Update

Ottawa Meeting of the IAEE

On February 24, 1997, Dr. Lee Schipper, Visiting Senior Scientist at the International Energy Agency in Paris spoke to the Ottawa Section of the International Association for Energy Economics. Dr. Schipper, who will remain on the IEA staff for the rest of 1997, is associated with Lawrence Berkeley Laboratory of the University of California and is a recognized authority in the field of energy conservation. His presentation, entitled 'Indicators of Energy Use and Efficiency–Human Activity, Energy Consumption and Carbon Dioxide Emissions' provided an update on energy indicator activities and gave a summary of the key indicators. Most of his presentation dealt with the problem of the deep interpretation of energy data and making meaningful comparisons among nations. The questions addressed in this presentation were: 1) What are indicators and what can we learn from them? 2) How can we improve them? 3) What we can and cannot learn from international comparisons using indicators; and 4) What is the role of indicators in monitoring energy efficiency progress from 1990-2000? The IEA will be publishing a book in this field shortly. In the meantime, a set of overheads from Dr. Schipper's talk is available at e-mail: dwalsh@magi.com.

In June 1996, Natural Resources Canada released a report entitled *Evolution of Energy Efficiency in Canada* (ISBN 0-662-81049-X) which provides much related Canadian information. It is available at fax: (819) 994-1498.

Conference on CO_2 Removal

The Third International Conference on Carbon Dioxide Removal (ICCDR-3) was held at MIT on September 9-11, 1996. The Conference coincided with the first major sequestering project which is now in the start-up phase at the Sleipner Vest field in Norwegian off-shore waters. Starting in October, 1996, about one million tonnes per year of CO_2 (which must be separated from natural gas containing about 9% of this gas to meet market specifications of less than 2.5%) is being sequestered in the Utsira aquifer that overlies the gas producing formation. (When in full operation, this project will avoid a 3% increase in Norway's emissions. Norway imposes a tax of $US 55 per tonne on CO_2 emitted to the atmosphere.) The announcement of this development was both timely and encouraging for this meeting. Two hundred and fifty delegates from 26 countries attended. There were 125 papers listed in the program of which 10 were from Canada.

In the Plenary Session there was general acceptance of the view that the increase in average world temperature should not be allowed to exceed 2°C and that the rate of increase should be

limited to 0.1°C each decade. Noteworthy in this session was the presentation by Richard Richels of the Electric Power Research Institute, who reviewed his work conducted with Prof. Alan S. Manne of Stanford University over the past few years on the least-cost approach for controlling CO_2 emissions on a world basis. These studies properly focused upon the concentration of CO_2 in the atmosphere (not emissions to the atmosphere) and showed that costs could be much reduced by relaxing the requirement for both where and when control measures are applied: costs are lowest when full international collaboration is allowed with the timing kept flexible to allow a full service life for the existing capital stock. This paper generated some controversy since it is counter to the intuitive view that the sooner efforts are made to reduce emissions the better. Furthermore, the rate of increase of temperature in the early years might well exceed the 0.1°C each decade, limiting value.

The Conference focused on technologies that might help allow the continued use of fossil fuels if CO_2 emissions are limited in the future because of greenhouse gas emissions. Most papers dealt with the core topic of how to effectively capture CO_2 from large stationary sources and the subsequent storage or use of this gas. Additional papers discussed economics, life cycle assessments, and comparisons to other mitigation options.

The technical papers were grouped into sessions dealing with chemical solvents, ocean storage (with many contributions from Japan), chemical processes, membranes and other novel separation techniques, geological storage, full fuel cycle analysis, combustion in oxygen, microalgae systems, biomass and co-firing practices, novel approaches and other energy cycles. Policy and implementation issues were also addressed. Progress was evident in many fields and, although projected costs are still high, several papers dealt with technical evaluations and comparisons of the many different options. There are perhaps too many choices at present. Advances were found in the field of separating agents and in flue gas contacting schemes for application to the conventional combustion process. Studies continue for the integrated-gasification combined-cycle option for coal and the combined cycle process for natural gas. Processes based upon the combustion of fuel in oxygen are gaining favour because of the reduced cost of the separation of CO_2 despite the increased cost of using oxygen in place of air.

As far as sequestering is concerned, there are three main options under consideration: in the forests, in the oceans, and in reservoirs and aquifers. The first option, storage in forests, is probably the cheapest but is limited in scope. Storage at depth in the oceans is essentially without limit, but a paper by Judith Kildow examined the political factors bearing on the public acceptability of this option with sobering results. Use in the enhanced recovery of oil and gas (an existing technology) and storage in depleted natural gas reservoirs or in aquifers offers both practicality, acceptability and the ability to accommodate large volumes of this gas. Whether an option exists for the large-scale utilization of captured CO_2 in chemical processes for the production of other materials remains controversial.

The final Panel Session dealt with the question: Where do we go from here? One speaker called for more actual research and fewer studies. Another expressed the view that his grandchildren, looking back in the future, would be dissatisfied with the progress at this conference. Nevertheless, it may be said that there is an evolving option for the capture and sequestering of CO_2 which at least one speaker, Wim Turkenburg of the University of Utrecht, believes is essential if present control targets are to be met.

The next meeting in this series will be held in Interlaken, Switzerland, August 30-September 2, 1998, under the new title of International Conference on Greenhouse Gas Control Technologies (GHCT-4). The meeting will now be formally coordinated with those organized by the IEA Greenhouse Gas R&D Programme which will become the sanctioning organization. The papers presented at ICCDR-3 were published in 1997 as a special volume of the British journal *Energy Conversion and Management*. More information on ICCDR-3 may be found at the following Web Site: http://web.mit.edu/energylab/iccdr3/info.

The IEA Greenhouse Gas R&D Programme is organizing a meeting on Technologies for Activities Implemented Jointly under the Framework Convention on Climate Change to be held in Vancouver May 26-29, 1997. Information and recent news on Activities Implemented Jointly may be found on the Web at JI Online (http://www.ji.org/).

Alliance for Responsible Energy Alternatives

The Alliance for Responsible Energy Alternatives (AREA) held its Second National Climate Change Conference in Ottawa, September 26, 1996. Founded in 1994 by a coalition of industry, labour and municipalities from across Canada, AREA provides a forum to reflect the views and represent the interest of a broad cross-section of Canadians in the Climate Change debate. It has 47 members at present and is associated with the International Climate Change Partnership. The Ottawa meeting was attended by about 95 delegates.

The meeting was conducted in four panel sessions after introductory remarks by John Redfern, Lafarge Canada Inc. and Eric Newell, President and CEO of Syncrude Canada. H.A. Clarke of Environment Canada brought greetings from his Minister, the Hon. Sergio Marchi, and reviewed the status of the negotiations following the July, 1996, Conference of the Parties (COP2) to the UN Framework Convention on Climate Change (FCCC). Mr Clarke confirmed the government's interest in the Voluntary Challenge and Registry (VCR) and in Activities Implemented Jointly (AIJ) with other, particularly developing, countries.

The First Panel was chaired by Josh Mendelsohn of the Canadian Imperial Bank of Commerce under the title Climate Change and its Impact on Competitive Position. Jim Frank of the Conference Board of Canada began by presenting an overview of his group's analysis of the position of the Canadian economy for the next few years. He expressed concern over the rising level of consumer debt. Mr Frank also noted that the Canadian dollar was trading lower than its Purchasing Power Parity level with respect to the US dollar and thus may be expected to rise somewhat. His concern was that the gain in Canadian productivity in the coming period may not be sufficient to offset this expected rise. Paul Wacko of Inland Cement called attention to the need for maintaining Canada's competitive position in world trade. Henry D. Jacoby of MIT presented a summary of the work of the now well-known Joint Program on the Science and Policy of Global Change at that institution. Using the proposal of the Association of Small Island States (AOSIS) for reduction in emissions as his base case, he showed that substantially less cost was incurred by allowing cooperation between developing and developed nations. There was even an advantage, although smaller from cooperation among OECD countries alone. So-called 'leakage' of emissions to non-OECD countries (arising from the relocation of fossil-fuel using industries to countries with no control limits) was projected as being surprisingly small at 8%, although it could be as high as 15%. Jim Popowich of Fording Coal also called attention to the need to keep competitive trade considerations in mind from the prospective of the Canadian coal industry.

The Second Panel dealing with the Manufacturing Sector–Including Transportation, Capital Stock Turnover, Regulatory and Marketing Impacts was chaired by Michael Cloghesy, Président of the Centre Patronal de l'Environnement du Québec who, in his introductory comments, stressed the need for industry and government to work together and noted the importance of regional interests. Mary Class, Environmental Consultant to the European Conference of Ministers of Transport, explained the importance of controlling emissions from the transport sector. Twenty-five per cent of the CO_2 emissions in Europe are from this sector, of which 80% arise from road transport. Cars account for about two-thirds of the road transport total. Road freight is increasing 5% and cars 3% per year: air transport is also rising rapidly. John Shiller of Ford Motor Company noted that there were about 625 million vehicles around the world and explained some of the factors involved in increasing their fuel efficiency. His company was examining an all aluminum car and also hybrid fly wheel/ engine/electric drive trains among its many activities in this field. He expressed the hope that the problem would not be treated in a 'sector-specific' way by such means as tighter CAFE standards because of the difficulties in increasing efficiency in the auto sector. David Egar of Environment Canada agreed reduction in emissions must be made in step with other nations and that, while the VCR program was effective in the energy-intensive sector, it was less so in the commercial and transport sectors. Dennis Rogoza of British Columbia Environment, Lands and Forests focused on the smog problem in the Lower Mainland region of his Province and its relationship to CO_2 reductions in the BC Clean Action Plan. About one-half of the latter such emissions are from vehicles in BC. The Province is growing about 3% per year in population and it will not meet the 1990 level by 2000 objective mainly on this ac-

count. A new Clean Air Act is planned and a Discussion Paper will be released early next year. Malcolm Rowan of the Alliance of Manufacturers and Exporters focused upon the question of energy embodied in Canadian exports and the need to get 'credit' for the emissions associated with this energy.

The Luncheon Speaker was Dr. Sallie Baliunas of the George C. Marshall Institute. She threw doubt on both the conclusions of the Second Assessment Report (SAR) of the Intergovernmental Panel on Climate Change (IPCC) and the process by which its report was edited. The main technical point at issue is the way in which water vapour is handled in the General Circulation Climate Models. She believes the climate is warming very slowly, if at all, and that there is no need for control measures at the present time.

The Third Panel was chaired by John Dillon of the Business Council on National Issues and dealt with the FCCC Process: Accomplishments, Concerns, Future Roles and Direction. The first speaker, Hans Buwalda of Woodward Clyde Consultants of Oakland, California, drew upon his previous experience in New Zealand. He believes the FCCC process started well but there has been insufficient analysis and assessment conducted to reach binding agreements at the COP3 meeting scheduled for Kyoto in December of 1997. He showed how individual countries have special problems. Up to now, 80% of the electricity in New Zealand has been generated from renewable sources (hydro and geothermal) but now that country will need to turn to more fossil fuel generation for additional electricity as it grows economically. The burden of meeting its commitments are thus greater than elsewhere. William F. O'Keefe of the American Petroleum Institute and Chairman of the Global Climate Coalition criticized the IPCC process and, particularly, the editing phase of the SAR. His message was "go slowly." David Grimes of Environment Canada defended the IPCC process and explained that there would be three Working Groups in the future and that more workshops were scheduled. Special attention will be directed to the concerns that had been raised at the meeting. The Third Assessment Report is due about 2000.

The Fourth Panel, chaired by Lucie Edwards of Foreign Affairs and International Trade Canada, dealt with the International Agenda. The first speaker, M.Z. Cutajar, Executive Secretary to the FCCC, departed from his prepared remarks to also defend both the IPCC conclusions and its process. He stated that the objections raised had long being known to those involved in the process and were nothing new. He noted that there was no alarmism in the IPCC SAR and that if, anything, the prose employed was too flat. He described the difficult road that lay ahead to COP3 in Kyoto by giving an appreciation of the positions of a number of different countries as well as groups such as OPEC. Bernarditas de Castro Muller of the Philippine Mission to the UN in Geneva described the problem from the point of view of a developing country. Though these countries have made no commitments in the FCCC negotiations, increasingly international aid agencies require such environmental issues to be addressed. In this connection, Charles Feinstein described the World Bank's program to assist developing nations through the introduction of benign technologies and the way this institution attempts to leverage its investments. For the short term, the Bank attempts to 'buy time' with efficiency improvements and the like until the long-term sustainable (mostly renewable) technologies are ready. He described a number of examples of the Bank's investments in Brazil (biomass electricity), India (wind farms and solar-thermal electric generation), and the Philippines (geothermal). Vivek Tulpulé of the Australian Bureau of Agriculture and Resource Economics (ABARE), an independent semi-official agency, stressed the need for equitable policies as well as the more common tests of effectiveness and efficiency to make the FCCC negotiating process work. He believes tradeable quotas give the best combination of the three tests by presenting a series of calculations of 'welfare losses' from emission commitments (including values for Canada). Y. Hosoya, Tokyo Electric Power Company, presented a summary of the position of Japan from the point of view of a large utility that supplies about one-third of that country's electricity. That country is developing a major 'decarbonization' strategy step-by-step. This long panel session concluded with a presentation by Ambassador Mark G. Hambley, US Special Representative to the UN Commission on Sustainable Development and Climate Negotiator. He described the new framework developed by the US for its participation in the FCCC negotiations because, in the view of his country, the system was not working and that the actions taken were not enough. There are three main elements to the US framework: 1)

the need for binding targets in the medium term which should be flexible, and include provisions for Activities Implemented Jointly and emissions trading; 2) a focus on reducing concentrations of greenhouse gases in the atmosphere in the longer term; and 3) recognition of the important role developing countries will play in the future in resolving this problem.

The Proceedings of the Second National Climate Change Conference were published in December 1996, and are available from AREA, 1840 Manulife Place, 10180–101 Street, Edmonton, Alberta, T5J 3S4 (Fax: (403) 441-9849). Previous to the meeting, the AREA Board approved an extension of its activities for at least another three years.

New Reports

National Energy Board

DEREGULATION OF NATURAL GAS

In November 1996, the National Energy Board (NEB) released *Ten Years after Deregulation*, the seventh in a series of Natural Gas Market Assessment Reports prepared as part of the Market-Based Procedure adopted by the NEB in July 1987. The purposes of this report are to: 1) review the changes that have taken place in the Canadian natural gas market in the 10 years since this market was deregulated; 2) describe the current functioning of the market; and 3) assist the Board in assessing whether or not the market is generally operating in such a way that Canadian requirements for natural gas are being met at fair market prices.

In the summary, it is stated that "natural gas has emerged as a commodity that can be traded on a short-time basis in a highly transparent spot market. The efficiency of the gas market has been enhanced by the development of a spot market and associated futures markets, and by improvements in the gas transportation system. ...The importance of aggregators as gas sellers has diminished as marketing companies have taken up a large share of the gas sales market. ... There has been a steady growth in gas consumption in Canada during the past ten years, with the most rapid growth occurring in the industrial sector. ...There has been a spectacular growth in Canadian gas exports in the last ten years, as exports quadrupled from the 1986 level. [Canada now supplies about 13% of US gas consumption] ... The North American gas market has become increasingly integrated over the past decade. ... Canadians who purchase gas from Alberta have paid prices which have been equal to or less, on average, than prices paid by export buyers for Alberta-sourced gas....The current initiative in the US to deregulate electric power markets eventually could have a large impact on the gas export market." The report also notes in Appendix II, which deals with Price Signals for Pipeline Expansion, that "since January 1995, the value of pipeline capacity going east has been greater than regulated pipeline tolls. In contrast, the value of capacity going to California has been less than regulated tolls." In consequence, it is expected that new pipeline extensions will be directed to markets in the Midwest and Northeast US.

This report, catalogued as ISBN 0-662-25193-8.311, is available from the National Energy Board, Sixth Avenue SW, Calgary, Alberta, T2P 3H2 (Fax: (403) 292-5503).

LONG-TERM CANADIAN NATURAL GAS CONTRACTS: AN UPDATE

On January 30, 1997, the National Energy Board released another in its series of Natural Gas Market Assessment Reports entitled *Long-term Canadian Natural Gas Contracts: An Update* which follows a report on the same subject issued in August, 1992. This report provides a comprehensive descriptive analysis of the changes that have occurred in the nature of long-term contracts governing the sale of western Canadian gas in the domestic and export markets from 1991 to 1995. The study analyzes contract terms and conditions but not gas flows or prices. Over this period, both Canadian gas production and exports increased markedly.

Prior to natural gas deregulation during the mid-1980s, Canadian and US buyers secured virtually all their gas supply requirements through long-term contracts. These contracts formed the basis for financing underlying exploration and development programs, and the pipeline projects necessary to develop the industry. There were only a relatively small number of buyers or sellers. Most marketers of western Canadian gas were supply aggregators that were usually associated with a Canadian pipeline. The daily quantity under most contracts was typically very large, often exceeding 5.7 million m^3 (200 million ft^3) per day.

This report surveys the changes since that era. End-users now elect more-and-more to purchase their gas requirements

directly from producers and marketers under short-term contracts although more recently, US gas marketers have emerged as a new market for gas purchased under long-term contracts. The volume of gas expected to be contracted under such arrangements is expected to grow, although the terms of these contracts will likely be 10 years or less. There is now more reliance upon prices discovered in futures trading markets.

Copies of this 33-page report (ISBN 0-662-25338-8), together with the glossary and an appendix listing contracts now in effect by destination of gas, are available from the National Energy Board.

STRESS CORROSION CRACKING ON CANADIAN OIL AND GAS PIPELINES

The National Energy Board released the report of an inquiry conducted by a Panel of three of its Members entitled 'Stress Corrosion Cracking (SSC) on Canadian Oil and Gas Pipelines' on December 19, 1996. This Panel was established after a number of recent pipeline failures were attributed to SSC: there have been 22 failures including 12 ruptures attributed to this cause mostly since 1985 on pipelines coated with polyethylene tape which were newly installed between 1968 and 1973. This coating has tended to separate from the pipe and so allow moisture to contact the underlying steel. Because polyethylene tape is an electrical insulator, it shields the steel from normal cathodic protection measures. This problem has been encountered in other countries and the NEB believes that this report will be helpful elsewhere.

SSC on pipelines begins when small cracks develop on the outside of the buried pipeline. These cracks are initially not visible to the eye and are most commonly found in colonies, with all the cracks positioned in the same direction. Over a period of years, these individual cracks may lengthen and deepen, and the cracks within a colony may join together to form longer cracks. This condition can exist in pipelines for many years since the problem develops slowly. The NEB believes that the SSC problem can be managed successfully and the report makes a number of specific recommendations in this regard. It is noteworthy that the report states that there is no clear evidence of a threshold level of pressure that SCC will not initiate and grow and, consequently, a reduction in operating pressure will not prevent failure and would be very costly to the industry. It does note, however, that decreasing the pressure means that a larger defect would be required before failure.

Copies of this 158-page report (including appendixes), dated November 1996, and catalogued as MH-2-95 (ISBN 0-662-25246-2), are available from the National Energy Board

Newsletters of the IAEE

The Fall 1996 *Newsletter* of the International Association for Energy Economics contains edited versions of a number of presentations of general interest given to the 19th International Conference of the Association held in Budapest in May 1996. These presentations include an extensive overview of 'The Outlook for Oil Demand, Supply, and Trade in the Asia-Pacific Region to 2005' by Fereidun Fesharaki; 'Energy Policies of South Africa' by Philip Swanson; 'Evolution and Outlook for Fossil Fuel Production Costs' by Jean Masseron and Jean Philippe Cueille; an interesting review of 'The North American Energy Scene' by John H. Lichtbau; an assessmemt of 'Opportunities for Western Companies in the Former Soviet Union' by Thorleif Enger; 'Is a Third Oil Crisis Looming Before the End of the 1990s?' by Mamdouh G. Salameh; and the 'Problems of Liberalization/Privatization' by Antoni Goszcz and Jerzy Michna.

The Winter 1997 *Newsletter* of the International Association for Energy Economics contains summaries of several interesting presentations given at the Association's 17th Annual North American Conference held in Boston, October 27-30, 1996. These include papers by: Keith Hamm 'The Impact of Deregulation on the Outlook for the Oil Industry;' William F. Hecht 'Choice in Electricity: Sound Public Policy;' Wolfgang Pfaffenberger 'Deregulation of the Electricity Sector in Germany;' three reports from the UK by M.J. Parker 'Will Domestic Competition Benefit Gas and Electricty Consumers?,' 'Is Competition in Electricity Markets Compatible with Security of Supply?' and 'The Outlook for UK Coal: Short-term Plenty, Long-term Famine?,' Morris A. Adelman 'No OPEC;' and Mamdouh G. Salameh 'Saudi Oil Power Keeping Iran's Economy in Check.' The *Newsletter* also contains a survey report on the October Annual North American Conference by Paul Roberts, Sylvia Bennett and Gary Flaharty.

Further information may be obtained from the IAEE at 28790 Chagrin Boulevard, Suite 210, Cleveland, Ohio 44122. Web site: http://www.IAEE.org or Fax:

(216) 464-2737.

Report on Environment and Sustainable Development

The first Commissioner for the Environment, Brian Emmett, was appointed in July 1996. Brian Emmett is a public servant of long experience with both Environment Canada and Natural Resources Canada. The position of Commissioner for the Environment, which is located within the Office of the Auditor-General of Canada, was established by Parliament to monitor activities in this field throughout the government.

On March 5, 1997, the Commissioner's first *Report on the Environment and Sustainable Development* was released. The *Report*, which includes an interesting section on the definition of Sustainable Development, examined 42 existing federal audits and found 70% of them cited problems with the implementation of environmental measures. The difficulty in meeting the international commitment to reduce the emissions of greenhouse gases to their 1990 levels by 2000 was acknowledged. In addition to the annual report, the legislation enables the Auditor-General to report to Parliament on behalf of the new Commissioner on urgent matters at any time.

In the coming year, the Commissioner's office will focus on climate change, ozone depletion, environmental degradation, and the health of Canada's fisheries. Twenty-four federal departments and agencies are scheduled to prepare their sustainable development strategies by December 1997.

Copies of this bilingual Report (ISBN 0-662-62842X) may be obtained from the Auditor General of Canada, 240 Sparks Street, Stop 10-1, Ottawa, Ontario, K1A 0G6 (Fax: (613) 954- 0696; E-Mail: green-report@oag-bvg.gc.ca).

Canada's Energy Outlook 1996-2020

The Department of Natural Resources released its 1996 update of *Canada's Energy Outlook* at the time of the regular meeting of Environment and Energy Ministers December 11-12, 1996. A number of copies were circulated in advance to those interested in the energy field for the purpose of consultation. The *Outlook* is prepared to develop views within a consistent framework, identify pressure points and to undertake policy analysis. The energy projections are the government's official reference case and, as such, are used for the review of Canada's progress under the National Action Program for Climate Change. The most important change in the two-year period since the last *Outlook* was released in 1994 is a drop in the estimate of greenhouse gas emissions expected in 2000 to a 9.7% increase from 1990 in comparison with the earlier estimate of a 12.5% increase between those years. The oil price scenario used in the economic calculations has lower prices than those used previously–$US 18 in the 1996 Outlook for 2000 as compared to $US 20.95 in the 1994 version for that year. Spot market prices were somewhat higher in December 1996.

As in previous *Outlooks*, there is much detailed information including estimates of energy demand by sector and projected supply/demand balances for the principal energy sources. Net oil exports are expected to continue to increase until 2000 and then decline gradually thereafter. The assumptions used in the econometric calculations are clearly set out. It is apparent the authors anticipate no major surprises before 2020.

Copies of *Canada's Energy Outlook 1996-2020* are available from the Communications Sector, Department of Natural Resources, 580 Booth Street, Ottawa, Ontario, K1A 0E4.

Report on the Rational Energy Program

Released on September 25, 1996, The Rational Energy Program was developed in consultation with members of the Climate Action Network from across Canada and co-ordinated by the Sierra Club of Canada. The Network, a non-government grouping of some 80 organizations in Canada, is connected to similar activities in a number of other countries. The Program is a package of initiatives designed to improve energy efficiency in the transportation, building and industrial sectors, and increase the use of renewable energy in the electricity sector. There is no nuclear component of the Program. The results of the econometric analysis employed indicate adoption of the measures recommended would result in a drop in secondary energy demand by 13% by 2010 together with an associated reduction of CO_2 emissions by 22% relative to a reference 'business-as-usual' case developed by Natural Resources Canada. The consultants, Informetrica Limited, concluded that the program was also a substantial job creator though conditions vary in different provinces.

The main economic instruments employed are a blend of a carbon tax on fossil fuels and higher taxes on transportation fuels. The revenue from these

taxes is used to reduce the Goods and Services Tax from 7 to 5.5% with the aim of revenue neutrality. The more restrictive CAFE standards on vehicles and the higher gasoline and diesel fuel taxes recommended, however, would require concerted action with the US to be feasible. The report recommends a series of activities to be undertaken as first steps in the various regions of the country.

The Rational Energy Program is a set of comprehensive measures that would affect almost all aspects of the Canadian economy and thus would require considerable public support for implementation. Copies may be obtained from the Sierra Club of Canada, 1 Nicholas Street, Suite 412, Ottawa, Ontario, K1N 7B7 (Fax:(316) 241-4611: e-mail: sierra @web.net)

Sector Competitiveness Framework for Petroleum Products

On October 7, 1996, Industry Canada released *Petroleum Products: Part 1–Overview and Prospects* as the first in a series of 29 Sector Competitiveness Framework Reports (SCFs). Prepared as a collaborative effort between Industry Canada and the industry concerned, SCFs are intended to provide strategic information to industry stakeholders, and to decision makers, investors and other industry observers. The report on Petroleum Products has sections on major trends in the industry, places it in both national and international contexts, reviews changing conditions in both the refining and retailing sectors, and deals with profitability and environmental issues. Much useful statistical information is included. Some 105,000 people were employed in the industry in 1994 when revenues of $25 billion were generated.

This report has been prepared as a basis for further discussion of issues and resolutions with key stakeholders. The outcome on these discussions will be published in *Part 2–Framework for Action* in late 1997. Further information concerning both the subject matter and the process followed may be obtained from Ms. Cindy Cristopher of Industry Canada at 25 Queen St. Ottawa, K1A 0H5 (E-Mail: cristopher.cindy@ic.gc.ca or Fax (613) 941-2463).

Copies of *Petroleum Products: Part 1–Overview and Prospects* (ISBN 0-662-24740-X) may be obtained from Industry Canada at the above address (Fax:(613) 941-0390; E-Mail: order.commande @ic.gc.ca and there is also access to this report at the following Web Site: http://strategis.ic.gc .ca /scf)

Annual Report of the Energy Analysis Divison

The *Annual Report* of the Energy Analysis Division of Berkeley National Laboratory operated by the University of California provides a succinct review of progress on the very large number of projects underway at this institution in the field of the efficient utilization of energy. The report is divided into three sections: International Energy and the Environment; Energy Economics, Markets and Policy; and Buildings and Their Environment. The report makes interesting reading as it comes at a time of dwindling government support for activities in this field. Especially noteworthy are the sections on cooperation with a large number of countries around the world. The Energy Analysis Program may be reached on the Web at http://eande.lbl.gov/EAP/EAP.html. The report may be obtained from the National Technical Information Service, US Department of Commerce, 5285 Port Royal Road, Springfield, Virginia, US 22161.

New Journal in the Energy Field

A new Journal of Energy Finance and Development, edited by Dr. Musa Essayyad of the School of Business of the University of Alaska at Anchorage, has begun publication on a semi-annual basis (ISSN 1085-7443). The first issue contains seven papers heavily weighted to oil matters in this field both in the US and in other countries, including a paper from an author from OPEC. The journal may be obtained from JAI Press Inc, P.O. Box 1678, Greenwich, Connecticut, 06836-1678 (Fax: (203) 661-0792).

New Books of Interest

• *Politics of Climate Change: A European Perspective* edited by Jill Jäger of the International Institute for Applied Systems Analysis and Tim O'Riordan of the University of East Anglia is a study of the political science of compliance with the Framework Convention on Climate Change (FCCC). One major finding of the study is that governments wishing to successfully implement a climate policy should avoid labelling it as such. The study also found that while the FCCC is taken seriously in some parts of all governments, there is no integrating focus within governments on the issue of climate change. This book, catalogued as ISBN 0-415-12573 is available from Routledge Publishing, London.

• *Aquifer Disposal of Carbon Dioxide–Hydrodynamic and Mineral Trapping* edited by Brian Hitchon deals with research carried out mainly by the Alberta Research Council over the period 1993-5 with nine chapters covering all aspects of this subject as related to the situation in that province. This book is available from Geoscience Publishing Limited, Box 79088, 1020 Sherwood Drive, Sherwood Park, Alberta T8A 5S3.

• *The Future Population of the World: What Can We Assume Today?*, edited by Wolfgang Lutz (ISBN 1 85383 349 5), which is based upon studies conducted by the International Institute of Applied Systems Analysis (IIASA with the following Web Site–http://www.iiasa.ac.at), was published in October 1996. The probabilistic projections suggest that the world's population, which has quadrupled over the past 80 years, may never double again. The world's population is expected to reach 7.9 billion in 2020, 9.9 billion in 2050, and 10.2 billion by 2100 in the most probable scenario. Four regions - Pacific OECD countries, Eastern Europe, Western Europe, and the European part of the former Soviet Union–are predicted to experience population declines before 2050. The editor also notes that "within less than three decades, China's old-age dependency burden will be higher than North America's and about the same as that currently in Western Europe." (The United Nations has also published revised population estimates for the world in 1996 which are slightly lower than those in the IIASA study.) This book is published by Earthscan Publications Ltd. of England (ISBN 1 85383 349 5) and further information may be obtained from IIASA (Fax: +43 2236 73 149).

• *The UK Experience–A Model or a Warning* edited by Gordon MacKerron and Peter Pearson (ISBN 1-86094-022-6) is a compendium of a conference held by the British Institute of Energy Economics at Warwick University. Forty-five authors have contributed to this book which deals with the recent and complicated history of energy in the UK (Published by Imperial College Press, London, 510 pages.)

• New Publications from the Royal Institute of International Affairs. The Energy and Environmental Programme of the Institute is releasing two new books of interest to the energy field entitled *The Geopolitics of Energy* by John V. Mitchell and *Transforming Electricity: The Coming Generation of Change* by Walt Paterson, four further reports in the series 'Renewable Energy Strategies for Europe,' and an occasional paper entitled 'Sharing the Effort: Options for Differentiating Commitments on Climate Change.' For Canada and the US, copies may be obtained from the Brookings Institute at 1775 Massachusetts Avenue NW, Washington DC, 20036 (Fax: (202) 707 6004).

Short Notes

• The Minister of the Environment, the Hon. Sergio Marchi, introduced a number of measures to reduce pollution from vehicles on March 3, 1997. The amount of benzene allowed in gasoline will be cut in half and allowable sulphur levels will be reduced to no more than 0.05% in diesel fuel, among a wide variety of measures announced. The Minister encouraged Ontario to begin a mandatory inspection system for vehicles along the lines of that already in operation in BC in the Vancouver and Lower Mainland regions of that Province. Many of these changes have been discussed previously by the Canadian Council of the Ministers of the Environment, and these measures were supported by the Canadian Vehicle Manufacturer's Association who wish harmonization with similar regulations in the US.

• The Iogen Corporation of Ottawa has continued its efforts to devise a way of producing ethanol as a fuel for vehicles from cellulose in wood wastes by the action of enzymatic processes. The company has so far spent about $30 million in its research efforts, and is in the planning stages for a $200 million facility to demonstrate the technology on a larger scale.

• On October 18, 1996, Commercial Alcohols Ltd. began the construction of a corn-to-ethanol facility in Chatham, Ontario that is expected to cost $153 million. Production is scheduled to begin in December 1997, or January 1998. Much of the 150 million litres of ethanol to be produced each year will be added to gasoline marketed by the Sunoco company. The company expects to spend about $53 million per year on the purchase of locally-grown corn.

• Electric Vehicles: A new book entitled *The Car that Could* by Michael Shnayerson (Random House, New York, 1996) recounts the story of the development of the electric vehicle known as the EV1 by General Motors Corporation. General Motors began leasing its EV1 electric car December 5, 1996, in the Los Angeles, San Diego, Phoenix, and Tucson areas based upon a sticker price of $US 33,995. Applicable tax credits

may, however, reduce this price 10% or more. The company expects the typical EV1 buyer will be 35 to 54 years old in a household with an annual income of $US 125,000 or more and at least one other car. The EV1, built with an aluminum frame, has a normal range of 125 km.

Chrysler Corporation, in cooperation with Arthur D. Little Inc. of Cambridge, Mass., is continuing the development of a process designed for on-board use in cars to produce hydrogen from gasoline. The hydrogen would power the electric car by generation in a fuel cell. The vapourized gasoline is first partially oxidized after which stage the sulphur content is reduced to a very low level to protect the catalysts in the final stage where the resulting gases are reformed with steam to produce more hydrogen. Ballard Power Systems Ltd. of Burnaby, BC has received a $4 million order to provide fuel cells to Delphi Energy and Engine Management Systems for a proof of concept vehicle being developed with Chrysler Corporation. The immediate objective is to overcome two of the three main objectives to EVs by this route by providing greater range without the need for a new fuel-supply infrastructure. The problem remaining is to reduce cost to acceptable levels.

The Ford Motor Company announced in March 1997, it is developing a new car based upon a constant speed reciprocating engine which generates electricity to power drives mounted in the wheel hubs.

Hydro-Québec announced in March 1997 that it is proceeding to a pilot plant for the production of an improved battery for cars. An investment of $8.3 million is required for this stage of the development which is being undertaken in cooperation with the major North Amercican vehicle manufacturers.

Electricité de France has begun building EV charging stations in Paris. There are estimated to be 21 sites at street level at present each of which can accommodate two cars and eight underground stations which together can handle a total of 80 cars simultaneously. France produces most of its electricity from nuclear energy. The Rosen Motor Company of the US reports the development of a new power train for cars involving a turbine which drives a generator which in turn produces electricity to drive motors. A flywheel is used to store energy when braking and to provide short bursts of extra energy to allow greater acceleration. Several hybrid electric vehicles of this type are under study. The advantages are reduced fuel consumption (and thus lower CO_2 emissions) together with less standard vehicle emissions.

In March 1997, The Toyota Company announced that it will be the first auto company to offer a hybrid vehicle to a mass market. The car, to be marketed only in Japan for the present, will employ a gasoline motor to drive an electric generator. The price will be less than $US 20,000.

The Honda company of Japan has won the fourth World Solar Challenge. The Honda vehicle Dream, with monocrystal silicon cells and a top speed of 140 km/hr, became the first to make the 3,010 km journey across Australia taking only four days. There were also Canadian vehicles participating in this solar car race: Dawn Treader from Queen's University finished in 11th place out of 46 starters, Sunstang from Western Ontario finished 12th, and Northern Sun from McGill University finished 27th. The Bombardier Company of Montreal announced in November, 1996, that production of its Neighbourhood Electric Vehicle (NEV) was beginning after a two-year period of tests and market development. The price is expected to be about C $ 9,350 for a vehicle designed for use in southern suburbs and in gated communities. At present, about 10 units a day are being assembled in the plant in Sherbrooke, Quebec.

The work of the US Advanced Battery Consortium, which numbers among its members the three leading US car manufacturers, is now in its second $US 105 million phase of its efforts to develop a superior battery for electric vehicles. This activity will focus on nickel- metal hydride batteries for the near term and lithium-based batteries for the next decade.

A comprehensive review article on Electric Vehicles has appeared in *Scientific American* Vol. 275, No. 5 (November), p. 54, 1996, entitled 'The Case for Electric Vehicles.' Daniel Sperling believes electric drives have many advantages whether the energy orginates from batteries, flywheels or fuel cells. A Solectria Sunrise vehicle powered by a 210-cell nickel/metal hydride battery set a record for the longest distance between recharges in May 1996. The vehicle, which carried two passengers with a curb weight of just under 1000 kg., went 601.25 km. between Pottsdam, Pa. and Chesapeake City, Md. travelling on both city streets and rural highways. (From IEEE *Spectrum* September 1996)

• Ballard Power Systems Inc. has announced a new plant for the production of 250 kW proton ex-

change membrane (PEM) fuel cells in Burnaby, BC. Support of a repayable $30 million will be provided from the Technology Partnerships Fund of Industry Canada as a component of this $93 million project. These cells, which use hydrogen as the fuel, are intended for use in vehicles and other small-scale applications. On December 17, 1996, it was announced a new company was to be formed, also based in Burnaby, called Ballard Generation Systems jointly with GPU International of New Jersey who will invest $31.2 million over two years in the commercialization of fuel cells for power generation based upon PEM technology.

The Daimler-Benz company of Germany unveiled a test vehicle in May 1996 based upon a fuel cell developed by Ballard Power Systems.

• A private company, Blacklight Power Inc. of Malvern, Pennsylvania, reports the production of excess energy in the conversion of hydrogen under fuel cell conditions. Patents have been issued in Australia and are pending in some other countries. The explanation offered for this effect revolves around a projected new ground state for the hydrogen atom. Most authorities are very sceptical of this apparent discovery which may be explored further at the company's Blacklight Power Web Site at http://blacklightpower.com/.

• On February 5, 1997, The National Energy Board directed TransCanada PipeLines Limited of Calgary to reduce the operating pressure of a section of its pipeline in northern Ontario some 10% until the safety of the line is verified. There was an explosion in this section on December 11, 1996. Subsequent hydrostatic testing in this area revealed other serious corrosion problems. The pressure is to be reduced until 31 May 1997, or until such time as the integrity of the pipeline is confirmed. No disruption is gas supply is anticipated.

• Imperial Oil has reported that production from the oil sands in northern Alberta in 1996 accounted for more than half of the company's production of liquid hydrocarbons. It is planned to continue expansion at its large Cold Lake field where average production is expected to be in excess of 15,900 m^3 (100,000 bbls) per day in 1997. The company noted that Canada's production of bitumen and upgraded synthetic oil has doubled in the last ten years and today accounts for about one-quarter of the country's crude oil production.

• Shell Canada has filed a public disclosure for an oil sands project on its Lease 13 holdings in the oil sands region with the Alberta Energy and Utilities Board and Alberta Environmental Protection for a projected one billion dollar recovery facility. The company expects to apply for regulatory approvals in late 1997 with the intention of producing the first oil in 2002. These plans call for an initial daily production of 15,900 m^3 (100,000 bbls) per day of bitumen which will be transported in a new pipeline to the company's Scotford Refinery in Fort Saskatchewan near Edmonton. It is possible an upgrader will be installed at the refinery. It is presumed the bitumen will be pumped using some form of the hydrotransport technique pioneered by Syncrude Canada. This method of economical shipment by pipeline allows the separation of the physical extraction functions of this very heavy hydrocarbon from the chemical processing stages, which may now be incorporated into an existing refinery.

• Preliminary engineering studies continue on the Sable Offshore Energy Project in Nova Scotia. Hearings for approval from the National Energy Board jointly with other responsible agencies began April 8, 1997. A pipeline to the US is planned although there is some controversy over the route to be chosen. Nova Scotia Power Corporation is expected to be a major consumer of this gas. The $ 2-billion project entails building conventional offshore production platforms in water up to 80 metres in depth, a system of gathering lines, a 225-kilometer pipeline to shore and onshore processing facilities. The long distance pipeline will be built by a separate consortium. The recoverable reserves are estimated at about 85 billion m^3 (3 trillion ft^3) of gas and when completed, the project will produce about 12.5 million m^3 (440 million ft^3) per day and 1,590 m^3 (10,000 bbls) a day of liquids over a 20-year period.

• Petro-Canada, Chevron Canada and Mobil Oil Canada will be equal partners in a $125.5 million project to drill exploratory wells off the coast of Newfoundland during the next five years. The three companies are already partners in the Terra Nova and Hibernia projects. Amoco Canada is expected to start drilling on a $90 million project in 1997 in the same region as announced in 1995.

Husky Oil Ltd. announced in December 1996, that it is planning a $1.5 billion offshore project at the Whiterose field located some 350 km east of St. John's, Newfoundland. Preliminary production at 1590 m^3 (10,000 bbls) per day is expected to begin as early as late 1998 with full pro-

duction to be underway by 2004.

• Contracts on Canadian natural gas began trading on the New York Mercantile Exchange September 27, 1996. This new futures contract, with supply based upon the Empress, Alberta, pipeline terminal location, is expected to facilitate natural gas exports to the US by providing a more transparent picture of the price situation in Canada. There is a surplus of natural gas in Alberta at present with supply limited by installed trunkline capacity.

• At the 15th International Oil and Gas Markets Conference of the Canadian Energy Research Institute, held in Calgary September 30 to October 1, 1996, two of the analysts present suggested a sharp increase in the price of oil was possible due to tensions between Iraq and Saudi Arabia.

• On December 9, 1996, it was announced that a final agreement had been reached between Iraq and the United Nations concerning the distribution of the food and medicines to be purchased from the revenue derived from the sale of oil now to be permitted from that country. The first oil shipments were scheduled for late December 1996. In essence, US$ 2 billion of oil may be exported every six months, which, at current prices, amounts to about 79,500 m^3 (500,000 bbls) per day. Most of this oil is exported by pipeline to the port of Ceyhan on the Mediterranean coast of Turkey.

• The National Energy Board announced on November 28, 1996, that it had approved an application by TransCanada Pipelines Limited of Calgary to install 205.5 km of pipeline looping and 13 compressor units totalling 350 MW together with associated equipment to provide 8.1 million m^3 (286.7 million ft^3) per day to serve both domestic and export gas markets. The cost of these new facilities is placed at 1996 C$ 897.0 million with construction to be completed by November 1,1997. The Board has also received an application from Palliser Pipeline Inc. of Calgary (owned equally by PanCanadian Petroleum Limited and Union Energy Inc.) to build 240 km of mainline pipeline and about 700 km of smaller pipeline laterals in southern Alberta and southwestern Saskatchewan to have a capacity of 34 million m^3 (1.2 billion ft^3) per day. The capital cost is estimated at $365 million with completion planned for November 1, 1998.

• US National Research Council, an arm of the National Academy of Sciences, announced on October 31, 1996, that a major study conducted under its auspices entitled 'Possible Health Effects of Exposure to Residential Electric and Magnetic Fields' had failed to find convincing evidence of a relationship between exposure to electromagnetic fields and cancer and other health abnormalities. This conclusion was based upon an analysis of more than 500 studies conducted over the past 17 years. The report did state, however, that more research was needed and that "most compelling is the need to pinpoint the unexplained factor or factors causing a small increase in childhood leukemia in houses close to power lines." There were also press reports in September, 1996, that a floor of a telephone company building housing computers and other electronic equipment in Hamilton, Ontario, has been closed due to an unusual number of cancer cases occurring among those working there. An association between leukemia in children and the proximity of television broadcasting towers was found in an Australian study published in December 1996. In that same month, a study published by Dr. Eugene Sobol and others at the University of Southern California in the journal *Neurology* found an association between Alzheimer's disease and electromagnetic radiation.

This Council has also released a report on 'Linking Science and Technology to Society's Environmental Goal' which is available on line at http://www.nas.edu/ The relationship between population growth and consumption is emphasized in this report. In the energy field, the report recommends decarbonizing the energy system because fossil fuels are its "most environmentally troublesome aspect." Research activities should focus on increased efficiency in the production and use of energy.

• On his visit to Ottawa November 6, 1996, to address a symposium organized by the Canadian Global Challenge Program of the Royal Society of Canada, the US Under Secretary of State for Global Affairs, Timothy E. Wirth, stressed the importance the Second Administration of President Clinton will place on environmental affairs and especially the negotiations now underway within the Framework Convention on Climate Change to deal with emissions of greenhouse gases. At this meeting the Environment Minister, Hon. Sergio Marchi, confirmed his support for a "vigorous performance-oriented voluntary approach" but added such activities "have to perform."

• The current severe floods in China are being attributed to a change in the pattern of the monsoonal rain which in turn is

thought to be intensified by changes in the global climate. China is now the largest producer and consumer of coal. (Source: *New York Times* September 15, 1996)

• Mitsubishi Motors Corporation of Japan has joined Toyota Motors in offering a direct- injection gasoline engine for cars. The advantage of this class of lean-burn, stratified-charge engine, made possible by the much improved electronic controls now available, is savings of from 25-35% in the consumption of gasoline. There are two main disadvantages. The higher cost of production has added about $US 300 to the price of one of the Mitsubishi models on sale in Japan, and it is more difficult to meet NO_X emission standards than with conventional fuel-injected engines.

• Ontario is expected to join British Columbia as the second province to require tests of the emissions from cars. Emissions from vehicle tailpipes are estimated to cause about one- quarter of the air pollution in the Province.

• Natural Resources Canada reports that the on-the-road fuel efficiency of private vehicles in 1994 was 11.8 litres/100 km driven. This is an improvement of 14.5% over the 13.8 L/100 km experienced in 1987. However, since the average distance driven by Canadian vehicles increased 17.2% over the same period, total fuel consumption increased.

• The largest off-shore wind farm so far is being planned by the British electrical company PowerGen in a windy location some three kilometres from the coast of Norfolk. Up to 25 wind turbines each 62 metres high will be installed by 1998 with an individual capacity of 1.5 MW. The total investment planned is £35 million. The cost of generation is stated at 4.3 pence/kWh which may be compared with 2.6 pence /kWh for a modern natural gas-fired combined-cycle facility. The wind installation is being launched as a component of the UK government's 'Non-Fossil Fuels Obligation,' which aims at 1,500 MW of capacity from various renewable energy sources by 2000.

• The Enron Company announced in March 1997, the construction of the world's largest wind turbine farm to be located in Iowa. One hundred and fifty turbines will be installed which will provide energy at an estimated cost of between 4 and 4.4 US ¢/kWh.

• The October 1996, issue of the IEEE journal *Spectrum* (Vol. 33, No. 10) contains an interesting article entitled Power Windows on the use of photovoltaic panels to supply the electrical requirements of houses. Installed in a house in Maine, a State with a relatively cold climate, the local utility offsets its expensive peak load energy with supply from the house in exchange for lower-cost off-peak power. The so-called net metering system thus obviates the need for an expensive battery or thermal backup system in the house.

• In Shanghai on November 26, 1996, Prime Minister Jean Chrétien witnessed the formal signing of a $4 billion deal between Atomic Energy of Canada Ltd. and the Chinese National Nuclear Corporation to build two 700 MWe CANDU 6 nuclear reactors at Qinshan, 125 km south of this city. One hundred Canadian manufacturers are expected to share about $1.5 billion in related supply contracts, with conventional export financing for about this sum being part of the sales arrangement. There are indications that there will be further reactor sales in the future. To meet its rapidly growing needs for electricity, China relies mostly upon coal-fired facilities, although there will be substantial hydroelectric generation from the Three Gorges project now under construction on the Yangtse River. China already operates two reactors of the Pressurized Water type supplied from France, and one of its own design. Only about 1% of the country's power is based on nuclear energy at present, but this proportion is expected to rise to 10% during the coming decades. This contract is the largest ever between Canada and China, although it is being opposed by some environmental groups.

• An account of the after-effects of the Chernobyl nuclear reactor explosion in Ukraine, April 26, 1986, appears in the IEEE *Spectrum* Vol. 33, No. 11 (November) 1996. There are three main early results of medical studies of this disaster: the incidence of thyroid cancer has risen more that expected among infants and children not yet born at the time of the accident; there is as yet no significant rise in leukemia among those affected; and that, not surprisingly, psychosomatic illnesses have proved important.

• There are indications that Sweden will not meet its target, set by the result of a 1980 referendum, to phase out nuclear power by 2010. Twelve reactors now supply about 50% of that country's electrical supply. Two studies, one by an official Energy Commission and the other by Professor William Nordhaus of Harvard University entitled 'Sweden's Nuclear Dilemma' and published by the independent Swedish Center for Business and Policy Studies, indicate that large costs are involved in a prema-

ture shut-down. Professor Nordhaus urges Sweden to change its policy and allow its reactors to continue to operate to the extent of their full service lives noting that, in addition to major cost savings, there is a significant advantage from the point of view of reducing greenhouse gas emissions. The report of the Energy Commission is sensitive to political considerations and may recommend shutting down one reactor by the time of the next election in October 1998. Originally it was thought these well-operated reactors would have a service life limited to 25 years but now 40 years is thought possible with the implementation of life-extension measures.

• On December 9, 1996, the retiring Secretary of Energy in the US, Hazel O'Leary, announced a major revised program for dealing with plutonium remaining from the weapons program in that country and the old USSR. The plan had two main elements: encasement in glass for long-term storage probably in Nevada, and disposal by radiation in a designated power reactor. Some tests of the latter possibility relative to CANDU Type Reactors are planned at the Chalk River Laboratories of Atomic Energy of Canada but there is now controversy as to how extensive an environmental assessment will be required to permit these small-scale trials involving a gram or two of this hazardous substance. Ontario Hydro is a member of a consortium bidding for a contract from the US Department of Energy for plutonium disposal at its Bruce A Generating Station on Lake Huron, but there are other bidders in the US as well.

• Steel used in nuclear reactors is subject to neutron bombardment over time which leads to embrittlement and other deleterious effects. This condition may limit the operational life of these capital-intensive facilities. To overcome this problem, ways of annealing the steel in place are being assessed. Trials of a system developed by the Cooperheat Company of the US are underway in which air superheated in a gas-fuelled burner is passed over the steel.

• The final hearings of the Nuclear Waste Management and Disposal Concept and Environmental Panel were held in Ottawa March 26-27, 1997. The report of this Panel, which was established to evaluate the concept prepared by Atomic Energy of Canada Ltd. (AECL), is scheduled to be published in the Fall of 1997. A summary of this proposal which was jointly funded by AECL and Ontario Hydro, was prepared in a document catalogued as AECL-10721 and dated September 1994. Copies are available from either organization.

• With the final passage of the Nuclear Safety and Control Act in March, 1997, the former Atomic Energy Control Board (AECB) is now known as the Canadian Nuclear Safety Commission (CNSC). The new name more accurately reflects its responsibilities arising from the revised and strengthened powers in the fields of health, safety, and the environment, including regulations for the decommissioning of nuclear power stations.

• Construction of the Three Gorges hydroelectric project in China began in 1993 and the course of the main Yangtse River is scheduled to be closed in 1997 to allow the main dam, some 176 metres in height, to be built. Generation of electricity is scheduled to begin in 2003 and, after completion in 2009, the project will provide about one-ninth of that country's electrical supply. The planned total installed generating capacity of 18,200 MW from 26 sets of turbines with a total average annual output of some 85 TWh is the equivalent of the combustion of about 40 to 50 million tonnes of coal in fossil-fuelled facilities. About 1.2 million people will have to be re-located from 300 towns and villages that will be flooded by a reservoir with a surface area of over 1,100 square km. Nevertheless, the project is expected to bring benefits in flood control and in navigation with a series of 14 locks capable of handing 10,000 tonne barges planned.

• It is reported in the *Scientific American* Vol. 275, No. 5 (November) 1996, p. 40, that CO_2 in the supercritical state at about 75 atmospheres and at least 31°C causes concrete to set faster and form a much stronger product than under normal wet conditions. The strong concrete may find application in the containment vessels needed in the radioactive waste disposal field. It has also been found that fly ash resulting from the burning of coal in power stations together with suitable additives can also be converted into useful strong products with the supercritical fluid. Carbon dioxide consumed in this way would, for all practical purposes, be sequestered indefinitely.

• The Panel on Public Affairs of the American Physical Society has prepared a paper 'Energy: The Forgotten Crisis,' which may be found at the following web site:http://aps.org/public_affairs\/popa/energy.html. Additional chapters will be added to this report shortly.

• Some useful Web Sites: The National Energy Board has established a Web Site at http://www.neb.gc.ca/ The Energy Council of Canada, the Canadian affiliate of the World Energy Council, has established a Web Site at http://www .energy.ca/ The Web Site of the International Energy Agency in Paris is http://www.iea.org. The Electric Power Research Institute (EPRI) of the US may be reached at http://www.epri.com The World Energy Efficiency Association (WEEA) may be reached at http://www.weea.org Links to energy and environmental sites may be found at the Web Site of the United Nations Industrial Development Organisation at http://www.unido.org/ The hydrogen and fuel cell newsletter can be viewed at the Home Page of the National Hydrogen Association (http://www.ttcorp .com/nha/). Information on the studies conducted at the Paul Scherrer Institute in Switzerland on the use of solar power to process chemical fuels into clean energy carriers may be found at http://www1. psi.ch/www_f5_hn/solar/solar_home.html. Canada's Clean Combustion Network may be found at http://www.combustion-net.com

Update *is prepared by John Walsh, Ottawa, Canada. He can be contacted at (613) 745-6279, or by visiting his Web site at http:// infoweb.magi.com/~dwalsh/jhw .html*