth highest since global records began 140 years ago.
- The last reactor at the Chernobyl power plant in the Ukraine was shut down December 15, 2000 in accordance with an international agreement that provides assistance to that country for developing new energy sources. The most serious nuclear accident in history occurred at this station in 1986.
- The Alliance natural gas pipeline formally began operations on 30 November 2000. This line links northeastern B.C. with the Chicago district. The connecting Vector pipeline is expected to be in service this year to move some of this gas to south-western Ontario. With the opening of this major facility, there are indications that installed transportation capacity from the Western Canada Sedimentary Basin now exceeds gas production for the first time in recent decades.
- The Sixth Conference of the Parties to the UN Framework Convention on Climate Change (COP 6) ended in The Hague November 25, 2000 without agreement. No consensus was found on the question of sinks for carbon as in the forests. Canada joined the U.S., Japan, and some other countries in seeking credits for emissions in this way but this approach was generally criticized by the European Union. An additional meeting was held in Ottawa in December in an attempt to reconcile these differences but it too ended without resolution. It is possible COP 6 will be reconvened in Bonn in mid-2001.
- An $11-million research facility known as the Petroleum Technology Research Centre was officially opened in the Regina Research Park on October 2, 2000. Incorporated as a separate legal entity, the PTRC is affiliated with the University of Regina, the Saskatchewan Research Council, and some other organizations. The new Centre is the first economic infrastructure project to be launched under the terms of the Canada/Saskatchewan Western Economic Partnership Agreement (WEFA). Funded from a variety of sources, a 13-member Board of Directors sets the strategic direction. Some fifty scientists and graduate students concentrate on extending the life of existing oil pools in the Province and it is hoped a further 2 to 3 billion barrels of oil can be recovered efficiently. The University of Regina is a leader in the field of chemical absorption of carbon dioxide from process flow streams.
- As a consequence of recent exploration successes, the gas resources of the off-shore Scotia Shelf are now expected to be greater than previously estimated perhaps by a factor of three to some 50 trillion cubic feet.
- Construction has started on Canada's largest cogeneration plant which will be built by TransAlta Corporation at the production facilities of Dow Chemical Company near Sarnia, Ontario. The costs are expected to be $400 million.
- As a consequence of a new Canada-U.S. Air Quality Agreement, cleaner air is expected in both southern Ontario and Quebec, and Atlantic Canada starting in 2004 as a result of the decision to reduce emissions of nitrogen oxides (NOX) and volatile organic compounds (VOCs). The draft agreement puts an annual cap of 39 kilotonnes of NO_2 from fossil fuel-fired

generating stations in Ontario by 2007, which represents a 50% reduction from the current average of 78 kilotonnes. Canada will also align emissions standards for cars, light trucks and Sports Utility Vehicles. Overall, the U.S. will reduce their emissions of smog-forming compounds (which contribute about half of the problem in southern Ontario), an estimated 36% by 2010 and Canada 44% by that time. To achieve this result, Ontario Power Generation may install devises to capture or inhibit the release of these compounds, increase the use of natural gas (although the current increase in prices has made this option more costly), or restore more closed nuclear reactors to service.

- Professor David Henshaw and his colleagues at the University of Bristol (U.K.) have new findings that link power lines to cancer clusters. These researchers believe that fine particles in the atmosphere, such as from automotive exhausts, become charged in the corona around power lines which causes them to stick in the capillaries of lungs when inhaled. This mechanism is proposed to explain medical research findings also conducted at Bristol where people living up to 500 metres downwind of such lines were found to have a 29% greater chance of contracting lung cancer. Several recent extensive studies in both the U.S. and Canada have found little or no association between electrical fields and cancer (usually leukemia) but no proof that such a relationship does not exist. The erratic results of such epidemiological studies might be explained by the charged-particle effect.
- Statoil of Norway has prepared a CD-ROM entitled 'CO_2 and Energy' which provides a short description of the Sleipner gas field in the North Sea and the CO_2 extraction and injection that is underway including the program to monitor the stored gas in the Utsira reservoir. It also contains Statoil's vision of a CO_2-free energy economy based upon the energy carriers of electricity and hydrogen. Copies may be obtained by contacting Astrid Fjell at asfy@statoil.com.

Electric Vehicles

The staff of the California Air Resources Board has recommended a third easing of the requirements for electric vehicles in that state. Under the existing standard, four per cent of the cars offered for sale must have no tail-pipe emissions starting in 2003. Under the new proposal, only two per cent would be required to have zero emissions (including hybrids which rely mainly on batteries) and another two per cent could be hybrids that rely heavily on gasoline power. The new proposed standard would require sales of as few as 4,650 all-electric vehicles in 2003 as compared with the previous 22,000. The change reflects the difficulties faced in the production of cost-acceptable electric cars with desirable driving characteristics and the rapid advances in the hybrid field.

The Ballard Power System's new production facility in Burnaby in the Vancouver district has begun production of proton-exchange-membrane (PEM) fuel cells. The first commercial product is a portable power generator which will be marketed in 2001. Another production facility is planned for fuel cells specifically designed for the auto industry.

The company has also announced that it is purchasing a position in Millennium Cell Inc., a New Jersey company that is testing sodium borohydride, a hydrogen-rich derivative of borax, as a source of hydrogen for portable fuel cells. The developer of this technology reports that the sodium borohydride releases hydrogen in the presence of an unspecified catalyst. A 40% solution of this compound is stated to contain the energy equivalent of gasoline.

Cominco Ltd., a large Canadian mining company based in Vancouver, has announced it is investing in Metallic Power Inc. a California company that makes zinc-air fuel cells.

The Ford Motor Company confirmed it will offer a hybrid version of its *Explorer* on a volume basis for model year 2004. General Motors Corporation will also market a Sports Utility Vehicle in 2004. GMC has outlined a new diesel-electric 'parallel hybrid' system for larger vehicles such as trucks and buses aimed at fuel savings. DaimlerChrysler has announced that it will offer a hybrid electric power train for its *Durango* sports utility vehicle in 2003. The gasoline engine will power the rear wheels and the electric drive the front. Fuel economy is expected to increase 20%.