# Update

## Centre to Advance Technology for Upgrading Heavy Oil and Bitumen

On March 19, 1993, the Federal and Alberta Governments announced the creation of the National Centre for Upgrading Technology (NCUT) to be located at the existing laboratory at Devon (near Edmonton), Alberta. The NCUT will be a collaborative effort between the Canada Centre for Mineral and Energy Technology (CANMET) of the federal Department of Natural Resources and the Alberta Research Council (ARC), the main research agency of that province. CANMET will relocate its upgrading program from its Energy Research Laboratories in the Ottawa region to its Western Research Centre at Devon where the ARC staff is already located. The combined effort of the NCUT will have an annual budget of approximately $7 million and a staff of about 50. The Centre's objective will be to revitalize research into heavy oil and bitumen upgrading by focusing on novel processes which have the potential to produce synthetic oil of high quality while significantly reducing capital and operating costs.

In a parallel initiative, Dr. Erdal Yidirim, President of the Alberta Chamber of Resources, announced the establishment of the National Task Force on Oil Sands Strategies, which will formulate long-term strategy for the future development of the oil sands and heavy oil resources. The Task Force will identify new concepts, technologies, and strategic approaches, and communicate the results to private and public decision makers.

Canadian resources of heavy oil and bitumens occur mainly in Alberta and, to a lessor extent, in Saskatchewan. The known potential exceeds the reserves of light crude oil in the Middle East. Canada obtained 13.7% of its crude oil production from synthetic sources in 1992, the highest of any country. The production of synthetic crude, together with heavy oil and bitumen either exported or used directly, amounts to some 40% of the present Canadian production of crude oil and its equivalent, and this proportion is expected to increase to about 55% by 2010 as the production of conventional light crudes in the western Canadian sedimentary basin declines.

The bitumen is mainly extracted by mining methods requiring a physical processing stage before upgrading, to separate it from the sand in which it is found embedded, while the heavy oil is produced from wells usually with some form of steam stimulation applied. The Alberta Oil Sands Technology and Research Authority (AOSTRA), a provincial research funding agency established in 1974, has supported an Underground Test Facility located near Fort McMurray to study the prospects for in situ recovery of the large resources of bitumen too deep for surface mining.

Most refineries are designed to process light crude. The purpose of the upgrading process is to convert heavy oil or bitumen to a synthetic crude oil with characteristics as similar as possible to conventional light crude. Upgrading also resolves a transportation problem since it is not possible to ship bitumen by pipeline, and heavy oils, though now pumped to distant markets,

must be mixed with an expensive diluent to reduce their viscosity. In chemical terms, the upgrading process breaks down large carbon-rich molecules into smaller molecules having higher ratios of hydrogen to carbon. Consequently, the basic processes involve the rejection of carbon in coking processes and the addition of hydrogen in hydrocrackers and hydrotreaters. At the same time, other undesirable contaminants, such as sulphur, nitrogen, and heavy metals (usually nickel and vanadium), are removed.

There are four upgraders in operation in western Canada at the present time. The Suncor Inc. plant began production in 1967 and now has a capacity of 9539 $m^3/d$ (60,000 bbls/d) using delay coking and hydrotreating processes. Syncrude Canada Limited began production in 1978 with a major expansion in 1988 and now has a capacity of 26,232 $m^3/d$ (165,000 bbls/d) using hydrocracking, fluid coking and hydrotreating processes. The Co-op Upgrader in Regina began operation in 1988 with a capacity of 7949 $m^3/d$ (50,000 bbls/d) using hydrocracking, delay coking and hydrotreating processes. The Bi-Provincial Upgrader in Lloydminster began production in 1992 with a capacity of 7313 $m^3/d$ (46,000 bbls/d) also using hydrocracking, delayed coking and hydrotreating processes. Sulphur and coke are by-products from the upgrading plants and the hydrogen consumed in the processing is produced from natural gas. The oil sands industry has made significant progress in reducing costs over the years with operating costs in the order of $\$97.50/m^3$ ($15.50/bbl) reported in the literature. Hydraulic methods of trans-porting the raw bitumen to upgrading sites are also under development.

Bitumen was first discovered by explorers along the banks of the Athabasca River as early as 1788. The first heavy oil well in Saskatchewan was drilled in 1945 near Lloydminster. Many efforts were made over the years to extract and convert this resource, including the development of new physical processes to separate the bitumen from the sand. When the age of conventional light oil began in Alberta with the Leduc discovery in February 1947, with the exception of the early Suncor plant, it was not until the increases in oil prices during the 1970s that major development occurred. The recent decrease in the price of oil has, however, made the upgrading option all the more difficult.

Using the existing upgrading technologies, the rule-of-thumb is that the price of heavy oil must be at least $\$44/m^3$ ($7/bbl) less than that of light crude to justify the installation of upgrading processes. Moreover, the mix of products and their quality resulting from refining synthetic crude oil is often less than what may be obtained from conventional crudes. This disadvantage is thought to incur a penalty of about $\$6.29/m^3$ ($1/bbl). Furthermore, concerns regarding the environmental disadvantages resulting from the high aromatic content of transportation fuels produced from synthetic crudes now threaten to increase this differential still further.

The new Centre at Devon, ironically located within the shadow of the derrick erected to commemorate the Leduc discovery which began the modern oil age in the west, thus has its work cut out for it to reduce the cost of upgrading. The success or failure of this effort will go a long way to determine whether Canada remains a net oil exporter after the turn of the century.

The importance of the bitumen and heavy oil resources to Canada has led to government support for this industry, particularly in the field of resource assessment, in the separation of the bitumen from the sands (the process now used was developed at the Alberta Research Council), and in upgrading. This support has now been extended to the operating plants, all of which, with the possible exception of the Suncor Inc. installation, benefited from some measure of assistance. Both free standing upgraders have encountered financial difficulties. Nevertheless, the National Energy Board believes one more upgrading installation will be built before 2010 and is now reviewing its licensing procedures for the long-term export of production from the oil sands.

Other countries are also active in the production of liquid transportation fuels from sources other than conventional light crudes. Very large resources of heavy oil occur in the Orinoco region of Venezuela and are now being marketed in the form of a stable oil/water emulsion ("Orimulsion") used mainly for thermal power generation. (Some of this latter fuel is now combusted by New Brunswick Power at its Dalhousie Generating Station.) In South Africa, about 15,900 $m^3/d$ (100,000 bbls/d) of synthetic oil are produced from coal in three plants, and a facility to produce liquid transportation fuel from natural gas has begun

production. Another such facility is located in Malaysia, while in New Zealand, gasoline (or high quality gasoline additives) are produced from methanol synthesized in the conventional way from natural gas.

Methanol is synthesized from natural gas in three major production facilities in western Canada and this alcohol is now finding specialized transportation markets when blended with gasoline, especially in regions with severe air pollution problems such as southern California. Some ethanol is now being produced from agricultural products in Canada for this same purpose.

## Models of the Energy Economy Used in Canada

The 1993 International Energy 2020 Conference was held in Ottawa June 23-25, 1993, under the joint sponsorship of the Office of Energy Research and Development (OERD) of the Department of Natural Resources, the Policy Assessment Corporation of Lindstrom, Minnesota, and Systematic Solutions of Fairborn, Ohio. This Conference was primarily devoted to assessing alternative methods for addressing energy, environmental, and technology issues, and to discuss the role of new energy technologies and computer models in energy and environmental planning. This meeting, attended by some 60 delegates from Canada and the US, provided an opportunity to review the different models of interest to Canada for systems studies in the energy field. The specific interest of OERD is to address the difficult task of setting priorities for energy R&D programs, a subject also explored at the MIES Workshops on Technology Options held during 1992 (see *ESR* 4:2, pp. 185-87 and *ESR* 3:2, p.194). The ENERGY 2020 model has been adapted by OERD for Canadian use and called the Energy Technology Planning Model (ETPM). Four other models applicable to the energy economy were also discussed at the Conference: the Inter-Fuel Substitution Demand Model (IFSD); The National Energy Modelling System (NEMS) used by the US Department of Energy; the Intra-Sector Technology Use Model for Industry (ISTUM), and the Market Allocation Model (MARKAL).

The Inter-Fuel Substitution Demand Model (IFSD) is used for general policy purposes by the Department of Natural Resources and as such is the official energy forecasting model for Canada. This model uses econometric equations to forecast residential, commercial, industrial, and transportation demands at both the provincial and the federal level. The electrical sector is simulated by using linear programming optimization procedures, and the other energy-supply sectors are forecast based upon accounting, special studies, or professional judgements. The object is to embody the best current wisdom concerning the Canadian future in the IFSD model derived from all relevant information. Econometric equations are then used for energy forecasting: the model's advantages and disadvantages are those of econometrics.

The National Energy Modelling System (NEMS), employed by the US Department of Energy, uses consumer-choice theory (consumer preference simulation) with stocks and flows (stock accounting) to simulate the demand sectors while linear programming methods are used to simulate the supply sectors. The model operates at a combined regional and national level. It is a comprehensive and detailed framework that requires a large team to support but provides much useful information.

The Intra-Sector Technology Use Model for Industry (ISTUM) is an end-use energy demand forecasting model which was originally developed in the US but adapted for Canadian use and further developed by Professor Mark Jaccard of Simon Fraser University. First applied to the BC pulp and paper industry, the model was extended to the entire industrial sector of BC. Currently, BC Hydro and the Department of Natural Resources have sponsored the expansion of the ISTUM-PC model to the entire Canadian industrial sector. As an end-use engineering model, it incorporates micro-level (bottom-up) analyses to estimate the specific mix of energy-using technologies that will serve user-specified, industrial production needs. Market constraints and variances in equipment costs across specific process needs are used to determine the market penetration of individual technologies while stockflow calculations ensure a realistic representation of the rate of change within a specified industry.

The Market Allocation Model (Markal) is a normative model which optimizes the choice of specified technologies to mini-

mize the total costs given a fixed demand forecast. The model assumes optimal decisions based upon perfect information to determine minimum costs. This calculation is linked to exogenous constraints to determine the extent of market penetration. The Markal model needs very disaggregated data for a large number of technologies. This attribute is both its strength and its weakness. All energy technologies must be reduced to a standard method of comparison, but to do this requires a major effort with a high risk of data inconsistency. The Markal model is used by the International Energy Agency's Energy Technology Systems Analysis Project, and in Canada, notably by Richard Loulou and his colleagues at the Groupe d'Etudes et de Recherche en Analyse des Décisions (GERAD) in Montréal (See *ESR* 4:3 1992 p.278).

The ENERGY 2020, or the Energy Technology Planning Model (ETPM), in the version used by OERD, uses consumer utility (preference) maximization assuming imperfect behaviour rather than assuming optimum behaviour as in the MARKAL case. Consumers make energy choices that maximize the utility of their decisions as perceived by them. In such a case, nonprice factors such as convenience, colour and taste may dictate the actual decision process. By including these terms, the ETPM model can include imperfections in the Canadian market and, unlike MARKAL, can actually reproduce history. Uncertainty analysis is used to provide the bound on its forecasts and the impact of policy tests. Furthermore, the costs used in ETPM are based upon the type of calculations made by each consumer, and thus include such relevant items as incentive rebates, pollution/efficiency standards, demonstration-program risk reduction, pollution fees, tax credits and federal/provincial/GST tax changes.

In terms of technology assessment, ETPM can tell whether a technology will be accepted under actual business, environmental and regulatory conditions, and how it will affect the market place. Like other such models, ETPM has a pollution accounting procedure which tracks both pollution generation by the fuels used in the demand sector and those from the supply sector. The running total of pollution generation may be fed back to the supply sectors to adjust production to meet environmental constraints.

There was considerable discussion of the relative merits and spheres of application of the various models at the meeting. It is now clear no one model will meet the needs of the energy system, large and complex as it is. Further information on the ETPM model and its application to the Canadian energy system may be obtained from Mr. Nick Macaluso of the Office of Energy R&D at the Department of Natural Resources in Ottawa. (Fax: (613) 995-6146)

## New Reports Available

### *Report of the National Energy Board for 1992*

The National Energy Board (NEB) released its report for 1992 on April 20, 1993. During the year, the NEB authorized $41 million worth of activity in the north; approved the construction of over 900 kms of new pipeline; authorized the collection of some $2.6 billion in pipeline tolls for gas and oil; approved the export of 85 billion $m^3/d$ (three trillion $ft^3/d$) of natural gas and 54,619 GWh of electricity over the next 30 years.

During the year, a new Energy Resources Directorate was created which combines elements of the former NEB group and the now disbanded Canada Oil and Gas Lands Administration. This group was formed to enhance the Board's understanding of Canada's energy resources and reserves. No new legislation or regulations were implemented in 1992, but several amendments and other changes were adopted.

The NEB reported energy production rose by 1% in 1992 over 1991. Exports continued to expand and domestic consumption increased marginally after two successive years of declines. Total exports of petroleum (including crude oil, refined petroleum products and natural gas liquids), natural gas and electricity were 4841 petajoules (PJ), an increase of 10% over the previous year. Higher exports were partly offset by higher imports so that net exports increased by 6.3%. The value of net exports rose by 6.7% to $ 9.5 billion, of which 49% were accounted for by petroleum and 44% by natural gas.

World oil demand was an estimated 10.7 million $m^3/d$ (67 million bbls/d) in 1992, some 64,000 $m^3/d$ (400,000 bbls/d) higher than in 1991. Over the past five years, world oil demand has grown on average by about 1.6% per year, roughly in step with population growth. In Asia, oil consumption rose by

about 9% in 1992, reflecting the continuing economic expansion in that region.

The Board's estimate of remaining reserves of conventional crude as of December 31, 1991, is 676.4 million $m^3$ (4.3 billion bbls), a decrease of about 2%, or 11.9 million $m^3$ (75 million bbls) compared with year-end 1990. Additions to reserves replaced nearly 85% of conventional crude oil production in 1991. Imports represented 37% of total refinery feedstock requirements in Canada compared with 38% in 1991. North sea crudes accounted for 59% of total imports.

On a regional basis, the Atlantic region depended totally on imported oil and Quebec imported about 99% of its requirements compared to 94% in 1991. This increase reflects the closure of the Sarnia to Montreal pipeline from mid-1991 to July 1992. In the Arctic, Panarctic Oils Ltd. transferred two shipments of oil by tanker from the Bent Horn field located on Cameron Island in the Northwest Territories. Approval has now been given to truck oil from this field over the winter ice.

Natural gas exports to the US rose by 17% in 1992 to a new record of 56.7 billion $m^3/d$ (2.0 trillion $ft^3/d$). Total gas export revenues also rose by about 22% to $4.4 billion in 1992 from $3.6 billion in 1991.

In electric energy, Canada's net generating capacity was about 106.2 GW, an increase of some 1.05 GW, or 1%, over 1991. Total Canadian consumption was about 480 TWh, up about 2% from 1991. Export sales continued the upward trend resumed during 1991. Total export sales were 26.2 TWh, an increase of 32% over 1991, and the associated revenue was $708 million, a 27% increase over the past year.

In June, the Board released another report in its series dealing with the Market-Based Procedure (MBP), the method now employed to assess long-term export licences for natural gas. A summary of the discussion on a Workshop on Export Impact Assessment (EIA) was published based upon a number of contributions from interested parties. The analysis in this latter report suggests that gas exports would average 62.3-70.8 billion $m^3$/year (2.2-2.5 Tcf/year) in the period up to 2020 as compared to the Board's Control Case of 56.7 billion $m^3$/year (2.0 Tcf/year). Overall, the impacts of higher exports on Canadian prices and domestic consumption do not appear to be large and are generally consistent with previous studies.

In addition to many hearings related to expansion in the natural gas industry, the NEB has received an application for a $258.2 million expansion of the facilities of Interprovincial Pipe Line Inc. (IPL) to be carried out in 1994. This expansion is intended to increase the pipeline's annual capacity from Edmonton to Gretna (on the Manitoba/US border) by approximately 17,500 $m^3/d$ (110,000 bbls/d) to meet the additional demands forecast on its system. The construction will involve about 704 kms (422 miles) of 406 mm (16") diameter pipe, reactivation of the currently idle pipeline between Regina and Cromer, Manitoba, the addition and modification of pumping units, and new storage capacity to serve the expanded system. The Board has also received an application from InterCoastal Pipe Line of Edmonton for permission to convert 209.7 kms (130.3 miles) of IPL pipeline in Ontario to natural gas service. The converted line would be a link in a new line with the capacity to transport up to 3.8 million $m^3/d$ (133 million $ft^3/d$) of natural gas to markets in eastern Canada and the northeast US from November 1, 1994, to October 31, 1996, and up to 5 million $m^3/d$ (175 million $ft^3/d$) thereafter. IntraCoastal proposed to be in service by November 1, 1994 with this $45.6 million project.

Proposals have also been filed this year to increase the flow of Canadian gas to the Pacific northwest states, where it will be consumed mainly for the generation of electricity. The NEB has also begun industry-wide consultations preparatory to an update of its regular long-term energy outlook *Canadian Energy Supply and Demand*, the next version of which is scheduled for publication in the first half of 1994. The *Annual Report* (catalogued as ISBN 0-662-20309-7) contains many useful tables in both the text and in the extensive appendices. Copies can be obtained from the Board at 311 Sixth Avenue S.W., Calgary, Alberta, T2P 3H2 (Fax: (403) 292-5503).

### *Report of the Parliamentary Standing Committee of Environment*

The Committee of Environment, Chaired by Hon. David MacDonald, former MP for Rosedale, issued its final report for this session of Parliament entitled *Our Planet...Our Future* in the form of a compendium of each of the Committee's major reports published since the

Committee was established in 1989. This report is intended to provide a record, in one convenient volume, of the work of the Environment Committee in such areas as climate change, ozone depletion, acid rain, federal-provincial issues as related to the environment, and emerging international obligations. The seven separate reports included are titled: (1) *Deadly Releases CFCs*; (2) *No Time to Lose: The Challenge of Global Warming*; (3) *Out of Balance: The Risks of Irreversible Climate Change*; (4) *Environment and the Constitution*; (5) *Ozone Depletion: Acting Responsibly*; (6) *From Words to Action*; and (7) *A Global Partnership*. The Committee's recommendations, some of which have already been acted upon, are also included. For its final sessions, the Committee held a Round Table to which some distinguished people, interested in environmental matters, were invited. Their main comments were included in the report. At this session, Mr. Maurice Strong, now Chairman of Ontario Hydro, stated: "I would contend, because we occupy one of the largest pieces of the world environment, Canadians individually, with our modest population in relation to the size of our country, really have stewardship on a per capita basis of more of the world's environment than almost any other people." Mr. Jim McNeil, Senior Fellow of the Institute for Research on Public Policy, stated: "Domestically, we need a program involving the provinces, which sets out clearly and precisely how we will achieve stabilization of carbon dioxide emissions at 1990 levels by the year 2000." The compendium report, *Our Planet...Our Future*, is available without charge from Mr. N. Radford, Clerk, Environment Committee, 180 Wellington Street, Room 640, Ottawa, Ontario, K1A 0A6.

### *IIASA Report*

The International Institute for Applied Systems Analysis (IIASA), located in Laxenberg, Austria, has been in operation for 20 years. Its *Annual Report* provides an opportunity to reflect on the organization's activities since it was formed, linking east and west at the height of the Cold War. The original impetus came from President Johnson of the US, who stated that it was time the scientists of the United States and the (then) Soviet Union worked together on other than military and space matters so as to concentrate on the problems that plague all advanced countries, such as energy, the oceans, the environment and health. The President called for a liaison between the scientists of east and west, and IIASA was the principal result. Only future historians will be able to say how important this initiative was in connection with the remarkable political events of recent years.

In IIASA's view, the environmental interdependence of nations has brought to the fore a new appreciation of the significance of global environmental change. In future, the Institute's activities will be focused on advancing the understanding and developing the means of assessing the interactions between human development and the environment by addressing environmental, economic, social, and technological issues under one roof to reveal opportunities or barriers to progress. Perhaps its greatest success over past twenty years has been its contribution to the methodology to address these concerns on a consistent, integrated basis. Its computer-based tools have illuminated many a complex problem.

Over the years, many Canadians have contributed to the work of IIASA. At present, the Canadian representative is Dr. Douglas T. Wright of the University of Waterloo. The Institute publishes a quarterly called *Options* (ISSN 0252 9572), which provides a record of its main activities. It is available from IIASA, Postal Code A-2361, Laxenberg, Austria (Fax: 43 2236 71313).

### *Special Issue of The Energy Journal*

Volume 14, Number 3 of *The Energy Journal* is devoted to the subject 'North American Energy Markets After Free Trade.' This special issue, supported by the Fraser Institute of Vancouver, was edited by G. Campbell Watkins (now with Charles River Associates Inc., Boston, MA) and Leonard Waverman (Centre for International Studies at the University of Toronto), who together also contributed a paper. Other Canadian authors include Stephen Randall of Calgary and André Plourde of the University of Ottawa. The papers present a wide range of economic studies on this question of topical importance.

### *Greenpeace Report*

Greenpeace has released the report *Fossil Fuels in a Changing Climate* which concludes that it is technically and economically

feasible to reduce the world consumption of the fossil fuels by half within 40 years. According to this organization, the use of oil and the other fossil fuels could be entirely phased out over the next century, with nuclear power being phased out by 2010. Mr. Paul Gilding, Executive Director of this environmental group known for its militancy, announced that his organization will now turn its attention to reducing the consumption of the fossil fuels, especially oil, which his group believes is the underlying cause of many of the world's environmental problems. Both this report and its extended technical supporting document, *Towards a Fossil Free Energy Future: The Next Energy Transition*, are available from Greenpeace International, Keizersgracht 176, 1016 DW Amsterdam, The Netherlands.

### *Report on Gas Resources of Western Canada*

In May, then Minister of Energy, Mines and Resources, the Hon. Bill McKnight, released a major study of the natural gas resources of Western Canada entitled *Devonian Gas Resources of the Western Canada Sedimentary Basin*, which was prepared jointly by the Geological Survey of Canada and the Energy Sector of the Department. The Devonian formation may contain as much as 25% of western Canada's undiscovered natural gas.

Part 1 of the study, conducted at the Institute of Sedimentary and Petroleum Geology in Calgary, contains a geological basin analysis and resource assessment. The natural gas potential of both established and potential "plays" were determined using a technique called the "discovery process model."

In Part 2, estimates were made of economically viable gas potential over the longer term, which are accomplished by taking into account the major technical and economic constraints to exploration, development and production. The report indicates that 567 billion $m^3$ (20 Tcf) of natural gas remain to be discovered in existing exploration plays in this formation, and another 1416 billion $m^3$ (50 Tcf) can be found in unexplored plays. The report, GSC Bulletin 452, is available from Canada Communications Group, Ottawa, Ontario K1A 2A7 for $24.75 + GST.

### *Energy Council of Canada Summary Report*

Dr. E.P. Cockshutt, Executive Director of the Energy Council of Canada, has prepared a useful six page paper which summarizes the statistical data prepared for the Madrid Congress of the World Energy Council (see *ESR* 4:3 p.306), together with his observations on some relevant energy topics. A limited number of copies of this paper, entitled *Energy: The New Realities*, originally published by the Canadian Society for Mechanical Engineering, are available from the Council at 400-30 Colonnade Road, Nepean, Ontario, K2E 7J6 (Fax: 613-952-6470).

## Short Notes

• The Hon. Anne McLellan became Minister of Natural Resources (still legally the Department of Energy, Mines and Resources) succeeding the Hon. Barbara Sparrow when the new government assumed office on November 4, 1993. Mr. Bruce Howe, previously Deputy Minister of Western Economic Diversification, and before that Deputy Minister of Energy, Mines and Resources, was appointed President and CEO of Atomic Energy of Canada Ltd, on June 23, 1993.

• The original budget proposed by the Clinton Administration in Washington earlier this year included a broad-based general tax on energy. The only element of this tax to emerge from the Congress when the legislation was signed into law on August 10, 1993, was the transportation component, which came into force October 1, 1993. The increased levy of 1.13 US ¢/litre (4.3 US ¢/US gallon) on gasoline is modest in comparison with those imposed in Canada and other western nations in recent years, and reflects the difficulty in reaching a political consensus on this matter. In the meantime, US oil imports continue to rise. The new tax is not expected to have much effect on the quantity of imported oil.

• An Innovative Partnerships Initiative has been established to raise the efficiency with which energy is used in government operations. Under this scheme, in a unique business arrangement called Energy Performance Contracting, an energy services company undertakes an efficiency improvement project and agrees to finance all the upfront costs. The energy services company is repaid over the life of the contract from the money saved on energy costs. The IPI's initial 32 partners include companies qualified to do energy efficiency upgrading, major Canadian utilities, and financial institu-

tions. Working together with officials from the Department of Energy, Mines and Resources, the allied partners are able to provide a comprehensive package of information, management, and financial services to promote energy-efficient projects. By the end of the year, it is expected that a network of some 80 such companies will be established.

The process begins with an energy audit of a federal facility to identify the energy efficiency measures that can be undertaken, the likely savings, and an estimate of the cost of these savings. A bidding process is then followed to award an energy management services contract to one of the companies on the pre-qualified list. The contract specifies the total cost of the project and the duration of the payback period. Improvements are then made to the building or other structure, and energy monitoring systems are installed so that both the management company and the department can track energy use and calculate the savings. The department, now paying lower energy costs, repays the project's cost from the energy savings that have been achieved. With experience, it is hoped this approach may find application through the private sector as well.

• On June 24, 1993, the Canadian Broadcasting Corporation (CBC) devoted 20 minutes of its flagship program, *Prime Time News*, to the cold fusion field. This name is now generally conceded to be a misnomer, since "fusion" does not occur in the generally accepted sense of the word, but it is not clear whether the Japanese term for this new field, "New Hydrogen Energy," will come into common usage despite the large program in that country.

Although there is much scepticism among the scientifically orthodox, many laboratories in several other countries have reported progress, usually involving electrodes of either palladium or nickel. Indian workers are concentrating on light water systems in the hope of finding a workable way to bring energy on a small scale to the many villages of that country. Russian investigators cautioned it may take many years to find the explanation for the "fusion" phenomenon. No reference was made to activities in Canada.

One of the original workers in this field, Dr. Stanley Pons, now working in a new laboratory in the south of France, and supported in part by Japanese funds, stated his organization expects to have a small "technological" unit of perhaps 10-20 kW thermal output in operation within the year.

Progress has not been without incident. At the Stanford Research Institute in California, a serious accident, which was presumably caused by a hydrogen explosion (although some believe it was due to rapid release of heat) claimed the life of one person and seriously injured others.

On the other side of this intriguing story, a new book by Gary Taubes, *Bad Science: The Short Life and Weird Times of Cold Fusion* (Random House), gives a devastating account of the behind the scenes activities. A review by David J. Kevles in *The New Yorker* of August 2, 1993, is especially revealing.

• The Environmental Technology Commercialization Program (ETCP) was established under the government's 'Green Plan' to share the financial risks of developing, demonstrating and commercializing new technologies to solve environmental problems, including those in the energy field, through the use of first-time pilot and demonstration projects. This program is administered by the Department of Industry, Science and Technology (DIST) with the support of Environment Canada and the Industrial Assistance Program (IRAP) Network of the National Research Council. Projects are normally undertaken in the form of strategic alliances, joint ventures and consortia in the environmental industry. Financial assistance is also available for preliminary studies and analyses to resolve a broad spectrum of issues related to the launching of demonstration projects, including assessing the technical or business feasibility of a project or determining the status of the intellectual property concerned. Successful projects may receive assistance of up to 50% of the eligible costs to a maximum contribution of $5 million. Related studies may receive a contribution of up to 75% of the cost of the study up to a maximum of $50,000. Projects will be accepted for registration until March 31, 1997 (Contact DIST at Ottawa, Ontario, K1A 0H5, Fax: (613) 954-3430).

• The first *Directory of Energy-Related Graduate Programs in US Universities*, describing more than 60 programs in the fields of energy, resources, environment and development, is available free of charge through the Energy Foundation in San Francisco. Contact *Home Energy Magazine*, 2124 Kitteridge St., No. 95, Berkeley, California, Zip Code 94704 (from IEEE *Spec-*

*trum*).

• The difficulty of powering electric vehicles with conventional lead-acid batteries can be illustrated by the fact that the maximum energy that can be stored is barely sufficient to lift the battery alone 610 metres in a vertical direction. Nevertheless, there is steady progress in alternative electrochemical systems. An Austrian company, Enstore R&D GmbH, announced a quick-charging technology that not only does not harm batteries but will actually extend their working lives. The company claims, for example, that the useful life of a nickel/cadmium battery may be extended from a typical average of 500 charge/discharge cycles to 5000. An Israeli company, Electric Fuel Limited, has devised an improved zinc-air system. The zinc, after discharging as the oxide at the end of the cycle, can be replaced by modules of fresh metal each weighing 159 kg. The zinc oxide is re-converted to zinc metal in a centralized facility. The replacement metal technique is somewhat similar to the system under development in Canada by Alupower Canada Limited of Kingston, Ontario, that uses aluminum in the same way (from IEEE *Spectrum* and the *New York Times*).

• Dr. M.J. Grubb has been appointed Head of the Energy and Environmental Programme of The Royal Institute of International Affairs in London (see *ESR* 3:2 pp.193-4). Three publications have recently been released by this group: a book analyzing the outcome of the UNCED 'Earth Summit' Meeting in 1992; a study entitled *Environmental Profiles in European Business*, and a report on the evolution of the climate policy of the European Community. According to the *Manchester Guardian* of May 16, 1993, the British government received a surprise at a meeting of businessman, academics, and environmentalists called in London by the Institute to determine how the UK should meet its international obligation to stabilize $CO_2$ and other greenhouse gas emissions at their 1990 level by the year 2000. The Environmental Secretary, the Hon. Michael Howard, had expected support from the business community in its policy of relying upon education and economic instruments to reach this objective. Instead, the many major companies represented (including energy companies) supported the view that regulation would be required and that they favoured the strict carbon tax option preferred by the European Commission.

• Some farmers in Saskatchewan have begun experimenting with locally-produced biodiesel oil as a fuel for tractors. This liquid can be made from oil-seeds such as canola or soybeans. The fuel is free of sulphur, and emissions of carbon monoxide and hydrocarbons are reduced. As a biomass product, it is considered to be neutral with respect to emissions of $CO_2$ to the atmosphere. In Europe, 200,000 tonnes of this fuel are now produced annually and there are plans to increase production by another 500,000 tonnes a year within two years.

In Canada, Arbokem Inc. is considering building a pilot plant in Prince George, BC, while testing of the fuel continues in diesel engines.

• The July 15, 1993, issue of the well-known UK journal *Nature* (Vol. 364, No. 6434) contains three important papers and other commentary related to global climate change. Studies by the International Greenland Ice-Core Project have revealed unexpectedly rapid climate change during periods in the past. A paper entitled *Century-Scale Effects of Increased Atmospheric Carbon Dioxide on the Ocean-Atmosphere System* by S. Manabe, *et al.*, drew special comments on its importance by Andrew J. Weaver of the School of Earth and Ocean Sciences of the University of Victoria. In other comments on the papers in this issue, J.W.C. White, referring to the general problem of climate change, concluded with the injunction: "Don't touch that dial."

• A recent paper presented at a conference at the University of Guelph in September, 1993, found unemployment, oil prices and real interest rates more closely correlated than hitherto thought. Alan Carruth, Mark Hooker and Andrew Oswald, in *Unemployment, Oil Prices and the Real Interest Rate: Evidence from Canada and the U.K.*, suggest the linkage occurs after a 12 month lag. Interesting implications of this paper were drawn in the *Manchester Guardian* of August 1, 1993, by Will Hutton, who believes this work indicates that the next movement in unemployment will be strongly downwards due to the current low prices for oil — welcome news indeed.

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Update *is written by John Walsh, Ottawa, Canada.*

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