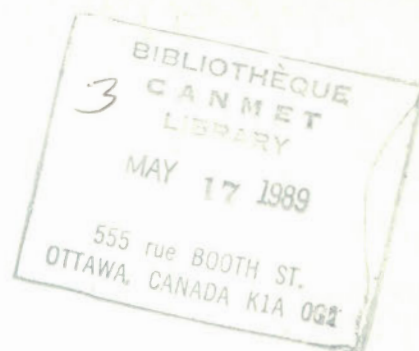


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EMR

Annual Report

1987-88



Energy, Mines and
Resources Canada

Énergie, Mines et
Ressources Canada

Canada

THE ENERGY OF OUR RESOURCES

THE POWER OF OUR IDEAS

LETTER FROM THE MINISTER

Her Excellency the Right Honourable Jeanne Sauv , P.C., C.C., C.M.M., C.D., D.H.L.,
D.Sc., L.L.D., D.U., Governor General and Commander-in-Chief of Canada.

Your Excellency:

I have the honour to present the Annual Report for the Department of Energy, Mines and
Resources for the fiscal year ending March 31, 1988.

I remain Your Excellency's obedient servant.



Jake Epp
Minister of Energy, Mines and Resources

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Energy, Mines and Resources Canada explores Canada's landmass, manages the research and development of energy and mineral technology, and carries out policies and programs to ensure the equitable development and sound management of Canada's mineral and petroleum resources.

Five thousand persons from coast to coast are employed in the department's three major sections: the Minerals and Earth Sciences Program, the Energy Program and the Administration Program.

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MINERALS AND EARTH SCIENCES PROGRAM

The Minerals and Earth Sciences Program consists of four sectors:

- Mineral Policy
- Geological Survey of Canada
- Mineral and Energy Technology
- Surveys, Mapping and Remote Sensing

The program's mission is to gather, generate and transfer information and technology and contribute expertise and policy advice concerning the Canadian landmass, including offshore areas, and its minerals, metals and fuel resources.

The program guides land use management and economic and environmentally sound resource development, and ensures public safety, security and sovereignty, through

- surveying, mapping and remote sensing
- geoscience research and surveys
- research, development and demonstration for safe and efficient extraction, processing and use of minerals, metals and fuels
- regional mineral development,

and through economic, financial, regional and international trade research and analysis.

MINERAL POLICY SECTOR

Markets and prices for many of Canada's major products improved considerably in 1987, and profitability soared in late 1987 and early 1988. The Mineral Policy Sector addressed both international and domestic concerns, creating new initiatives to increase market access and knowledge.

In May, the Minister of State (Forestry and Mines) released The Mineral and Metal Policy of the Government of Canada. It was prepared in response to a report by the Ministerial Task Force on Program Review (September 1985), which recommended that the government adopt an explicit minerals and metals policy. The document ensures improved cooperation between all federal officials concerned with minerals and metals, and informs provincial governments, industry and labour of the minerals and metals measures the federal government may be expected to pursue.

The policy contains six objectives.

- A fair and balanced fiscal and regulatory framework
- Development of the minerals and metals sector as a foundation for regional economic development
- Improved technological performance and increased international competitiveness throughout the industry
- Assistance to workers and communities affected by industrial adjustment
- Enhanced mineral and metal exports and access to new and traditional markets
- Timely economic, technical and scientific information for industry, government and the public

Consultation

The Minister of State (Forestry and Mines) consulted extensively with provincial and territorial governments, industry and labour. Formal discussions were held at the Mines Ministers' Conference, and with the National Advisory Committee on the Mining Industry. Informal discussions took place regularly as well.

The Minister and officials of the Mineral Policy Sector also participated in extensive consultations with industry and associations regarding flow-through shares. These talks resulted in recommendations that the effectiveness of flow-through shares be maintained in financing mineral exploration.

In September, the Minister led a mining and forestry mission to Korea and Japan, during which he discussed minerals and trade with national political and business leaders. The Mineral Outlook '87 Conference held in May with the theme 'Living in a New Market Environment,' provided a forum for the exchange of views of the minerals and metals industry's future. Representatives of government, industry and the financial community presented papers.

Mineral Development Agreements

EMR implements and administers mineral development agreements (MDAs) with the provinces, and co-manages (with the Department of Indian Affairs and Northern Development) similar agreements with the Yukon and Northwest Territories.

In 1987-88 MDAs were in place in nine provinces and two territories. They are carried out, mainly over five-year terms, under federal-provincial economic and regional development agreements (ERDAs). The federal government provides \$135 million of a total commitment of \$242 million.

During the year, the Canada-Quebec MDA was amended to add an exploration assistance program and a \$1.6-million increase in funding for technico-economic studies. Also, discussions began on an amendment to the Canada-Newfoundland MDA, which would introduce an industry assistance program similar to the Mineral Investment Stimulation Programs already in place in Nova Scotia and New Brunswick.

International Developments

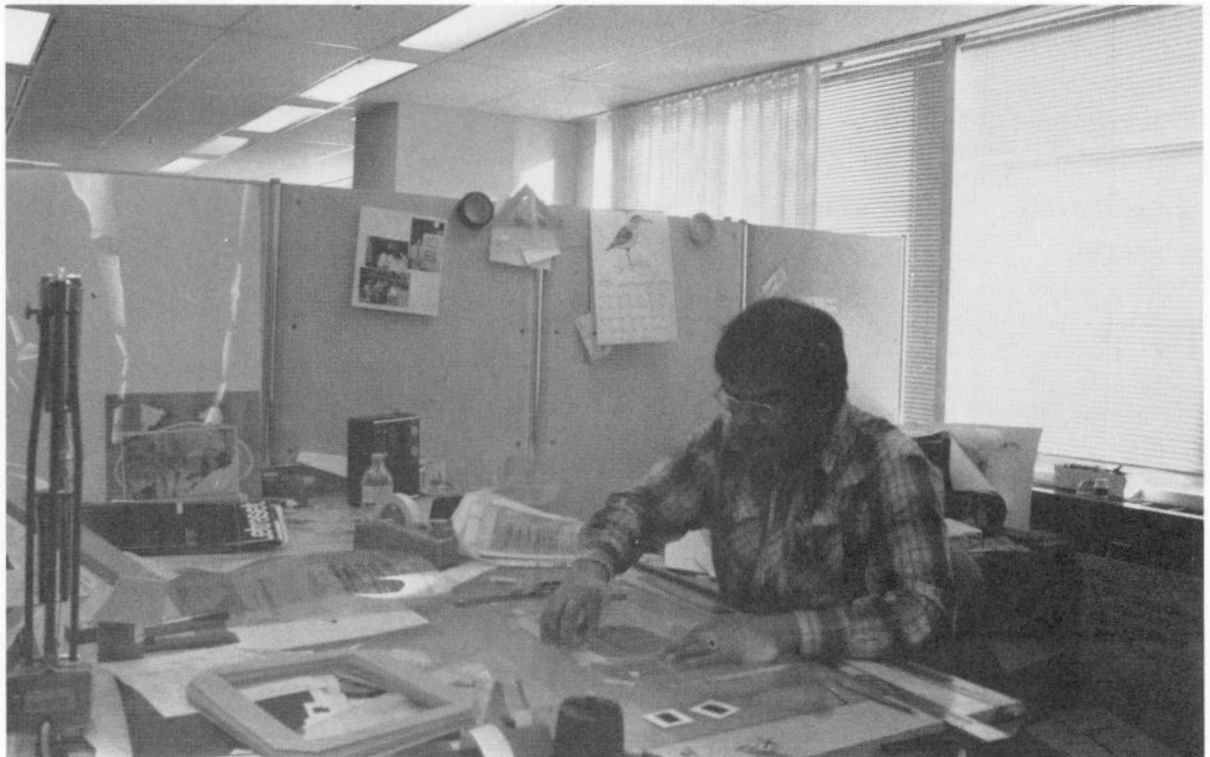
The Mineral Policy Sector participated in several international initiatives undertaken to improve market transparency and encourage consultations between governments. Further progress was made in attracting enough members from interested countries to inaugurate the International Nickel Study Group. Negotiations began for establishing similar groups for copper and tin. And Canada assumed the chairmanship of the International Lead and Zinc Study Group.

The sector led a successful initiative to remove restrictions on the export of certain nickel, columbium and tantalum products to socialist countries. Established by the Coordinating Committee for Multilateral Export Control (COCOM), these restrictions, unwarranted in the light of recent technological advances, were removed to increase Canadian export opportunities. In the same vein, the sector helped suspend the Canadian duty on a particular class of ferrocolumbium. Because there are no domestic facilities to produce ferrochrome, Canada exports colombium concentrates. However, the duty had effectively precluded reimportation of Canadian colombium because it had to compete with Brazilian ferrochrome, which was eligible for a duty-free general preferential rate.

Canada-U.S. Free Trade Agreement

After Prime Minister Mulroney and President Reagan signed the Canada-U.S. Free Trade Agreement in January, the Mineral Policy Sector, in consultation with other departments, prepared a report entitled 'The Canada-U.S. Free Trade Agreement and Minerals and Metals: An Assessment.' Released by the Minister of State (Forestry and Mines) in early February, the report

The Graphics and Audiovisual Services Division serves the whole department.



detailed how the agreement would affect Canada's minerals and metals sector.

Acid Rain Abatement Program

EMR participated in discussions with federal and provincial governments and industry regarding financial assistance for modernizing zinc-copper smelters in Flin Flon, Manitoba. Such improvements would considerably reduce sulphur dioxide emissions.

Carcinogenicity of Metals

In cooperation with the departments of National Health and Welfare and External Affairs, the sector undertook to clarify the International Agency for Research on Cancer's classification of nickel and its products as human carcinogens. It also helped finance an international study on whether exposure to forms of nickel and nickel compounds on the job is detrimental to health.

Asbestos

The federal government continued to promote international adoption of what it regards as the most sensible regulatory approach to asbestos: the controlled-use principle. At the 1986 International Labour Organization (ILO) Conference, the ILO adopted a convention on asbestos incorporating the controlled-use approach for workers, governments and industry. The convention was ratified by Sweden in September 1987; Canadian ratification is expected in 1988.

The government continued to study the U.S. Environmental Protection Agency's (EPA) proposal to ban asbestos. The arguments put forward by the Government of Canada, the Asbestos Institute and the industry have already forced the EPA to revise many of its estimates on the effects of asbestos use. In March the EPA published four new asbestos studies in which estimates of both the risk of exposure and the benefit of a ban were lower than those cited in 1986. The government analyzed the EPA's new evidence and prepared further arguments based on the most recent scientific evidence supporting the controlled-use approach to asbestos to counter the EPA's still-proposed ban.

Coal

Funding of the Coal Utilization Program ended in March, after major projects such as the 22 MW circulating fluid bed combustion unit at Chatham, New Brunswick and the coal-water fuel combustion

plant at Charlottetown, Prince Edward Island, were successfully completed.

EMR participated in the Intergovernmental Secretariat to the Deputy Prime Minister's Action Committee on Western Canadian Low-Sulphur Coal to Ontario. In November, the Secretariat completed a report recommending government assistance to develop technologies to reduce the delivered cost of western coal to Ontario. The report was accepted by the Action Committee early in 1988 and implementation is now under way.

Exploration and Reserves

The sector's report *Canada Mines: Perspective from 1987* critically reviewed production, reserves, development and exploration. It observed that, while high-level production of base metals has been maintained with the help of significantly improved efficiency, the decline in base-metal reserves that began in 1981 is still going on. The most significant cause of this situation seemed to be the great interest in gold: gold exploration accounted for more than 80 per cent of all mineral exploration expenditures in 1987 -- at the expense of base-metal exploration. The annual survey of mines, that the sector conducts with the provinces, brought to light this disturbing drop in Canada's total base-metal reserves. The finding sparked considerable discussion, and the industry is now considering practical ways to arrest shrinking base-metal reserves to head off a decline in production and exports in the 1990s.

Offshore Mining Legislation

Canada's continental shelf is a new frontier for non-fuel minerals. Increasing private-sector interest in Canada's nearshore areas has been expressed mainly through requests for permits to search for gold, though some requests for sand and gravel permits have been received as well. The lack of appropriate regulations was addressed in the 1987 Mineral and Metal Policy, which announced the intention to establish, in full cooperation with the coastal provinces, uniform regulations for all of Canada's offshore area. Consultations during 1987-88 with the provinces, industry and other interested parties established the basis for a unique cooperative management scheme that would integrate environmental and fisheries protection objectives with mineral development.

GEOLOGICAL SURVEY OF CANADA SECTOR (GSC)

In April 1987 the GSC was established as a separate sector at EMR, giving it a higher profile and a stronger voice in the department. Although the GSC's place in the organization has changed, its overall objective remains the same: to provide its clients with the best available geological, geophysical and geochemical expertise concerning the Canadian landmass and offshore areas.

This expertise, both scientific and technological, encompasses mineral and energy resources and natural conditions affecting land and seabed use, and is indispensable to maintaining public safety and security, to effectively exploiting mineral and energy resources, to estimating our country's resource base and to formulating policy.

The new organizational framework brings the former GSC divisions under four new branches.

The Program, Planning and Services Branch and Office of the Chief Scientist

This branch plans, coordinates and evaluates the GSC's scientific programs to ensure that research is conducted effectively and economically. It coordinates work with the provinces and the territories under the Mineral Development Agreements; manages special, cross-sectoral activities such as the Frontier Geoscience Program and international relations; oversees the departmental Research Agreements Program; provides central administrative services; and, through the Geoscience Information Division, directs the Survey's publishing and communications programs and the library.

The Sedimentary and Marine Geoscience Branch

This branch ensures that geological, geochemical and geophysical knowledge pertaining to the sedimentary basins of western and Arctic Canada, the Cordillera and the offshore regions of the Arctic and the east and west coasts is available. It assesses oil, gas and coal resources and administers frontier and marine geoscience programs at both national and international levels. The branch consists of three divisions: the Atlantic Geoscience Centre in Dartmouth, N.S., the Cordilleran and Pacific Geoscience Division with offices in Vancouver and Sidney, B.C., and the Institute of Sedimentary and Petroleum Geology in Calgary, Alta.

The Continental Geoscience and Mineral Resources Branch

By maintaining a national geoscience knowledge base, this branch is a source of expertise and technology on the nature, magnitude and distribution, onshore and offshore, of Canada's mineral resources, the Canadian Shield, and the deep geology and geophysics of the Canadian landmass. Its two Ottawa-based divisions are the Mineral Resources Division and the Lithosphere and Canadian Shield Division.

The Geophysics and Terrain Sciences Branch

The branch is a source of knowledge and expertise relating to geophysics, geotechnical studies and terrain mapping and analysis. It is particularly concerned with the operation of national networks and surveys, and with the study of unconsolidated deposits and engineering related to terrain use and hazards. Headquarters and research facilities for its two divisions, the Terrain Sciences Division and the Geophysics Division, are located in Ottawa. Observation facilities for the national seismological, geomagnetic and geodynamic networks are placed throughout Canada.

Polar Continental Shelf Project (PCSP)

'Polar Shelf' provides logistics support and advice to scientific research groups working in the Arctic, and keeps the scientific community and Arctic residents informed of ongoing scientific operations. PCSP headquarters are in Ottawa; base camps are at Tuktoyaktuk and Resolute Bay, N.W.T. Polar Shelf also maintains a permanent research station on a floating ice island in the Arctic Ocean.

Special Programs

Frontier Geoscience Program (FGP)

An external independent evaluation of the FGP based on feedback from its users -- oil and gas companies, government agencies, universities -- concluded that the program is producing important new information about the geology and reserve potential of Canada's frontier areas. GSC management is using the report to adjust the program's objectives in light of industry priorities, and to plan the data output phase.

The program continues to benefit from joint ventures and information-sharing with industry. Some milestones of the scientific program include:

the *Labrador Sea Basin Atlas*, now nearing publication; the release of maps related to thermal maturity studies in the Arctic islands and the western Arctic; completion of regional gravity coverage of the Yukon from the coast southward to 64° N; and the preliminary interpretation of an integrated geological-geophysical survey of the Queen Charlotte Basin.

Ocean Drilling Program (ODP)

The nine-year, American-led ODP is a multidisciplinary scientific research program for gathering information on the geology of the deep oceans and continental margins.

New strategic objectives for the 1990s were set as the ODP moved away from its preliminary phase of global exploration to one focused on specific fundamental geoscience problems. Among those of direct interest to Canada are technological development, earthquake monitoring from boreholes in the seafloor and investigations of seafloor metallic deposits. During the year, GSC scientists participated in research cruises in the Indian Ocean and eastern Antarctica, and assisted in planning future site drilling programs.

Mineral Development Agreements (MDA) with the Provinces and Territories

An MDA with the Northwest Territories was signed in July, and collaborative work continued under eight other MDAs and a federal program coordinated by the GSC, called the Gaspé and St. Lawrence Initiative. Another federal project, the Asbestos Initiative in Quebec's Eastern Townships, was completed. MDA maps, publications and presentations have helped stimulate exploration activity across the country, notably in B.C., Nfld. and N.S.

Lithoprobe

Following Cabinet's decision to fund the five-year, \$25-million Lithoprobe project, one of the largest multidisciplinary earth science studies ever undertaken in Canada, the Lithoprobe Secretariat was established at the University of British Columbia. The program will keep Canadian scientists at the forefront of worldwide deep-earth studies aimed at learning more about the interior forces that create mineral deposits. The GSC plays an active role in Lithoprobe, providing funding, staff, expertise and equipment.

Canada-U.S.S.R. Arctic Science Agreement

Exchange visits continued successfully, allowing Canadian scientists and their Soviet hosts to conduct field work in areas of the U.S.S.R. previously difficult to study. The resulting correlation charts, rock sample analyses and joint publications have led to an improved knowledge of Arctic geology.

Nuclear Fuel Waste Management Program

The publication in October of a series of reports completed the GSC's formal involvement with Atomic Energy of Canada Limited (AECL) in this cooperative geoscience research program, which sought to develop the concept of subsurface disposal of high-level nuclear fuel waste.

Research Agreements Program

This departmental program, administered by the GSC, continued to fund researchers at Canadian universities and research institutes to do scientific work in support of EMR priorities. In 1987-88, \$1.39 million was awarded to 171 projects at 40 research centres across Canada.

Scientific Programs

Atlantic Geoscience

Scientists are using the basin atlas concept to present all Frontier Geoscience Program results. In 1987, the *Labrador Sea Basin Atlas* neared publication and compilation for the Grand Banks, Scotian Shelf and Gulf of St. Lawrence atlases proceeded rapidly: 800 km of deep seismic reflection lines were shot along the Grand Banks margin, Jeanne d'Arc and Orphan basins, and deep refraction studies and two major aeromagnetic surveys in the Grand Banks area were completed successfully. Work on the basin atlases continued to benefit tremendously from data contributed by industry.

The GSC also initiated its own borehole program on the Grand Banks, providing the first opportunity to sample stratigraphic units previously defined only on the basis of seismic data. In the North, processing of Hudson Bay seismic data, acquired in 1986, was completed. Scientists continued to participate in Quaternary and refraction studies from the ice island research station. Methods developed to estimate the temporal and spatial distribution of iceberg scours on the Grand Banks will be useful for future ice-scour risk analyses. Researchers continued to build a

digital database pertaining to seabed stability off the east coast.

Cordilleran and Pacific Margin

Under the FGP, a major new project, using land and marine geological and geophysical studies, was initiated to assess the hydrocarbon potential of the Queen Charlotte Basin. Systematic regional mapping of the Yukon's lead/zinc-rich Selwyn Basin was completed, and regional gravity coverage of the Cordilleran north of 64° N continued.

Aeromagnetic data on the Queen Charlotte Islands and continental margin were published as 77 geophysical maps. Eleven research cruises were undertaken to continue studies on the Juan de Fuca Ridge and in Queen Charlotte Sound. In April 1987, the GSC completed its first deep drill hole (367m) in the Fraser Delta as part of a continuing subsurface mapping program to improve earthquake hazard assessment. Analysis of data from the 1986 earthquake near Prince George, B.C. was completed. In western Canada, 51 seismograph stations now monitor earthquake activity.

Sedimentary and Petroleum Geology

Two major studies neared publication: 'Conventional Oil Resources of Western Canada (Light and Medium)' and 'Coal Resources of Canada.' Some 40 projects were active in the western Arctic and Arctic islands under the FGP. This year's highlights included a summary of the Arctic Ocean region's petroleum resource potential, completion of geological mapping of Prince Patrick and Eglinton islands at the 1:250 000 scale, the startup of detailed mapping in the northern Yukon and field studies in the Beaufort-Mackenzie area.

As the national coal geoscience program continued, GSC scientists worked closely with counterparts in provincial agencies, coal companies and universities. This cooperation is expected to yield research studies of greater focus, comprehensive databases of national coal geoscience information and national standards for assessing and reporting coal resource potential.

Three major cooperative projects to assess the Western Canada Sedimentary Basin's resource potential were in progress: the Peace River Arch project, formalized in April 1987 by a Memorandum of Understanding with the Alberta Geological Survey, the Williston Basin project and a new natural gas assessment project.

The new gas-chromatography - mass-spectrometry (gc-ms) facility carried out significant work on oil-oil

and oil-source correlations in the Williston Basin project and other frontier area projects.

Lithosphere and Canadian Shield

Almost 100 projects were active. Of particular note were the preparation of a synthesis of geoscience data documenting the formation of an Early Proterozoic craton, and the discovery of previously unknown Cretaceous deposits and various deeply subsided sub-basins in the Hudson Strait and Foxe Channel.

In the Northwest Territories, continuing studies of major tectonic zones focused on the southern extension of the Thelon Tectonic Zone and on a gold-producing area in central Slave Province. The GSC completed 1:250 000 mapping in Chesterfield Inlet, and undertook detailed structural mapping in central Baffin Island.

Field work in the eastern half of the Cape Smith belt in northern Quebec was completed. Results include an innovative model of complex structure that will prove a useful guide to future exploration programs in the mineralized belt.

In the south, remapping of the north shore of Georgian Bay continued to aid in interpreting new seismic results from the Canada-U.S. Great Lakes International Multidisciplinary Program on Crustal Evolution (GLIMPCE). This project is yielding important new insights into the nature and structure of the crust beneath the western Great Lakes.

Published for the first time, *Radiogenic Age and Isotopic Studies* is an annual series to present analytical results generated by the Survey's geochronology unit.

Two commercial successes resulted from technology transfer to industry: a receiver capable of multi-channel data collection for audiomagnetotelluric, magnetotelluric and controlled electromagnetic measurements; and a portable seismic refraction instrument.

Mineral Resources

The development of mineral deposit models and signatures for use in exploration proceeded for platinum group elements, massive sulphide deposits and gold. Release of 1986 regional geochemical surveys and airborne radiometric surveys contributed to increased staking activity in parts of the country, notably British Columbia, Newfoundland and Nova Scotia.

Joint work with the provinces and territories, on about 65 projects under the Mineral Development Agreements, ranged from regional geochemistry to mineral deposit studies. GSC scientists continued to participate in the International Strategic Minerals Inventory (producing the ISMI report on tungsten), and provided technical assistance to the International Atomic Energy Agency and to CIDA projects in Jamaica, Thailand and Zimbabwe.

Other highlights included the release on Open File of a major report on Platinum Group Element environments, the first recorded Canadian occurrence of four rare earth minerals in the Strange Lake Alkalic Complex of central Labrador and the completion of the Calgary borehole calibration facility. The GSC's index to Canadian mineral deposits, CANMINDEX, was adapted to microcomputers, making data more accessible and reducing cost. Geophysical equipment in the Skyvan aircraft was upgraded, and a detailed survey was flown over Maniwaki, Quebec as part of a study conducted with the Department of Health and Welfare on soil radioactivity and radon in houses.

Geophysics

Information on seismic events is immediately available from the GSC's seismicity database. This year almost 1500 earthquakes, 35 of which were felt, were documented in or near Canada. Canada exchanged seismic data with other countries, notably Sweden, the U.S., U.K. and U.S.S.R., as part of its role in the global seismicity network that monitors earthquakes and nuclear explosions. Meanwhile, the modernization of seismological facilities at Yellowknife continued on schedule.

In geomagnetism, the GSC issued 10 alerts of major geomagnetic activity -- the earth is now entering the upswing phase of the 11-year solar cycle of geomagnetic activity. Researchers completed gravity coverage of the entire polar continental shelf from the Mackenzie Delta to Ellesmere Island. Data from other surveys off the east and west coasts and the Great Lakes were added to the National Gravity Data Base.

In geodynamics, the GSC compiled results from 12 years of intensive monitoring of tilt, strain, well levels and gravity variations of the Charlevoix seismic region. An aeromagnetic survey covering all



Mineral exploration research in Quebec's Eastern Townships studies the origin of alluvial gold.

of Lake Superior completed the mapping of the Great Lakes; and magnetic anomaly maps at the 1:5 million scale of Canada (fifth edition) and of North America (in collaboration with the U.S. Geological Survey) were published.

Terrain Sciences

Glacial deposits studies in the High Arctic focused on collecting datable materials to gain information about climatic change. Field tests, with support from the Department of Indian and Northern Affairs, were carried out to monitor the interaction between the Norman Wells pipeline and its surrounding permafrost soils. In southern British Columbia, work to assess landslide hazard continued, and the GSC completed studies of the massive rockslide triggered by the Nahanni, N.W.T. earthquake of 1985.

Four national synthesis maps were published portraying the retreat of the Laurentide Ice Sheet and the paleogeography of northern North America from 18 000 to 5000 years ago. Two major publications are nearing completion: the multi-volume *Beaufort Sea Atlas*, of value for planning hydrocarbon exploration and assessing environmental impact; and an atlas showing sea-level changes throughout the coastal regions of Canada in post-glacial times.

Applications of sedimentological research to practical problems in mineral exploration, environmental geochemistry and seismic hazard research were of prime concern; and work continued on establishing a national database of glacial sediments.

GSC scientists played an active role on the organizing committee and in the scientific program of the International Union for Quaternary Research's (INQUA) successful XIIth International Congress held in the summer in Ottawa. GSC is becoming increasingly involved in many aspects of the new international Global Change Program.

Geoscience Information

The GSC must ensure that results of its scientific program are made available, as maps or reports, in a timely and cost-effective manner. In 1987-88 about 5800 pages of new scientific text, as well as some 1000 pages of general text, such as popular booklets and open file reports, were published. The GSC is coordinating production of the Canadian contribution to the Decade of North American Geology (DNAG)

project, and during the year considerable effort was focused on planning and placing adequate staff and facilities to handle the nine DNAG volumes that will comprise the *Geology of Canada* series. Two volumes, *Quaternary Geology* and *East Coast Canada*, are slated for publication during 1988-89.

Polar Continental Shelf Project

Polar Shelf gave logistical support to 232 field parties working in the Canadian Arctic, making the 1987 field season one of the largest to date.

Geoscience-related projects ranged from geological mapping to the physics of sea ice around drilling platforms. Marine wildlife studies in the Lancaster Sound region were carried out to prepare for possible designation of the sound as a marine national park. Studies at the fossil forest on Axel Heiberg Island were recorded by a film crew for eventual release as a documentary, and the site was under consideration by National Museum staff for possible heritage status.

The permanent research station, established in 1984 on a drifting ice island in the Arctic Ocean, was occupied in 1987 from early March to the end of August; marine geological, geophysical and oceanographic investigations of the continental shelf north of Meighen Island were conducted. Renovations of Polar Shelf's base camps at Resolute and Tuktoyaktuk continued on schedule.

MINERAL AND ENERGY TECHNOLOGY SECTOR

The sector consists of three organizations: the Canada Centre for Mineral and Energy Technology, the Explosives Branch and the Office of Energy Research and Development.

Canada Centre for Mineral and Energy Technology (CANMET)

CANMET, the main research and development (R&D) arm of EMR, assists mining, minerals, metals, materials and energy industries. In partnership with its clients, CANMET performs and sponsors predominantly commercial and cost-shared R&D and technology transfer to:

- enhance the competitiveness of the Canadian mineral, metal and energy industries;
- improve health, safety and environmental control in the client industries; and
- support government policy initiatives.

CANMET's program is oriented to the needs of industry and to a large extent is guided by consultation with industry through the Minister's National Advisory Council to CANMET (MNACC), and with research establishments, professional and technical groups and private companies.

In 1987-88, CANMET developed a strategy to implement new federal government policies designed to effectively use science and technology. This was incorporated into the CANMET Business Plan finalized in November and endorsed by MNACC.

CANMET worked actively on approximately 180 research projects and spent \$73 million, a significant proportion of all R&D conducted in Canada in the mineral, metal and energy industries. CANMET initiated 192 contracts with a total value of \$14.3 million, primarily with the private sector. Industry contributed \$4.8 million to CANMET cost-shared contracts. CANMET also recovered \$1.6 million as direct cost recovery for services to its clientele.

CANMET continued to develop technology-transfer opportunities with its industry partners. Six major projects with a total value of \$6.2 million were sponsored by CANMET and funded equally by the National Research Council and private industry. During 1987-88, another seven projects worth \$4.7 million were completed. CANMET also sponsored and co-sponsored seminars, workshops and conferences.

Equally significant was the R&D that provided the basis for technological advice required to further government policies and objectives in areas such as health, safety and environmental concerns.

Under economic and regional development agreements, the federal government and the provinces have established federal-provincial mineral development agreements (MDAs). Several CANMET-related activities were part of these agreements. During 1987-88, efforts under the Newfoundland MDA were directed towards improved iron ore processing and the assessment of metallic and non-metallic deposits. In Nova Scotia, processing work focused on identifying and developing new sources of industrial minerals and developing extractive processes for sulphide minerals. In Ontario, MDA projects concentrated on support capabilities, placement techniques and engineering design for both sand and rock backfills, and software suitable for use on computers at small mines. In Manitoba, work concentrated on non-ferrous smelter technology and industrial minerals; in Saskatchewan, on the dry processing of potash.

CANMET is made up of five divisions of laboratories: Mining Research, Mineral Sciences, Metals Technology, Coal Research and Energy Research. During 1987-88, a number of technological successes were achieved by the laboratories, often in partnership with clients.

Mining Research Laboratories

Large Stope Mining and Supports

In collaboration with La Mine Niobec, CANMET applied finite element analysis to identify areas of potential weakness in mines, and monitored ground stability during excavation. The results of this project provided mine planners with valuable information on how much artificial support is necessary for safe operation, and on the potential impact of mining and mining sequence in the excavation of large stopes.

Salt Backfill Technology

Current provincial regulations prohibit New Brunswick potash mining companies from storing waste salt on the surface. To overcome this difficulty, CANMET developed a method of using the salt waste underground as backfill. The structural support provided by this salt backfill could also have a beneficial impact on ore recovery. The strengthening of salt's support properties is currently being tested in a large instrumented test stope study.

Model recalibration based on the study's findings will enable CANMET to research mine layouts, using waste salt as backfill. Several clients, including the Saskatchewan potash industry, are enthusiastic about adopting this technology for future mine development.

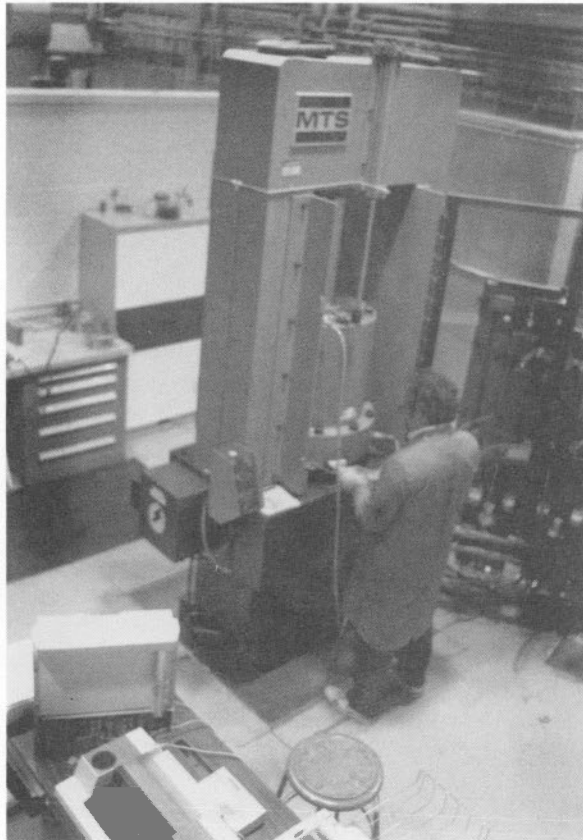
Sudbury Backfill Laboratory

CANMET opened a new laboratory on the campus of Laurentian University in Sudbury to support the concentration of backfill work being carried out in Ontario mines. Initial work is geared almost exclusively to studying mine backfill properties.

Diesel Emission

CANMET's program to reduce emissions from diesel machinery in underground mines advanced well into the technology transfer stage. Ceramic filters on diesel equipment used in underground mines could allow mine operators to reduce ventilation in a given area by up to 50 per cent and still maintain acceptable air quality. Mines using CANMET's diesel filter technology could potentially double production by increasing the number of diesel vehicles operating in an area.

*Mining Research
Laboratory*



Mineral Sciences Laboratories

Biotechnology

A Canadian smelter is being prepared to accommodate a biological process developed by CANMET in one of its large-scale pilot plants. This process recovers metals from diluted acid effluents produced by smelters at base-metal mines. Economic analyses indicate full recovery of capital costs in 1.7 years. High-purity metal is produced from effluents currently treated and stored in waste-holding areas.

Expert Systems for Process Control

Based on the success of the SPOC (Simulated Processing of Ore and Coal) project, CANMET recognized the substantial promise of expert systems as an area to advance technology for the mineral industry. To adapt this technology, CANMET quickly developed expertise in the field and established relationships with both hardware and software firms, as well as with interested customers in the mineral industry.

During 1987-88, CANMET developed off-line expert systems for application in leaching and the control of grinding circuits. Two equally ambitious projects are now studying on-line process control. All of these projects are evolving under cost-shared agreements with the private sector, and signify potential savings for Canadian industry.

Silver Recovery from Zinc Leach Residues

Most zinc concentrates contain silver. Additional silver can be found in zinc leach residues that have been stockpiled over the years. Silver lost in these residues costs the Canadian zinc industry an estimated \$10 million each year. CANMET, through contacts with Noranda Inc. of Pointe Claire, Quebec, developed a viable flotation process to remove silver from the neutral leach residues generated during zinc processing. If initial pilot-plant test findings are realized on a plant scale, the industry could recover approximately \$7.5 million worth of silver annually.

Advanced Ceramic Transducers for Non-Destructive Testing (NDT)

In 1987, BM Hi-Tech successfully marketed a range of improved transducers for non-destructive testing based on an advanced piezoelectric ceramic material

first identified by CANMET. Subsequent development was made possible through an effective networking process, including contracting out, National Research Council technology-transfer programs and the secondment of BM Hi-Tech personnel to CANMET's laboratories.

Metals Technology Laboratories

Strip Casting

Canadian ferrous and non-ferrous producers have shown considerable interest in developing strip casting processes. As a result, CANMET scientists and engineers designed, constructed and now operate an apparatus capable of producing sizeable lengths of 100-mm-wide strip about 2 mm thick. To date, zinc-aluminum, aluminum-12 per cent silicon, copper-nickel-tin and stainless steel strip have been cast. Researchers are developing a modification for casting mild steel strip. Commercial application of these technologies will substantially decrease sheet metal processing costs.

Cam Plastometer

The American Iron and Steel Institute, representing eight North American steel companies, including STELCO, will be using CANMET's cam plastometer to characterize the hot deformation behaviour of various types of steel. Results of these characterizations will allow sponsoring companies to improve their control procedures for hot rolling of steel.

Defect Characterization

A three-dimensional imaging system for defect characterization based on concepts developed at CANMET was commercialized this year by Techno Scientific Inc. of Woodbridge, Ontario. The system, called AUFIS (automated ultrasonic flaw imaging system) was developed to help engineers determine the exact size and position of defects or cracks in welds. However, the first customer for AUFIS was the Canadian Imperial Bank of Commerce, which will use it to examine gold bars and coins for illegally added tungsten.

Coal Research Laboratories

Blast Casting

CANMET demonstrated this technology in a cost-shared project with Fording Coal at its Elkford Mine in southeastern British Columbia.

Significant savings in overburden removal were achieved by using explosives rather than conventional shovel-truck, dragline or tractor-stripping techniques. Fording Coal has assessed the physical conditions under which this technology can be successfully used, along with its sensitivity to various factors, including angled holes, explosive type and blasting pattern.

On-Board Truck Information System

This system was demonstrated in a joint project with Gregg River Resources. Researchers installed instrumentation on two regular haulage trucks at the Gregg River Mine, Alberta, and obtained accurate data on basic haulage parameters. Estimates suggest that a \$100 000 investment for instrumentation produces \$250 000 in savings a year.

Rolling Resistance Trailer

Maintaining mine haulage fleets represents a significant portion of the total cost of a mine's operation. Productivity of haulage trucks is directly related to the rolling resistance of mine hauling roads. Current methods of measuring rolling resistance use two trucks, making the cost of conducting these measurements high. To overcome this, CANMET commissioned the construction of an instrumented trailer, towed by a service truck equipped with an automated data acquisition system to measure rolling resistance. Shakedown trials have been completed, and the trailer is being used to survey mine-road conditions and to examine various road construction methods for improving rolling resistance in both coal and oil-sands mining operations.

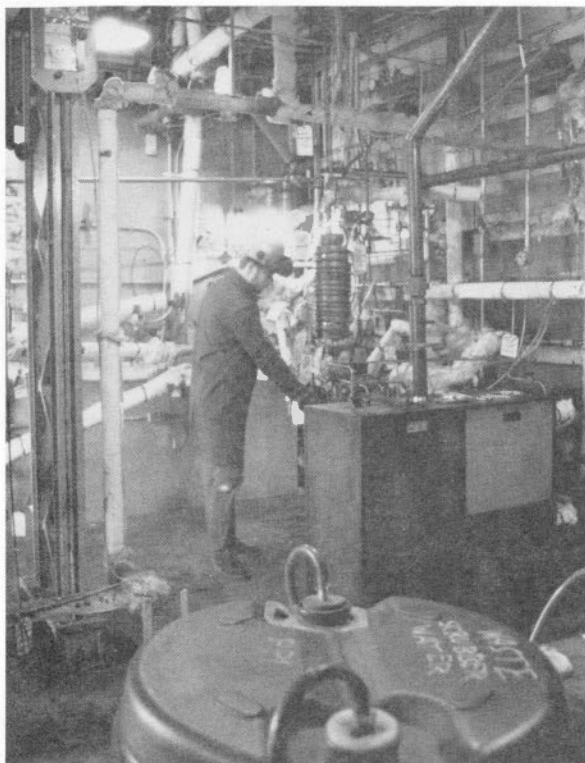
Fine Coal Processing

CANMET's pilot-scale facilities for processing fine coal were enhanced by the installation of a column flotation and fine-grinding circuit. Successful trials using spirals for fine coal cleaning and reclamation of tailings have led to benefits for Canada's coal industry.

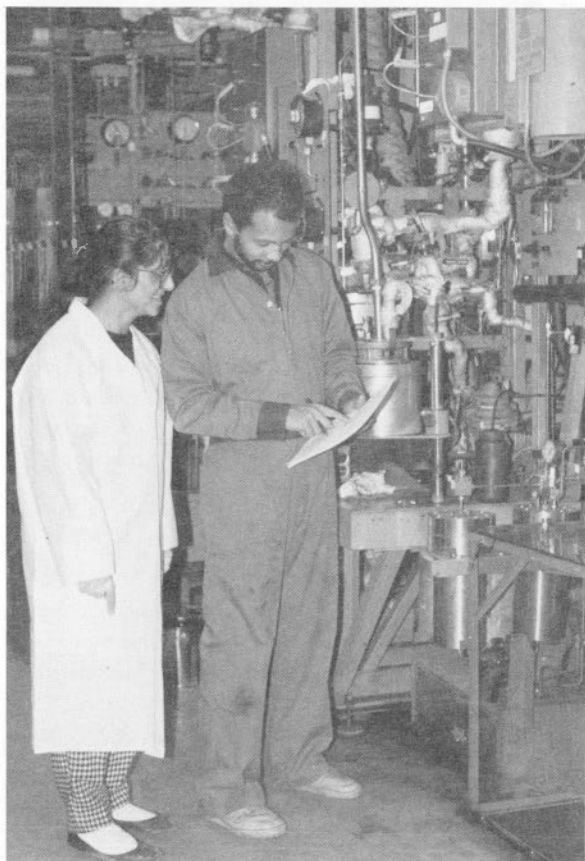
Mobile Coal Preparation Plants

CANMET's mobile preparation plants were used to train coal plant operators, and to streamline two coal preparation processes: the optimization of centrifuges for dewatering coal tailings, and the refinement of a belt filter process for dewatering fine tailings.

Bitumen and Heavy Oil Recovery Laboratory



Energy Research Laboratory



Energy Research Laboratories

Coal-Water Fuel

An industrial coal-water fuel burner was developed, featuring a dual fuel (oil and coal-water) capability and a capacity of 30-80 GJ/hour with excellent flame stability and no nozzle wear. The burner was tested on a demonstration scale and additional trials have been planned with two Maritime utilities. In conjunction with the private sector, this advanced burner will allow CANMET to market an overall technology package that could be used in the conversion of industrial- and utility-scale boilers from oil-firing to coal-firing. This technology will help Canadian industry to secure the sale of coal in many new markets.

Fluidized Bed Combustion

The bubbling fluidized bed pilot plant, designed to burn coal, was modified to burn liquid bitumen and heavy oil residues. Efficient combustion with low acid-rain emissions was achieved with these non-conventional fuels.

Gasification

Several industrial waste solids have been identified as sorbents for hot gas clean-up prior to the combustion of gas in integrated gasification combined cycle units. These materials are less expensive and more efficient than proprietary compounds now in use.

Working with a cement manufacturing company, researchers compared techniques for the safe use and disposal of spent pot-liner from the aluminum industry. A high-carbon conversion was realized during combustion and gasification, and the solid was identified as an important source of hydrogen fluoride for industrial application.

Bitumen and Heavy Oil Recovery

CANMET participated with the Alberta Oil Sands Technology Research Authority (AOSTRA) and industry to develop field trials for novel concepts of horizontal well in-situ steam recovery technology. Horizontal wells may be the most promising means of achieving major commercial in-situ recovery from the Athabasca Tar Sand deposits or from marginal heavy oil reservoirs such as those in Saskatchewan. With support from CANMET, AOSTRA, and Environment Canada, a technology originally

developed to extract and partially upgrade bitumen from mined tar sands (called TACIUK) was applied to extract bitumen from sludges and residual petroleum wastes.

Catalyst Development

Great efforts were made to encourage more industrial participation in catalyst development. A program was designed to focus on catalyst problems associated with upgrading Canadian heavy crudes and synthetic fuels, and companies were invited to join a consortium organized by CANMET.

Refinery Waste Residues

A cost-shared project with Ultramar Ltd. successfully demonstrated the capability of vacuum pyrolysis technology to dispose of refinery waste residues. This technology could enable the petroleum industry to recycle oil present in these residues in a cost-effective manner without harming the environment.

High-Efficiency, Gas-Fired Water Heater

CANMET played an important role in the design of a prototype high-efficiency, gas-fired water heater with an energy efficiency of more than 90 per cent, a potential energy saving of 40 per cent over current gas-fired heaters. A production model, soon to be developed by the private sector, will replace inefficient water heaters now on the market. This development will dramatically increase energy efficiency in houses using natural gas.

Explosives Branch

The Explosives Branch regulates the manufacture and distribution of explosives, as well as some aspects of their road transportation. It also classifies new explosives for all means of shipment and acts as advisor to the Transportation of Dangerous Goods Directorate.

During 1987-88, there were two serious accidents with pyrotechnics: a large fireworks depot burned down; and an industrial pyrotechnic under development caught fire in a laboratory, injuring four people. The Explosives Branch investigated the first accident, and monitored the investigation and restart of operations of the second.

The branch licensed 103 factories to manufacture explosives and issued 2087 magazine licenses. Observance of the terms of licenses and permits was monitored by 1447 factory and magazine inspections and 203 inspections of trucks.

The Canadian Explosives Research Laboratory determined the characteristics of over 400 explosives and pyrotechnic samples, allowing the Chief Inspector of Explosives to assess their safety for import or manufacture.

Courses for fireworks supervisors were conducted at centres throughout Canada. More than 1000 persons attended some 60 educational courses given to industry.

The branch also helped to plan and carry out the fireworks display at the Calgary Olympics, and provided similar assistance at Canada Day and other celebrations in major cities.

Office of Energy Research and Development

The Office of Energy Research and Development, secretariat to the Federal Panel on Energy Research and Development, is responsible for coordinating the Interdepartmental Federal Energy Research and Development Program, which is managed by the panel and in which 12 departments and agencies participate. The office also coordinates Canadian participation in cooperative energy R&D through the International Energy Agency (IEA) and bilateral energy agreements with other countries.

In 1987-88 the program was allotted \$89 million, augmented by resources of participating departments and contributions from the private sector in cost-shared projects, to develop the science and technology base for a diversified, economically efficient and environmentally sustainable energy economy. About 53 per cent of the federal funds were spent on research on the environment, health and safety, 14 per cent on long-term energy options and 33 per cent on industrial support. More than 60 per cent of the supported funds was spent in the private sector.

Technical progress in EMR's work led to recent significant results, such as the CSA code for offshore structures, a refueling probe to permit public self-service at natural gas vehicle fueling stations, a heat pump for exhaust heat recovery in swimming pool facilities, the development of substantially more efficient sealed-unit windows with internal lowers and the production of automotive parts using powder metallurgy.

Several major initiatives, jointly funded by federal and provincial governments and industry, commenced or reached milestones in 1987-88: the Pulp and Paper Research Institute of Canada's development of impulse drying of newsprint, the National Incinerator Testing and Evaluation Program and a program to define the impact of proposed diesel engine emission standards on fuel composition and consumption under Canadian conditions.

The office continued to participate fully in the IEA's research and development committees which oversee cooperative R&D projects, in 48 of which Canada participates. In 1987-88 the office reviewed Canada's participation in the IEA's R&D programs and found significant benefits to Canada.

The office continued to cooperate with industry, universities and provinces through informal meetings and seminars, and through participation on the governing and other committees of the Alberta-Canada Energy Resources Fund, the Canadian Electrical Association and the Natural Sciences and Engineering Research Council.

SURVEYS, MAPPING AND REMOTE SENSING SECTOR

The Surveys, Mapping and Remote Sensing Sector, announced as a new organization in April, formulates and develops programs for the survey and definition of Canadian lands and waters, and a national program for acquiring and using remote sensing data.

Canada Centre for Remoting Sensing (CCRS)

The centre provides remotely sensed data and improves the technology for resource management and environmental monitoring.

During 1987-88, CCRS initiated a Radar Data Development Program to prepare Canadian agencies for using data from future radar satellites, including Canada's RADARSAT. In Canada, airborne radar data collection began with agriculture, forestry and geology experiments. In Scandinavia, Canadian aircraft flew two major operations in the course of ice-and-wave experiments conducted with Sweden and Norway.

A Crop Information System, developed using CCRS technology, was installed at the Manitoba Remote Sensing Centre. It provides drought and crop monitoring services.

CCRS successfully completed technology transfer projects with resource management agencies in Newfoundland and Saskatchewan, and initiated a two-year program to integrate remote sensing technology into environmental and resource management decision-making processes in the Northwest Territories.

A state-of-the-art airborne remote sensing system was loaned to Canadian industry. The system allows users in the resource field to buy imagery from this electro-optical sensor package.

The centre continued to participate in the European Space Agency's Earth Resource Satellite (ERS-1) Program. ERS-1 is scheduled for launch in 1990 and will carry radar and microwave sensors for ice, oceans and land applications research. Canadian industry is under contract to CCRS to develop a radar data processing facility for the ERS-1 launch.

Canada Centre for Mapping (CCM)

The centre maps the nation for economic development and sovereignty. It produces topographical and geographical maps of Canada, including aeronautical charts, and the *National Atlas of Canada*.

Over the next decade, the centre will increasingly use electronic computers and space technology in mapping and charting. Digital systems are now being integrated into the production of aeronautical charts, the national atlas, topographical maps and data bases.

The centre participated in several forward-looking projects.

- The National Advisory Committee for the *National Atlas of Canada* made recommendations to the Minister of State (Forestry & Mines) for the future of the atlas. The report will provide strategic guidance for the future.
- Federal and provincial mapping organizations adopted standards developed by the Canadian Council on Surveying and Mapping (CCSM) for the exchange of digital map data.
- In August the Canadian Permanent Committee on Geographical Names coordinated the Fifth

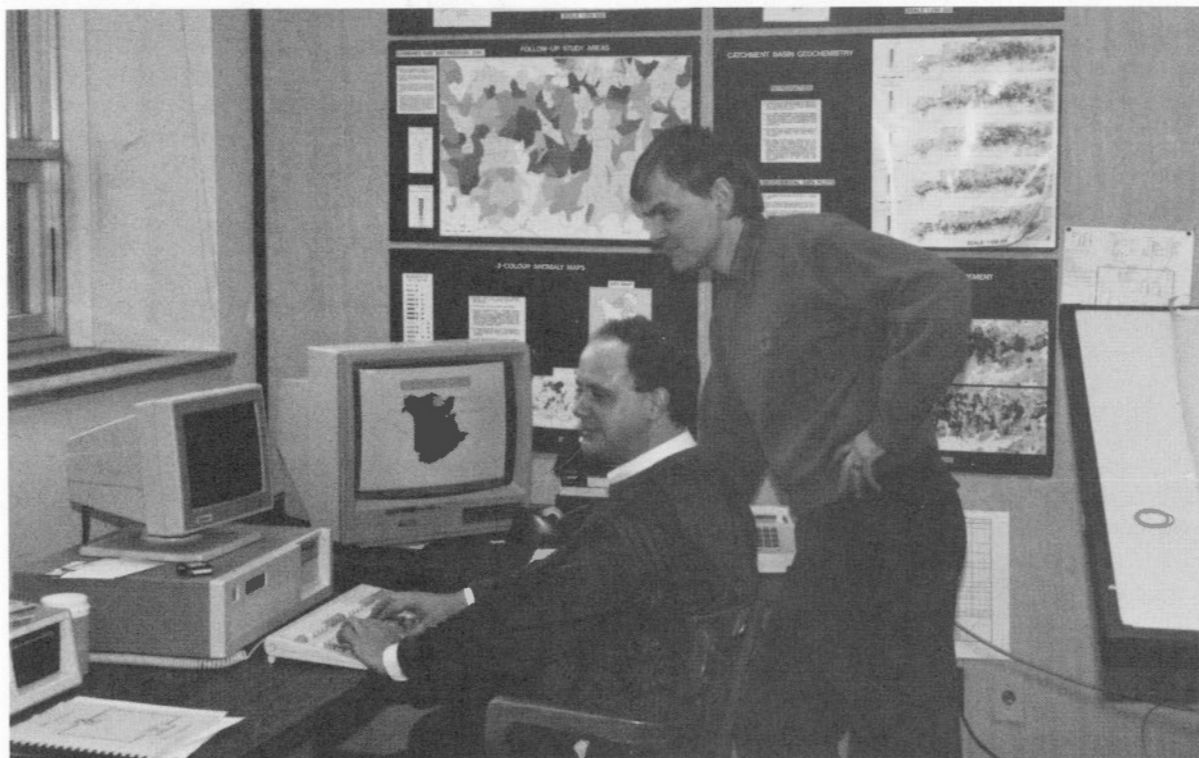
United Nations Conference on Geographical Names in Montreal.

- The Topographical Mapping Division was reorganized to centralize research and development, to create more responsive program planning and to expand digital technology in the production teams.
- As part of an effort to take advantage of the best modern technology, the centre acquired a SCITEX system for automatic drafting of aeronautical charts.

Topographical Mapping Division

The division develops national standards for the topographic mapping of Canada. Using information acquired by aerial photography, space imagery, and field surveys the division coordinates the design, content and production of these maps to provide an accurate representation of the earth's elevations, natural features and major structures. Resource development, environmental protection, transportation, communications and defence are only a few of the applications for topographical maps in Canada today.

The entire country has been mapped at the reconnaissance scale of 1:250 000 in 917 map sheets. **At the larger scale of 1:50 000, 272 first-edition sheets were recently produced, bringing total**



Computer-assisted mapmaking

national coverage to 84.5 per cent. Also, the division revised 292 maps, using both conventional and digital methods. Satellite imagery is extensively employed in revising the 1:250 000 scale maps and in detecting changes on the 1:50 000 scale series. During 1987, the Cartographic Data Processing System for automated digitizing of the 1:250 000 scale series was used to convert 250 maps into digital format.

The division joined with the United States Geological Survey to produce the prototype for digital international boundary maps; provided technical support for CIDA on surveying and mapping projects in Egypt, Indonesia, Tanzania and Zimbabwe; and continued to help manage federal-provincial flood-damage programs.

Geographical Services Division

The Geographical Services Division gathers and disseminates geographical data, and produces aeronautical charts and flight information publications. Maps for the 5th edition of the *National Atlas of Canada*, published by the division, provide information on the physical, socio-economic, and historical geography of Canada.

The division maintains the National Toponymic Data Base, which contains more than 400 000 place names. This data base is used for general names inquiries, national mapping and the publication of provincial volumes of the *Gazetteer of Canada* series.

Extensive cartographic work was done for other federal departments and agencies, including Parks Canada and the Chief Electoral Officer. Work progressed on new maps for the Waterton Lakes, Elk Island and Pacific Rim national parks. More than 1500 aeronautical charts and related flight publications were produced for navigation and air traffic control in Canada, and numerous maps of federal electoral ridings were prepared.

In response to the growing demand for digital geographic information, the division continued its investigation of computer-based geographical information systems. A new system was obtained in March, and work continued on the second version of the Electronic Atlas (Mark II). Geographic and cartographic staff are being trained in automated mapping and analysis while identifying systems design and data modelling requirements for the National Atlas Information

System (NAIS). During the year, specifications were completed for acquiring a commercial automated mapping capability to supplement the Electronic Atlas.

Canada Centre for Geomatics (CCG)

In August 1987, the Canadian government decided to establish a cartographic division in Sherbrooke. The Surveys, Mapping and Remote Sensing Sector was asked to implement this decision within 12 months and has been doing so throughout the year. The division will participate in digital mapping of Canada and related R&D.

The Sherbrooke organization has two components: the Canada Centre for Geomatics itself, formerly called the Sherbrooke Institute of Cartography, and the Quebec Regional Office of the Legal Surveys Division. The Canada Centre for Geomatics' mandate is to work with the CCM's Topographical Mapping Division to establish and maintain the National Topographic Data Base.

Under a 1985 agreement between the former Surveys and Mapping Branch and the Institut Géographique National of France, two test areas were chosen, one in Canada and the other in France, and four experiments were carried out to evaluate the topographic applications of SPOT data. The experiments in Canada were conducted by MacDonald Dettwiler Ltd., Gregory Geoscience Ltd., and the CCG; those in France by the Institut Géographique National. The centre was responsible for establishing the Sherbrooke test area, coordinating the Canadian tests and analyzing the results, which will be reported at a symposium on SPOT data.

The centre continued to develop software for the exchange of topographical data in the CCSM format. The first version of the software was installed at the Department of National Defence's Mapping and Charting Establishment and at the Ministry of Energy and Natural Resources of Quebec. Comments and recommendations made by the various agencies resulted in changes that have increased processing speed and versatility, while reducing the space required on tape.

Updated software is now available and the centre continues to provide the necessary technical support. The centre is cooperating with the CCSM Secretariat

to effect acceptance of the CCSM exchange format as the national standard.

The centre is working with the Topographical Mapping Division to prepare specifications for the National Topographical Data Base.

Canada Centre for Surveying (CCS)

The centre, created late in 1987 as the result of a reorganization of the former Surveys and Mapping Branch, aims to:

- provide a national survey framework;
- complete the legal description of Canada lands; and
- maintain the Canada-U.S. international boundary.

The centre has three divisions, some 290 staff and an annual budget of about \$20.4 million. Over the next decade, the centre will increasingly use computer and space technology and will continue to monitor and adapt emerging technology through in-house and contracted research and development.

In keeping with this objective, EMR, industry, and the universities last year launched a concerted effort to develop software for processing satellite data. The centre intends to continue its long-standing tradition of providing advice on surveying to provinces, industry and universities.

Geodetic Survey Division (GSD)

GSD maintains a national positioning reference system that provides a basis for compatibility of resource-related information such as surveys, maps and charts.

The division continued to develop the national satellite positioning system, the Active Control System (ACS), based on Global Positioning System (GPS) technology. This system will comprise a series of satellite data monitoring stations throughout Canada. Last year a prototype station was successfully developed and tested. In the future, system data will be used to improve orbit determination and to provide a basis for differential positioning. Meanwhile, the division is increasingly using GPS for all facets of routine positioning.

A National Geodetic Information System (NGIS) is being developed to manage the increasingly complex and voluminous data associated with ASC and the new datum projects. The NGIS will be linked with

similar provincial systems to meet data-sharing requirements.

Legal Surveys Division

Under the terms of the Canada Lands Survey Act, this division, headed by the Surveyor General, manages and regulates all surveys of Canada Lands and maintains a survey framework for the registration of interests within Canada Lands. These activities safeguard the government's interests as well as those of holders of rights in Canada Lands, particularly native people. Canada Lands consist of national parks, the Yukon and the Northwest Territories, the offshore, and 2300 Indian reserves. Properties protected by the Canada Lands Surveys Records are valued in excess of \$15 billion.

The division completed approximately \$1.5 million in boundary surveys for the Inuvialuit Native Land Claim Settlement. These surveys were carried out under contract to the private sector. Work continues on the Manitoba Northern Flood Agreement and on the automation of the Canada Lands Information System, a database of survey and administrative information.

Contracts for approximately \$250 000 were used for boundary surveys bearing on the settlement of a claim with the Fort Chipewyan, Alberta Cree Band. Preparatory work is now under way on surveys of several large native land-claim settlements in Saskatchewan, Manitoba, Ontario, the Yukon and the Northwest Territories.

Last year Legal Surveys completed an intensive study and rationalization of anticipated resource use. This resulted in a decision to approach Treasury Board for additional resources to meet the anticipated workload.

International Boundary Commission (Canadian Section)

The International Boundary Commission is a bilateral treaty organization that maintains and regulates the land and water boundary between Canada and the United States.

The commission undertook field maintenance for 112 km along the Quebec-Maine and the British Columbia-Montana portions of the international boundary.

The location of the boundary at North Portal, Saskatchewan was confirmed in connection with a court case involving drug-smuggling charges.

Cartographic Information and Distribution Centre

The centre makes available, on a cost-recovery basis, data compiled by other divisions of the sector. Topographical and geographical maps, aeronautical charts and air information publications are reproduced by multicolour offset printing. These materials are sold either by authorized dealers in Canada, the United States, and 12 other countries, or by mail order from the Canada Map Office. Custom-made reproductions of aerial photographs and satellite images are sold to the public through the National Air Photo Library.

In 1987-88, the centre printed 2400 map titles, distributed 2 600 000 maps, reproduced 240 000 aerial photographs and, in cooperation with DND's Directorate of Cartography, developed the first Canadian videodisk of topographic maps.

The centre was reorganized into six divisions and an administrative support section. New responsibilities were added in digital cartographic outputs and provision of common services for the sector. Laser plotting equipment for producing graphics from digital cartographic data was procured. The system will be operational in the new year.

A regional agreement was signed with the Central Survey and Mapping Agency on behalf of Saskatchewan for the distribution of federal maps and charts in that province. Saskatchewan joins British Columbia, Alberta, Manitoba and the Maritimes in taking advantage of this type of sales agreement.

ENERGY PROGRAM

The Energy Program has four sectors.

- Energy Policy
- Energy Programs
- Energy Commodities
- Canada Oil and Gas Lands Administration

The Energy Program establishes and maintains policies and initiatives for the supply, efficient use and conservation of energy resources. The program promotes the orderly development of secure sources of energy, and facilitates access to optimal technical capability for energy supply, use, R&D and processing.

ENERGY POLICY SECTOR

The Energy Policy Sector is a source of information and advice on federal energy policies, strategies and activities, with due regard to their economic, social, regional and environmental effects and to Canada's international energy relations.

The sector is comprised of four branches.

- Energy Strategy
- Financial and Market Analysis
- International Energy Relations
- Energy Policy Coordination

Energy Strategy Branch

This branch coordinates analysis of policy objectives and instruments. It studies and develops new energy policy recommendations on federal-provincial relations; northern and aboriginal issues; supply, demand, and prices; trade; and the government's Canadianization goals.

During the year, the branch produced several significant policy documents. In June, two discussion papers on energy security were released: 'Energy Security in Canada,' developed in the branch, examined the nature of the energy security problem and analyzed national options in the event of oil supply disruptions; and 'The Sarnia-Montreal Pipeline: An Evaluation of Prospects,' prepared by the Energy Commodities Sector's Oil Branch. Both papers evolved from the Energy Ministers' Conference in January 1987, where ministers, noting persistently low oil prices, discussed the security implications of increased dependence on oil imports.

The branch coordinated departmental support for *Energy Options: A Canadian Dialogue*. 'Energy in Canada - A Background Paper', released in December, was prepared for discussion at the closing conference of Energy Options. It concludes that an effective energy policy should help to make markets work by giving the various energy commodities an opportunity to compete on an equal footing.

Following the October announcement of the Canada-U.S. Free Trade Agreement, the branch carried out a detailed analysis of the agreement's energy-related elements. In February, a document entitled 'The Canada-U.S. Free Trade Agreement and Energy: An Assessment' was released. It concluded that the short- and long-term effects of free trade in the energy economy will be positive and will mainly affect uranium, electricity, petrochemicals and oil products.

In February, the Minister tabled in Parliament 'Oil Scarcity & Security,' the government's response to the eighth report of the House of Commons Standing Committee on Energy, Mines and Resources. The response, prepared in the Energy Strategy Group, endorsed the committee's observation that Canada's needs are best served by an energy policy that avoids the extremes of laissez-faire and extensive



Graphics and Audiovisual Services Division equipment

government intervention. It supported a number of the committee's recommendations, such as sensible energy use, diversity of energy supply and a fair and efficient fiscal system.

Throughout the year, the branch advised the government on privatization, Canadianization and acquisitions. It counselled Petro-Canada on its operations and corporate plan, and advised Investment Canada on the energy policy implications of several proposed acquisitions of oil and gas companies.

The branch also worked with other federal departments and territorial governments in the negotiation of native land claims and the development of oil-and-gas policy in the North.

Finally, branch personnel assisted in preliminary negotiations towards an offshore accord with the Province of British Columbia.

Financial and Market Analysis Branch

To plan, develop and maintain an effective energy taxation and incentive system, the branch:

- forecasts industrial and governmental energy revenues;
- evaluates federal and provincial royalty, taxation and incentive systems;
- encourages new petroleum projects;
- develops policy recommendations on supply-demand and price issues; and
- analyzes the impact of energy policies on the economy.

During the year, the branch continued to play a key role in federal negotiations with provincial governments and private sponsors for the development of major oil projects.

Negotiations proceeded on the Hibernia oil field development project, the Lloydminster heavy oil upgrader and the OSLO (Other Six Leases Operation) oil sands project. Branch officials assisted in the formulation of federal policy on megaprojects.

In consultation with the Department of Finance, the branch worked on the energy-related elements of the

federal government's tax reform proposals, released in June and modified in December.

The branch completed a well received study entitled 'The World Oil Market and Views on World Oil Prices'. The study aimed to forecast trends in international oil prices by considering, in the light of recent experience, oil supply-demand balances under various pricing scenarios, and emergent pressures on main producers.

Another major paper, 'Frontier Economic and Fiscal Realities - A Federal Perspective' provided a federal view of the economic and policy issues surrounding frontier megaproject development.

The branch continued to monitor the economic effects of changes in energy prices, taxes and investments, and, where negative effects were found, developed policies to counteract them.

International Energy Relations Branch

The branch advises on the management of Canada's energy relations with other nations and international organizations; and addresses international energy issues, policies and developments of interest to Canada.

During 1987-88, the International Energy Relations Branch helped organize more than 20 foreign trips and incoming visits, facilitating bilateral and multilateral energy dialogue.

Foreign officials visited Canada from such countries as Brazil, Cameroon, Czechoslovakia, Hungary, Japan, Jordan, Morocco, the Netherlands, New Zealand, Romania, Thailand, the United States, Venezuela and Yugoslavia. In February, Nigeria's Rilwanu Lukman, Chairman of the Organization of Petroleum Exporting Countries, met with senior government officials during his Canadian tour.

In May, the Minister chaired a meeting of the governing board of the International Energy Agency (IEA) in Paris. Energy ministers from 21 IEA countries examined energy policy in the light of lower world oil prices and their potential medium- and long-term effects on energy security and world markets.

In late summer, at the Quebec Summit of Francophone Nations, the Minister of Energy, Mines and Resources and the Quebec Minister of External Relations announced a Canadian contribution of \$1 million towards cooperative energy programs between summit participants. These funds will promote energy conservation, energy planning and the energy applications of remote sensing.

In January, the Minister announced that EMR would contribute \$1 million to the committee responsible for organizing the 14th Congress of the World Energy Conference (WEC '89), to be held in Montreal in September 1989. The International Energy Relations Branch will serve as the liaison between congress organizers and ministers and departmental representatives.

Energy Policy Coordination Branch

The branch plans and implements energy programs and services in support of the Minister's parliamentary functions; and develops and carries out program planning, evaluation and information functions directed towards Canada's energy policy objectives.

During the year, the branch produced a series of twelve publications called *Federal Energy Programs*, listing all federally funded energy activities by province and territory.

As part of a general analysis of the Canada-U.S. Free Trade Agreement, the branch produced a summary of energy-related testimony given before the House of Commons Standing Committee on Foreign Affairs. Reports were also written in connection with the Senate Foreign Affairs Committee's study of the agreement's chapter on energy.

ENERGY PROGRAMS SECTOR

The Energy Programs Sector promotes responsive supply and responsible use of Canada's energy resources, in accordance with the government's broader social, economic and environmental objectives.

Petroleum Ownership and Control Incentives

The orderly phase-out of the Petroleum Incentives Program and the Canadian Ownership and Control Determination Program continued through advice and guidance in policy and audit activities.

The Canadian Exploration and Development Incentives Program (CEDIP), was established as a temporary relief measure for the oil and gas industry to help overcome the impact of the 1986 world oil price decline, and to provide a comparable regime to that in the mining industry. CEDIP will terminate on December 31, 1989.

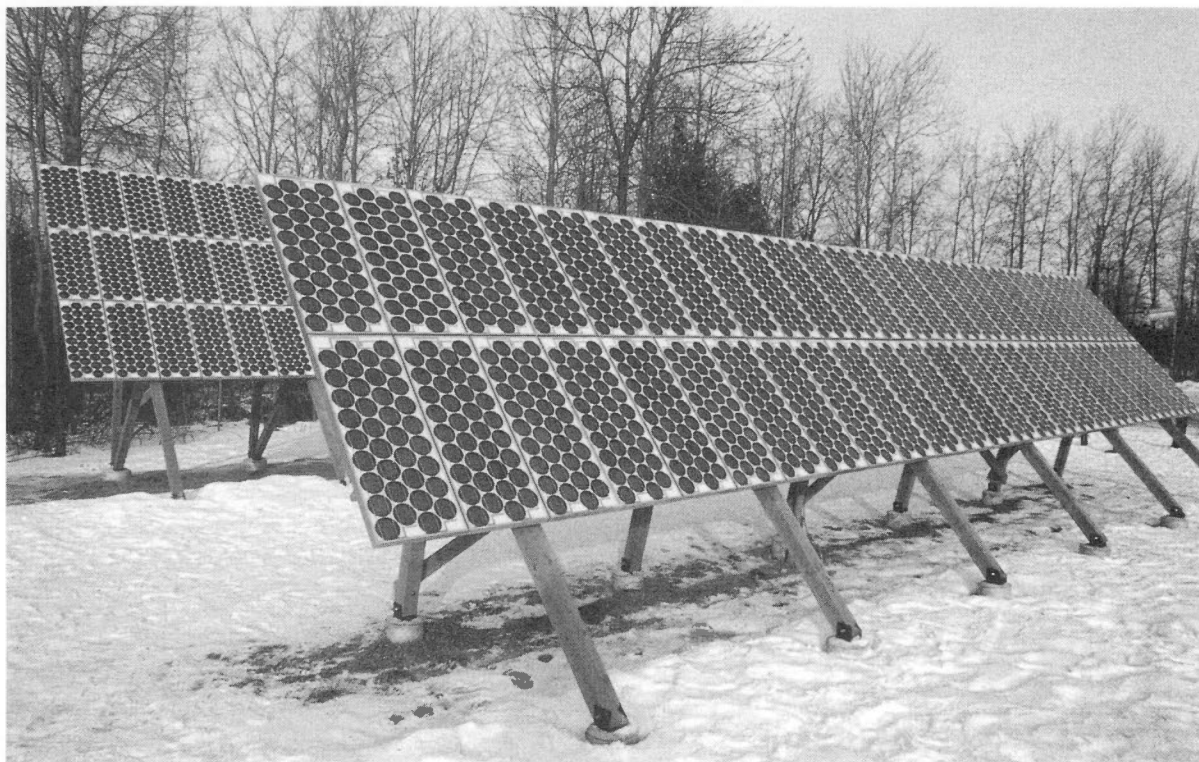
New Initiatives

During 1987-88, the sector assisted industry in dealing with the inherent risk and uncertainty in the resource supply and use equation. Two new programs were proposed: the Canadian Exploration Incentives Program (CEIP) is designed to help junior mining and oil and gas exploration companies to raise new equity in the marketplace by using flow-through shares; the Energy Efficiency and Diversity Initiative (EED) is designed to support the development, testing and application of innovative technologies for energy use and conservation by disseminating knowledge and information about these technologies and about the benefits of a more efficient and diverse energy economy.

Renewable Energy Branch

The branch frames and carries out the department's research, development and demonstration (RD&D) programs. Last year it contributed to the technical advancement of many diverse renewable energy technologies that now account for seven per cent of Canada's primary energy supply. In 1987-88, various R&D projects received international recognition, and various strategic demonstration and information transfer projects -- all of them unique in Canada -- were successfully carried out.

Photovoltaic system



Remote Community Demonstration Program (RCDP)

To illustrate how energy efficient technologies can benefit Canada's remote regions, the program carried out practical demonstration projects and information transfer activities.

The program administered 25 demonstration projects, nine of them new and 16 ongoing.

- Canada's first wind farm was opened in Cambridge Bay, NWT.
- A 5MW wood-fired power plant was approved for Roddickton, Newfoundland.
- The first multiple-unit residential R-2000 senior citizens' complex was built in Whitehorse, Yukon.
- A 150 kW mini-hydro private utility began operating in Mary's Harbour, Newfoundland, successfully breaking down barriers to private power development in the province.
- Several energy efficient houses were under construction.

The program's information and training packages covered topics such as interfacing small power systems with existing electrical grids, waste heat recovery, wood heating, energy efficient house construction and community energy planning. Also, to bring together concerned representatives from the private and public sectors, the program continued its regional seminars and workshops.

Bioenergy R&D Program

More than 120 ongoing projects, contracted out to universities, industry and research institutions, resulted in a program expenditure of \$5.8 million. Several projects, such as conversions of biomass pyrolysis oil to gasoline, vegetable and tall oil to diesel fuel, used tires to refinery feedstock and carbon black and wood to ethanol and other coproducts, realized significant technical achievements that dramatically reduced the time required for commercialization.

Other projects included a field evaluation of a continuous on-line moisture sensor for waste-wood-fueled boilers, and a non-consolidating feeder for handling biomass materials.

The ENERDEMO Program

Progress continued on 64 ENERDEMO-sponsored projects during the year, with \$2 089 521 contributed to public groups and corporations in nine provinces and one territory. The ENERDEMO program was winding down. On March 31 the federal-provincial agreements for joint funding of projects lapsed, allowing a one-year extension for completion of previously approved projects.

Bioenergy Demonstration (BIODEM)

As part of the ENERDEMO program, BIODEM's projects demonstrate the conversion of biomass to energy. During the year 22 new projects were initiated with private sector funding in excess of \$25 million and EMR contributions totalling \$3.8 million.

Major BIODEM projects demonstrated more efficient waste combustion, and improved environmental performance for wood-fired plants and energy from waste plants.

The Alternate Energy Development Program

Part of an Economic and Regional Development Agreement with Prince Edward Island, this program administered 24 projects to which EMR contributed \$2.5 million. Approval of a 13.7 Mw district heating system was a significant step.

The Solar Energy Development Program

The program continued to support RD&D projects concerned with alternative energy sources like active and passive solar, photovoltaics, wind, mini-hydro and geothermal. The program distributed \$8.5 million among 165 R&D projects. Advanced technology was applied to high-performance windows, gallium arsenide photovoltaic crystal fabrication, lightweight solar collectors and high-capacity commercial wind turbines.

During the year, several joint projects with utilities and private concerns demonstrated that connecting mini-hydro, wind and photovoltaic energy systems directly into electrical grids was viable. Demonstrations also promoted new applications of photovoltaic power, documenting its benefits as a reliable and environmentally acceptable source of energy for remote sites across Canada. Significant activities, with respect to ground-source heat pumps, included information transfer and the development of standards.

In 1987-88 the Solar Demonstration Program ended. Over its five-year life, it financially assisted 11 500 domestic solar hot water systems and 240 commercial and industrial solar installations across Canada.

Operations

The role of the Programs Offices is to be a catalyst for regional activity. The offices are the major delivery agent for EMR programs (such as the low-cost/no-cost activities which are part of EED). The offices also undertake other program (CEIP) and the Energy Supply Allocation Board Contingency Plan); represent the department in the negotiation and implementation of federal-provincial/territorial agreements that deal with energy efficiency and diversity; and monitor and gather information on the impact of EMR's initiatives and provincial energy trends.

Energy Conservation Branch

The Residential Energy Management Division

The Residential Energy Management Division encourages Canadians to improve the energy efficiency of their homes through a program of consumer information and industry development.

Last year, a study commissioned to measure the effectiveness of this program revealed that, of Canadian households implementing energy conservation projects since 1984, 402 494 would not have done so without the EMR information program. The program therefore accounts for annual energy savings equivalent to \$1 million worth of oil. The study reported that "program costs were insignificant compared to energy savings."

In an effort to build on this success, the division is maintaining its existing information programs while venturing into the field of instructional video where it has already participated in three productions. In its first effort, the division worked with manufacturers of conservation products to sponsor a series of how-to videos called 'Renovation Zone.' The videos have been made available at public libraries, and through an arrangement with a commercial distributor. They will soon be for sale in building supply outlets and bookstores.

The most recent video, called 'Listen to Your House,' was developed in response to a demand from contractors. The video demonstrates the importance

of considering the house as a system of related components when undertaking renovations.

Instructional video promises to be an important new tool in the field of consumer information and should prove particularly useful in presenting the how-to and why-to of home energy improvements to Canadians.

To hit the market hard with the idea of R-2000 homes, the program presented the R-2000 Parade of Homes. To attract the interest of a wide range of home buyers, showcase homes featured a variety of designs, layouts and prices and were shown in seven different provinces across the country.

The Canadian Home Builders' Association (CHBA) has participated in the R-2000 Home Program since it began in 1980. EMR continues to work closely with the CHBA, and plans to transfer complete program responsibility to the association by March 1989.

'The House as a System' is a concept central to a series of training courses developed by the division's Technology and Industry Group in cooperation with the energy conservation retrofit industry. Many businesses are preparing to take advantage of these training programs entitled Air Leakage Control, Insulation, Windows and Doors, Exterior Insulation Systems, and Whole House Retrofit and Energy Efficient Heating System Service and Replacement.

The courses have been conveyed to current industry practitioners through funding training agencies. New entrants into the field are being accommodated through vocational and trades-training institutes.

Recognizing that delivery is as important as content, the group has made every effort to structure these courses according to the varied needs of an adult population. Hands-on instruction makes the courses attractive to those who learn faster by practice than through lectures, and quality assurance is maintained through the use of performance checklists and other competency verification techniques.

Business and Government Energy Management Division

Industry Energy Research and Development Program (IERD)

To encourage the development of products and processes to increase the efficiency of industrial energy use, IERD normally contributes up to half the eligible costs of a project. This means that

government is initiating an R&D effort that may double the value of an industrial applicant's contribution. During the year, IERD gave \$6 million to 30 active projects.

The Canadian Industry Program for Energy Conservation (CIPEC)

Industry-organized and government-assisted, this program has a core network of 14 voluntary energy management task forces charged with promoting industrial energy efficiency. In 1987-88 industry reported a 2.7 per cent improvement in energy efficiency over the previous year, representing the energy equivalent of 67 million barrels of oil.

The Accelerated Capital Cost Allowance - Class 34 Program

This program permits a three-year write-off on eligible assets that either save energy or use a renewable source of energy. Since it began in 1976, about \$220 million in eligible investments have been made, resulting in annual energy savings equivalent to 1 100 000 cubic metres of oil.

The February federal budget proposed legislation restricting the use of Class 34 to corporations that own the eligible assets and employ them in the course of business.

FedSave Energy Management Program

Federal energy consumption has declined by 29 per cent over the past 10 years, representing a 1987-88 cost avoidance of \$250 million, and accumulated savings of some \$1.1 billion since 1975.

FedSave's major initiatives include upgrading facilities to make buildings more energy efficient, off-oil investments which have displaced more than 160 000 cubic metres of oil in federal operations, building surveys to identify conservation opportunities and information dissemination and training programs.

Task Forces

During the year, the six commercial-institutional-agricultural task forces held 14 awareness sessions with each of their sectors, provided display units for nine conferences, presented 21 seminars and workshops, published eight energy management manuals, printed five newsletters, made several successful energy management awards and produced eight video-taped presentations.

ENERGY COMMODITIES SECTOR

Petroleum Resources Branch

The branch monitors and advises on exploration and development in the Canadian petroleum industry and, through selected upstream indicators, also advises on activity in the U.S. and other countries.

In collaboration with other federal agencies, the branch does technical and economic studies on discovered and undiscovered petroleum resources, including cost estimates for new supplies from discoveries of conventional oils and natural gas, enhanced oil recovery, heavy oils and oil sands.

During the year, the branch reported on upstream activities and heavy oil, and issued pertinent nonfinancial statistics on land holdings, reserves and production. A study of the economics of conventional light and medium oils in western Canada was published as part of a Geological Survey of Canada report.

To increase recovery from heavy oil deposits, the branch, acting through the Canada-Saskatchewan Heavy Oil and Fossil Fuel Agreements, advised on industry pilot projects and research. One project proposes to examine the use of horizontal wells from

primary and tertiary heavy oil production. The project has received extended funding under the agreements which end in 1988.

Oil and Emergency Planning Branch

The Energy Emergency Planning Group was incorporated into the Oil Branch, forming the Oil and Emergency Planning Branch. The branch collects and analyzes data on domestic and international crude oil and petroleum product prices, supply and disposition. It monitors and reports on specific market conditions, and gives technical and policy advice on refining and upgrading petrochemicals and natural gas liquids.

The branch also helps prepare and develop contingency plans for the National Emergency Agency for Energy (NEAE). In close consultation with Emergency Preparedness Canada, the Energy Supplies Allocation Board (ESAB), the provinces and industry, contingency plans were formulated for establishing and operating the natural gas and electric power components of the NEAE. The branch coordinated delegating to the National Energy Board (NEB) the Minister's responsibilities regarding planning for Public Welfare Emergencies pursuant to the Emergencies Act (1988) and the



*Esso's Cold Lake
oilfield*

Emergency Preparedness Act (1988). A departmentally developed oil database system was accepted by NATO for use during international supply crises and exercises.

The Oil Pricing and Market Analysis Division monitors Canadian crude oil and petroleum product prices in relation to domestic and international market trends. Regularly collected data from the petroleum industry form the basis of comprehensive monthly pricing reports as well as assessments of Canadian oil market developments and industry profitability.

International oil market developments, including OPEC activities and numerous reports from market analysts and the international oil industry, were monitored by the International Oil Supply Division. These reports assessed the short- and medium-term course of world oil supply, demand and crude oil prices. The division represented Canada on the International Energy Agency's Standing Group on the Oil Market.

As part of its role in monitoring and analyzing developments in the Canadian oil market, the Domestic Supply Division published a report evaluating prospects for the Sarnia-Montreal pipeline. This review resulted from federal and provincial concerns about the effect that reduced domestic crude oil flows to eastern Canada might have on Canada's crude oil pipeline system. The division is also studying the future use of this and other Canadian oil pipelines.

The Downstream Petroleum Technology Division monitored developments in the petroleum refining, petrochemical, petroleum upgrading, natural gas liquids and oil pipeline sectors. The division continued to calculate the effect on refineries of improved environmental controls and changes in crude oil supply and product demand.

Energy Supplies Allocation Board

During 1987-88, the Energy Supplies Allocation Board (ESAB), with staff from the Energy Emergency Planning Group (EEPG), contributed significantly to the activities of the International Energy Agency (IEA) and NATO.

Senior EEPG staff helped prepare the IEA's manual on Coordinated Emergency Response Measures and participated in the first CERM test coordinated by the agency. Staff also assisted in preparing the IEA's Allocation Systems Test No. 6 (AST-6), scheduled to take place late in 1988.

EEPG staff began preparing for the annual NATO Wartime Oil Organization Training. During the actual training, scheduled to take place in Iceland, Canada will be represented by the ESAB chairman and EEPG staff.

The board initiated a study to determine the costs and benefits of establishing emergency petroleum stocks in Canada to assist its mandatory allocation program.

It completed work on a Memorandum of Understanding (MOU) for cooperative actions between federal, provincial and territorial agencies during an oil emergency.

Other major ESAB activities included drafting amendments to the *Energy Supplies Emergency Act* in collaboration with EMR Legal Services, carrying on further work on the Motor Gasoline and Diesel Fuel Rationing Program, and maintaining the emergency organization.

Natural Gas Branch

To provide policy advice and information on the natural gas industry in Canada, the branch monitors all legislative and regulatory initiatives in the provinces or in foreign natural gas markets that can affect Canadian sales and prices. It prepares reports to ensure that special interest groups and the general public are informed of developments in domestic and export natural gas markets.

The branch ensures compliance with the principles of the Agreement on Natural Gas Markets and Prices by overseeing a committee of officials representing signatory governments. The committee monitors the deregulation of the natural gas industry.

The second report of a series on developments in Canadian natural gas prices, 'The Natural Gas Price Monitoring Report' was released in March. It gave information on domestic-export price behaviour during the first full year of natural gas price deregulation.

The Quebec Natural Gas Laterals Program, officially over in December, 1986, continues to bear operation and maintenance costs until March 1991.

Uranium and Nuclear Energy Branch

The branch provides policy advice and information on the uranium and nuclear industries and on radioactive waste management and radiation issues.

The branch plays a lead policy role in the uranium industry through the Uranium Exports Review Panel, which reviews contracts for consistency with Canadian uranium export policy. It also coordinates the Uranium Resource Appraisal Group (URAG), which assesses and publishes a biennial report on Canadian uranium supply capability.

During the year, the branch advised on the implementation of Canada's new policy, announced in December, on non-resident ownership in the uranium mining sector. The branch also assisted in completing the agreement to merge and then privatize Eldorado Nuclear Limited and Saskatchewan Mining Development Corporation.

On the nuclear industry front, the branch assisted in the selection of Canadian input to the Nuclear Energy Agency (NEA) of the Organization for Economic Co-operation and Development's (OECD) questionnaire on electricity and the nuclear fuel cycle; and participated in the negotiation of the Canada-Hungary Nuclear Cooperation Agreement. It helped market CANDU, MAPLE research and SLOWPOKE nuclear reactors to industry; coordinated the federal government's approach to the Point Lepreau 2 CANDU project in New Brunswick; and developed a discussion paper on AECL and the future of the nuclear industry in Canada.

Branch officials serve as expert representatives on several international committees, including the NEA Steering Committee, the Fuel Cycle Committee that oversees the NEA's economic and technical studies and the NEA Uranium Group that, with the International Atomic Energy Agency (IAEA), produced the authoritative assessment of world uranium supply.

Activities in radioactive waste management included referral of the high-level waste disposal concept for environmental assessment and review, response to *The Eleventh Hour*, the Standing Committee on Environment and Forestry's report on high-level radioactive waste in Canada, and continued guidance to AECL's Office of Low-Level Radioactive Waste Management in Port Hope.

The branch responded to the Siting Process Task Force Report on low-level radioactive waste disposal *Opting for Co-operation*, and collaborated with Ontario on uranium mine tailings and with British Columbia on the issue of incidental wastes.

Transportation Energy Branch

The branch administers programs and policies to encourage adoption and development of cost-effective transportation energy technologies and alternative fuels.

Under Project MILE (Methanol In Large Engines), the two methanol-powered bus fleets inaugurated in 1986-87 in Winnipeg and Medicine Hat continued to furnish information on fuel consumption, emissions, operability and operating costs. In September, Williams Moving and Storage Company began running two methanol-fueled, long-haul trucks from Vancouver to Calgary, and the City of Vancouver began operating a city garbage truck on methanol.

Field trials of the FORD Flexifuel vehicles continued to be impressive. Cold-start improvements, as well as fuel economy, performance and emissions measurements, all confirmed the vehicle's ability to operate on gasoline, methanol, ethanol or any mixture of the three without driver adjustments.

Through cooperative projects with the Canadian Gas Association (CGA), the Propane Gas Association and the Canadian General Standards Board, the branch continued to support national standardization of alternative fuels. It also participated in three IEA agreements concerning combustion technology, alcohols as motor fuels and hydrogen.

The industry-government CGA R&D program awarded research contracts to projects on safety, combustion, gaseous fuel injection, tank recertification, stress corrosion and cracking and refueling compressors. One prominent success was the development of a safer refueling probe.

Work continued on the interaction between future diesel fuel composition, engine emissions and environmental concerns. The branch has joined forces with the Petroleum Association for the Conservation of the Environment to support a program at the Ontario Research Foundation to study the impact of various fuels on engine operation and emissions.

Through contributions to national associations, the branch continued to advocate the use of propane and natural gas in the transportation sector. Promotional activities were conducted through joint agreements between industry and government.

Since the Natural Gas Vehicles Program began, 15 212 grants of \$500 each have been awarded for converting vehicles to natural gas. This program has been extended to March 1989 in British Columbia and to March 1991 for the rest of the country. Under the extension, natural gas distribution utilities are responsible for the program in their respective territories.

As of March 1988, 125 applications were approved under the Natural Gas Fueling Station Contribution Program, which was also extended to March 1989.

The Protrucker Program, an information transfer program to encourage energy efficiency in the trucking industry, continued in Manitoba and was launched in Newfoundland, Quebec and the Maritimes. Over the year, 4000 truckers attended Protrucker technical seminars on fuel economy.

The branch is also involved in a program to demonstrate a 40 kW phosphoric acid fuel cell. The fuel cell, powered by natural gas, provides heat and electricity to a municipal swimming pool complex. Results to date are encouraging.

Work proceeded on developing an advanced lithium aluminum - iron sulphide battery suitable for transportation. And, polymer membrane separators have been developed for electrolytic cells to produce hydrogen from water. The separators may more efficiently convert electrical energy, through electrolysis, into chemical energy stored in hydrogen. The branch initiated a project to develop polymer membranes for fuel cells. Since a fuel cell and an electrolytic cell are essentially the same but run in opposite directions, this project will build on expertise developed for the electrolytic cell membranes.

With provincial governments, the Regional Transportation Energy Program conducted surveys on energy management for municipalities in Quebec, Newfoundland, P.E.I. and Nova Scotia. Working with the Federation of Canadian Municipalities, a request for a proposal was drafted for producing an energy management guide for municipalities.

The Driver Outreach Program offered seminars on fuel-efficient driving in several provinces, a Car Economy Challenge, and various other projects related to vehicle maintenance and fuel economy for Canadian drivers.

Electrical Energy Branch

The branch provides advice to and information on the electrical energy industry by developing, negotiating and managing agreements with electrical utilities, provinces and the national industry association.

During the year, the branch's greatest challenge was to develop a new policy on electricity exports and international power lines regulation. The Minister asked the National Energy Board to conduct a public inquiry, which resulted in a report setting out a broad range of policy options. Following extensive consultations with provincial government officials, the branch developed a specific policy proposal to streamline the regulation of electricity exports.

The branch initiated studies on electricity policy development and supply-demand for major countries. It also undertook an analysis of federal and provincial environmental assessment review processes as they relate to electrical energy projects.

Other work involved monitoring U.S. opposition to Canadian power exports, preparing a paper on Canada-U.S. electricity trade in 1986, and studying both Ontario Hydro's supply-demand planning strategy and the calculation of downstream power benefits under the Columbia River Treaty.

Through its annual publication *Electric Power in Canada* the branch provides information on industry activities and future plans. The branch also publishes *Canada-U.S. Electricity Trade*, *Electricity Rates in Canada* and Canadian and regional main electric transmission maps.

CANADA OIL AND GAS LANDS ADMINISTRATION (COGLA)

COGLA regulates the exploration, development and production of oil and gas on frontier lands not yet under joint-management accord legislation. It regulates worker safety and ensures effective resource conservation, environment protection and full and fair Canadian access to the benefits arising from hydrocarbon exploration and development. COGLA reports to the Minister of Energy, Mines and Resources for areas south of 60°, including Hudson Bay, and to the Minister of Indian Affairs and Northern Development for areas north of 60°.

Frontier lands regulated by COGLA include the Yukon Territory, the Northwest Territories, Hudson Bay and most of the country's offshore areas. The Canada-Newfoundland Offshore Petroleum Board regulates the Newfoundland and Labrador offshore area. The Nova Scotia offshore area is administered by the Canada-Nova Scotia Offshore Oil and Gas Board, under the chairmanship of COGLA's Administrator.

In 1987 a new rights-management regime came into effect with enactment of the Canadian Petroleum Resources Act. This legislation provides for three new licences: exploration, significant discovery and production; and modifies the structure of the Environmental Studies Research Funds.

In April the governments of Canada and Newfoundland and Labrador simultaneously proclaimed the *Canada-Newfoundland Atlantic Accord Implementation Acts*. The 1985 Atlantic Accord ensures joint federal-provincial management and revenue sharing of petroleum resources off the coasts of Newfoundland and Labrador.

In May the Nova Scotia Legislature passed the *Canada - Nova Scotia Offshore Petroleum Resources Accord Implementation Act*. It was tabled in parliament in June and is awaiting Royal Assent.

In June the governments of Canada and British Columbia released their joint response to 'The West Coast Offshore Environmental Assessment Panel Report' and announced that oil and gas exploration could resume off the British Columbia coast under certain conditions. An Environmental Coordinating Committee was established to formalize federal-provincial follow-up to the government response. Negotiations began between Canada and British Columbia on a Pacific Accord that would

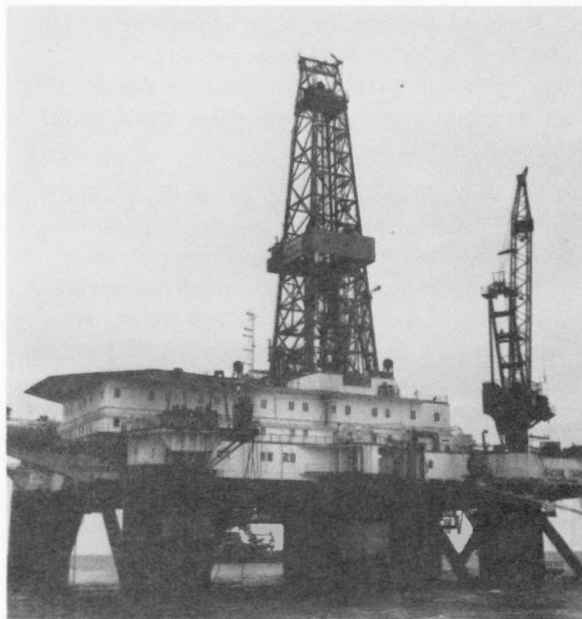
establish new joint management arrangements for the offshore.

In 1987, 10 exploratory and four delineation wells were drilled on the frontier lands, 42 fewer than in 1986. The Laird F-25A gas discovery, the year's only significant find, occurred on the mainland of the southern Northwest Territories. Three delineation wells tested successfully, confirming that oil and gas reserves exist in significant discoveries.

In the North, the Beaufort Sea continued to be the most important area for exploration and development. Gulf Canada Resources Ltd. drilled two delineation wells, F-24 and 2F-24, on the 1984 Amauligak oil and gas discovery. Esso Resources Canada Ltd. drilled two exploratory wells, Kaubvik I-43 and Angasak L-03. Both proved dry and were abandoned.

In the Fort Good Hope area, exploration rights were issued in November under the *Canada Oil and Gas Act*, since repealed and replaced by the *Canada Petroleum Resources Act*. Chevron Canada and the community entered into a joint venture allowing local participation in the exploration program.

In the High Arctic, Panarctic expanded its storage facilities and shipped two tanker loads of oil from its Bent Horn field. Some of this oil was sold to northern markets. At Norman Wells, in the Mackenzie valley, Esso continued its infill drilling program by drilling 33 additional wells.



Bow Drill 3 operating on the Grand Banks

Off Newfoundland, Petro-Canada began a delineation drilling program to confirm that additional oil reserves exist in the Terra Nova structure. Terra Nova H-99, the structure's fifth delineation well, flowed oil and confirmed the existence of a good-quality production reservoir. When its delineation program is complete, Petro-Canada plans to file a development plan application, based on a floating production platform system, with the Canada-Newfoundland Offshore Petroleum Board.

Off Nova Scotia, Petro-Canada and Nova Scotia Resources (Venture) Ltd. delineated the Panuke discovery with the Panuke F-99 well, which produced 3700 m³ of oil in six days of testing. Production from this well led to the first shipment of oil from the eastern offshore.

In 1987 COGLA collaborated with Labour Canada to develop the Canada Oil and Gas Occupational Safety and Health Regulations, promulgated under Part IV of the Canada Labour Code. Under a Memorandum of Understanding with Labour Canada, COGLA applies Part IV of the code to personnel employed in exploration, production, processing, conservation or transportation of oil and gas on frontier lands. The new health regulations set out specific minimum standards for the work site regarding lighting, noise levels, material handling equipment, sanitation and drinking water quality.

In light of the Hickman Royal Commission on the Ocean Ranger's recommendations, COGLA and other federal departments began a review of the *Oil and Gas Production and Conservation Act*. Proposed amendments to the act will be discussed with the Accord provinces, the offshore boards and industry.

COGLA administered several major projects under EMR's Program for Energy Research and Development (PERD). It initiated research studies and projects on rig evacuation, improved emergency equipment and sea rescue techniques, standards for the design, construction and installation of offshore structures, pipeline protection, ice structure interaction and biological testing of drilling fluids.

The Environmental Studies Management Board was established to recommend study programs to be funded under the Environmental Studies Research Funds.

ADMINISTRATION PROGRAM

The Administration Program ensures the effective management of departmental programs and central support services.

It has three sectors.

- Corporate Policy and Communications
- Finance and Administration
- Human Resources

CORPORATE POLICY AND COMMUNICATIONS SECTOR

Corporate Policy and Communications, a new sector organized as a corporate unit, assists the Minister, Deputy Minister and the department's Executive in directing and coordinating EMR policies and operations and in complying with the department's environmental responsibilities.

The sector provides corporate policy, planning and operations analysis, advice and support, and administers EMR's responsibility for environmental assessment. It assists the department in developing cohesive responses to government priorities.

The sector consists of five branches: Strategic Policy and Plans, Cabinet Affairs, Corporate Affairs, the Office of Environmental Affairs, and Communications.

Strategic Policy and Plans Branch

This branch, which began operations on February 1, 1988, provides analyses and intelligence to assist the Minister and senior managers to articulate a corporate policy agenda compatible with government priorities.

It advises and helps develop strategy for integrating policy priorities into a coherent agenda for change and for directing the resolution of issues that cross departmental sector boundaries.

Cabinet Affairs Branch

This branch helps the Minister and senior management secure Cabinet approval or confirmation for EMR initiatives and evaluates other departments' initiatives with respect to their potential impact on EMR's ministerial and departmental interests and activities.

The branch provides the Minister and senior management with intelligence and analytic and advisory services in the form of briefings on Cabinet matters and other issues.

It coordinates and maintains effective liaison with departments and central agencies and helps EMR meet its corporate needs. It advises the Deputy Minister and the Associate Deputy Minister on EMR's compliance with and implementation of Cabinet decisions.

Corporate Affairs Branch

Corporate Affairs Branch is concerned with managing the department. It gives information, analysis and advice on operations and management issues. It is the corporate focal point for parliamentary affairs, and is a liaison with central agencies. It also evaluates programs, conducts an internal audit and offers management consulting services.

The branch coordinated a management review to assess and identify courses of action. This led to a consensus among EMR management on the department's priority operational issues, on means to make management information and practices simple and relevant to managers, and on which administrative services to curtail, modify and improve.

The branch coordinated preparation of ministerial and executive correspondence and provided an executive document control service to senior management and a liaison service with Parliament.

Corporate Affairs Branch made independent and objective evaluations of the Super Energy Efficient Home Program, the Industry Energy Research and Development Program, the Frontier Geoscience Program, the Distribution System Expansion Program, and, under the auspices of federal-provincial management committees, the Alternate Energy Development Program (P.E.I.) and the Canada-Saskatchewan Heavy Oil Agreements (1976-81).

The branch does independent and objective audits of departmental organizations, functions, systems and processes. This year it reported on the Geological Survey of Canada, the Energy Commodities Sector and the Renewable Energy Branch. The branch also assessed the management processes and controls for the functions of records management, fleet management and the procurement of goods and services.

By providing management consulting services to departmental managers, the branch assisted in the developing a consensus on a new departmental publishing policy for Communications Branch and a

comprehensive planning guide for Energy Programs Sector. It also assisted in identifying the operational requirements needed to support the Human Resources Sector, the Canadian Exploration and Development Incentives Program and COGLA's Frontier Lands Registration System.

Office of Environmental Affairs

The Office of Environmental Affairs is the main contact point in the department for cross-sectoral environmental issues. It provides both policy and technical advice on environmental and related socioeconomic matters to senior management, EMR branches, other federal and provincial governments, industry and the public. It has specific responsibility for carrying out the Federal Environmental Assessment Review Process within EMR.

In 1987-88 the office developed an Environmental Strategy and Action Plan to help focus EMR's efforts on addressing key environmental issues. It also created an intradepartmental group on environmental issues to encourage the integration of environmental considerations into energy, mineral and economic decision-making. The office also became an active member of the Secretariat of the National Task Force on Environment and the Economy, whose recommendations were reflected in the Action Plan.

To ensure better representation of the public's concerns in designing federal screening procedures, the office has been revising the Environmental Assessment and Review Process (EARP) and will circulate the results for public review. The office also participated in working groups to develop new procedures for training programs and public involvement manuals and played a key role in developing the National Workshop on EARP. These activities were over and above the regular screening of departmental projects to ensure that their design was sensitive to environmental and related socioeconomic issues.

Because of the public's concern over a planned low-level radioactive waste disposal facility in southern Ontario, the office coordinated the Siting Process Task Force and delivered a report to the Minister of State (Forestry and Mines) in December. Two key reports produced by EMR and Environment Canada on the environmental impacts of energy and mineral development were also coordinated by the office and will help EMR determine its progress on environmental issues. The office has also been supporting the upcoming OECD review of Canada to

further investigate energy-environment linkages in Canada.

Communications Branch

Public Affairs

The Free Trade Agreement signed between Canada and the United States generated intensive communications support activity for the energy and minerals sectors, as did the announcement of the Canadian Exploration Development Incentives Program (CEDIP).

The branch supported the Energy Options Secretariat and helped publicize the Pro-Trucker program launch in Atlantic Canada and the extension of support for the Natural Gas Vehicles program.

It communicated renewable energy and residential energy conservation initiatives and the R-2000 Home Program.

The branch again promoted the Mineral Outlook Conference by preparing speeches and news releases for the Minister of State for Mines. It also communicated GSC activities and promoted the work of CANMET. A series of folders on CCRS technology applications and the RADARSAT program was expanded.

Editorial

In support of ministerial activities, 218 press releases and more than 120 speeches were produced. The division published the EMR scientific quarterly, *GEOS*, the monthly employee newspaper *Entre nous* and departmental annual reports and reviews.

Exhibits, Audiovisual and Advertising

EMR staged more than 160 displays throughout Canada, ranging from large home shows in major metropolitan centres to local fairs, and carried out 66 advertising campaigns on such subjects as oil exploration, the *Canadian Minerals Yearbook*, EMR energy research and technology, the Geological Survey of Canada Forum, transportation fuels, new geochemical maps and energy conservation.

The branch produced 27 audio-visual shows, and launched a successful campaign to market EMR videos to educational institutions and cable distributors across Canada.

The branch developed a corporate advertising campaign, a corporate look for all of EMR's public communications and a slogan: *The energy of our resources - the power of our ideas.*

Monitoring and Evaluation

To provide timely and accurate public environment analyses and strategic advice to management, the branch prepared 162 media analyses and briefing notes, a benchmark study on public awareness of EMR's role as a knowledge broker in energy research and technology development, an evaluation of communications products and regular analyses of public opinion research data.

Public enquiries

The branch responded to 5400 written and verbal enquiries, received nearly 90 000 public requests for publications and mailed more than five million publications to consumers.

Organization

At year end, Communications Branch reorganized to accommodate a downsizing of more than one quarter of its staff during the next two years. Editorial Division was folded into a new Client Services Group. A Strategic Analysis and Ministerial Coordination Division was created to combine public environment analysis and strategic planning in one unit.

FINANCE AND ADMINISTRATION SECTOR

Finance

The department expended \$709 million for the Energy Program, \$344 million for the Minerals and Earth Sciences Program and \$53 million for the Administration Program. Offsetting revenues of \$281 million included levies of \$54 million collected under the *Energy Administration Act*. Total net expenditures were \$825 million, including \$150 million for purchased goods and services.

Information Technology

Department-wide standards were set for microcomputer software. Late in the fiscal year, the branch discussed with Assistant Deputy Ministers a major downsizing of the department's central informatics function in favour of decentralized service.

The Computer Services Centre began its lead role in the government's supercomputing consortium, SUPERNET, which will make a supercomputer available for scientific research.

Administrative Services

Effective April 1, 1988, arrangements were made to assume responsibility from Public Works Canada for 106 000 m² of special-purpose accommodation in the



The Computer Services Centre

National Capital Region (NCR). Telephones in the NCR were reconfigured to the Enhanced Exchange Wide Dial service offered by the Government Telecommunications Agency.

Union-management occupational health and safety committees, established under Part IV of the Canada Labour Code, became fully operational. The branch developed a program to implement the Workplace Hazardous Materials Information System, legislation that is expected to be passed next year.

Information Management

The department's automated Information Management System (IMS) was installed in several branches in the NCR and in the Institute of Sedimentary and Petroleum Geology in Calgary, Alberta. Sectors and branches now have access to the departmental bilingual inventory of information holdings. They are contributing to the corporate data base while using the IMS for their records office operations.

Security

The department's Security Office introduced new procedures to upgrade protection of personal and classified information and valuable assets held in departmental custody. The new process requires all employees to have security levels that correspond to the sensitivity and value of information to which they have access.

HUMAN RESOURCES SECTOR

In 1987-88 the sector developed policies and programs to meet current and future personnel management needs of the department. It provided significant support to management during the realignment of programs and organizational changes made to meet new government initiatives and EMR objectives.

The department's efforts to redeploy employees affected by downsizing and reorganization were remarkably successful. More than 70 per cent have been placed; less than four per cent were laid off.

Giving line managers a role in evaluating positions significantly increased management's involvement in and control over the classification process. The Suggestion and Merit Award programs were successful -- 19 employees received suggestion awards and 46 merit awards -- partly due to heightened interest in the programs generated by the sector.

Efforts to increase the representation of women and francophones in the management category during the fiscal year resulted in significant increases for both groups. Five women were recruited into the management category during the year bringing the total to 16 (8.7 per cent of the category), its highest ever at EMR. During the same period the number of francophones increased to 16.2 per cent, from 18 to 29.

Training session



FINANCIAL SUMMARY

1987-1988

	Operating Expenditures	Capital Expenditures	Grants and Contributions and Transfer Payments	Total
(thousands of dollars)				
Administration Program				
Direction and Coordination	7388	233		7621
Finance and Administration	26 718	1478		28 196
Human Resources Management	4706	98		4804
Communications	12 330	507		12 837
	<u>51 142</u>	<u>2316</u>		<u>53 458</u>
Less: Revenues for Computer Services	<u>7937</u>			<u>7937</u>
TOTAL COSTS OF PROGRAM	<u>43 205</u>	<u>2316</u>		<u>45 521</u>
Energy Program				
Energy Policy	11 078	214	670	11 962
Conservation and Renewable Energy	52 082	1036	29 146	82 264
Energy Commodities	13 002	324	15 737	29 063
Petroleum Ownership, Control & Incentives	9690	139	154 474	164 303
Administration of Frontier Oil & Gas Lands	7487	5	51 298	58 790
Program Management and Support	4607	98	1285	5990
Canadian Exploration & Development Incentive	5087	1386	350 000	356 473
	<u>103 033</u>	<u>3202</u>	<u>602 610</u>	<u>708 845</u>
Less: Receipt of Levies pursuant to Section 65 of the Petroleum Administration Act			<u>53 930</u>	<u>53 930</u>
TOTAL COSTS OF PROGRAM	<u>103 033</u>	<u>3202</u>	<u>548 680</u>	<u>654 915</u>
Minerals and Earth Sciences Program				
Mineral Industry Development	13 403	18	19 524	32 945
Administration of the Canada Explosives Act	1729	71		1800
Mineral and Energy Technology	67 391	6167	1048	74 606
Geological Surveys	98 198	6931		105 129
Polar Continental Shelf	5717	896		6613
Remote Sensing	22 273	14 352	10 088	46 713
Surveying and Mapping	59 946	4503	117	64 566
Program Management and Support	6825	369	4508	11 702
	<u>275 482</u>	<u>33 307</u>	<u>35 285</u>	<u>344 074</u>
TOTAL COSTS OF PROGRAM	<u>275 482</u>	<u>33 307</u>	<u>35 285</u>	<u>344 074</u>
TOTAL EXPENDITURES FOR THE DEPARTMENT	<u>421 720</u>	<u>38 825</u>	<u>583 965</u>	<u>1 044 510</u>

CROWN CORPORATIONS AND AGENCIES

CROWN CORPORATIONS

Atomic Energy of Canada Limited

Petro-Canada

Petro-Canada International Assistance Corporation

AGENCIES

Atomic Energy Control Board

Board of Examiners for Canada Lands Surveys

Canadian Permanent Committee on
Geographical Names

Energy Supplies Allocation Board

National Energy Board

Petroleum Monitoring Agency

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