Office of Energy Research and Development
Business Report 2004

Natural Resources Canada
Ressources naturelles Canada

Canada

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Introduction

The *OERD Business Report 2004* is a good example of how the Government of Canada's science and technology (S&T) is changing. It describes recent federal energy S&T initiatives and is the offspring of the *PERD Business Report 2002*, an overview of technology achievements of the Program of Energy Research and Development (PERD), established by Natural Resources Canada in 1974.

How is federal energy S&T changing? By responding more effectively to Canada's important economic, environmental and social needs. As it has for many years, it provides a knowledge base, national expertise and the facilities to support the development and implementation of energy policy. More recently, its aims are also focused on highlighting new strategies and technology solutions for issues such as climate change. S&T is playing a more crucial role in building Canada's national capacity for innovation, facilitating technology deployment and pre-commercialization, and supporting international trade.

Federal energy S&T is not done in a vacuum. Partnerships are the norm, with industry, the provinces, universities and other research organizations. National and international networks are key for sharing information and expertise, and for ensuring that Canada is a player on the global energy stage.

Measurement of progress and the reporting of results. Accountability. They all add up to getting the best possible return on the Government of Canada's investment in energy S&T.

Federal energy S&T programs are working hard to help Canada address its challenges related to climate change, air quality and energy efficiency. They are providing the foundation for sound policy, standards and regulations. They are supporting the development of technologies that contribute to a strong, innovative economy.

OERD Overview

The Office of Energy Research and Development (OERD) at Natural Resources Canada (NRCan) manages the Government of Canada's non-nuclear energy S&T activities. It supports S&T designed to ensure a sustainable energy future for Canada, in the best interests of both our economy and our environment. This is accomplished through S&T programs, international collaborations and coordination of NRCan's corporate energy S&T responsibilities.

The Government of Canada's energy S&T programs operate horizontally across the federal structure and link with stakeholders and clients. This ensures that its S&T activities use and disseminate knowledge and resources in collaboration with other important areas such as the environment, transportation, health and agriculture. Energy S&T is focused in the following areas: cleaner fossil fuels; cleaner transportation; energy-efficient buildings and communities; energy-efficient industry; and power generation. OERD's annual budget is approximately $85 million.

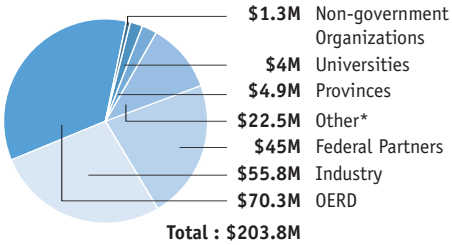
OERD Partnerships

OERD provides funds directly to its partner departments and agencies, thereby ensuring maximum benefits and impacts from the Government of Canada's energy S&T. Many departments and agencies conduct their research in federal laboratories located across Canada. Most work also involves industry and the provinces. OERD's partner departments and agencies are:

- Agriculture and Agri-Food Canada
- Canada Mortgage and Housing Corporation
- Environment Canada
- Fisheries and Oceans Canada
- Health Canada
- Indian and Northern Affairs Canada
- Industry Canada
- National Defence
- National Research Council Canada
- Natural Resources Canada
- Public Works and Government Services Canada
- Transport Canada

Appendix A provides a listing of federal laboratories which undertake projects with OERD funding. They supplement the money they receive from OERD's programs with funding from their own organizations. OERD programs leverage additional funds from industry and industry associations, the provinces, universities, and other funding programs such as the Natural Sciences and Engineering Research Council (NSERC), the Industrial Research Assistance Program (IRAP) and Technology Early Action Measures (TEAM) (see Figure 1).

Figure 1 OERD and Complementary Energy R&D Funding Sources, 2003-2004



* Funding programs, e.g. Natural Sciences and Engineering Research Council (NSERC), Industrial Research Assistance Program (IRAP), etc.

OERD receives important input and advice to its strategic planning and priority-setting processes from external advisory committees composed of representatives from industry and each partner department and agency. It also solicits advice through regular meetings of the NRCan Advisory Board on Energy Science and Technology.

What does OERD do?

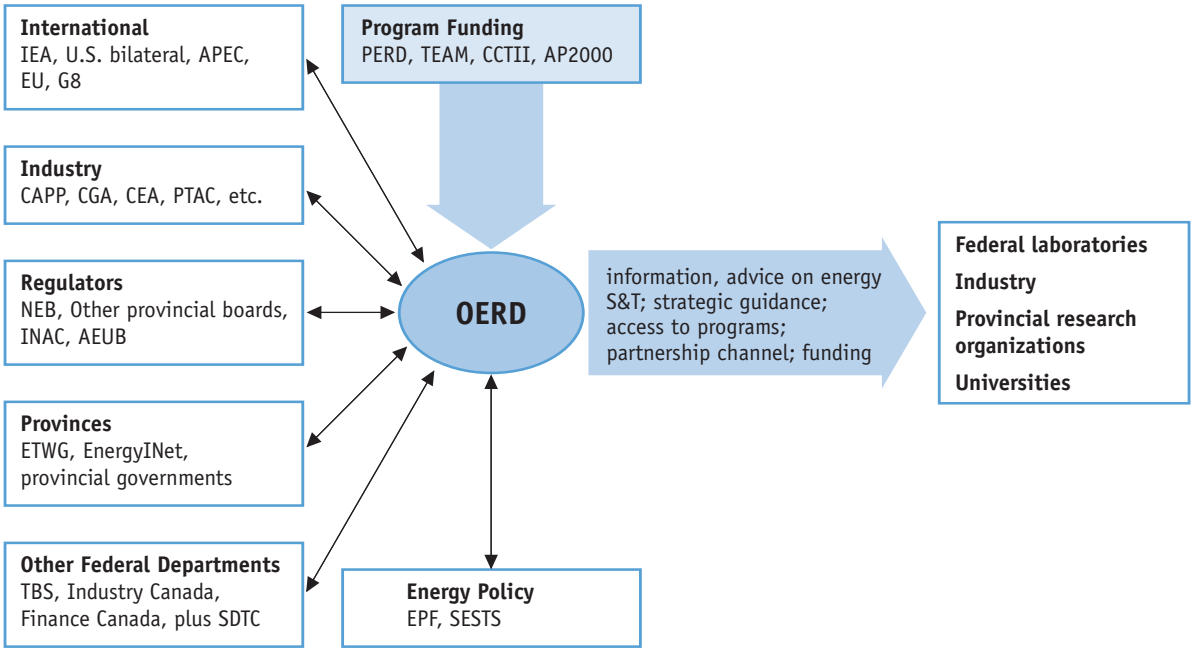
OERD is responsible for the strategic planning, funding, evaluation and ongoing management of federal energy S&T programs. It ensures technology's role in the sustainable development of Canada's natural resources, climate change and innovation. It coordinates the Government of Canada's participation in international energy S&T, mainly through the International Energy Agency (IEA), the North American Energy Working Group (with the U.S. and Mexico), the Energy Technology Working Group (federal-provincial-territorial), the U.S. Department of Energy, and the European Union. It reports to Parliament concerning activities of Sustainable Development Technology Canada, a not-for-profit foundation created by the federal government in 2001 to support the development and demonstration of technologies related to climate change, air quality, clean water, and clean soil.

Through strategically targeted funding, OERD promotes the sustainable development and responsible end-use of Canada's energy resources in a clean and safe manner, and the development of energy-efficient, renewable and alternative energy sources and technologies. It contributes to meeting the Government of Canada's climate change objectives by supporting:

- selected "next-generation" clean and efficient technologies to prepare them for demonstration
- new and improved policies, codes, standards and regulations
- increased energy efficiency
- increased awareness and acceptance of technologies to reduce greenhouse gases and achieve other environmental benefits
- a strengthened Canadian industrial capacity

OERD supports applied energy S&T. However, recent efforts are also placing a high priority on taking advantage of successful S&T results by moving them towards commercialization through demonstration, and pre-commercialization of new technologies and processes.

The following chart illustrates how OERD: integrates input from numerous sources (domestic and international) as an essential part of its strategic planning and energy S&T programs; manages and leverages funding from federal programs; and provides direction and a channel of access to the organizations that work in partnership to conduct energy S&T activities.



AP2000 – Action Plan 2000 on Climate Change
APEC – Asia-Pacific Economic Cooperation
AEUB – Alberta Energy and Utilities Board
CAPP – Canadian Association of Petroleum Producers
CCTII – Climate Change Technology and Innovation Initiative
CEA – Canadian Electricity Association
CGA – Canadian Gas Association
EPF – Energy Policy Framework
ETWG – Energy Technology Working Group
EU – European Union
IEA – International Energy Agency
INAC – Indian and Northern Affairs Canada
NEB – National Energy Board
PERD – Program of Energy Research and Development
PTAC – Petroleum Technology Alliance Canada
SDTC – Sustainable Development Technology Canada
SESTS – Sustainable Energy Science and Technology Strategy
TBS – Treasury Board Secretariat
TEAM – Technology Early Action Measures

Results-based Management

OERD uses a results-based management system to provide timely, relevant and credible information about its energy S&T programs. Cost-effectiveness, transparency, accountability – OERD is committed to these principles and uses its results-based information to assess progress and make decisions about the ongoing alignment of programs, and the allocation of funding.

Since 2002 OERD has evaluated most of the energy S&T programs it manages. Future evaluations may be modified to:

- increase the emphasis on outcomes and impacts to gauge program effectiveness
- make better use of evaluations to inform energy S&T planning processes
- increase the focus on performance measures to assess progress
- introduce a risk-based decision process for targeting evaluation areas

Highlights of Program Outcomes

What happens with successful S&T results? How do they move from the laboratory to the marketplace? The Government of Canada has identified the need to bridge that gap and has started new S&T programs to address it. The following descriptions highlight the outcomes and selected progress reports on programs included in the *PERD Business Report 2002* and provide details regarding new priorities.

Cleaner Fossil Fuels

Oil and natural gas account for most of the energy consumed in Canada. While the Government of Canada is committed to developing alternative fuels and renewable energy, it also wants to ensure the sustainable development of our important oil and gas reserves. OERD programs focus on:

- offshore and northern oil and gas
- oilsands and heavy oil
- environmental and safety issues

Flaring

Solution gas is a by-product of crude oil extraction – changes in pressure or temperature cause it to break out of oil when it is produced and become free. Available in sufficient quantities, solution gas can be collected, cleaned, and sold as a fuel if there is a gas pipeline to transport it for processing. In the absence of processing facilities, the solution gas is typically burned off, or "flared," which produces toxic and greenhouse gas emissions.

OERD's program produced a better methodology for collecting these emissions. It provided S&T input to improve regulations in Alberta, and it demonstrated that flaring can be an efficient means of disposing of waste gas that poses few environmental and health effects. The World Bank is promoting the results of this initiative in the developing world where the flaring of solution gas from primary oil production is widely practised.

In response to recommendations from Western Canada that the major S&T issues with flaring have been resolved, NRCan has redirected its funding into other air issues related to the upstream petroleum industry such as venting, fugitive emissions, and better emissions measurement. Environment Canada is leading the research in these areas in partnership with NRCan, National Research Council Canada, the governments of Alberta and British Columbia, universities and a number of major oil and gas companies.

Pipelines

Pipelines deliver most of our oil and gas (valued at $40 billion per year) and would cost $100 billion to replace. OERD S&T supports:

- assessment of natural hazards for new and existing pipelines
- testing and assessment of the performance of pipeline materials
- regulation, operation and maintenance of pipelines
- terrain science issues in the north, e.g. impacts of degrading permafrost

Since 2002 the following program results were achieved:

- a patent is pending for an on-line monitoring probe to reduce failures
- developed a high-strength steel and new welding techniques to prevent corrosion
- provided S&T input for better regulations and influenced National Energy Board and Indian and Northern Affairs Canada decisions on pipeline route selection and design in the north

OERD also redirected some of its funding to northern pipeline integrity issues, such as higher strength steels and cold weather welds.

Offshore Drilling and Production Activities

There are numerous hazards and risks associated with drilling for oil and gas in Canada's offshore regions. The future promises increased levels of offshore drilling for as long as Canada continues to rely on fossil fuels for its heating, industrial and transportation needs. S&T is necessary to develop better environmental impact assessment procedures, operational standards, and regulations to improve safety, reduce costs and address environmental concerns.

Since 2002, the following program results were achieved:

- provided results of biological effect studies on fish and shellfish to the Offshore Petroleum Boards
- data used to revise regulatory guidelines for produced water discharge
- refined mathematical models to optimize the design and placement of equipment for regulating produced water discharge
- the U.S. Environmental Protection Agency co-funded an NRCan-led project to study the efficiency and toxicity of chemical oil dispersants, an initiative that will result in the development of international guidelines
- improved the identification of compounds that cause detrimental effects on fish and the extent of impacts from different types of oil and different exposure scenarios, useful for selecting oil spill clean-up options to minimize damage to Canada's fishery resources

OERD also increased its funding for S&T activities related to produced water issues and emergency evacuation and rescue systems in the north.

Oilsands and Heavy Oil

Bitumen is a naturally-occurring, complex, viscous mixture of hydrocarbons. Most of Canada's supply is in the form of oil sands, where the bitumen is mixed with sand, water and clay. To remove it the oil sands must be mined and processed. Federal S&T is helping develop new technologies and innovations to ensure the continued sustainability of this rapidly expanding industry. This is being accomplished mainly through improving energy efficiency, reducing damaging effects on the environment, and decreasing greenhouse gas emissions.

Unlike conventional petroleum, bitumen cannot be recovered through a well in its natural state. It can only be refined into common petroleum products like gasoline, kerosene, or gas oil after being first upgraded to produce a synthetic crude oil. Bitumen product quality must be improved so it can be refined more easily into clean transportation fuels.

In 2004, working in partnership with industry, NRCan demonstrated a new solvent-assisted process for extracting bitumen from oil sands.

This rapid-settling technique involves the underground use of carbon dioxide (CO_2) to manage tailings. It also helps the flow of the bitumen being processed and inhibits the corrosion of parts. The end result is more energy-efficient upgrading (improving the bitumen quality so it can be refined more easily into clean transportation fuels). This process is now being used commercially and is being further developed by external organizations with funding assistance from Sustainable Development Technology Canada and federal initiatives such as Technology Partnerships Canada and the Industrial Research Assistance Program.

Cleaner Transportation

In 1997 vehicles accounted for 25 percent of Canadian greenhouse gas emissions. By 2010, this figure is projected to increase to 32 percent. Vehicles also contribute in a big way to the smog in our large cities.

The Government of Canada wants to reduce the projected growth in greenhouse gas emissions from the transportation sector without harming trade, our economy, the industry's competitiveness, or restricting the mobility of Canadians. It has recognized improved urban air quality as a significant health issue. As a result, OERD's investment will be doubled in 2005-06. OERD transportation programs focus on:

- development of fuel cells and their associated hydrogen technologies and infrastructures
- alternative gaseous and liquid fuels
- fuels from renewable sources (ethanol and biodiesel)
- measurement and control of the emission of particulate matter
- development of advanced lightweight materials for vehicle components

Particulate Emissions

Particulate matter, a by-product of various combustion processes used to power our vehicles, consists of tiny particles with a diameter of less than ten microns – less than one-tenth the thickness of a human hair. These particles are so small that they can find their way into our lungs and bronchial passages, resulting in inflammation and respiratory distress.

To address this issue, this program brings together researchers from each step of the process, from engine combustion products to health effects studies, to identify potential strategies to reduce particulate matter. Program results since 2002 include:

- licensed the Laser-Induced Incandescence (LII) instrument, a tool to measure particulate emissions from vehicles, to a Canadian company
- published data from a field study regarding vehicle emissions and other pollution sources – regulators are using this information to review current standards on smog levels and air quality in Canada's urban centres

Canadian Lightweight Materials Research Initiative (CLiMRI)

The Canadian Lightweight Materials Research Initiative (CLiMRI) is a coordinated, interdisciplinary research initiative to develop and implement light-weight and high-strength materials in transportation applications. The aim is to reduce greenhouse gas emissions through improved vehicle efficiency and to improve the competitive performance of Canadian primary metals, automotive, truck, rail car and aircraft manufacturing industries and their associated parts suppliers.

CLiMRI delivers its program through national and international partnerships and collaboration. It works closely with influential programs such as the U.S. Automotive Materials Partnership (USAMP), the AUTO21 Network of Centres of Excellence and the Centre for Automotive Materials and Manufacturing (CAMM).

Key CLiMRI activities include:

- improved materials engineering performance
- improved manufacturing technologies
- improved component and vehicle systems

Since 2002, the following program results were achieved:

- developed aluminum hybrid composite brake rotors that are at least 50 percent lighter and more wear-resistant than conventional cast iron brake rotors, and have passed Ford rotor testing criteria. This work has also led to a U.S. pending patent and work on commercializing the new brake rotors is in progress.

- helped General Motors design and produce a high-performance magnesium alloy engine cradle which is 35 percent lighter than its aluminum counterpart. Results from this project have led to new research activities funded by the auto industry.
- collaborated with industrial partners to produce prototype seam-welded aluminum tubes on a conventional tube mill. By replacing conventional methods with this technology, there is the potential to reduce the weight of this vehicle component by 25 to 50 percent.
- examined materials used in the cooling circuits of fuel cell systems to address the corresponding problem of fuel cell degradation and found that specific coatings of aluminum components provide significant protection. A Canadian company used these program results to design and produce prototype components currently being tested in experimental fuel cell systems.

OERD is placing a higher priority on light-weight materials research, with a particular focus on magnesium and high-strength steels, because of the potential greenhouse gas reduction benefits.

Transportation Fuels From Renewable Sources

This program aims to develop and demonstrate the feasibility of producing transportation fuels from renewable sources, mainly ethanol from lignocellulosic feedstocks (plant fibre from materials such as straw, agricultural and wood waste). Iogen Corporation makes ethanol from wheat straw at its demonstration facility in Ottawa. In December 2004 the Government of Canada announced that its vehicle fleet is the first in the world to use cellulose ethanol on an ongoing basis.

NRCan, Agriculture and Agri-Food Canada and other Government of Canada departments are now using Iogen's cellulose ethanol at a rate of about 100,000 litres per year. As well, in April 2004 Iogen began commercial shipments of bioethanol to Petro-Canada's refinery in Montreal.

Hydrogen Energy Economy

This program is aimed at removing or lowering the obstacles related to using hydrogen in Canada's vehicles and transportation systems. Such obstacles include: emission-free production; the cost of components; their reliability and durability; and the lack of codes and standards.

Since 2002 the following program results were achieved:

- in partnership with the province of Manitoba and private sector partners, continued work to develop a 40-foot transit bus with improved energy efficiency, reduced greenhouse gas emissions and no tailpipe emissions, with field testing in Winnipeg, Manitoba planned for 2005-06
- assessed fuel cell vehicle performance and systems operation under real-world conditions
- published the Guide for Basic Hydrogen Safety and completed a draft of the Canadian Hydrogen Installation Code. This code will expedite the approval of hydrogen installations by providing officials across Canada with common guidelines.
- operated three prototype hydrogen fuelling stations (two in Toronto and one in Vancouver) for light-duty fuel cell vehicles

Transportation energy S&T priorities are changing. R&D on conventional gaseous fuels has been significantly reduced due to the increased costs of these fuels, combined with minimal environmental benefits and high vehicle conversion costs. OERD is, therefore, increasing its efforts on new advanced diesel technologies.

Energy-efficient Buildings and Communities

Buildings and their equipment in Canada account for 27 percent of greenhouse gas emissions. The Government of Canada wants to reduce those emissions through better energy efficiency, the use of renewable energy technologies and better life-cycle performance of buildings. At the same time, it aims to support healthier and more comfortable indoor environments and help Canadian companies supply high-performance building technologies to domestic and global markets.

The Government of Canada is also playing a greater direct role with communities. An important objective is to encourage the use of environmentally acceptable energy technologies in urban, rural and remote communities to reduce their overall energy intensity and reduce greenhouse gas and other air emissions.

OERD activities focus on:

- technologies for residential, commercial and institutional buildings
- waste recovery and use
- integration of energy efficiency and renewable energy technologies
- design concepts, planning tools and technologies to reduce energy consumption, emissions and wastes in communities
- district heating and cooling

The R&D highlights described below were achieved since 2002.

eKOCOMFORT

NRCan worked with five Canadian manufacturing consortia to develop an integrated combustion system, called eKOCOMFORT. It combines space-heating, water-heating and ventilation-air technology into a single unit. Canada already has a well-established energy-efficient furnace technology for heating systems, but most water-heating systems are very inefficient. Integrating the three technologies into one unit will increase the efficiency of residential combustion systems.

eKOCOMFORT combines these three complementary technologies, resulting in greater efficiency than either would produce in isolation. A single gas burner provides the heat and hot water for the house, as well as replacing the traditional electric defroster within the ventilation air system. This system, in the heating, cooling, and ventilation of a home, employs a high-efficiency motor that uses one-half to one-tenth the electricity of a normal motor to move the air around the house. The units use a form of artificial intelligence — dubbed Fuzzy Logic — to memorize a homeowner's preferred comfort settings. The unit complies with these patterns to operate at peak efficiency in all applications. NRCan is also examining how the concept could carry over to larger applications in shopping malls, office buildings, institutions and industrial complexes.

Community Heating System in Okotoks, Alberta

NRCan started a project planned for Okotoks, Alberta using a novel method for heating a community. The system uses a bore-hole to store thermal energy generated from solar panels installed on garages. Fifty-two homes in the subdivision will be connected to a district heating system that draws energy from the bore-hole storage system. Solar energy will provide 90 percent of the homes' space heating needs and 60 percent of their hot water needs. As a result, the community should use 30 percent less energy, thus eliminating 260 tonnes of greenhouse gas emissions per year.

Energy Storage at the University of Ontario

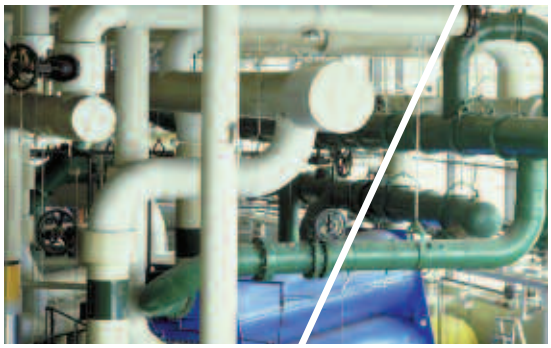
With technical assistance from Environment Canada and NRCan, the largest Borehole Thermal Energy Storage (BTES) system in Canada was installed in Oshawa, Ontario for nine buildings at the new University of Ontario. Heating and cooling is from 146 km of pipe buried in 384 specially-designed energy storage boreholes. The system is the second largest commercial earth energy system in North America.

Other program achievements include:

- tested equipment that produces energy from landfill gas
- developed planning tools and resources to help communities incorporate sustainable energy and distribution supply options into community sub-systems, e.g. solid waste management, transportation planning, landscaping and urban design, land use planning, and water and sewage systems
- published a *Buyer's Guide on Micro-hydropower Systems* that targets remote residential homes, cottages, small communities, First Nations Aboriginal communities, camps, parks, and lodges not connected to the electrical grid
- completed building rating procedures for commercial buildings
- published energy-efficient guidelines and standards for housing retrofits and for Canadian housing exporters
- published a window standard and established rating/labelling system criteria

Energy-efficient Industry

Manufacturing, process and resource industries use 42 percent of all energy consumed in Canada and generate 34 percent of the greenhouse gas emissions. The Government of Canada supports R&D to develop cross-cutting technologies applicable to several industrial sectors and sub-sectors such as process integration, sensors and controls, combustion, separation processes, and bio-based energy and processes. It also supports better energy efficiency in the basic resource industries – pulp and paper, agriculture, fisheries and mining.



Canadian Hemp Clothing and Accessories

Over a billion t-shirts a year are sold in North America, most of which are cotton. Each cotton shirt requires 1,740 US gallons of water and 1/3 lb. of chemicals (fertilizer, pesticides, herbicides, and insecticides). Hemp is a plant which needs no chemicals and can be irrigated by rainwater. Due to its absorbency, hemp clothing requires less dye for colouring. However, fibres of the hemp plant are so strong that manufacturing is a challenge, particularly for the clothing industry where softness and comfort are crucial. To combat the issue, China, the world's largest hemp producer, uses chemicals to break down fibres; Europe uses a biochemical process using enzyme technology. Neither are ideal solutions but, to date, there have been no other options.

In 2004 NRCan funded R&D conducted by National Research Council Canada (NRC) which promises to greatly improve the energy efficiency of hemp processing, thereby reducing greenhouse gas emissions. It has developed an enzyme technology which uses an enzyme called pectinase to alter the hemp fibre and can potentially reduce the time for fibre processing to five hours from the current industry standard of forty-five days. Once treated, the fibres are softer, more pliable and of higher quality than those from either China or Europe.

Hemp has other qualities which make it a real champion of energy efficiency. Hemp shirts last three to five times longer than their cotton counterparts, grossly reducing the energy used for production. Hemp is also four to five times more effective at converting carbon dioxide to biomass than typical forestry. Hemptown Clothing Inc. is a Vancouver-based company which manufactures hemp/cotton blend clothing. Since Canada has no manufacturing base for either material, the company has been forced to import its raw material from China. Now, thanks to the NRC's new enzyme technology, Hemptown believes that soon it will be using 100% Canadian, 100% chemical-free hemp to produce 100% cotton-free hemp clothing and accessories.

Initial results show such promise that 80 acres of land were donated by Craik, Saskatchewan to grow hemp on a large scale. Hemptown is now building a $3-5 million, 40,000 square-foot mill there to capitalize on this emerging technology. The company believes this new process will revolutionize the Canadian clothing industry.

Other achievements since 2002 include developing:

- an energy-efficient membrane-based process to recover nitrogen and hydrocarbons in the petrochemical industry
- an energy-efficient microwave-assisted solvent extraction process for edible oils
- energy-efficient fishing (trawling) techniques and technologies

The federal government has discontinued its R&D program regarding industrial drying because of a lack of capacity by Canadian developers and manufacturers. It has increased efforts in the following areas:

- process integration knowledge and technologies that promise reduced energy use and greenhouse gases
- materials transport to improve the energy efficiency of delivering pulverized feedstocks suspended in air or liquids
- precision energy systems to increase the efficient use of energy, e.g. microwave, high-frequency radiation and lasers required for chemical reactions and physical processes

Power Generation

Fossil fuels in Canada account for 27 percent of the electricity generated. The combustion of these fuels is a major source of emissions which affect air quality and climate change. The Government of Canada supports energy R&D to help reduce such environmental emissions while also preserving the benefits of hydrocarbons, particularly coal, as plentiful and inexpensive fuels for electricity power production.

OERD activities are focused on:

- electric power generation from renewable energy sources
- cleaner conversion of coal to electricity
- small-scale or distributed generation, with an emphasis on combined heat and power applications
- carbon dioxide capture and storage

Achievements since 2002 include:

- installation of a combined heat and power microturbine prototype in a commercial building that achieved 80 percent efficiency
- application for a patent for an oxy-fuel burner that replaces air by oxygen and facilitates CO_2 capture
- demonstration of off-grid technologies, e.g. photovoltaic, wind and small hydro in the Yukon

The Government of Canada has increased its R&D in clean coal technology to provide a solution to climate change and air quality issues. CO_2 capture and sequestration is tied to work in this area. Although research has been progressing for several years on sequestration, the cost of capturing CO_2 is a significant barrier. As a result, CO_2 capture is being increasingly integrated with the capture and elimination of other priority substances, such as mercury.

Distributed generation (the generation of energy close to the point of use) is another priority technology because it can use locally-available renewable feedstock, e.g. solar, wind, micro-turbines, and fuel cells, and reduce emissions.

Wind-Diesel Power Generation

Power generation in remote locations is a challenge faced by many Canadian communities. The town of Ramea, Newfoundland has installed a 390 kW wind-diesel demonstration project as an alternative to electricity obtained solely from diesel generators. It uses a unique control system to combine wind and diesel power that was developed, with NRCan support, at the Atlantic Wind Test Site in P.E.I. This is an important demonstration of the technology which has the potential for reducing greenhouse gas and other emissions in remote areas that are not connected to the electricity grid.

Canadian Wind Energy Atlas

Many Canadians may not know that Canada has very good potential for wind energy. However, harvesting it for energy cannot be done before investing in exploration. Publicly unveiled in October 2004, the Wind Energy Atlas pinpoints the best locations in Canada to take advantage of this renewable energy source. It will help to reduce costs and the time it takes to develop a site.

The atlas was created with a database, the Wind Energy Simulation Toolkit, as part of a federally-funded R&D project. Work was conducted in partnership between experts at Environment Canada (meteorology), NRCan (wind energy), and National Research Council Canada (user interface design). As of September 2004, Canada had 439 megawatts of installed wind energy capacity, thereby avoiding as much as 1.1 megatonnes/year of carbon dioxide emissions.

Grid Integration

There is increasing interest in Canada by both producers and consumers in electricity from distributed generation. However, institutional barriers exist regarding the interconnection of distributed generation technologies to the electrical grid. Technical challenges include the safety, reliability and quality of the electricity produced, and its impact on the main power grid. Regulatory issues must be resolved regarding provincial and regional jurisdiction. Business practices must be standardized with respect to contracts and procedures.

In 2004 NRCan allocated new funding to contribute to the development of new and revised Canadian Standards Association codes and standards and new regulatory guidelines. NRCan also focused its R&D efforts on helping to improve the capability of Canadian utilities to store intermittent supplies of electricity produced from distributed generation. R&D activities will also take full advantage of international expertise and networks.

OERD's International Connections

OERD is active outside Canada by coordinating the Government of Canada's participation in international energy R&D. Indeed, we derive great benefits from our collaborations with other countries, mainly by:

- learning about and influencing S&T policies, programs and technologies in other countries
- leveraging from international partners to work on common issues

Canada's international energy S&T objectives are mainly advanced through participation in 31 of 40 Implementing Agreements of the International Energy Agency (IEA). OERD also chairs the IEA Committee for Research and Technology (CERT) and represents Canada on each of its four Working Parties. Established in 1974, the IEA facilitates the development and commercialization of energy technologies which promote the energy security, environmental protection and economic development of its Organization for Economic Co-operation and Development (OECD) member countries. Implementing Agreements are frameworks which facilitate the initiation, implementation, monitoring and review of these collaborative efforts.

Canada also cooperates with the U.S. Department of Energy (DOE) on energy research and development in the areas of fuel cells, fossil fuels, bioenergy, community systems and microgeneration, nuclear fission, and carbon sequestration. It participates in the following U.S.-led multi-lateral technology initiatives:

- Carbon Sequestration Leadership Forum
- International Partnership for a Hydrogen Economy
- Methane to Markets

Other bilateral agreements to implement Canadian technology abroad include:

- Small Hydro Turbines – Poland
- Small Hydro Control Systems, Site Rehabilitation, and Biomass Gasification – China
- Solar Crop Drying – Brazil
- Natural Gas Vehicles – Romania
- Super E (energy-efficient manufactured housing) – Japan, Germany
- Building Energy Efficient Capacity (training, tools, demonstrations) – Russia
- Waste Gasification – Spain

For example:

- a project to evaluate new after-treatment devices for reduced emissions from diesel engines was jointly funded with the New York Department of Environmental Conservation and the New York Transit Authority. International engine and trap manufacturers also made in-kind contributions.
- NRCan researchers helped establish an international Light Metals Alliance to explore collaborative R&D work in the areas of melt cleanliness, recycling and novel casting applications. Partner countries include Germany, Austria, Australia and the U.S.
- NRCan conducted a commercial-scale demonstration of the CANMET Hydrocyclone, a new technology to separate heavy oil from water, and signed an international license agreement to market it.

Looking Ahead

The Government of Canada recently announced its plan to develop a Sustainable Energy Science and Technology Strategy by the end of 2006. Its main objectives will be to:

- develop S&T goals regarding the efficient production and use of conventional and renewable energy
- develop a detailed action plan for reaching these goals
- lever ideas and resources of the private sector, universities, and the provinces

The development of new technologies will play a key role in meeting Canada's targets to reduce greenhouse gas emissions. Not only that, such technologies can also provide enormous economic opportunities for Canadian industry, at home and in international markets. OERD will conduct broad consultations in early 2006 to ensure input from stakeholders and interested parties.

Contact Us

Want to know more about the Government of Canada's energy S&T activities? Give us a call, or send us an e-mail, a fax or a letter. We'll be happy to hear from you.

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Appendix A

Federal Government Laboratories Conducting Energy R&D

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Appendix B

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Appendix C

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Conversion of Bitumen, Heavy Oil, Natural Gas and Waste Oils ($3.733 M)
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Offshore Environmental Factors for Regulatory, Design, Safety and Economic Purposes
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Northern Production ($1.213 M)
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Regulatory Requirements for Offshore Drilling and Production Wastes, Assessment of Cumulative Effects, and Remediation of Accidental Offshore Discharge and Spills
($903 K)
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Upstream Petroleum Air Issues Research Initiative ($416 K)
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Pipelines ($1.495 M)
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Groundwater and Soil Remediation for the Oil and Gas Industry ($876 K)
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Cleaner Transportation

Support the Development of Technological and Other Measures to Control and Reduce Emissions of Particulate Matter ($713 K)
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Advanced Fuels and Transportation Emissions Reduction ($1.754 M)
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Canadian Lightweight Materials Research Initiative (CLiMRI) ($993 K)
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Optimization of the Energy Efficiency of Transportation Systems ($1.498 M)
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Energy-efficient Buildings and Communities

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Application of Renewable Energy Technologies and Integrated Systems in Off-grid/Remote Communities ($582 K)
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Energy Management for Sustainable Communities ($954 K)
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Industry Energy Research and Development (IERD) ($3.523 M)
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Reduction of Fossil Fuel Energy Intensity in Canada's Agri-Food Sector ($813 K)
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Bio-Based Energy Systems and Technologies ($2.708 M)
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Highly Energy-efficient Industrial Systems and Technologies ($3.477 M)
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Power Generation

Improving the Economics and Efficiency of Conversion of Renewable Energy to Electricity Including Related Storage, Hybrid, and Systems Technologies ($1.192 M)
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Distributed Generation – Fossil Fuel ($709 K)
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Characterization of Canadian Fuels and Their Emissions ($642 K)
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Clean and Efficient Combustion Technologies for Large Utility Electricity Generation ($2.254 M)
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CO_2 Capture and Storage ($1.308 M)
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Climate Change

Climate Change Impacts on the Energy Sector ($734 K)[1]
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Enhancement of Greenhouse Gas Sinks ($1.889 M)
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[1] This program was terminated in 2004-05 and resources allocated to other energy R&D priorities.

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Unconventional Gas Supply ($995 K)
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