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Canadian Energy Up-Date

John Walsh

THE RE-NEGOTIATION OF THE KYOTO PROTOCOL

The Sixth Conference of the Parties to the 'UN Framework Convention on Climate Change' was re-convened in Bonn, the location of the Secretariat, July 16-27, 2001. COP 6, which had opened in The Hague earlier in the year, had been suspended when it was not possible to reach a compromise agreement in an atmosphere complicated by the decision of the then new Bush Administration of the U.S. to withdraw from the Kyoto Process on March 28, 2001. The Ministerial portion of the Conference ended with a somewhat surprising compromise agreement to proceed with changes to the Kyoto Protocol which was reached among the 178 nations attending after an all-night negotiating session in the early morning of July 23, 2001.

At the opening of the Bonn Conference, Dr. Robert Watson, then chairman of the Intergovernmental Panel on Climate Change (IPCC) delivered a synopsis of the Third Assessment Report which had been issued in early 2001. The expected temperature increase over the next century was revised upwards in this report and the link between climate change and human activity was found to be stronger than ever. Dr. Watson also stated that under every scenario used by the IPCC, carbon dioxide concentrations, temperatures, sea levels, and extreme weather events are all expected to increase.

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Update in continuous preparation for future issues of the 'Energy Studies Review' may be found on the Web at: pages.ca.inter.net/~jhwalsh/update.html John Walsh may be reached at jhwalsh@ca.inter.net

The re-negotiated agreement involved compromises in four important areas: (1) Land Use, Land Use Change and Forestry; (2) Mechanisms; (3) Compliance, and (4) Financing. The Land Use group may involve any or all of the following activities in the first commitment period to 2008-2012 provided they were human induced and occurred since 1990 including forest, cropland and grazingland management, and re-vegetation. These sinks were also to be eligible within certain limitations as Clean Development Mechanism Activities (CDM). These changes were strongly supported by Canada.

As far as mechanisms were concerned, the Conference was not a strong supporter of the earning of credits by exporters of nuclear facilities. The compromise states that host countries have the responsibility for the determination of which projects are consistent with their own sustainable development priorities but that Annex 1 Parties are to 'refrain from using emissions credits generated by nuclear facilities to meet [their] commitments.' As noted above under the Land Use option, carbon sequestration by aforestration and reforestration projects is permitted, but Annex 1 Parties will be limited to 1% of the base-year emissions times five. Reductions under each of the mechanisms will also be fully fungible or interchangeable without restriction. A fast-track procedure was established for small projects in a variety of supply or demand fields. An Executive Board was also formed to manage the CDM Mechanisms.

An organization has been established for the monitoring of compliance. A mandatory restoration rate of 1.3 times the excess emissions over that previously agreed has been set for sequential compliance periods. A Special Climate Change Fund and a Least Developed Countries Fund were established. The non-participating delegation from the United States confirmed there will be no participation from that country on the ground that the Protocol is 'not sound policy' and would be harmful to its economic interests but that it would not attempt to interfere with the negotiations. The U.S. for its part, will offer new proposals in 2002.

The final details of the revised Kyoto Protocol were agreed to after four years of negotiations at the subsequent COP 7 meeting held in Marrakech, Morocco, in November 2001, which set the first binding restrictions on releases of greenhouse gases to the atmosphere. The parties have agreed as to what is an infraction, how a case is to be decided, and the penalties that will apply. Canada, Japan and Russia were joined by Australia in insisting upon a trading mechanism for credits that will, its supporters claim, foster international markets for energy-efficient technologies. Sinks such as carbon sequestering in forests are important for Canada to meet its emission objectives. It is now widely expected the final version of the Protocol will be ratified, possibly later in 2002. The importance of the revised Kyoto Protocol is not thought to be the relatively minor degree of reductions in greenhouse gases that

it requires but the mechanisms and institutions that are being created to deal with this increasingly important problem.

Despite its withdrawal from the Kyoto process, President Bush announced on 13 June 2001 that the U.S. would spend an additional $160 million on research into climate change. Of this, $120 million will be assigned to NASA over three years for carbon dioxide and water vapour studies in the atmosphere, and their relationship to climate change. Another $25 million will be devoted to research into the capture and sequestration of carbon dioxide to be augmented with matching funds from the energy industry. More emphasis is to be placed on the control of methane emissions into the atmosphere. In a related matter, fourteen million dollars of the debt of El Salvador is to be forgiven in exchange for measures to be undertaken by that country to conserve its forests so as to sequester carbon dioxide. Forestry practices will be studied in Brazil and Belize to the same end.

NEW REPORTS

Annual Report of the Commissioner of the Environment and Sustainable Development (Canada)

Chapter 6 of the Commissioner's Annual Report to the House of Commons was devoted to Climate Change and Energy Efficiency. The efforts of the federal government to respond to the challenge of climate change were found to fall short of what is needed to achieve the commitments Canada has made to meet the Kyoto Protocol. The Commissioner noted that Canadian greenhouse gas emissions have continued to rise and in 1999 were 15 percent above 1990 levels. Nevertheless, the Commissioner found that Natural Resources Canada has made satisfactory progress in addressing previous recommendations on its energy efficiency initiatives.
The Commissioner considered the progress in other fields in terms of the Recommendations and Observations made in a previous report issued in 1998. The areas of concern were: Federal Roles and Responsibilities; Management Structure; Partnering Arrangements; Public Awareness and Education; Costs and Benefits; Federal Portfolio of Measures; National Portfolio of Measures; Implementation Plan; and Reporting to Parliament. The performance was graded as 'Some Progress' in all areas except Reporting to Parliament which was deemed rather surprisingly as 'Unsatisfactory.'

Chapter 6 is particularly useful in that it sums up the government's activities in this field in a short 42 pages including six appendices of tabular information. Copies of the full report may be obtained from the Office of the Auditor General of Canada, 240 Sparks Street, Stop 10-1, Ottawa, Ontario, KIA 0G6 (Fax: (613) 954-0696; Toll-free telephone 1-888-761-5953). The text of Chapter 6 may be obtained on-line

at www.oag-bvg.gc.ca/environment.

***Living in One World – Sustainability from an Energy Perspective* - A New Book from the World Energy Council**

The World Energy Council has published Living in One World – Sustainability from an Energy Perspective another book in a recent series dealing with the global energy outlook. In 1999, in cooperation with the International Institute for Applied Systems Analysis (IIASA) in Laxonberg, Austria, the Council published 'Global Energy Perspectives' (Edited by N. Nakicenovic, A. Grübler and Alan McDonald, Cambridge University Press, ISBN 0 521 64200 0) which was a systems-based exploration of world energy prospects based upon six scenarios of interest. As a follow-up, the Council published a formal policy statement Energy for Tomorrow's World Acting Now (ISBN 1-901640-06-X) in 2000. In it the Council proposed three goals for national and international policies - accessibility, availability, and acceptability. Ten policy areas were identified as the basis for action: Reap the Benefits of Market Reform and Appropriate Regulation; Keep all Energy Options Open; Reduce Political Risk of Key Project Investments; Price Energy to Cover Costs and Ensure Payment; Promote Higher Energy Efficiency; Foster Financing Partnerships linked to Environmental Goals; Ensure Energy Affordability for the Poor; Advance Education and Public Information; and Make Ethics a Strong Component of Energy System Governance.

In the new document, the Council departs somewhat from the previous practice in that the opinions expressed are those of the report's authors which are not necessarily endorsed in all respects by the membership drawn from the 93 countries that support this important Non-Governmental Organization of long standing. The introductory section alludes to the 'strongly-held' opinions of some members indicating that the compromises necessary for a unified position may not have been possible. This is not always a bad thing.

The book tackles the vexing problem of sustainability - a field to which Canadians have made many contributions in the past. It first examines how 'we got to where we are now' from the historical beginning of technology by using an expository technique reminiscent of James Burke's well-regarded TV Series 'Connections.' For the future years, the approach is unusual and perhaps unique in that the course of a possible unsustainable future is projected in Chapter 4 under the title 'The Threat of an Unliveable World.' This section is interesting but may not be entirely self-consistent. For example, are not the damaging factors that lead to the population drop projected in this chapter self-correcting? This book was produced under the auspices of François Ailleret, the Chairman of the WEC Studies Committee, by John Baker, a former Chairman of the WEC, with the aid of an

Advisory Committee. Michael Jefferson was the coordinating author and Director of the Study. Copies of this publication may be obtained from the World Energy Council, Regency House, 1–4 Warwick Street, London, England, W1R 6LE (Web: www.worldenergy.org) and the Energy Council of Canada, 807 – 350 Sparks Street, Ottawa, Ontario K1R 7S8 (Fax: (613) 952-6470; Web: www.energy.ca). The publication is unusual in that it contains advertizing which no doubt reflects the growing cost of preparing and printing such volumes.

Future U.S. Highway Energy Use: A Fifty Year Perspective

The Office of Transportation Technologies of the U.S. Department of Energy has sponsored a study entitled Future U.S. Highway Energy Use: A Fifty Year Perspective, which was prepared by several authors drawn mainly from the National Laboratories. This well-documented 41-page report may be downloaded in draft form from the Web at www.ott.doe.gov/pdfs/hwyfuture.pdf. The main conclusions are: 'the world's transportation systems must make a transition from conventional petroleum to other sources of energy within the next fifty years'; 'Long before 50 percent exhaustion [of conventional oil] is reached, a transition to alternative energy sources must begin;' 'Plausible alternatives exist, although achieving them will require advances in the technologies of vehicles and fuels, as well as effective public policies'; and in all cases 'It takes several decades for the effects of the new technologies and fuels to be fully effective, implying that early action is critical.' Comments on this interesting report are invited.

National Energy Report on Conventional Heavy Oil Resources in Canada

Canada's National Energy Board released Conventional Heavy Oil Resources of the Western Canada Sedimentary Basin in late August of 2001. The assessed heavy oil-in-place has been increased by 20 percent to 49.9 billion barrels when compared to the Board's 1999 Supply and Demand Report. Conventional heavy oil may be produced in wells in the normal way as opposed to bitumen recovered from the oil sands. The increase amounts to some 600 million barrels of recoverable oil of which 65 percent could be recovered at a cost of less that $C10 per barrel. The report considers the technology required to produce this oil and the potential for improved recovery.

Copies of this report may be obtained from the National Energy Board at 444 Seventh Avenue SW, Calgary, Albert, T2P 0X8 (Fax: (403) 299-5576) or on the Web at www.neb.gc.ca.

U.S. Report of Scenarios for a Clean Energy Future

A new report prepared cooperatively by five national laboratories – Argonne, Lawrence/Berkeley, National Renewable Energy, Oak Ridge, and the Pacific Northwest organizations - entitled Scenarios for a Clean Energy Future claims to be the most comprehensive study of the role of energy technologies in reducing local and global environmental emissions that the U.S. Department of Energy has ever commissioned. The study was based upon three scenarios of energy use: business-as-usual (BAU) as compared to moderate and advanced options. The BAU scenario is similar to the Department's Reference Case published in the Annual Energy Outlook 1999. The results illustrate that in the view of these authors, the U.S. can reduce its greenhouse emissions by 5% below the BAU level as soon as 2010 in the moderate scenario, and by either 13% or 17% in the advanced scenario, depending upon whether the carbon permit-trading charge is assumed to be $25 or $50/ton. Primary energy use is 3% below the BAU value in the moderate scenario and 8-10% below BAU in the advanced scenario again in 2010. The study concludes that the energy cost savings for the more efficient use of energy can equal or exceed the direct cost of the policies and technologies deployed in both the moderate and advanced scenarios by 2010. The July issue of the IEEE journal Spectrum (Vol. 38 No. 7 - Web: www.spectrum.ieee.org) contains an interesting comparison between selected passages of the text of the official U.S. energy policy document Report of the Energy Policy Development Group issued on May 16, 2001 and this Clean Energy Future Report prepared by the national laboratories. The latter lays much greater stress on the potential for energy efficiency and conservation. (The report on a clean energy future may be found on the Web at www.ornl.gov/ ORNL/Energy_Eff/CEF.htm)

Issue of 'Technology' Review Devoted to Energy

The January/February 2002 issue of Technology Review contains seven articles dealing with current issues in energy technology. Charles C. Mann deals with the oil situation in 'Getting Over Oil'; David H. Freedman writes on 'Fuel Cells vs. The Grid'; Peter Fairley on 'Solar on the Cheap'; David Talbot on 'The Next Nuclear Plant'; Gary Taubes on 'Whose Nuclear Waste?'; David Voss on 'Hitting the Natural Gas Jackpot' and Robert Pool on 'Electricity Goes to Market'. (Web: www.technologyreview.com)

IEEE Journal 'Spectrum'

The IEEE Journal Spectrum for January 2002 (Vol.39 No. 1) contains an article

by Tekla S. Perry entitled 'Capturing Climate Change' which is a useful short overview of the present state of play in this field. There is also an interesting interview with Professor Alfred E. Kahn, father of deregulation in the airline field, entitled 'How to make Deregulation Work' with particular reference to the electrical field. A news item entitled 'Delhi Stalls on Conversion of Transit Fleet to Natural Gas' reports on the difficulties faced by the Indian capital in dealing with its major problem with air quality.

The November 2001 Spectrum, Vol.38 No.11, is devoted to a number of articles under the rubric of 'Nuclear Power Gets a Second Look' by Telka S. Perry. Steve Miller writes on 'Pragmatic Concerns Fuel Nuclear Support', Jenny Weil on 'Pebble-Bed Design Returns', Jason Makansi on 'ReactorLand: A Board Game', Glenn Zorpette on 'Canned Heat', David P. Amber on 'Extending Life by Half' and 'Core Studies Make Comeback', and Glenn Zorpette and Steve Miller on 'Unconventional Nuclear Weapons'. The current interest in pebble bed reactors is noteworthy as is the extension of operating life by another 20 years from the 40 originally designed. (Web: www.spectrum.ieee.org)

UK Journal 'Energy Policy'

A special November 2001 issue of the British journal Energy Policy (Vol.29 No.14) has been devoted to 'Scenarios for a Clean Energy Future'. Edited by M.A. Brown, W. Short and M.D. Levine, this publication contains a Guest Editorial and eleven papers dealing with this subject that includes the question of market imperfections and barriers. (Web: www.elsevier.com/locate/enpol

Lawrence Berkeley National Laboratory 'Newsletter'

A special issue of the Environmental Energy Technologies Division Newsletter of Lawrence Berkeley National Laboratory (Vol.2 No.4) was devoted to the California energy crisis of 2000 and the research and development activities undertaken within that Division aimed at rectifying the situation. The issue opened with a short factual summary of the evolution of the crisis followed by a brief description of a number of both long- and short-term solutions. The projects that were undertaken to deal with the situation include technical assistance for peak load demand reduction programs and peak load savings programs. The Newsletter then describes activities listed as promoting High-Performance Building Systems, Supporting the Cool Roofs Standard, and other such measures as well as the establishment of two Web Sites to advise Californians on saving energy. (Web: eetd.lbl.gov/news/)

Newsletter of the International Association for Energy Economics

The *Newsletter* for the Fourth Quarter 2001 of the International Association for Energy Economics contains papers by Francisco Garcia Hernadez, Michelle Michot Foss and Alberto Elizalde Baltierra on 'The Mexican Electricity Market: Regional Forecasting and Restructuring of the Power Industry'; Alexander G. Kemp and Linda Stephen on 'The Economics of Field Cluster Developments in the UK Continental Shelf'; Petter Osmundsen and Ragnar Tveteras on 'Issues of Decommissioning'; Peter Hartley and Kenneth B. Medlock III on 'Controlling Carbon Dioxide: An Analysis of Competing Marginal Effects'; and Douglas B. Reynolds on 'Risk and the Reserve/Production Ratio.'

The *Newsletter* for the Third Quarter of 2001 also contains a number of papers of interest. Carol Dahl and Zauresh Atakhanova write on 'Managing in the Multicultural World of Oil'; Paul Stevens on 'Restructuring the Oil Industry in the Middle East'; William R. Edwards on 'OPEC's Challenge'; Reinhard Haas and Hans Auer on 'How to Ensure Effective Competition in Western European Electricity Markets'; Fereidoon P. Sioshansi on 'FERC Buckles under Pressure, Unveils New Price Mitigation Plan'; Paul Tempest on 'Has Energy Economics a Viable Future?'; and Sebastien Barreau on 'Innovations and External Growth Strategy: The Case of Oil and Gas Supply and Service Companies.'

The *Newsletter* may be obtained from the IAEE at 28790 Chagrin Boulevard, Suite 350, Cleveland, Ohio, 44122 (Fax (216) 464-2737; E-Mail: IAEE@IAEE.org; Web: www.IAEE.org)

UK Journal 'Nature'

The 15 November 2001 issue of the U.K. journal Nature contains a number of review articles concerning materials for clean energy processes. After an introductory article 'Alternative Energy Technologies' by M.S. Dresselhaus and J.L. Thomas, Michael Gratzel writes on 'Photochemical Cells', Brian C.H. Steele and Angelika Heinzel on 'Materials for Fuel-cell Technologies', Louis Schlapbach and Andreas Zuttel on 'Hydrogen Storage Materials for Mobile Application', J-M. Tarascon and M. Armand on 'Issues and Challenges Facing Rechargeable Lithium Batteries', and David Larbalestier et al on 'High-Tc Superconducting Materials for Electric Power Applications' (Web: www.nature.com).

IEA Greenhouses Gas R and D Programme publication 'Greenhouse Issues'

A synopsis of a major report commissioned by the Dutch government agency NOVEM entitled Potential for CO_2 Sequestration and Enhanced Coalbed Methane

Production (ECBM) in the Netherlands appeared in the September 2001 issue of Greenhouse Issues (Number 56). The report concluded that ECBM could become an economically feasible option for the Netherlands in a relatively short time. The technology could at least play a significant (and potentially very large) role in reducing greenhouse gas emissions in that country for about fifty years. Copies of Greenhouse Issues may be obtained without charge by contacting the Greenhouse Gas R and D Programme, Stoke Orchard, Glos. GL52 4RZ, United Kingdom. (Web: www.ieagreen.org.uk; Fax: +44 (0) 1242 680753)

SHORT NOTES

Canada

The James Bay Cree voted in February 2002 to accept an offer from the Québec Government which opens the door to hydroelectric development of the Eastmain and Rupert Rivers. An investment of the order of $3.8 billion dollars is contemplated in these facilities. The Crees would receive at least $3.5 billion over fifty years.

The Mackenzie Delta Producers Group and the Mackenzie Valley Aboriginal Pipeline Corporation announced in January 2002 that $200-250 million would be allocated to prepare the applications necessary to permit the construction of the pipeline and the development of the onshore natural gas resources in the Mackenzie Delta. The formal application is expected to be filed in 2003. The total cost of the project is placed at about $4 billion but its advocates claim it is less costly than the rival Alaska Highway pipeline project. The consortium proposing the $3 billion Mackenzie Valley gas pipeline (Imperial Oil, Shell Canada, Conoco Inc. and ExxonMobil) reached an agreement with the Mackenzie Valley Aboriginal Pipeline Corporation under which the organizations representing Canada's aboriginal peoples could become the owner of one-third of the line. The aboriginal groups would be involved in permit preparations and applications, as well as the regulatory review process in a marked change from past procedures. The pipeline remains under study as does its rival, the Alaska Highway project.

The Canadian Federal Budget of 10 December 2001 included a special provision of $400 million for the protection of key energy facilities such as refineries, pipelines and power plants from terrorist attacks. The Office of Critical Infrastructure Protection and Emergency Preparedness, which was established earlier this year by the Department of National Defence, will be responsible for this task. The Budget also provided $260 million to encourage the generation of electricity from the wind. The goal is to increase generation five fold from the present capacity of 200 megawatts to 1,000 megawatts over the next fifteen years.

On 4 December 2001, PetroCanada submitted regulatory plans for its new $800-million oil sands plant to be built at Meadow Lake near Fort McMurray, Alberta. It is intended to

produce 80,000 barrels per day by 2007. This heavy oil will be upgraded at the company's Edmonton refinery. Total production from the oil sands is expected to reach 1.7 million barrels per day within this decade.

The Suncor Energy Company announced that its major Millennium oil sands project in Northern Alberta built at a cost of $3.4 billion is essentially complete and that production reached 225,000 barrels per day by the end of 2001. The company has announced that its goal is to double its oilsands production in northern Alberta to exceed 500,000 barrels per day by 2012. A new upgrader may be built as part of these expansion plans.

The new Government of British Columbia announced it is considering allowing development of the petroleum resources thought to exist in the offshore regions of the Province.

The Province of Nova Scotia released a 300-page energy strategy in December 2001 that includes a proposal to establish an Energy Department with its own Minister. The new policy includes measures to allow newcomers to build or participate in electrical generation facilities and the encouragement of renewable energy sources. The Province will no longer insist on the requirement that gas distribution companies serve all its regions. The Premier John Hamm stated that the policy would aim at negotiated and voluntary arrangements with energy companies to encourage local job creation and other economic benefits. Later, the operators of the Sable Island field off the Nova Scotia shore reported a significant drop in the reserves at this first major gas production site in the Atlantic Provinces. The Provincial Government still expects another five or so similar gas developments over the next decades.

The Government of Newfoundland has approved the first on-shore oil production in that Province from the Garden Hill oil and gas field on the Port au Port Peninsula. The field was discovered by Hunt Oil and PanCanadian Petroleum in 1995 but considered non-commercial at that time. Imperial Venture Corporation of St. John's plans to drill up to six wells over the next two years.

The last coal mine in Cape Breton closed in November 2001.

B.C. Hydro has identified two sites on the west coast of Vancouver Island as possible locations for wave energy installations.

Ontario Power Generation has installed what is presently the largest wind turbine in North America. The 1.8 MW unit with 39 metre blades mounted in a tower 78 metres high is located at Pickering.

United States

The El Paso pipeline company is proposing an undersea gas pipeline to extend from the emerging offshore Nova Scotia gas fields to New York. It would touch land at Lockport in

the southern region of Nova Scotia.

The U.S. Department of Energy has recommended that the Yucca Mountain Site in Nevada be used to store radioactive waste materials from the nuclear power industry and the nuclear weapons factories. Some $US 4.5 billion has been spent proving this site to date over the last fourteen years. The project is ultimately expected to cost more than $US 40 billion. There are still many obstacles to this development and the repository cannot open before 2010 at the earliest.

The California Public Utilities Commission voted to eliminate the right of electrical consumers to choose their own power providers in September of 2001 thus taking an important step to re-regulating the electrical industry in that State.
In November 2001, President Bush ordered the Strategic Petroleum Reserve to be filled. The Reserve, created in 1975, has a capacity of 700 million barrels of oil. The re-charging process will require storing 100,000 barrels per day for about two years. The Reserve now contains about 545 million barrels which would last 53 days if imports were halted. The U.S. actually imports a smaller percentage of its oil from the Middle East than it did 30 years ago.

The Secretary of Energy, Spencer Abraham, announced on January 9, 2002 that the Bush Administration was discontinuing the Partnership for a New Generation of Vehicles (PNG) which began eight years ago and has expended some $US 1.5 billion to date. Canada also participated in this project that was aimed at the production of affordable cars with standard characteristics with a fuel consumption of 80 miles to the U.S. gallon. Instead, the Department of Energy will concentrate on the replacement of the internal combustion engine altogether, primarily by emphasis on the hydrogen-based fuel cell technologies through a new research partnership with the auto companies and others active in the field to be known as 'Freedom Cooperative Research.' The funding will be announced as a component of the 2003 budget. Canadian developers of fuel cells for cars welcomed the new program.

A Utah-based company, Eneco Inc., in a paper presented to the Materials Research Society in Boston in November, reported significant advances in the field of thermoelectric devices. By refined doping procedures, 17% conversion of heat to electricity has been achieved as compared to the best present level of about 10%. A successful development of these devices would open the door to recovery of much waste heat as electricity whether in power plants or cars.

Other

Dr. Robin Jeffrey, Executive Chairman of British Energy and Chairman of Bruce Power stated during the W.B. Lewis Lecture for 2001 in Ottawa on 17 October that his firm was interested in the new generation of CANDU reactors for application in the United Kingdom. British Energy operates reactors of a number of types in Britain, in joint ventures in the U.S., and at the Bruce Power Station. The designers of the CANDU-NG Reactor hope to reduce

the capital requirements by some 40%. In a later press release it was stated as many as ten reactors were under consideration for installation in Britain.

The government of India has approved the construction of two 1000 MWe pressurized light water reactors of Russian design in the State of Tamil Nadu. These reactors are expected to come into service in 2007 and 2008.

Frank N. von Hipple has written an interesting analysis of recent proposals to revisit the question of plutonium and the reprocessing of spent fuel in the 28 September 2001 issue of the AAAS journal Science Vol.293, No. 5539. He concludes that 'both nonproliferation and the nuclear power establishment would be best served by focusing on the basics during the coming decades and sticking to the simple, economical 'once through' (i.e. nonreprocessing) fuel cycle.' (Web: www.sciencemag.org)

The World Meteorological Organization reported in December that it expects the average temperature for the year 2001 to be 14.42 degrees C which would be the second highest since global records began 140 years ago. The record was set in 1998 when the average temperature reached 14.57 degrees C. Nine of the ten warmest years in the last four decades have occurred since 1990, and temperatures are rising three times faster than in the early 1900s. A representatives of the WMO stated 'temperatures are getting hotter, and they are getting hotter faster now than at any time in the past.' (Web:www.wmo.ch/index-en.html)

Sallie W. Chisholm et al have written a critique of ocean fertilization schemes aimed at enhancing the flow of carbon dioxide from the atmosphere to the ocean to deal with greenhouse gas emissions in the 12 October 2001 issue of the AAAS journal Science Vol. 294 No. 5541. These authors suggest that 'ocean fertilization, on the open seas or territorial waters should never become eligible for carbon credits' because of the danger of encouraging a 'tragedy of the commons.' (Web: www.sciencemag.org)

A paper titled Storing Carbon on Land by R.J. Scholes and I.R. Noble has appeared in the 2 November 2001 issue of the journal Science (Vol. 294 No. 5544) which provides a concise overview of this issue important in the Kyoto Protocol negotiations. (Web: www.sciencemag.org)

The KLIMATEK Program funded by the Government of Norway will involve studies in the field of the capture and sequestration of carbon dioxide. A concept will be tested for the co-production of electric power and hydrogen from natural gas with integrated carbon dioxide capture at high overall efficiency. In a related study, the combustion of natural gas with oxygen in gas turbines with re-circulation of the exhaust gas to provide the necessary temperature control will be assessed. Such a practice provides an exhaust gas consisting mainly of water and carbon dioxide which facilitates the separation of the latter greenhouse gas.

A paper by Devra Lee Davis et al at Carnegie Mellon University in Pittsburgh published in the Journal Science in the 17 August issue (Vol. 293 No. 5533, p.1257-59) claims more people now die from auto pollution than in traffic crashes around the world. This effect is particularly noticeable in four major cities – Sao Paulo, Mexico City, Santiago and New York City. (Web: www.aaas.org)

The Forum of Federations, established in 1998 as a non-profit organization to aid federal governance around the world, is undertaking an energy project that will concentrate on a comparative analysis of the constitutional frameworks of Canada, Mexico and the U.S.A. There will be papers on jurisdiction, regulation environment and the influence of First Nations. (Web: www.forumfed.org)

Shell Hydrogen has joined with the Mitsubishi Corporation of Japan and Johnson Matthey PLC to form Conduit Ventures Ltd. of London with an initial capital of $100 million available to invest in companies that have established fuel cell and related hydrogen technologies.

Electric Vehicles

The American inventor Dean Kamen unveiled a battery-powered scooter to serve as an urban transportation device on 3 December 2001. Designed for sidewalk use, the Segway Human Transporter can move one person at a maximum of 20 km per hour. With no brakes, its speed and direction are controlled gyroscopically by shifting the rider's weight with the aid of a manual turning mechanism on one of the handlebars. It is foreseen that this new device, to be offered initially at about $US 3000, will be used first in warehouses, etc., and then will gradually be adopted by the public in urban centers. Operational characteristics under winter conditions are claimed to be good.

The States of New York, Massachusetts and Vermont are considering postponing their requirement for the sale of electric vehicles by four years. This change would leave California as the only state requiring the sale of electric cars over the next several years thus cutting the potential market by about half. In California, regulations require at least 10 percent of the cars sold by each manufacturer starting in the 2003 model year to be significantly improved over current models with 2 percent to be rated as zero-emission vehicles (ZEVs). The northeastern states believe giving manufacturers more flexibility to meet standards through the introduction of hybrid vehicles will lead to more environmental benefits in the longer run.

In the U.S., the Dupont Company has entered into an agreement with H Power Corporation to develop direct methanol fuel cells with outputs in the range of 100 to 1000 watts to be targeted at small mobile applications such as scooters, bicycles and golf carts. The cells will be based upon Dupont's Nafion membrane technology.

In October 2001 it was announced that Ballard Power Systems of Burnaby, B.C. would acquire Xcellis GmbH from the DaimlerChrysler Company and Ecostar Electric Drive Systems LLC from the Ford Motor Company in exchange for shares valued at $553 million giving DaimlerChrysler 23.6% and Ford 19.5% of the company. The car companies would

also invest $110 million in cash and $55 million through a private placement of Ballard shares. Ballard's workforce will double to about 1,600 with the development of fuel cells for cars to the concentrated in Germany and the development of cells for buses to continue to be based in the Vancouver region. This change is in preparation for the large-scale introduction of hydrogen-based fuel cells in cars by 2004 with mass production expected in about 2010. The source of the hydrogen is still an open option. Ballard Power also announced it had begun production of a 1.2 KW fuel cell module called the 'Nexa' based upon hydrogen aimed at consumer and small industrial applications.

General Motors Corporation has announced it will market a fuel cell-powered S-10 model pick-up truck, which will be available for test-drives in 2002 this year. The company has taken a 28% equity stake in the fuel cell firm Hydrogenics of Mississauga, Ontario. The company has also announced it is developing a fuel cell to meet stationary electrical needs. Alone among the major car companies, GM has extended its work on vehicle propulsion systems to the business and home markets for electricity. The fuel input may be natural gas or gasoline. These units could store hydrogen produced in off-peak periods to provide electricity on peak. In the vehicle field, the company has developed a 25 kW hydrogen cell based on gasoline to power a Chevrolet pick-up truck. A fifty percent gain in mileage is claimed with a corresponding reduction in greenhouse gases. The company is now investigating the use of capacitors for the storage of electricity in hybrid vehicles in cooperation with Maxwell Technologies of San Diego. These achieve high capacity through the use of carbon electrodes of high surface area. Capacitors, unlike batteries, may be charged very quickly and this attribute allows a higher capture of the energy recovered in dynamic braking. The company expects to install these devices in its hybrid buses due in 2003. The company announced on 12 June 2001 that it would acquire a minority interest in Quantum Technologies Inc. of Irvine, California, a company that is developing a lightweight tank to hold hydrogen for fuel cell-equipped vehicles

The Toyoto Company of Japan has announced it has developed a hybrid gasoline-electric drive train applicable to some of their mass- market vehicles as opposed to the system used in the specially designed 'Prius' now on sale. The company has introduced a hydrid gasoline-powered minivan called the 'Estima' that is equipped with both front and rear electric motors and a secondary nickel-metal hydride battery that is claimed to be twice as fuel efficient as the gasoline-only model. This vehicle can also serve as a mobile 1.5-kw generator. The company has also announced a fuel cell-powered bus.

The Federal Government announced on 11 June 2001 that $ 23 million would be provided through the Canadian Transportation Fuel Cell Alliance program to establish a network of stations to supply hydrogen for fuel cell-equipped vehicles in British Columbia, Manitoba, Ontario, Quebec and the Maritimes over the next five years. Demonstrations will be included of natural gas reforming to hydrogen at distributed stations; distributed electrolytic hydrogen fuelling for large-and small-scale applications; centralized electrolytic hydrogen fuelling for fleets using liquid hydrogen tankers; and methanol stations for vehicles equipped with on-board reforming apparatus to produce hydrogen. This program is timed to coincide with the first production of this class of vehicle expected in 2004.

A new company, Phostech Lithium Inc. has been formed in Montreal to manufacture re-chargeable iron-lithium batteries in which the cobalt electrodes normally used are

replaced with an iron phosphate-based material with the object of markedly reducing material costs. The new batteries are based upon research conducted at the Université de Montreal by Michel Gauthier.

The Calgary light rail rapid transportation network is now powered with electricity derived from wind turbines installed in the windy Crowsnest Pass area of Alberta by Vision Quest Windelectric Inc.The 21 gigawatt hours of electricity to be supplied each year is expected to displace 21,000 tonnes of carbon dioxide from the atmosphere. The extra cost is stated to be one-half cent per rider.