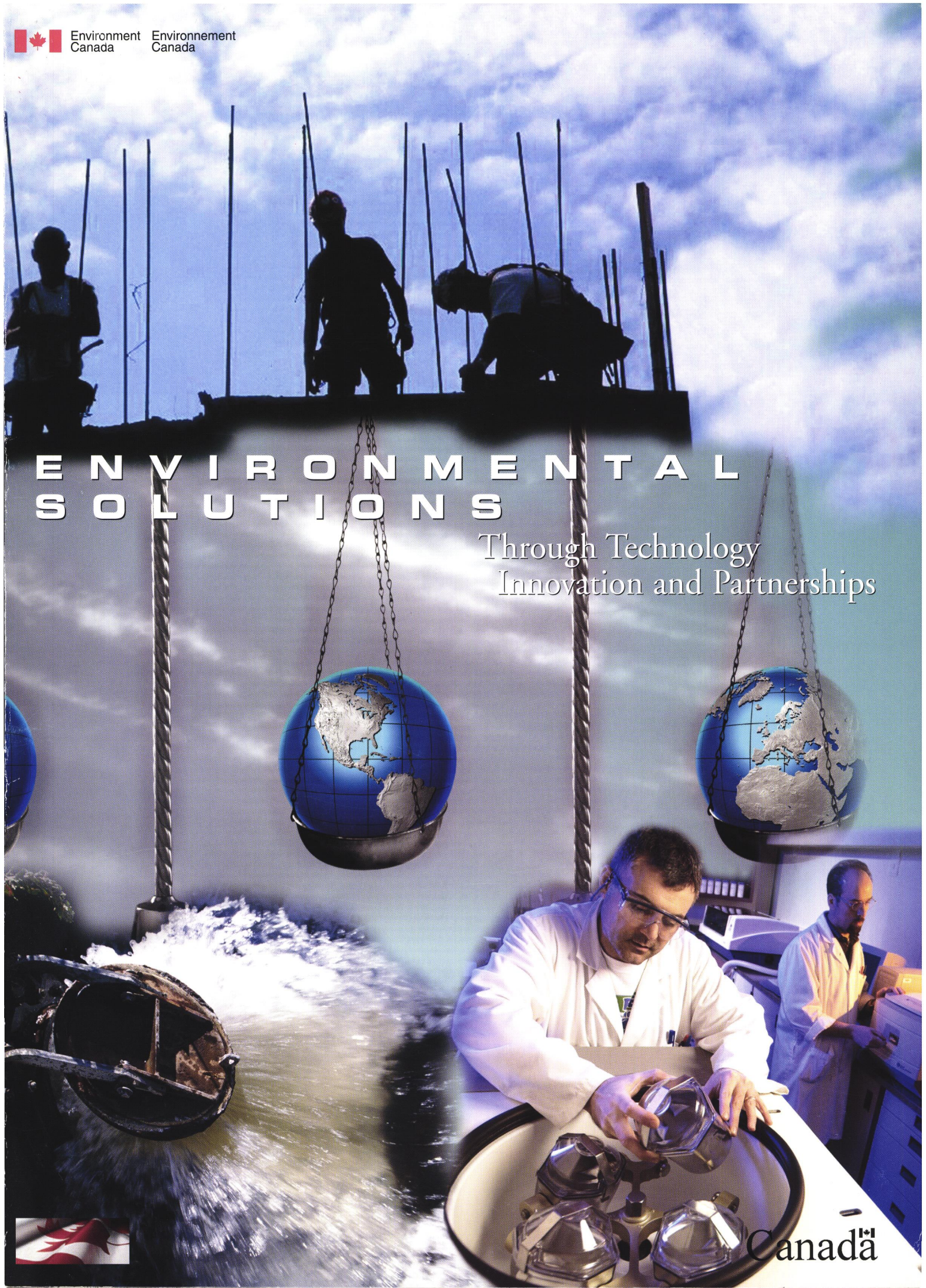
Environment Canada Environnement Canada



ENVIRONMENTAL SOLUTIONS

Through Technology Innovation and Partnerships

Canada

ENVIRONMENTAL SOLUTIONS THROUGH TECHNOLOGY INNOVATION AND PARTNERSHIPS

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ENVIRONMENTAL SOLUTIONS

Through Technology Innovation and Partnerships

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Environmental Protection Service

Environment Canada

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Special thanks for invaluable guidance, technical input and review go out to many individuals within Environment Canada's regional offices; Environmental Protection Service laboratories — the Environmental Technology Centre and ETAD-Burlington; Environmental Protection Service directorates — the Environmental Technology Advancement Directorate, the Air Pollution Prevention Directorate, the Toxics Pollution Prevention Directorate and the Strategic Priorities Directorate; the three Canadian Environmental Technology Advancement Centres; Science Applications International Corporation; Technology Early Action Measures; Program on Energy Research and Development; and industry and private sector companies.

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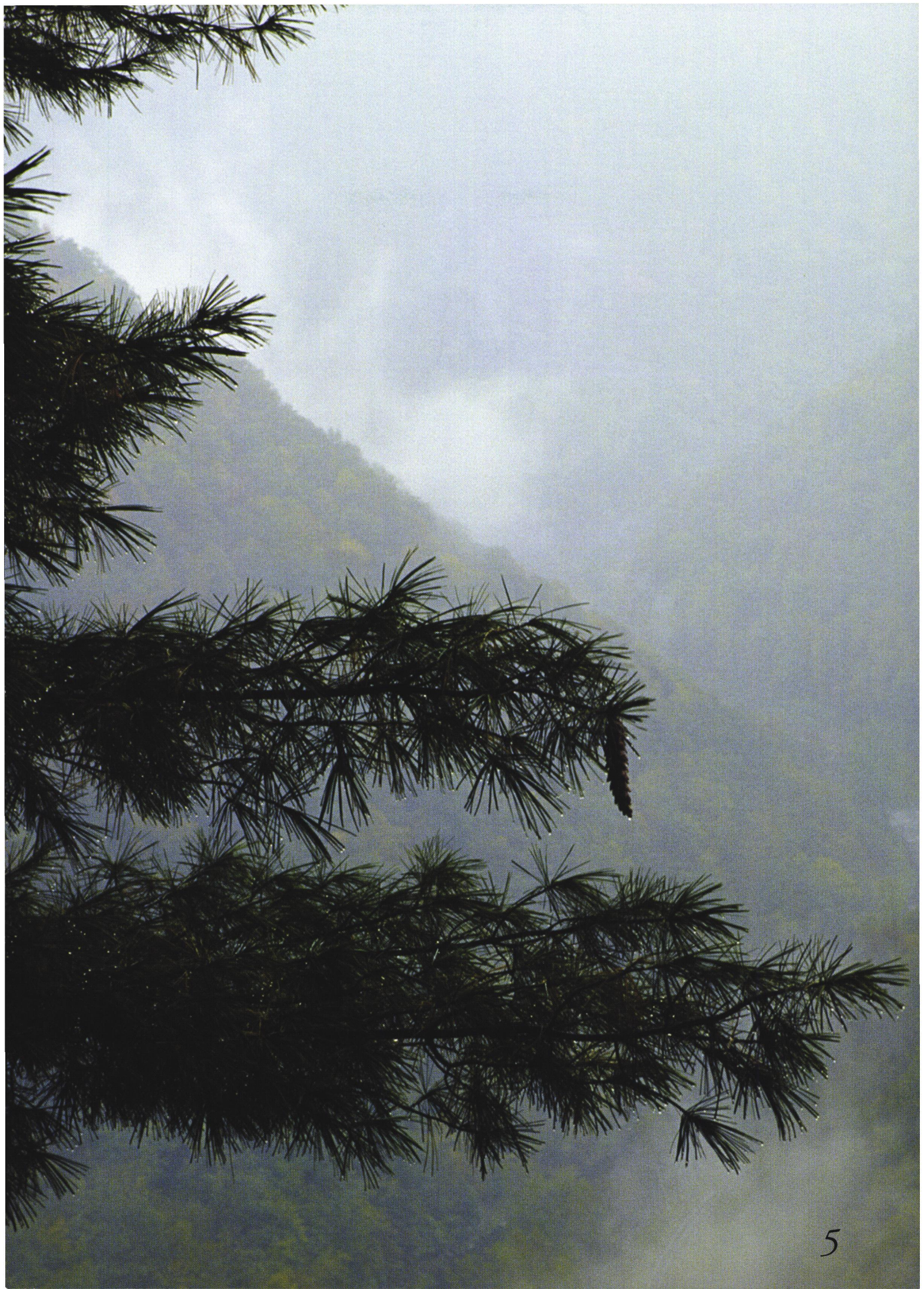
About This Report

This report, *Environmental Solutions Through Technology Innovation and Partnerships*, is an overview of success stories from the past few years, illustrating the key role played by Environment Canada's Environmental Protection Service and regional offices in the development and demonstration of practical environmental solutions. These successes are the result of collaborative efforts and partnerships established with the private sector, academia, research centres, local communities and other levels of government sharing a common concern for the environment. The projects presented here illustrate real, tangible solutions to our environmental challenges and were selected to represent diverse examples from across all departmental priorities, Environment Canada regions, Environmental Protection Service directorates, Environment Canada laboratories and a broad range of other partners, including funding programs.

The report commences by outlining the need for ongoing technology innovation to effectively address Canada's environmental challenges and highlighting Environment Canada's commitment to respond by catalyzing the development of new technologies through collaborative partnerships. The report then moves to identifying sound science as the foundation for this technology innovation process, with a subsequent focus on technology development and demonstration. Specific technology projects in Environment Canada's priority areas of Climate Change, Clean Air, Fresh Water and CEPA Toxics are showcased, with additional projects focused on managing and sharing our knowledge on technology solutions. The report concludes with a discussion of the path forward, outlining the many benefits of continued cooperation, collaboration and partnerships in the area of technology innovation.

In addition to the featured stories, Environment Canada's technology partners and support programs are presented in Annex A, while many more of the Department's successfully partnered technology innovation projects are listed in Annex B.

This report was developed as a communications tool and thus does not link specific targets and objectives to associated resources, as may be expected in a performance report. The intention is to share information, within and beyond the Department, on the development of innovative, environmentally sound technologies and best practices in which Environment Canada was a collaborative player. In so doing, the report should prove to facilitate uptake of these technologies and to encourage further innovation as a set of practical solutions to address environmental challenges both within and beyond our borders.



Addressing Canada's Environmental Challenges

The federal government's overall agenda is to help Canadians live and prosper in an environment that is protected and conserved. Despite decades of progress, Canada and the rest of the global community continue to be faced with the challenge of mobilizing people, expertise and resources in order to confront ongoing environmental issues. These issues include the mitigation of climate change, the provision of clean air, the protection of fresh water and the sound management of toxic substances.

Driven by these domestic and international environmental realities, Canadians are demonstrating both leadership and commitment through the development of new technologies and approaches based on innovation and the application of knowledge. Building on Canada's National Innovation Agenda, Environment Canada has strengthened partnerships and refocused its research, development and demonstration initiatives to create a culture of cooperation that addresses the Department's priority environmental issues.

Environment Canada's contribution to technology innovation and the application of practical solutions is based on sound science and an understanding of what we as Canadians can do to preserve and protect environmental quality for future generations.

PHOTO: SAIC CANADA

Catalyzing Technology Innovation

Environment Canada is taking action to improve the availability and selection of environmentally sound technologies and to enhance their adoption and use. Consistent with its mandate, Environment Canada is collaborating with many partners to catalyze progress in technology innovation. The Department relies on sound science for identifying and prioritizing its direction and priorities on technology innovation.

THE APPLICATION OF SOUND SCIENCE: THE FOUNDATION OF INNOVATION

Sound science provides the foundation for technology innovation. Science helps us to understand and identify environmental issues and challenges, while technology is the tool that provides solutions to the challenges that science has uncovered. Sound science is a fundamental component of Environment Canada's integrated strategy to protect the environment. Through its scientific programs and laboratory resources, Environment Canada uses science to identify, monitor and evaluate environmental issues. This information forms the foundation for Environment Canada's action on technology innovation.

Science **helps us understand and identify environmental issues and challenges.**
Technology **is the tool that provides solutions to the challenges that science has uncovered.**

TECHNOLOGY DEVELOPMENT AND DEMONSTRATION

With science providing strategic direction, Environment Canada engages in the development and demonstration of practical technological solutions to achieve pollution prevention and cleaner production measures — central to Environment Canada's mandate under the *Canadian Environmental Protection Act, 1999*. Although there are many funding programs managed by other departments and third party organizations, Environment Canada collaborates with these programs and initiatives to promote targeted technology demonstration and deployment. Environment Canada also collaboratively researches and develops new tools and technologies necessary for the delivery of its programs. The principal element of this collaborative approach involves the establishment and nurturing of partnerships among technology users, developers and funding agencies to optimize the effective use of collective resources for addressing environmental priorities.

PHOTO: EC-ETAD BURLINGTON

PHOTO: UNIVERSITY OF ALBERTA

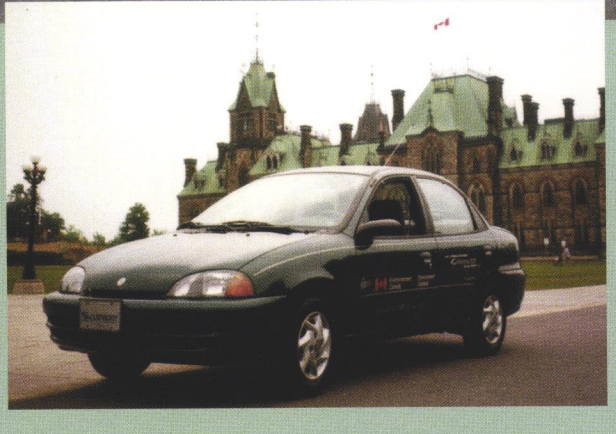
KNOWLEDGE MANAGEMENT OF TECHNOLOGY SOLUTIONS

By facilitating awareness, providing access and linking existing information sources through a report such as this one, Environment Canada is helping to ensure that the most up-to-date and comprehensive information is available in Canada and abroad for addressing our many environmental priorities.

Working Through Partnerships

The development of a sound scientific and technological foundation requires the nurturing of collaborative partnerships. A broad range of stakeholders, including the private sector, federal government departments, academia, funding programs, provincial/territorial and municipal governments, other institutions and organizations and international agencies, is essential for encouraging technological innovation and the implementation, adoption and wide use of practical environmental solutions.

PHOTOS: ▲ EC-QUEBEC REGION, ▼ PIERRE SYLVESTRE



As noted in the feature stories, Environment Canada is committed to working in partnership with many other organizations to encourage the development, adoption and use of environmentally sound technologies and practices, while recognizing the associated social and economic impacts and benefits. Environment Canada's technology programs and initiatives are making an important contribution to sustainable development through partnering efforts with others. By working together, governments and other stakeholders are building the necessary capacity and technological capabilities for achieving innovative and sustainable solutions. The strength and success of this cooperative collaboration lie in its flexibility, market orientation and benefits to all stakeholders that share a common concern for the environment. Some of Environment Canada's key partners, collaborators and supporting programs are profiled in Annex A.

Focusing on Environment Canada's Priorities

The strategic direction taken by Environment Canada for technology development and demonstration, as presented in this report, is in line with the following departmental environmental priorities:

- climate change, a problem that has captured global attention, giving rise to the call for immediate action to reduce greenhouse gas emissions;
- clean air, which is essential for both human and environmental heath;
- fresh water, which involves the protection of groundwater, freshwater and marine resources not only in Canada, but also in those parts of the world where poverty alleviation is closely linked to the availability of adequate water supply and sanitation;
- sound management of CEPA toxics (substances defined as "toxic" under section 64 of the *Canadian Environmental Protection Act, 1999*) in a manner that preserves the integrity of ecosystems and the health of people; and
- central to addressing these priorities is effective knowledge management to improve the quality and availability of information for the selection of the appropriate technology options.

The case studies presented in this report provide excellent examples of some of the important work completed for addressing priority environmental issues. These brief descriptions illustrate how environmental technology innovation is being supported by Environment Canada in partnership with other key stakeholders for the benefit of Canada and the world. In addition to the representative projects featured in this report, more success stories are listed in Annex B.

Climate Change Mitigation

Addressing climate change is a challenge that requires the commitment of all Canadians. Both innovative and practical solutions are needed. These will require the nurturing of effective cooperation and partnerships to strengthen the ability of communities to be resourceful and of industries to remain competitive. Initiatives undertaken by Environment Canada to tackle the climate change issue are geared towards the development of environmentally sound technologies and eco-efficient production methods that conserve resources for future generations while minimizing the potential for negative impacts on ecosystems and the biosphere. The following climate change technology projects illustrate how Environment Canada and other key stakeholders are addressing climate change and reductions in greenhouse gas emissions at a practical level, while benefiting air quality in the process.

HARNESSING WIND POWER REDUCES GREENHOUSE GASES

A Toronto project is demonstrating that a waterfront wind turbine can produce enough clean, sustainable power to supply 250 to 300 households per year. Each waterfront wind turbine can provide 1400 megawatt-hours of energy, which offers a viable alternative to coal-fired electricity generation. Through a partnership between the Toronto Renewable Energy Co-operative and Toronto Hydro, this green power option is available to Toronto customers. Environment Canada's Ontario Region has committed to purchasing green power for its own facilities and has provided funding and technical support for the environmental assessment of the proposed waterfront sites. This support for green energy alternatives will help to reduce emissions of greenhouse gases and other air pollutants resulting from conventional forms of electrical power production.

Partners: Toronto Renewable Energy Co-operative, Toronto Hydro Energy Services, Technology Early Action Measures, Environment Canada – Ontario Region and Air Pollution Prevention Directorate

PHOTO: JIM MOYES

PHOTO: VILLE DE MONTRÉAL

ELECTRIC VEHICLES — AN OPTION FOR CLEANER AIR

The Montréal 2000–Electric Vehicle Project has helped integrate battery-powered electric vehicles into institutional and private vehicle fleets as a sustainable way of reducing air pollution and greenhouse gas emissions by more than 3.8 tonnes per year per vehicle (as CO_2). The first demonstration of its kind in Canada, this project in the greater Montréal region had three major goals: scientific evaluation of electric vehicles under normal operating conditions, promotion of this transportation mode in an urban setting and technical support for participating organizations. Organizations acquiring the electric vehicles included Bell Canada, Hydro-Québec, Les Services Électriques Blanchette, City of Montréal, Ville de Saint-Jérôme, Ministère des Transports du Québec, Canada Post, Transport Canada, Department of National Defence and Environment Canada. The project ran for 27 months, and all 24 electric vehicles remain in service in the greater Montréal area, offering the promise of broader application for this alternative transportation technology.

Partners: The above-listed partner companies, ISAAC Instruments, Hydro-Québec, Gouvernement du Québec, Centre for Electric Vehicles in Quebec, Technology Early Action Measures, Canada Economic Development, Environment Canada – Québec Region

MICROWAVES TO REDUCE ENERGY USE AND TOXIC SOLVENTS

PHOTO: EC-ETC/MAP™

Energy requirements can be reduced by as much as 99 percent using the Microwave-Assisted Process (known as MAP™), developed by Environment Canada. Using the same kind of microwaves that heat a cup of coffee, MAP™ is an energy-efficient way of reducing or eliminating the need for solvents in various applications, including chemical extraction and contaminated site remediation — which means fewer greenhouse gas emissions. With financial support from Technology Early Action Measures, CanAmera Foods and BC Research Inc. are using MAP™ to explore the extraction of edible oils from agricultural products such as canola, flax and soya. This approach to extracting cooking oils is more efficient than conventional energy-intensive extraction methods. If all 10 CanAmera plants in Canada were converted to this cleaner production process, a 1.2-megatonne reduction in annual carbon dioxide emissions would be predicted. MAP™ has now been licensed to a number of companies around the world. New uses for this innovative technology are continuing to be developed at Environment Canada's Environmental Technology Centre and ETAD-Burlington laboratories, which will lead to further energy-saving process applications.

Partners: Environment Canada – Environmental Technology Centre and ETAD-Burlington, CanAmera Foods, BC Research Inc., Technology Early Action Measures

PHOTO: SPHERAL SOLAR POWER INC.

REALIZING THE POTENTIAL OF SOLAR POWER

Innovation is revolutionizing the solar power industry, making this renewable energy source a viable option to combat global greenhouse gas emissions. Through research undertaken by ATS Automation Tooling Systems, the next generation of Spheral Solar(tm) Technology (SST) has been developed. SST solar cell panels consist of tiny silicon spheres bonded in a flexible aluminum foil matrix. Improved manufacturing (using ATS semi-automated assembly lines) and product flexibility are making it easier and cost-effective to use solar photovoltaics in new ways for consumer products, building integrated products and remote power locations. A full-scale SST production line is under construction in Cambridge, Ontario, with a planned capacity of 20 megawatts annually, equivalent to the total annual power requirements of 6000 homes. ATS is securing strategic partnerships to increase market opportunities, accelerate the commercial success of this technology and demonstrate the potential of solar power.

Partners: ATS Automation Tooling Systems Inc., Technology Partnerships Canada, Technology Early Action Measures, Natural Resources Canada, Environment Canada – Environmental Technology Advancement Directorate

THE EARTH'S THERMAL CAPACITY TO STORE ENERGY

The earth has remarkable insulating properties, which can be used to store thermal energy underground for extended periods of time. An engineered approach to underground thermal energy storage, or UTES, uses either permeable, water-bearing rock formations called aquifers or bore-holes drilled into the earth as underground storage areas for water to store available, surplus energy — such as cold winter temperatures or waste heat from mechanical processes — for cooling or heating buildings. With the assistance of Environment Canada's Atlantic Region, Sussex Hospital in New Brunswick has become the first hospital facility in North America to adopt UTES. The hospital has realized savings of $50,000 per year in energy costs by reducing cooling costs by 80 percent and heating costs by 40 percent, leading to significant reductions in emissions of greenhouse gases and ozone-depleting substances.

Partners: Sussex Hospital, New Brunswick Power, Canadian Electricity Association, New Brunswick Department of the Environment, Program of Energy Research and Development, Environment Canada – Atlantic Region

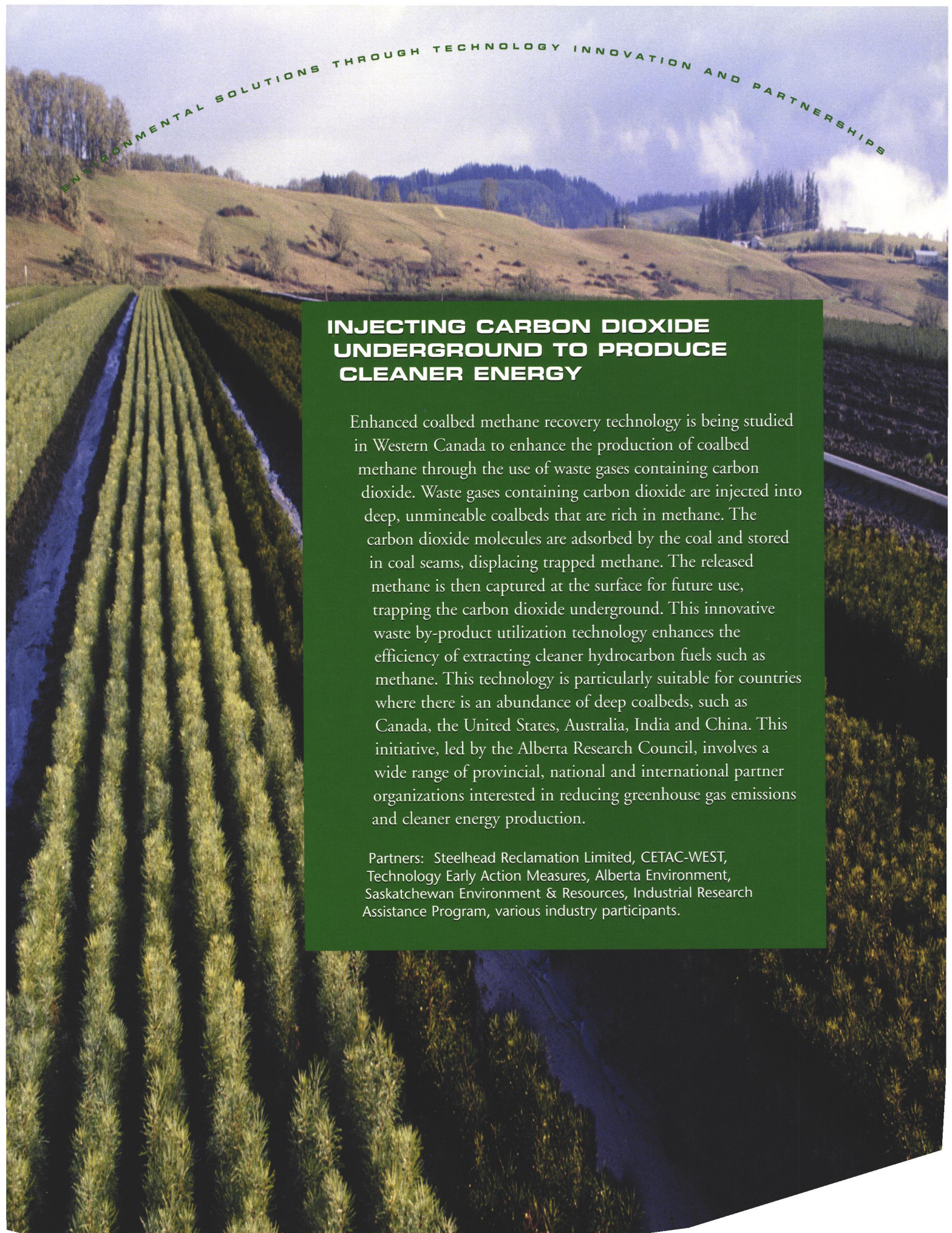
PHOTO: COREL CORPORATION

PHOTO: COREL CORPORATION

WASTE BY-PRODUCTS IN CONCRETE REDUCE CARBON DIOXIDE

Cement production accounts for 90 percent of the energy used to make concrete. This produces substantial amounts of carbon dioxide, representing about 8 percent of global greenhouse gas emissions. EcoSmart™ Concrete is an innovative alternative for the construction industry that provides both environmental and economic benefits. This eco-efficient technology substitutes industrial by-products such as fly ash or furnace slag for up to 50 percent of the cement in concrete. It is considerably less expensive and more durable than its conventional alternative, thus reducing construction and maintenance costs while at the same time diverting industrial waste materials from landfill. A true public–private partnership success story, EcoSmart™ Concrete has been successfully demonstrated in several projects in British Columbia.

Partners: EcoSmart partners, including Tilbury Cement Ltd. (now Lehigh), Lafarge Canada, Greater Vancouver Regional District, Technology Early Action Measures, Industry Canada, Natural Resources Canada (CANMET), Environment Canada – Pacific and Yukon Region



INJECTING CARBON DIOXIDE UNDERGROUND TO PRODUCE CLEANER ENERGY

Enhanced coalbed methane recovery technology is being studied in Western Canada to enhance the production of coalbed methane through the use of waste gases containing carbon dioxide. Waste gases containing carbon dioxide are injected into deep, unmineable coalbeds that are rich in methane. The carbon dioxide molecules are adsorbed by the coal and stored in coal seams, displacing trapped methane. The released methane is then captured at the surface for future use, trapping the carbon dioxide underground. This innovative waste by-product utilization technology enhances the efficiency of extracting cleaner hydrocarbon fuels such as methane. This technology is particularly suitable for countries where there is an abundance of deep coalbeds, such as Canada, the United States, Australia, India and China. This initiative, led by the Alberta Research Council, involves a wide range of provincial, national and international partner organizations interested in reducing greenhouse gas emissions and cleaner energy production.

Partners: Steelhead Reclamation Limited, CETAC-WEST, Technology Early Action Measures, Alberta Environment, Saskatchewan Environment & Resources, Industrial Research Assistance Program, various industry participants.

AUTOMATED LIGHTING SYSTEM SAVES POWER

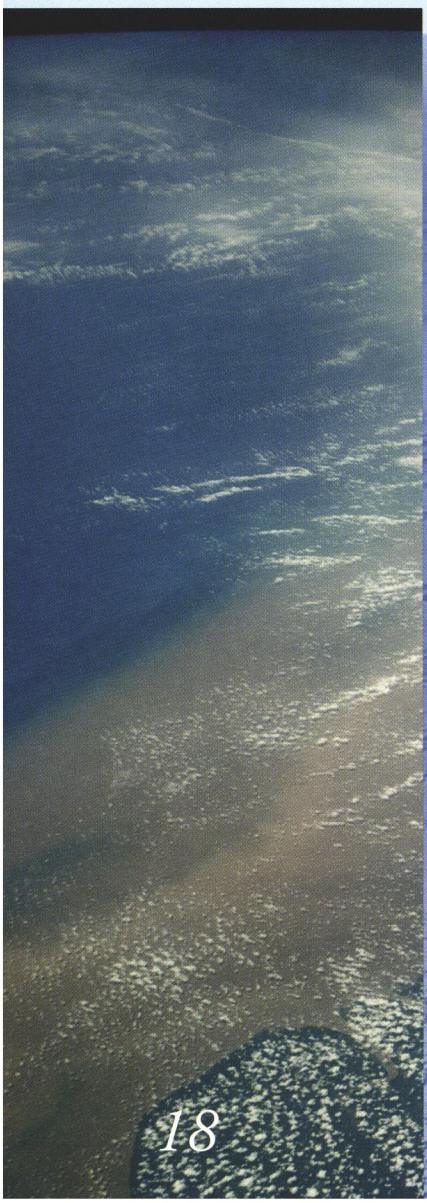
Encelium Technology Inc. has created an automated technology for controlling electrical loads in commercial buildings. This proprietary energy management tool has a range of applications, including permitting occupants to control lighting levels in their individual workspaces and allowing facility managers to control common use areas. Environment Canada's Environmental Technology Verification Program has confirmed energy savings of up to 70 percent using this technology, with low capital cost and a payback of two to three years. The Ontario Centre for Environmental Technology Advancement has played a major role in marketing the Encelium system by identifying buildings where the system could be installed and further demonstrated. These efforts are helping to accelerate market acceptance of innovative products and control systems that optimize the energy efficiency of buildings and related infrastructure.

Partners: Encelium Technology Inc., ETV Canada, OCETA, Environment Canada – Environmental Technology Advancement Directorate

PHOTO: ENCELIUM TECHNOLOGIES INC.

Clean Air

As urban populations continue to grow, communities are faced with the challenge of ensuring that air quality is maintained and that the threat of airborne contaminants to human and environmental health is eliminated. The development and implementation of appropriate clean air technologies are essential in order to provide practical and reliable technological solutions to mitigate air pollution. By working closely with industry and technology innovators, Environment Canada is helping to define viable solutions as well as to outline the scope and boundaries of air pollution problems. The following clean air technology projects represent just some of the many initiatives undertaken by Environment Canada and its project partners to improve air quality. In the process of targeting air issues, contributions to climate change mitigation are inherently made.



ELIMINATING HALONS, PROTECTING THE OZONE LAYER

Halons, used as fire-fighting agents, are ozone-depleting substances that are up to 10 times more damaging to the ozone layer than chlorofluorocarbons. In order to meet the objectives of the Montreal Protocol, developing countries have committed to a phase-out of ozone-depleting substances by 2010. As part of its Montreal Protocol bilateral cooperation program, Environment Canada has assisted the government of Venezuela in the establishment of a national halon recovery, recycling and reclamation facility through the provision of equipment, training and education on viable alternatives. The facility, which maintains its operations by charging a fee for recycling used halons to International Organization for Standardization standards, provides major Venezuelan users with access to reclaimed halons for essential applications. The use of recycled and reclaimed halons has allowed Venezuela to completely ban production of new halons, reaching its target 10 years ahead of schedule. Environment Canada, through its contributions to the Multilateral Fund for the Implementation of the Montreal Protocol, has facilitated projects such as this one, to help developing countries work towards the phase-out of the use of ozone-depleting substances.

Partners: Fondo Venezolano de Reconversion Industrial y Technologica, Taylor/Wagner Inc., Control Fire Systems Ltd., Government of Venezuela, Environment Canada – Environmental Technology Advancement Directorate

FUELLING CITY BUSES WITH RENEWABLE BIODIESEL

Transportation accounts for nearly 40 percent of total greenhouse gas emissions and is a major focus of Canada's strategy on climate change. In a unique demonstration and impact assessment project, 125 transit buses in Montréal are being operated over a one-year period on a range of biodiesel fuel blends. The use of biodiesel helps to reduce emissions of greenhouse gases and other air pollutants without compromising performance or reducing energy efficiency. The biodiesel fuel being used in this project is derived from agro-industrial waste, which includes 10 percent non-food-grade vegetable oil, 45 percent recycled cooking oil and 45 percent animal fat. The "BIOBUS" project is the largest demonstration of biodiesel in a North American transit system to date and is important for assessing the performance of this alternative transportation fuel in cold winter conditions. Social, economic and environmental impacts of the biodiesel option will be examined, and the potential marketing of this product as a fuel for a broader range of diesel-fuelled vehicles will also be considered. The engine test facility at Environment Canada's Environmental Technology Centre is a key partner in this project through the services it has provided in measuring emissions from the 15 different blends of biodiesel and conventional diesel fuels.

Partners: Rothsay/Laurenco, Canadian Renewable Fuels Association, Fédération des Producteurs de Cultures Commerciales du Québec, Société de Transport de Montréal, Gouvernement du Québec, Technology Early Action Measures, Canada Economic Development, Natural Resources Canada, Environment Canada – Québec Region and Environmental Technology Centre

PHOTOS: EC-ITC

REDUCED EMISSIONS FROM AUTO-RICKSHAWS

In many parts of Asia, affordable transportation is provided by auto-rickshaws — motorcycles modified for multipassenger use that are also major contributors to poor air quality. Significant reductions in air pollution are possible by converting these two-stroke engines to compressed natural gas or liquefied petroleum gas, replacing the use of leaded gasoline. Environment Canada's Environmental Technology Centre (ETC) has been working with Yugo-Tech Conversion Gas Systems Inc. of Mississauga to refine the technology, facilitating cost-effective conversion. Environment Canada is also providing a chassis dynamometer, developed at ETC, to assist in the conversion and maintenance of auto-rickshaws, as well as providing system setup and operator training. With commitments by the governments of Bangladesh, India and Pakistan to install refuelling stations in major urban centres, natural gas represents a viable and cleaner alternative fuel for over one million rickshaws. Successfully tested at ETC and in the field in both Pakistan and Bangladesh, this technology will significantly reduce the emissions of particulate matter, benzene and other smog-causing pollutants that affect the health and environment of urban residents. It has been estimated that if both new and in-use vehicles were converted, greenhouse gas emissions would be reduced by over 20 percent.

Partners: Yugo-Tech Conversion Gas Systems Inc., Environment Ministries of Bangladesh, India and Pakistan, Technology Early Action Measures, Canadian International Development Agency, Environment Canada – Environmental Technology Centre and Environmental Technology Advancement Directorate

GREEN TRANSIT FOR CLEAN AIR IN CITIES

The demand for "green" public transit has led to the testing and evaluation of innovative approaches to reducing particulate and greenhouse gas emissions from urban buses. A collaborative, multiyear effort involving Environment Canada's Environmental Technology Centre (ETC) and New York state and city governments is evaluating a range of alternatives, including alternative fuels such as natural gas, hybrid propulsion systems, fuel blends, lubricating oils and emission control technologies such as the Continuous Regenerative Trap, which has the potential to reduce total particulate emissions by as much as 90 percent. These alternatives are being tested on city buses in New York and Ottawa to determine their effectiveness in reducing emissions and their durability under typical operating conditions. This is a good example of how the expertise and facilities available at ETC are being used to help establish benchmarks and credible test methods for evaluating technology performance.

Partners: New York City Transit Authority, New York state and city governments, Ottawa-Carleton Transit, Environment Canada – Environmental Technology Centre

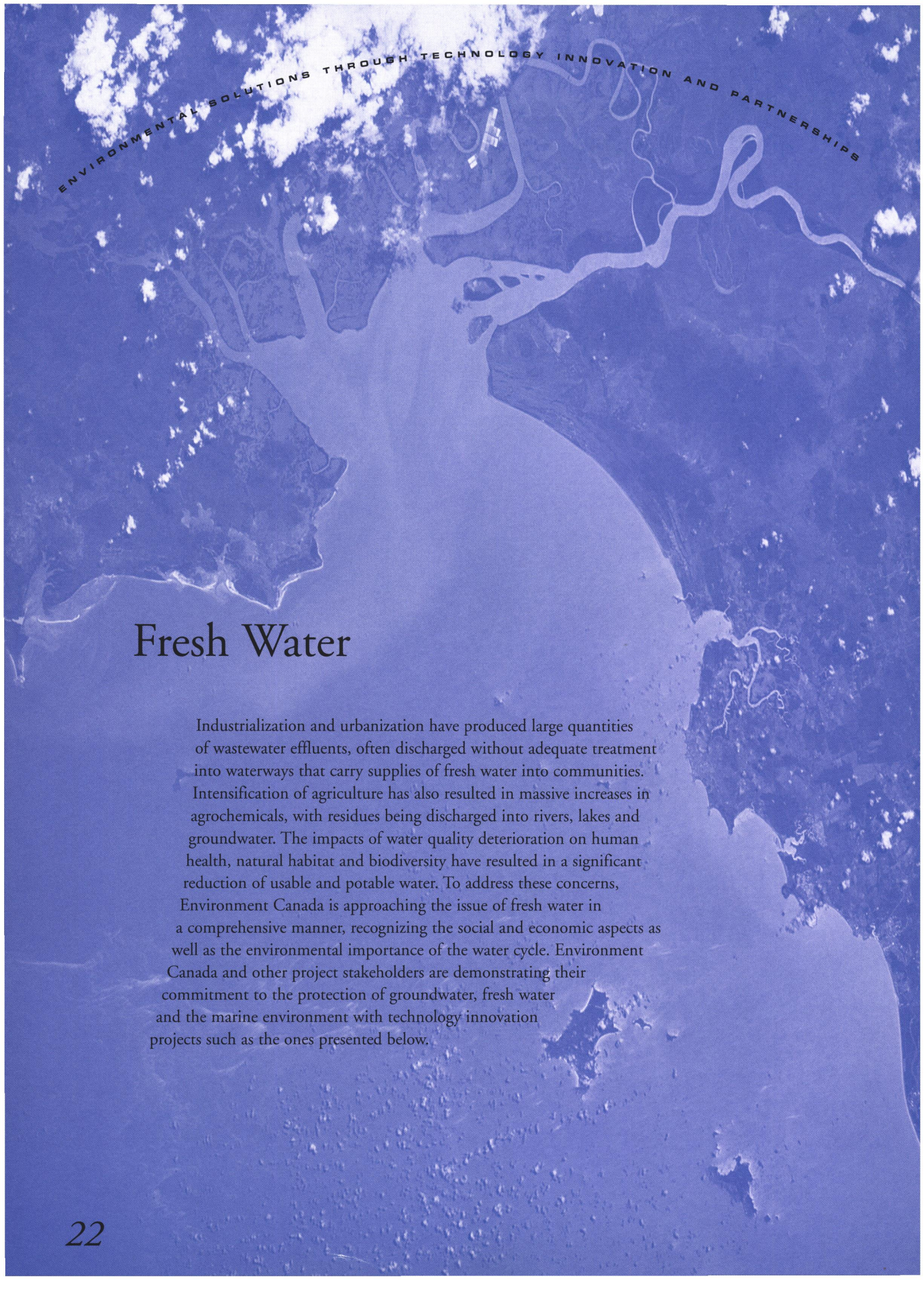
PHOTO: EC-ERMD

PHOTO: MG SERVICE

HEALTHIER AIR FOR INDOOR ARENAS

The operation of ice resurfacing equipment in indoor arenas threatens the health of arena users because of the resulting elevated levels of carbon monoxide and nitrogen dioxide. MG Service in Québec has demonstrated a solution that makes it possible to convert the internal combustion engines in ice resurfacers (commonly known by the commercial name of Zamboni™) to battery-powered electric propulsion units. The technology ensures better air quality at a lower cost. The benefits are numerous: carbon monoxide and nitrogen dioxide emissions are eliminated; the batteries require little maintenance and are recyclable; electric ice resurfacers require less maintenance; and the combination of lower fuel costs for the resurfacers and reduced facility ventilation requirements results in lower energy costs. Through support from Environment Canada's Québec Region, this project has helped to demonstrate the practical application of environmentally sound technology at the community level.

Partners: MG Service, Centre d'Expérimentation des Véhicules Électriques du Québec, TPR Inc., Canada Economic Development, Environment Canada – Québec Region



Fresh Water

Industrialization and urbanization have produced large quantities of wastewater effluents, often discharged without adequate treatment into waterways that carry supplies of fresh water into communities. Intensification of agriculture has also resulted in massive increases in agrochemicals, with residues being discharged into rivers, lakes and groundwater. The impacts of water quality deterioration on human health, natural habitat and biodiversity have resulted in a significant reduction of usable and potable water. To address these concerns, Environment Canada is approaching the issue of fresh water in a comprehensive manner, recognizing the social and economic aspects as well as the environmental importance of the water cycle. Environment Canada and other project stakeholders are demonstrating their commitment to the protection of groundwater, fresh water and the marine environment with technology innovation projects such as the ones presented below.

PROTECTING URBAN WATER SYSTEMS

Contaminants in stormwater and combined sewer overflows are a major concern in many municipalities during severe weather conditions. These contaminants affect water quality, as well as the health of aquatic systems in urban receiving waters. To demonstrate effective ways of controlling pollution during wet weather conditions, ETAD-Burlington has provided support to the evaluation of chemically aided settling, which removes suspended solids from combined sewer flows. Work undertaken in the City of Toronto as part of this program has shown that 80 percent of the total suspended solids can be removed using a cationic polymer. These findings suggest that cost-effective treatment of wet weather flows is technically feasible and can be considered by municipalities as a viable option for minimizing the environmental impact of combined sewer overflows.

Partners: City of Toronto, Ontario Ministry of the Environment, Great Lakes Sustainability Fund, Environment Canada – National Water Research Institute and ETAD-Burlington

PHOTO: PHOTOLUX 2001

WATER PURIFICATION AND AQUACULTURE

PHOTO: JOHN BABALUK, DFO

The impacts of aquaculture on water quality and availability and its potential to affect the quality of naturally occurring aquatic species are major concerns for this important industry. A cost-effective treatment system that permits water recycling is essential if high-quality fish are to be produced in an environmentally sound manner. Conventional methods of treating discharge streams tend to be prohibitively expensive due to the large volumes of discharge water involved. The Bio-Aqua project in Québec provides a cost-effective solution by integrating a water treatment system that provides for continuous recirculation. The system has been specially adapted to the production of Arctic char in a controlled environment, with the potential to benefit many other similar applications. This innovative project is meeting the financial and production requirements of the aquaculture industry while reducing its environmental impacts, thus making the industry sustainable over the long term.

Partners: Bio-Aqua Technologies, Enviro-Accès, Gouvernement du Québec, National Research Council of Canada, Canada Economic Development, Environment Canada – Québec Region

INNOVATIVE TECHNOLOGIES TO ADDRESS MANURE MANAGEMENT ON HOG FARMS

The hog farming industry is benefiting from the development of a number of innovative manure management technologies, supported by Environment Canada through its regional offices and the three Canadian Environmental Technology Advancement Centres (CETACs): Enviro-Accès, OCETA and CETAC-WEST. Because of the large scale of many hog farms, a number of environmental issues must be addressed, such as the reduction of greenhouse gases emitted by the operations, the prevention of surface water and groundwater contamination, and odour management.

The Environmental Technology Advancement Directorate has played a significant role in bringing together successful initiatives from three regions and facilitating cooperation and information sharing among the key partners.

PHOTOS: JIM MOYES

Highlights of the companies responsible for the development of these manure management technologies and key features of their products or processes follow below:

- *Integrated Waste Systems (IWS)* — a closed-loop process producing grey water (suitable for non-potable use on the farm) and reusable manure solids.
- *PDK* — use of infrared spectrophotometers as freestanding, on-site management tools for analyzing hog manure for nutrient values to optimize soil injection.
- *BP Environmental* — an aerobic digester system within an enclosed tank.
- *System Ecotechnologies Inc.* — a chemical process separating solid and liquid fractions of manure to recover ammonia, recyclable grey water and biosolids.
- *Global Earth Products* — Marvel™, an aerobic in-vessel composting system for liquid and solid manure, with forced aeration and mechanical mixing.
- *BIO-TERRE Systems Inc.* — an anaerobic digester to stabilize the organic fraction, reduce odours and produce energy from biosolids.
- *Cogenor Lanaudière* — an agricultural cooperative demonstrating use of aerated lagoons and aquaculture to treat hog wastes.
- *Rédal Inc.* — assessing market potential for a biotechnology developed by MD Technologies Inc. to convert hog wastes into biomass enriched with protein.
- *EPA Canada Ltée.* — Envirodom™, a lightweight, impermeable cover to protect and enhance storage capacity of new and existing hog waste reservoirs.
- *Envirogain Inc.* — Biofertile Solution, a package of technologies for the composting and treatment of manure biosolids and liquid wastes.

The effective treatment of hog waste has major environmental benefits, including reduced odours, reduced emissions of greenhouse gases and other air pollutants, the preservation of local groundwater and surface water resources, and the opportunity to improve soil quality through the use of treated hog manure in compost. Ancillary economic benefits can include the production of usable biogas, animal feed, organic fertilizer and recycled water. Environment Canada's support for these demonstrations will help to fast-track the implementation of environmentally sound solutions.

Partners: The broad range of private sector companies listed above, working in cooperation with Technology Early Action Measures, Enviro-Accès, OCETA, CETAC-WEST, Environment Canada – Québec Region, Ontario Region, Prairie and Northern Region and Environmental Technology Advancement Directorate

TURNING WASTE INTO HIGH-GRADE COMPOST

With the increasing cost and reduced availability of landfills, alternative approaches to waste management are high on the agenda. Clean It Green It Composting Systems Inc. has developed a process to turn non-hazardous industrial and municipal waste into high-grade compost. Materials accepted at the facility are first tested to ensure that the concentrations of trace elements are within established safe limits. Then, through a high-temperature aerobic process, hydrocarbon-contaminated soil, mixed municipal waste and industrial sludge are converted into high-grade compost. There are multiple benefits to this system: by diverting waste from landfills, methane gas emissions are reduced; by reducing the need for chemical fertilizers, nitrogen dioxide emissions are reduced; and by increasing soil moisture retention and reducing the amount of energy needed for irrigation, the use of compost reduces carbon dioxide emissions. CETAC-WEST has provided a series of technology development services aimed at helping *Clean It Green It* to successfully commercialize its systems.

Partners: Clean It Green It Composting Systems Inc., KC Environmental Group Ltd., CETAC-WEST, Western Economic Diversification, Technology Early Action Measures, Industrial Research Assistance Program, Agriculture and Agri-Food Canada, Environment Canada – Prairie and Northern Region

PHOTO: COREL CORPORATION

QUICK BACTERIA DETECTION SAVES WATER TREATMENT SYSTEMS

Corrosion of pumps and water systems in North America is estimated to cost $8 billion to $12 billion annually; diagnosing problems quickly can result in significant cost savings. Droycon Bioconcepts has developed two devices that quickly and accurately determine the presence and levels of specific bacteria in water treatment systems, without the need for more expensive and time-consuming testing by outside laboratories. One device identifies sulphur-reducing bacteria that can lead to hydrogen sulphide formation, resulting in biofouling, odours and severe corrosion of pipes and pumps. The second device identifies iron-related bacteria, which can result in unpleasant taste and odours, corrosion and clogging of wells. With support from Environment Canada, both of these devices have been verified under Canada's Environmental Technology Verification Program. In addition, work is continuing on devices for biochemical oxygen demand and coliform detection, in an effort to further improve the speed and efficiency of water testing for a range of contaminants affecting human health.

Partners: Droycon Bioconcepts, OCETA/ETV Canada Inc., Environment Canada – Environmental Technology Advancement Directorate

BETTER WAYS OF IDENTIFYING PATHOGENS

In the wake of the Walkerton tragedy, it has become clear that we need to identify and track waterborne pathogens from municipal wastewater treatment processes that can affect human health. One way to do this is through the development of new detection tools and techniques. Through its Strategic Technology Applications of Genomics for the Environment Program, ETAD-Burlington is developing new DNA-based methods for the identification of a wide range of pathogens from municipal wastewater treatment plants. This work utilizes state-of-the art DNA microarray technology, which is cost-effective in screening large numbers of pathogens at one time while reducing the risk of human exposure. This innovative assessment tool offers a practical way of accurately identifying pathogens of concern, thereby providing the necessary information to control pathogenic organisms and prevent the spread of waterborne diseases.

Partners: Environment Canada – ETAD-Burlington

AIRBORNE DETECTION AND MAPPING OF OIL SPILLS

Timely and accurate detection, identification and mapping of oil spills in the environment are greatly enhanced by technology developed at Environment Canada's Environmental Technology Centre (ETC). It is often difficult to distinguish oil from other materials, such as rocks and vegetation. A state-of-the-art Scanning Laser Environmental Airborne Fluorosensor prototype has been installed in ETC's DC-3 aircraft. This aircraft-mounted system is designed to unequivocally detect and classify the type of oil in a marine or terrestrial environment. Work is also continuing on the development of an airborne laser-ultrasonic sensor for the remote measurement of oil slick thickness. Environment Canada is helping to provide access to reliable information about the nature and extent of oil spills, greatly enhancing emergency response and enforcement efforts.

Partners: Barringer Research, Optech Toronto, Imperial Oil, U.S. Minerals Management Services, National Research Council of Canada, Transport Canada, Environment Canada – Environmental Technology Centre

PHOTO: EC-ETAD BURLINGTON

Sound Management of CEPA Toxics

The *Canadian Environmental Protection Act, 1999* stresses the importance of the precautionary principle to protect against the negative consequences of toxic contaminants in the environment. Environment Canada's initiatives to help clarify potential risks and to institute precautionary pollution prevention and sound management measures are supported by the work undertaken with its project partners on toxics management technologies. Examples of this work are provided below, with the ultimate goal of protecting the environment and the health of Canadians.

FOCUSING THE SUN'S RAYS ON ORGANIC POLLUTANTS

By harnessing the energy of the sun, a Canadian-developed technology is providing an energy-efficient and cost-effective way of removing toxic contaminants from groundwater. The Solaqua® process uses solar energy to treat problematic organic contaminants such as BTEX (benzene, toluene, ethyl benzene and xylene). Although a number of advanced oxidation process technologies already exist for treating contaminated groundwater, many of these are expensive to operate due to the high costs of system maintenance, including ultraviolet lamp replacement. Canadian researchers, in partnership with SAIC Canada, continue to develop and demonstrate this technology in a number of applications across the country. This is an excellent example of how the renewable and natural photooxidation properties of the sun can be harnessed to solve environmental problems in a more sustainable manner.

Partners: SAIC Canada, Trans Mountain Pipelines, Natural Resources Canada, Program of Energy Research and Development, Environment Canada – Environmental Technology Centre

PHOTO: SAIC CANADA

CAPPING ABANDONED OIL AND GAS WELLS

A new process developed by Steelhead Reclamation Ltd. will help to reduce potential leakages and venting of petroleum products from abandoned oil and gas wells, while reducing the use of highly toxic substances. In this process, liquid asphalt is used as a sealing medium for permanently abandoned wells instead of concrete, which can become brittle over time and develop fractures. The eventual breakup of the concrete could potentially result in the migration of petroleum fluids to uncontaminated water zones and cause gases to escape to the atmosphere. The use of asphalt would significantly reduce these occurrences and would also stop the downward drainage of surface runoff into usable aquifers and of groundwater into lower porous formations. As well, the use of the asphalt plug would replace the current practice of placing a highly toxic and suspected carcinogenic corrosion inhibitor inside the casing. A demonstration program consisting of 20 wells is being developed in Alberta and Saskatchewan to display this technology.

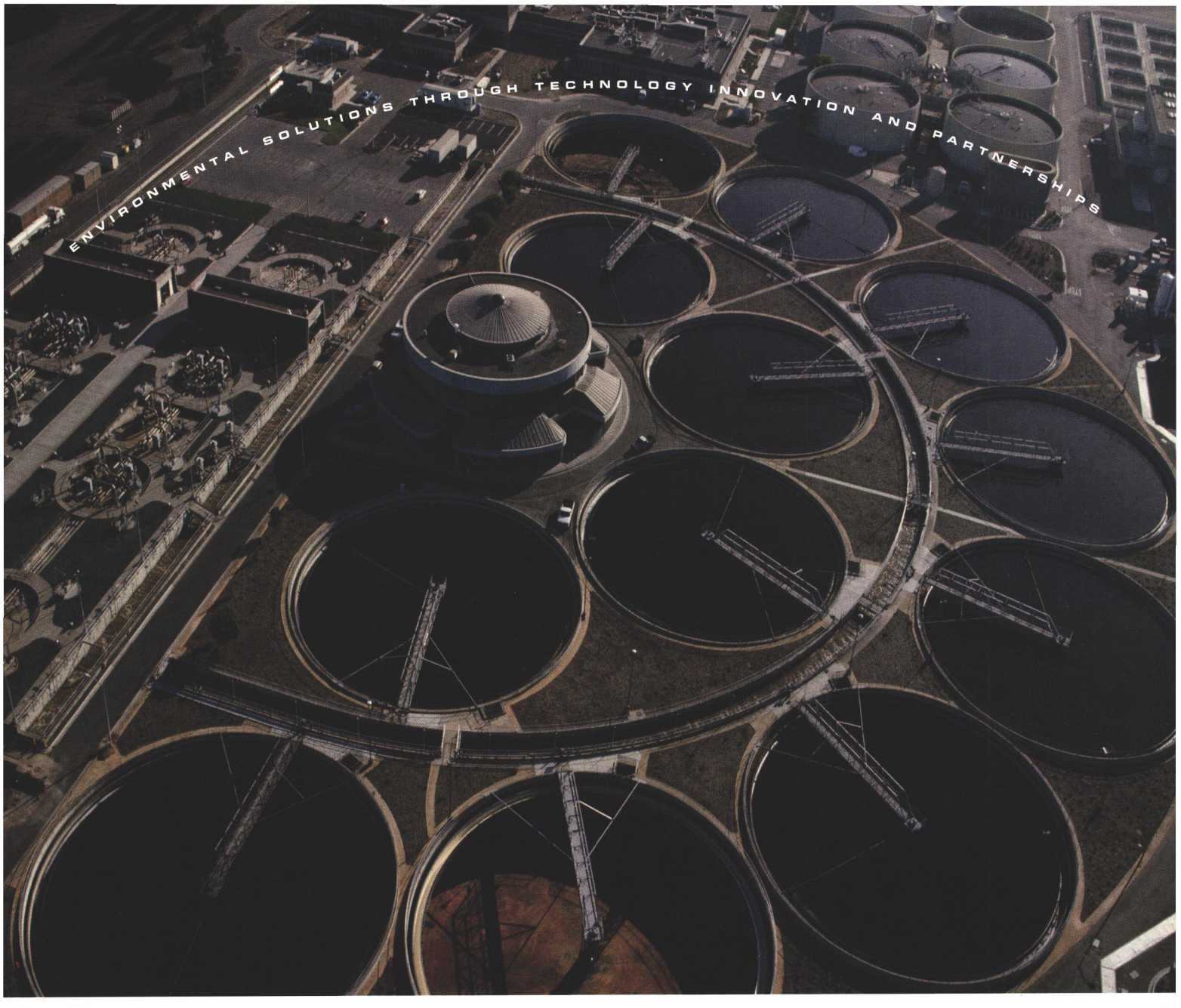
Partners: Steelhead Reclamation Ltd., Technology Early Action Measures, Alberta Environment, Saskatchewan Environment & Resources, Industrial Research Assistance Program, various industry participants, CETAC-WEST, Environment Canada – Air Pollution Prevention Directorate

PHOTO: SAIC CANADA

MICROBES CLEAN UP PCBS

The fast and effective treatment of PCB-contaminated soil is being demonstrated using an innovative two-stage bioreactor developed at Queen's University and microbe cultures at the University of British Columbia. The process involves extracting PCBs from soil using a solvent and feeding the solvent into a bioreactor containing two types of microbes; the first functions in the absence of oxygen (anaerobic) to destroy the chlorine bonds of the PCB molecule, and the second then functions in the presence of oxygen (aerobic) to break down the remaining dechlorinated molecule. The use of a two-stage bioreactor allows the two microbes to work sequentially, thereby speeding up the biodegradation process. SAIC Canada has been instrumental in its development and demonstration. This innovative technology offers a potential alternative to other more energy-intensive PCB remediation technologies, such as incineration.

Partners: SAIC Canada, Queen's University, University of British Columbia, Royal Military College, Memorial University of Newfoundland, Public Works and Government Services Canada, Environment Canada – Environmental Technology Centre



MINIMIZING THE RISK OF ENDOCRINE DISRUPTORS

Endocrine disrupting substances can have many adverse effects on aquatic organisms, including reduced reproductive success and biological abnormalities. These substances are often found in municipal wastewater. In response to this, ETAD-Burlington has recently completed a study on the effective removal of endocrine disrupting substances from municipal wastewater effluents. This work has contributed to improving our understanding of the fate and effects of these pollutants in wastewater effluents and sludges, as well as ways of optimizing available technologies and control strategies.

Partners: Hydromantis Inc., Environment Canada – National Water Research Institute and ETAD-Burlington

PLANTS — NATURE'S WAY TO CLEAN CONTAMINATED SITES

Phytoremediation is becoming a cost-effective alternative to multimillion-dollar cleanup and remediation efforts, both as a stand-alone process and as a complement to conventional cleanup methods. As a biotechnology solution, phytoremediation involves the use of plants to remove contaminants such as metals and petroleum products from soils, sludges, sediments and water. The selective cultivation of plants at a contaminated site allows the plants' natural processes to absorb, stabilize or mineralize the contaminants in the soil. The plants are then harvested and disposed of safely, with an additional opportunity to recover and recycle some of the more valuable constituents. Environment Canada's Environmental Biotechnology Applications Division and its partners are currently investigating the efficiency of plant species to extract lead and zinc from firing range soil in Chilliwack, B.C. In addition, a partnership with the U.S. Environmental Protection Agency and several petroleum companies is exploring the use of plant species to degrade petroleum hydrocarbons in different ecozones, with two test sites in Saskatchewan. A series of constructed wetlands in Trail, B.C., have also been designed to extract cadmium, zinc and arsenic from industrial landfill leachate. By supporting the development and demonstration of phytotechnology, Environment Canada is helping to find sustainable solutions to environmental problems.

Partners: Various petroleum companies, Cominco, Royal Military College, U.S. Environmental Protection Agency, University of Saskatchewan, Department of National Defence, Natural Resources Canada, Environment Canada – Environmental Biotechnology Applications Division

PHOTO: JIM MOYES

Knowledge Management

New approaches to environmental management continue to emerge, based on the recognition that the complexity of global environmental issues demands new and innovative strategies. Governments, communities and citizens, as well as the private sector, need access to reliable information on innovation. With respect to technology, it is our responsibility to improve the way in which technology-related information and data are managed and presented. Environment Canada recognizes this and is taking concrete action to ensure that essential information on environmental solutions is managed and communicated in a form that is applicable, accessible and clear. The following initiatives are presented to illustrate how Environment Canada is working in collaboration with various partners to provide the most up-to-date and comprehensive information on technology solutions.

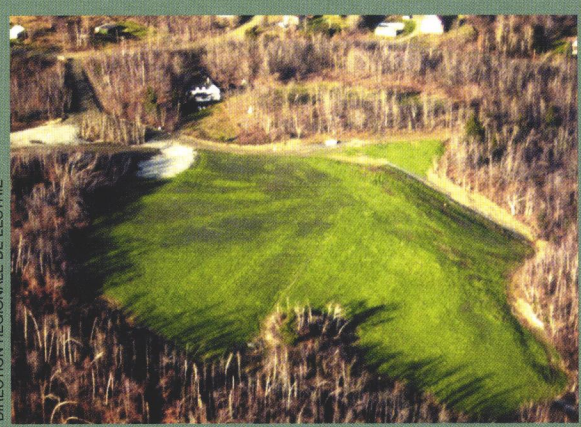


PHOTO: ROBERT GOULET, MENV, DIRECTION RÉGIONALE DE L'ESTRIE

ABOUTREMEDIATION.COM — A WEALTH OF KNOWLEDGE

Initiated by Environment Canada – Ontario Region, aboutREMEDIATION.com is a unique Internet-based tool for site remediation and brownfields development. Supported by a broadly based partnership, this web-based directory is a leading source of information on technologies for remediating soil, sediment, water and air at contaminated sites.

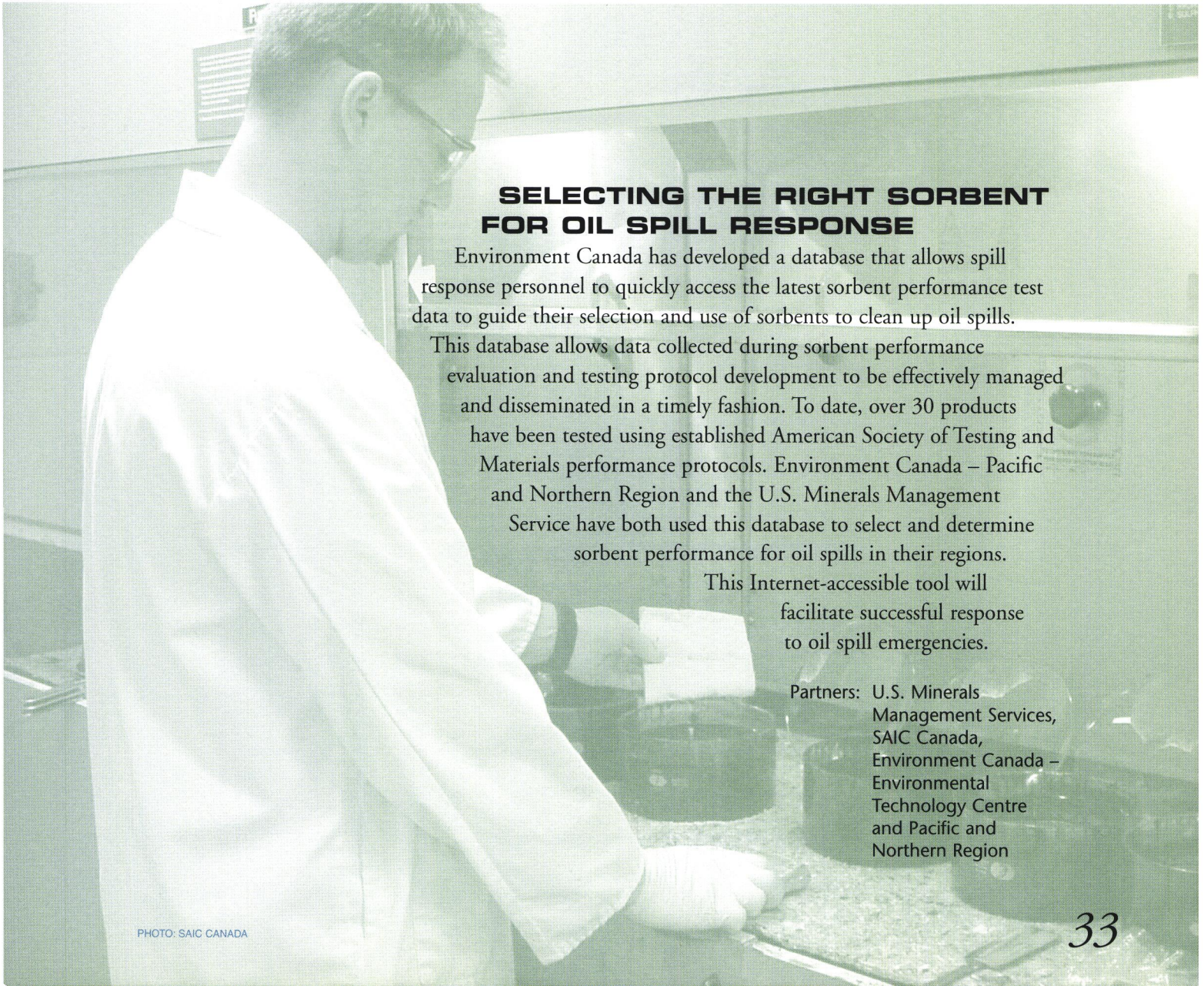
AboutREMEDIATION.com references proven technologies with user-specific site criteria, detailed technical specifications and capabilities, cost information on each technology, case studies and technology demonstrations, full contact information on technology developers and vendors, as well as technology schematics, photos, graphs and maps. AboutREMEDIATION.com greatly facilitates access to reliable information on available remediation technologies.

Partners: Royal LePage, EcoLog, OCETA, Province of Ontario, Aon Reed Steenhouse Inc., Gowlings Lafleur Henderson LLP, Environmental Canada – Ontario Region

PHYTOREM AND PHYTOPET — SELECTING PLANTS FOR SITE DECONTAMINATION

PHYTOREM has been developed by Environment Canada and its partners as a worldwide interactive electronic database of more than 700 plants, lichens, algae, fungi and bryophytes that have demonstrated the ability to tolerate, accumulate or hyperaccumulate a range of 19 different metals. Species with considerable potential to do this include sunflowers, ragweed, cabbage, Indian mustard, geranium and jack pine. Accompanying this database are 35 different search fields containing additional geographical, regulatory and eco-physiological data on each species. A complementary database, PHYTOPET, has been developed to provide information on plant species that degrade petroleum hydrocarbons in soil, sediments and water. These databases make it possible for the owners and managers of contaminated sites, both in Canada and around the world, to choose the species that suit their site conditions and take the steps necessary to secure regulatory approval for their use.

Partners: Environment Canada – Environmental Biotechnology Applications Division, Cominco, Royal Military College, University of Saskatchewan, Department of National Defence, Natural Resources Canada



SELECTING THE RIGHT SORBENT FOR OIL SPILL RESPONSE

Environment Canada has developed a database that allows spill response personnel to quickly access the latest sorbent performance test data to guide their selection and use of sorbents to clean up oil spills. This database allows data collected during sorbent performance evaluation and testing protocol development to be effectively managed and disseminated in a timely fashion. To date, over 30 products have been tested using established American Society of Testing and Materials performance protocols. Environment Canada – Pacific and Northern Region and the U.S. Minerals Management Service have both used this database to select and determine sorbent performance for oil spills in their regions. This Internet-accessible tool will facilitate successful response to oil spill emergencies.

Partners: U.S. Minerals Management Services, SAIC Canada, Environment Canada – Environmental Technology Centre and Pacific and Northern Region

PHOTO: SAIC CANADA

Moving Forward

The case studies presented in this report provide a review of projects, initiatives and programs illustrating how Environment Canada's Environmental Protection Service and regional offices are helping to foster technology development and demonstration. Through partnerships and innovation, Environment Canada's technology programs and initiatives are providing technology solutions to address the Department's priorities of climate change mitigation, clean air, fresh water and the sound management of CEPA toxics. Environment Canada's ongoing work with other departments and levels of government, as well as private stakeholders, builds on Canadian environmental technological capacity and capability, providing practical resources for achieving sustainable development. In the process, Canada's private sector will benefit by strategically positioning itself to play a value-added role in a competitive global economy.

PHOTO: ECOSMART™ CONCRETE

This report is intended to serve several immediate and future needs:

- sharing information on successful environmental technology within the Department, across Environment Canada's regions and in cooperation with other departments;
- acting as a reference document to communicate the Department's work related to innovative technology solutions to technically knowledgeable stakeholders;
- serving as a communications report to raise public awareness of Environment Canada's work in providing technology tools to address current environmental priorities;
- providing departmental recognition to the many stakeholders and partners for making these projects possible;
- identifying all those within Environment Canada who play an important role in bringing technology solutions to market; and
- functioning as a springboard to foster further innovation and potential collaboration and partnerships.

The Innovative Solutions Division of Environment Canada proposes to increase the value of this report by providing web links to an associated electronic version, in order to facilitate access to additional information on feature stories as well as to the programs and partners listed in Annex A and the projects listed in Annex B.

Based on the response to this report, the authors will give consideration to preparing a similar report within the next two years. This would provide an opportunity to review trends in the development and demonstration of technology solutions that target Canadian and international environmental challenges.

Annex A: Technology Partners and Support Programs for Environmental Solutions

Environment Canada provides leadership in linking science, technology and innovation to facilitate the implementation of practical environmental solutions. The Department has a broad range of resources to draw upon in providing relevant information and creating the right conditions for the implementation of sustainable solutions to environmental problems. Some of these resources, partners and support programs are listed below.

TECHNOLOGY PARTNERS

Environmental Technology Advancement Directorate (ETAD)

Headquarters: ETAD strategically develops, uses and transfers Canadian know-how and technologies to help protect and enhance the environment at home and abroad. Within ETAD, the Innovative Solutions Division focuses on the funding, development, demonstration and deployment of innovative technologies to address Canada's environmental priorities. The Division assists in providing real, verifiable and economic solutions to reducing priority environmental problems. This is achieved by:

- disseminating intelligence on environmental funding opportunities;
- focusing technology funding on Environment Canada's priorities;
- brokering technology demonstrations on priority issues;
- supporting deployment of innovative solutions; and
- showcasing innovative solutions.

Air Pollution Prevention Directorate (APPD): APPD responsibilities include managing and coordinating pollution prevention activities with respect to the global air issues of climate change and ozone depletion; transboundary air issues of smog, acid rain, particulates and hazardous air pollutants; pollution data, including the National Pollutant Release Inventory and conventional pollutants; transportation systems and related industries; and oil, gas and energy industries.

Toxics Pollution Prevention Directorate (TPPD): TPPD contributes science, knowledge, leadership and innovation to the prevention and resolution of pollution problems. TPPD determines the issues and risks associated with toxics, with particular focus on persistent bioaccumulative toxics. TPPD performs risk assessment and management for existing and new substances, oversees ocean disposal and marine protection from land-based activities, implements controls for transboundary movements of hazardous wastes, and provides support to producer responsibility and product stewardship programs in Canada.

Environment Technology Centre (ETC): ETC supports the Department's mandate for environmental protection nationally and internationally by developing and transferring pollution measurement, prevention, control and remediation knowledge and new technology in areas related to air pollution and unplanned releases of oil and hazardous materials, and by providing relevant specialized sampling and analytical expertise and services.

ETAD-Burlington (traditionally known as the Wastewater Technology Centre): ETAD-Burlington is an integrated, proactive research, development and demonstration facility dedicated to advancing technological solutions to environmental challenges. Among other activities, ETAD-Burlington develops and assesses novel wastewater technologies and advances those technologies that offer high potential for reducing waste and greenhouse gas emissions.

Environment Canada Regional Offices: Environment Canada's regional offices in the Atlantic, Quebec, Ontario, Prairie and Northern, and Pacific and Yukon regions are often the frontline points of contact and the facilitators and brokers for partnerships in environmental technology innovation. The regions are closely aligned with and engaged in the ideas, innovations and applications that take shape at the provincial/territorial and community levels.

The St. Lawrence Centre (SLC): Founded in 1988, the SLC studies the ecosystems of the St. Lawrence River and conducts research programs with the aim of better understanding how these ecosystems function, while maintaining up-to-date knowledge of the St. Lawrence River. As part of Environment Canada, the SLC uses science to support action, sharing the vast amounts of information its activities generate with a broad range of stakeholders. The Centre emphasizes mutual cooperation and a thorough understanding of river ecosystems throughout the St. Lawrence River basin to ensure that the principles of integrated management are realized.

National Water Research Institute (NWRI): Environment Canada's NWRI generates scientific knowledge through ecosystem-based research to support the development of sound government policies and programs, public decision-making and early identification of environmental problems. NWRI is located at the Canada Centre for Inland Waters in Burlington and at the National Hydrology Research Centre in Saskatoon.

Canadian Environmental Technology Advancement Centres (CETACs): The three CETACs — Enviro-Accès, OCETA and CETAC-WEST – were created by Environment Canada as not-for-profit corporations operating at arm's length from the government. They are mandated to help environmental enterprises demonstrate and deploy their technologies. The CETACs provide business and technical services to small and medium-sized enterprises and assist clients in the commercialization of innovative environmental technologies, products and processes. With

alliances involving business corporations, industrial associations, universities, research centres and federal and provincial/territorial governments, the CETACs act as catalysts for action on environmental issues such as sustainable development, technology verification, climate change, greenhouse gas reduction, energy efficiency, remediation, water and wastewater treatment and recycling.

Science Applications International Corporation (SAIC Canada): SAIC Canada is an advanced technology, research and engineering company focusing in the market areas of environment, energy and health. It provides high-technology support for both industry and government, applying scientific expertise, computer and systems technology and information technology. SAIC Canada undertakes technical work in the site remediation and environmental emergencies areas on behalf of Environment Canada, working closely with the Environmental Technology Centre through an alternative service delivery contract.

Other Organizations: Success in implementing practical, sustainable solutions to environmental problems requires close cooperation with a variety of other collaborating organizations in addition to those described above. These include other federal departments, such as Agriculture and Agri-Food Canada, Canada Customs and Revenue Agency, Industry Canada, Natural Resources Canada, National Research Council of Canada and the Canadian International Development Agency, as well as provincial and municipal governments. Other key collaborators include universities, research centres and the private sector.

TECHNOLOGY INNOVATION SUPPORT PROGRAMS

Environment Canada also works with a number of government programs that provide funding in support of technology innovation on a national and regional basis, including the National Research Council's Industrial Research Assistance Program (IRAP), Canada Economic Development, Western Economic Diversification, Atlantic Canada Opportunities Agency, and the Federal Economic Development Initiative for Northern Ontario (FedNor). Some major technology innovation support programs are described below.

Technology Early Action Measures (TEAM): A key component of the Climate Change Action Fund, TEAM supports federal programs that fund technology projects to reduce greenhouse gas emissions nationally and internationally, while sustaining economic and social development. TEAM brings together partners from all levels of government, industry and communities, and Environment Canada has been instrumental in facilitating several high-profile TEAM initiatives. In addition, Environment Canada technology specialists are participating in a number of TEAM projects.

Program of Energy Research and Development (PERD): PERD is a federal, interdepartmental initiative operated by Natural Resources Canada, with a funding component managed by Environment Canada. PERD funds research and development aimed at sustainable energy and directly supports 40 percent of all non-nuclear energy research and development in Canada undertaken by the federal and provincial governments. Environment Canada is actively involved in a number of PERD projects.

Environmental Technology Verification (ETV): Developed by Environment Canada and now in use around the world, the Environmental Technology Verification Program provides validation and independent verification of environmental technology performance claims. ETV Canada Inc. is the private sector company, owned by OCETA, that delivers the voluntary ETV Program, under licence by the Department. With ETV verification, environmental technology can be marketed worldwide as delivering on its promise.

EcoLogo^{M}: Environmental Choice Program: The Environmental Choice Program is administered under licence from Environment Canada by TerraChoice Environmental Services, Inc. The

Environmental Choice Program certifies the leadership of environmentally preferable products, technologies and services, which then bear the program wordmark, EcoLogo[M].

Great Lakes Sustainability Fund: The Great Lakes Sustainability Fund is administered by Environment Canada on behalf of eight Government of Canada departments that make up the Great Lakes Basin 2020 Action Plan team. The Fund is a five-year, $30-million program designed to accelerate Canada's commitment to restoring pollution "hotspots," designated as Areas of Concern by the International Joint Commission. Each Area of Concern develops a Remedial Action Plan to identify local beneficial use impairments and ways of eliminating these in order to improve the local environment. The Fund partners with federal departments, provincial ministries, municipalities, conservation authorities, the private sector, local community groups and volunteers to implement each Remedial Action Plan.

Toronto Regional Sustainability Program and Business Water Quality Program: These two programs were developed by Environment Canada's Ontario Region, in collaboration with OCETA, and other departmental, provincial and municipal partners and stakeholders. Their purpose is to implement pollution prevention planning and other environmental best management practices identified through a comprehensive facility review and assessment process. These programs improve the environmental performance of small and medium-sized enterprises and help reduce or eliminate the use of toxic substances.

EnviroClub™: This program was developed by Environment Canada's Québec Region and Canada Economic Development and also receives regional funding from IRAP. It helps small and medium-sized companies improve profitability and competitiveness through environmental performance by making them aware of pollution prevention and environmental management measures that support profitability and competitiveness.

Network for Environmental Technology Innovation (NETI): Environment Canada's NETI, recently established by ETAD, provides a venue to build strategic partnerships among technology users, developers and funding agencies so that environmental technology development is stimulated, demonstrated and deployed in Canada. NETI is creating community clusters that can address our environmental priorities. As it evolves, NETI will provide a link among the CETACs, the Canadian Environmental Sciences Network and other networks.

Annex B: Additional Technology Innovation Projects

The success stories featured in this report are just a few of the examples of projects in which Environment Canada's Environmental Protection Service and regional offices have played a key role in the development and application of practical environmental solutions. This section lists many more equally important examples of successful technology innovation projects, accomplished in collaboration with project partners. Due to space limitations, only a project title and an Environment Canada partner have been listed. Please contact the Innovative Solutions Division for further information on these projects or the contributing partners.

- Assessment of an *in situ* biobarrier for biotreatment of contaminated groundwater and soil (Québec Region)
- Evaluation of nitrogen oxide reduction technology for marine engines (Environmental Technology Centre)
- Pilot-scale demonstration of adsorption/microfiltration technology for arsenic-contaminated water (Environmental Technology Centre, SAIC Canada)
- Operation of a ground loop heat pumping system for building heating and cooling (Atlantic Region)
- Development of a removable structure for the protection of manure pits (Québec Region)
- Early stage development of particle separator/concentrator technology (Environmental Technology Centre)
- Evaluation of permeable reactive barrier technology for remediation of contaminated heavy metal groundwater (Pacific and Yukon Region)
- Pre-commercial demonstration of lithium-metal-polymer batteries in an electric vehicle application (Québec Region)
- Development and commercialization of an accelerated bioreactor for industrial wastewater treatment – System HydroKleen (OCETA)
- Bioreactor technology development for the treatment of contaminated soils and groundwater (Québec Region)

- Installation of geothermal technology — Alternative heating/cooling system (CETAC-WEST)
- Development of chassis dynamometer simulator technology — Multi-DST™ (Environmental Technology Centre)
- Evaluation of phytoremediation for toxic explosives residue (Québec Region)
- Knowledge-based technology development for control and management of bioremediation projects — Smartsoil (Québec Region, ETV Canada)
- Purification and reuse of hydrocarbon refrigerants in Cuba (Environmental Technology Advancement Directorate)
- Development of the "Coat" system for the analysis and continuous maintenance of lubricating oil (Québec Region)
- Assessment of innovative non-chlorinated wastewater disinfection methodologies (ETAD-Burlington)
- Development of landfill emissions sampling device — Dynamic Dilution Tube (Environmental Technology Centre)
- Development of electro-coagulation and electro-osmosis technology water and residue treatment (Québec Region)
- Installation of halon recycling and reclamation plants in India and Brazil (Environmental Technology Advancement Directorate)
- Development of fluidized-bed incineration technology for domestic waste to energy production — Biosyn (Québec Region, Enviro-Accès)
- Development of a database/website for contaminated site remediation technologies (Environmental Technology Centre, SAIC Canada)
- Demonstration of a reclamation technology process for management of ozone-depleting hospital anesthetics — Delta™ (OCETA)
- Thermal energy storage system technology for refrigeration units (Québec Region)
- Demonstration project to replace an ozone-depleting fumigant, methyl bromide, in China (Environmental Technology Advancement Directorate)
- Demonstration of renewable energy technologies for an eco-efficient, "zero energy" home (Atlantic Region)
- Demonstration of natural gas motorcycles for urban pollution mitigation in Egypt (Environmental Technology Centre and Environmental Technology Advancement Directorate)
- Groundwater remediation technology to dissolve/biodegrade PAHs from diesel spills (ETAD-Burlington)
- Development of dynamic dilution sampling system for vehicle exhaust emissions — DOES2™ (Environmental Technology Centre)
- Development of an oil-under-ice detector technology prototype (Environmental Technology Centre)
- Development of a performance verification method for manure management technology — MMTech (Ontario Region, ETV Canada)
- Development of technologies to minimize pharmaceutical discharges from municipal wastewater treatment (ETAD-Burlington)
- Application of underground thermal energy storage/solar heating for an apartment complex (Atlantic Region)
- Technology development to address acid mine drainage residues (Québec Region, Enviro-Accès)
- Technology development to increase solution gas flaring efficiency and performance from oil and natural gas production (Air Pollution Prevention Directorate)