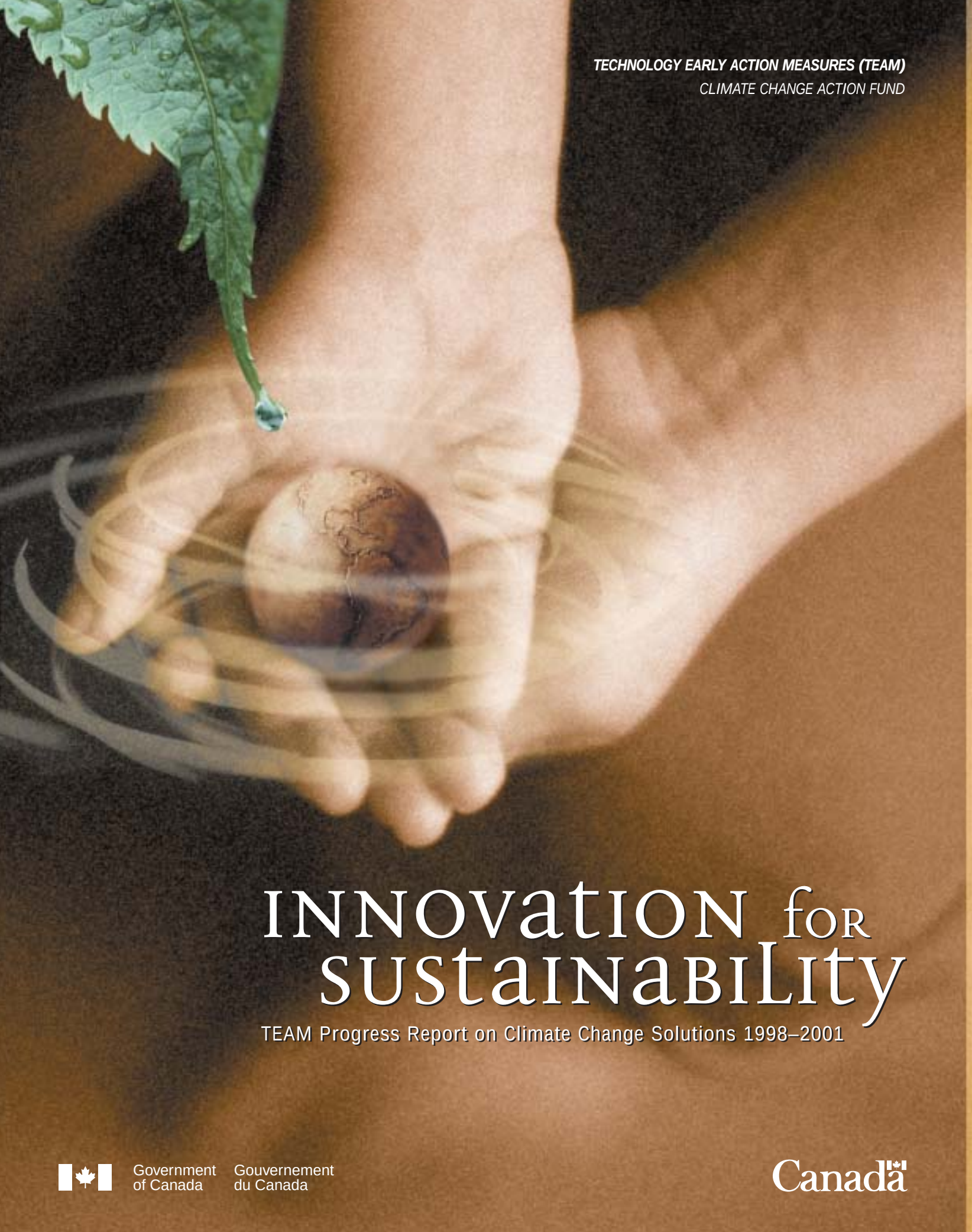


TECHNOLOGY EARLY ACTION MEASURES (TEAM)
CLIMATE CHANGE ACTION FUND

INNOVATION FOR SUSTAINABILITY

TEAM Progress Report on Climate Change Solutions 1998–2001

Government of Canada / Gouvernement du Canada

Canada

TEAM

at a glance

TEAM is a Government of Canada Climate Change Action Fund initiative that brings together partners in the public and private sectors to demonstrate in the marketplace new technological products and processes that reduce greenhouse gas (GHG) emissions. Since 1998, TEAM investments have served as catalysts for innovation operating under the leadership of Natural Resources Canada, Environment Canada and Industry Canada, with the participation of several other federal government departments.

By creating a nationwide, federal project-delivery distribution network and by harnessing the ideas, expertise, enthusiasm and investment of Canadian companies, TEAM has developed a reputation for being responsive and effective. By minimizing the requirement for administrative expenses and maximizing private sector involvement, TEAM has become a new model for service delivery. Its current domestic and international project portfolio of $780 million includes six times more investment from the private sector and other partners than from the federal government. This level of investment clearly demonstrates that Canadian firms are taking bold steps towards the future and that TEAM is an effective vehicle to help them get there.

This report highlights a series of Canadian success stories; not the end of the climate change problem but the beginning of an effective, viable, dynamic solution that brings together the best of Canada's companies and government experts.

TEAM at a glance

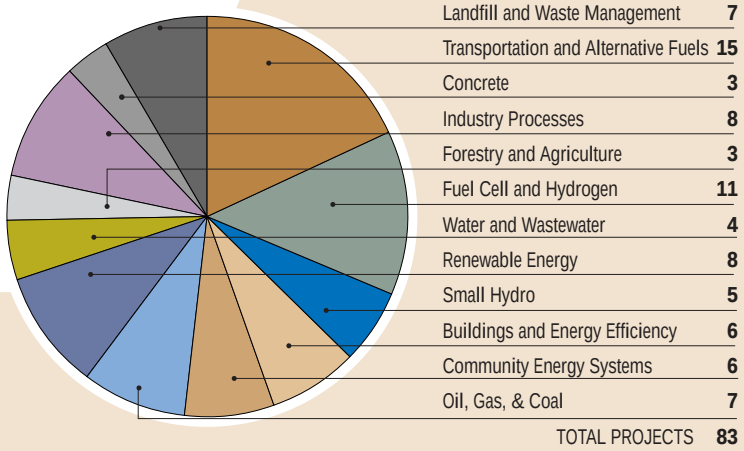
TEAM Mission:

To facilitate technology deployment and development in support of early action to reduce GHG emissions, nationally and internationally, while sustaining economic and social development.

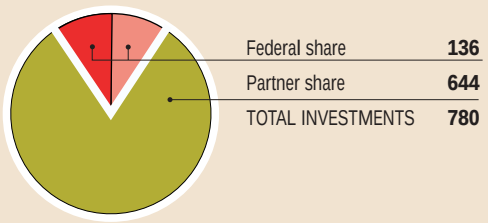
Business Snapshot

- **Projects in 53 Canadian cities**
- **13 countries worldwide**
- **248 private companies and organizations**
- **38 federal partner programs and departments**
- **42 other government, government agencies, and research institutions in Canada and abroad**

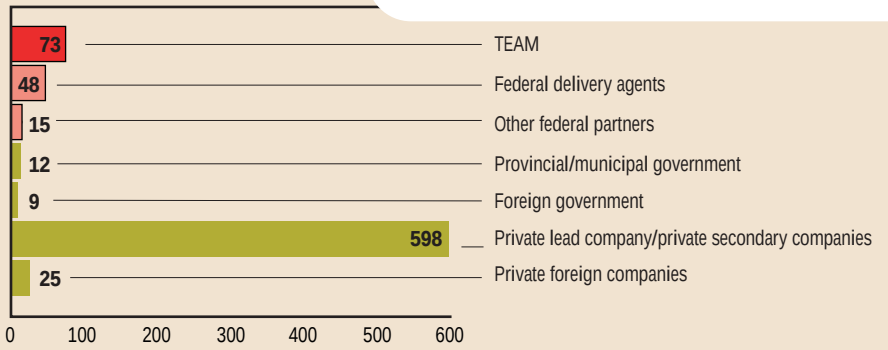
TEAM Sectors (Number of projects)



TEAM Funding ($ millions)



TEAM Partners ($ millions)



Project Locations

Canadian cities Offshore sites

TEAM receives high honours

In December 2000, TEAM received the prestigious Head of the Public Service Award, the highest possible honour that can be awarded to a Government of Canada program. TEAM was named for its “excellence in policy,” thereby recognizing the innovative model that has been created to match government policy priorities with business opportunities.

Visit the Head of the Public Service Award Website at:
http://www.tbs-sct.gc.ca/hr_connexions_rh/sigs/ Awards/Head_public/siglist_e.html

INNOVATION FOR SUSTAINABILITY

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acknowledgements

None of these projects would have been possible without the financing, long-term vision and creative efforts of the participating private companies, the technology project officers in participating federal programs and other governments in Canada and abroad.

This note also acknowledges the extensive support of the many individuals in federal departments and agencies who have contributed the time, effort and financial resources that have made possible the development, review and implementation of TEAM projects. Special thanks are extended to the TEAM Management Committee, Working Group Chairs and members, TEAM Operations Office staff, Climate Change Secretariat staff and to the communications and financial management staff of Natural Resources Canada, Environment Canada and Industry Canada.

Visit TEAM at the Government of Canada Climate Change Website and Project Database: www.climatechange.gc.ca

Additional copies of this report can be obtained from:
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CANADIANS MEETING THE CLIMATE CHANGE CHALLENGE

Climate change is an enormous challenge for humanity that requires a significant commitment of creativity and resources to deal with its far-reaching and unpredictable consequences. Its impacts go beyond the environment, affecting all aspects of society and the economy.

Changing patterns of temperature and precipitation, including extreme weather events, will have serious consequences for biodiversity, agriculture and land use. Although climate change will affect all nations, vulnerable populations and species at risk will suffer the most. Uncertainties about food and water security will contribute to political and economic instability and a growing number of environmental refugees. The Canadian North has become an example of what is to come. Thinner ice caused by shorter winters is limiting the ability of hunters to access food sources. Hotter summer weather has led to large-scale thawing of the permafrost, causing inland lakes to drain, killing freshwater fish.

Achieving greenhouse gas (GHG) reductions and adapting to the inevitable changes in climate represents a significant challenge for Canada. While it is still unclear which policy options will be employed to achieve GHG reductions and meet our Kyoto commitments, it is clear that new technology development is critical to meeting Canada's climate change objectives. GHG reductions to date have capitalized on low-cost options. Subsequent reductions will require strategic investment in new technologies that will ultimately help reduce the GHG intensity of Canadian industry and our Canadian lifestyle. TEAM turns the climate change challenge into an opportunity by investing in technologies that will help achieve further reductions in the future, and by positioning Canadian companies to supply global markets for GHG-reducing solutions. We are moving into an era with a new approach to energy production and use, one in which these TEAM partnerships are playing a significant role.

HOW TEAM WORKS

The initiative acts as a catalyst for the development of GHG-reducing technology. TEAM and its federal partners identify the market potential for technology projects, arrange for both funding and technical assistance for their development, and assist the proponents during the execution of the projects. The TEAM partners then help to expedite the entry of the resulting new products and processes into the marketplace.

TEAM builds on existing long-term, sustained government investments in technology research and development. Through the resulting investment partnerships, the Government of Canada, private sector and other collaborators contribute to early action on GHG reduction while promoting economic growth and social development.

TEAM invests in projects that involve a significant financial commitment from many parties, ranging from the business community to the provinces and municipalities, thus promoting national research and development in the private and academic sectors. All proposals are evaluated through an interdepartmental review process.

Overall TEAM administration and process is managed through a TEAM Operations Office. Eligible projects must meet TEAM criteria, including demonstration of innovation and resulting in, or leading directly to, GHG reductions. Projects must be approved under an existing Government of Canada technology advancement program offered by one of TEAM's federal partners. All TEAM projects are implemented and managed through these federal delivery programs.

In order to establish and maintain a high level of credibility, all TEAM projects must undergo a rigorous measurement and reporting process called SMART. Each SMART report clearly indicates the technical performance of the TEAM-supported technology and assures customers, investors and the public that these solutions are real opportunities.

Climate change and the Kyoto Protocol

The surface temperature of the Earth is regulated by what is known as the "greenhouse effect." Small quantities of a few gases in the atmosphere – like carbon dioxide, water vapour and methane – act like the glass in a greenhouse, trapping the heat generated by the sun's rays. These "greenhouse gases" (GHGs) maintain the Earth's climate in reasonable equilibrium within a temperature range that is perfect to sustain life as we know it. Climate change is the term we use to describe an increase in the concentrations of GHGs with the corresponding alterations to all aspects of weather, climate, wind patterns, and the temperature and currents of the oceans.

The potential consequences of climate change are so far-reaching and severe that, between 1997 and 1999, Canada and more than 160 countries signed the Kyoto Protocol that sets targets for the reduction of GHG emissions. It will take effect when ratified by at least 55 countries representing 55 percent of carbon dioxide emissions in 1990, the base year.

Canada has undertaken to achieve an annual emission level six percent below 1990 levels by the period 2008-2012. Because GHG emission production has increased since 1990, our reduction from "business-as-usual" levels has to be nearer to 26 percent in order to meet the target. This is a substantial challenge.

Climate Change Action Fund

The Government of Canada signalled an early and strong commitment to deal with the effects of climate change. It established the Climate Change Action Fund in 1998 under the leadership of Natural Resources Canada and Environment Canada, with the support of most other federal departments. A recent 1998-2001 report entitled "Responding to the Challenge: The Climate Change Action Fund (CCAF)" highlighted Fund progress and achievements. The primary initiatives of the Fund are:

Building for the Future

Support for the policy and consultation process, including the federal and national secretariats, analysis and modeling activities, development of policy options such as Targeted Measures and Domestic Emissions Trading, and related communications activities.

International Policy and Related Activities

Support to enhance Canada's international analysis and negotiating capacity in such key policy areas as Kyoto mechanisms, sinks, engaging developing countries and cleaner energy exports.

Public Education and Outreach

Communications activities directed at informing Canadians about climate change and encouraging them to take action.

Science, Impacts and Adaptation Research

Targeted research to improve understanding of climate processes and to assess the impact of climate change on the regions of Canada and the options for adaptation.

Technology Early Action Measures

Cost-shared support for the development and deployment of emission reducing technologies.

GHG reduction

ECONOMIC GROWTH THROUGH INNOVATION

Sustained economic success is required in order to maintain our standard of living, preserve the environment and keep our social programs strong. This, in turn, relies heavily on our continuing capacity to innovate so that our trade-dependent country can keep ahead of international competition. Through TEAM, the Government of Canada has tapped into the enormous entrepreneurial leadership across Canada with the know-how and capacity to develop new and innovative GHG reduction technologies. The Government of Canada has been very active in developing and implementing a strategy of encouraging innovation as one of the principal engines of economic growth in Canada, and fully recognizes the importance of the private sector in generating jobs and wealth.

The generation of new technologies and innovative approaches for reducing GHGs requires long-term research and development. TEAM helps bring the results of the sustained capital investment of government R&D programs and their private sector partners into the marketplace.

The projects in this section illustrate how good ideas about preventing and mitigating climate change can also stimulate technological innovation and economic growth.

Stuart Energy Systems Inc.

Advancing the hydrogen economy

Transportation is a major part of the economy and a major source of GHGs and air pollution. Therefore, there is considerable ongoing research to replace conventional gasoline and diesel-powered internal combustion engines with cleaner alternatives. One promising solution is to use hydrogen in fuel cells or internal combustion engines. In both of these technologies, hydrogen fuel combines with oxygen in the air to form water as a by-product.

Building on a long-standing relationship with Natural Resources Canada's (NRCan) Transportation Energy Technology Program, Stuart Energy is working with TEAM, NRCan and Technology Partnerships Canada on two projects to develop an inexpensive and reliable system for producing and delivering hydrogen. In one project, Stuart is constructing and testing a simple appliance to produce hydrogen for use in small installations, like private homes, to refuel vehicles powered by hydrogen. In the other project, Stuart is developing a fuel-delivery system that converts water to hydrogen at commercial refuelling stations.

These systems aim to reduce the cost of hydrogen production and distribution and increase its convenience – the main keys to success in setting up a viable infrastructure for hydrogen-fuelled vehicles. Both projects will pave the way to a more widespread, global adoption of these clean modes of transport, benefiting the environment and furthering innovation and economic growth in Canada.

Dynetek Industries Ltd.

Hydrogen fuel storage systems

The driving range of a vehicle powered by a fuel cell is limited by the amount of hydrogen it can carry on board. The simplest solution – adding more storage cylinders – is ineffective. The cylinders take up valuable storage space and add weight, which reduces the vehicle's fuel efficiency.

Previous NRCan R&D work with Dynetek focused on development of high pressure storage for natural gas and hydrogen. Dynetek is now pursuing another approach in which increased storage pressure allows more compressed hydrogen to be stored in the same space. This NRCan Transportation Energy Technologies Program-led TEAM project covers designing, building and testing a lightweight system that allows the gas to be kept at a pressure of 5,000 psi. This is 66 percent higher than existing systems and directly translates into a corresponding improvement in the driving range.

Global Thermoelectric Inc.

Optimizing fuel cell performance

Because they produce cleaner energy, fuel cells hold exciting potential in many sectors. However, their performance levels, cost-effectiveness and durability must be optimized in order to compete with conventional power sources. Following an earlier R&D collaboration with NRCan, Global Thermoelectric is receiving funds from TEAM through the National Research Council's (NRC) Industrial Research Assistance Program to investigate R&D issues applicable to next-generation solid oxide fuel cell components.

Furthermore, Global will be working with NRC's Institute for Chemical Process and Environment Technology over the next two years on advanced cell materials and new fabrication methods.

Global Thermoelectric, the world's leading manufacturer and distributor of thermoelectric generators for remote power applications, has already opened Canada's first solid oxide fuel cell production facility in Calgary. The company expects to begin commercializing its fuel cell technology in the next two years.

Suncor, Petroleum Technology Research Centre and partners

Moving towards CO_2 neutral heavy oil and oil sands production

Canada is blessed with vast reserves of fossil fuels in Western Canadian heavy oil and oil sands reservoirs. The challenge is to develop and produce these reserves in an environmentally sustainable manner. Based on long-term R&D supported through the Petroleum Recovery Institute (now part of the Alberta Research Council and the Petroleum Technology Research Centre), TEAM and NRCan's Western Research Centre are participating in three projects to optimize vapour extraction (Vapex) and thermal solvent technology for production of these reservoirs in a cost-effective and environmentally sound manner. The projects bring together the Petroleum Technology Research Centre (PTRC), Suncor Energy Inc. and 13 other companies to demonstrate that Vapex can offer cost effective heavy oil and oil sands recovery, can sequester CO_2 in reservoirs and will greatly reduce GHG emissions from the production process.

Hydrogenics Corporation

Hydrogen fuel cells for buildings

Fuel cell technology enables electricity users to have their own reliable source of cleaner energy and, if necessary, allow them to be independent of the electricity grid distribution system. These advantages show why it is widely believed that the first mass-market application of fuel cell technology will be in stationary power plants.

With investment from TEAM and the NRCan Transportation Energy Technologies Program, Hydrogenics Corporation is developing a prototype power generator known as the HySTAT. This system is fuelled by natural gas and uses proton exchange membrane (PEM) fuel cell technology to generate electricity. Emerging from previous R&D collaboration with NRCan on a fuel cell thermoelectric generator for the Arctic, the new Hydrogenics system is designed to provide both electrical power and space and water heating. Initially, the system will be available for adoption in multi-dwellings and small commercial buildings, with a possible later use in a wide range of other stationary power applications.

It is estimated that the widespread use of fuel cells in stationary power generators in Canada could reduce carbon dioxide emissions by one megatonne over 12 years. On the economic side, this is a new market, so there are excellent prospects for new jobs in the design and manufacture of this innovative technology.

"It means a great deal to Hydrogenics that the Government of Canada supports our efforts and a shared vision of clean and efficient energy through fuel cell technology."

Pierre Rivard, President and CEO, Hydrogenics Corporation

"It is the water treatment of the future. This technology has performed trouble-free, producing superb water quality with less energy consumption."

Terry Hockley and Gary Cascaden, Collingwood Public Utilities Commission

Orenda Aerospace Corporation

Biofuel for greener industry

Farming and industries that use forestry or agricultural products generate large quantities of waste based on biological materials used in their processes. This waste can be used as a feedstock under controlled conditions to create liquid "biofuel," a potentially huge source of energy for displacing conventional fossil fuels in many applications.

Orenda has been a pioneer in showing how turbine power generation systems can be operated using liquid bio-fuel and will further advance this technology with support from TEAM and Technology Partnerships Canada. The company will develop and test commercial-scale systems for engines that operate on biofuel and redesign and refine the combustion system, fuel processing and fuel storage. Orenda will also develop the design specifications for a full-scale commercial power generation system.

While reducing GHGs, the project will also provide many new high technology jobs in the fast-growing field of green power generation.

Zenon Environmental Inc.

Improving water quality

Many conventional processes for cleaning water have an adverse effect on the environment because of their high energy consumption. Recent outbreaks of microbial diseases have increased demand for membrane technology solutions to protect public health. Zenon Environmental, a key supplier of membrane technology for water purification, is pioneering the development of energy-efficient alternatives that provide both increased public health protection and lower energy use.

Zenon has been running a successful pilot project in Collingwood, Ontario, in which their new ZW-1000 membrane product provides clean water with more efficient use of energy to the local Public Utilities Commission. Zenon has had a long-term R&D relationship with Environment Canada's (EC) Wastewater Technology Centre. Support from TEAM and NRCan's Industrial Energy R&D Program will advance innovation further with another pilot project treating water of high turbidity and colour. In addition to less energy use, the improved purification process is expected to reduce the required frequency of cleaning and increase the life of the membranes. The new design should lead to a 20-percent decrease in energy costs and a concomitant reduction of GHG emissions. The economic spin-offs are already coming to fruition as Zenon expands the production capacity for the new membrane plant in Oakville, Ontario to launch this new product into the marketplace.

Automation Tooling Systems Inc.

Producing photovoltaic panels in China

There is no more sustainable and less polluting source of energy than the sun, so considerable research is being undertaken to find out how it can be harnessed economically. One promising way is to use photovoltaic cells in the form of panels that convert solar energy directly into electricity. Thanks to successful research, photovoltaic panels are becoming more efficient to use and less expensive to make – important prerequisites to widespread adoption.

Through the NRCan Photovoltaic Hybrid Systems Program, TEAM is helping Canada's Automation Tooling Systems develop innovative, semi-automated assembly lines to make these panels in Changshu (a city near Shanghai), with related test sites there and in Canada. The factory is expected to be operational in early 2002, after which the Canada-China joint venture expects to install the panels in homes and build solar power stations in communities throughout China.

"Westport's technology provides us with a means to meet Grande Prairie's long-term strategy for self-reliance in power generation and environmental stewardship."

Wayne Ayling, Mayor of Grande Prairie

Westport Innovations Inc.

Replacing diesel with natural gas

Because natural gas burns cleaner than diesel fuel, it promises to be an attractive option for replacing diesel in many applications, especially in stationary engines that generate electric power. To test this idea, TEAM and NRCan's Industrial Energy R&D Program are helping Westport to equip a small natural gas-fuelled generator to provide energy to a water and wastewater treatment plant in Grande Prairie, Alberta, and to export any excess to the Alberta Power Pool for distribution on its grid. The project is expected to reduce emissions of nitrogen oxides by 85 percent and carbon dioxide by up to 20 percent compared to the diesel engines it replaces. The successful outcome of this project is expected to create a considerable demand for innovative engines of this type and generate new investments in manufacturing capacity, with many new jobs resulting.

GHG reduction

fiscal responsibility

With strong leadership from the federal government, Canada has made great strides in improving the way in which public finances are managed. TEAM is an excellent example of how this philosophy translates into action. As the pie chart on the inside cover of this report illustrates, the program helps dollars go further through leveraging. That is, TEAM provides only part of the funding for projects, with the rest invested by other partners in the public or private sectors.

Through leveraging, more projects can be realized with a given amount of funding. Because others have financial stakes in TEAM projects, the risks are shared. By using existing Canadian government technology programs for delivery, TEAM minimizes administrative costs, making more money available for other GHG-mitigation investments.

The program has experienced a high degree of success in accelerating the development of new technologies that might otherwise suffer from a lack of funds or the inability to access the necessary technological expertise – as is often the case with smaller businesses.

A little leveraging goes a long way. The projects described in this section are examples of substantial commitments by the partners and thus are excellent illustrations of TEAM success in ensuring that limited public resources go further in meeting Canada's needs.

City of Toronto

Using lake water to cool buildings

Conventional air conditioning systems for office buildings use special refrigeration units that require a considerable amount of electricity to enable the refrigerants to cool the water used in the heat exchangers. The City of Toronto is working with NRCan's Community Energy Systems Program and other partners to use the cold water from the bottom of Lake Ontario as the cooling agent in the heat exchangers, thereby eliminating the need for electricity-intensive refrigerants. The project was triggered by the recognition that the proposed expansion of the drinking water facilities for the City of Toronto could create the opportunity for significant energy benefits.

The trial involves a few buildings in the downtown core. If an expected 90 percent reduction in electricity costs for air conditioning is achieved, it is expected that half the city core will be serviced in this way by the end of the decade. The environmental benefits go beyond a reduction in GHG emissions, because the cold lake water will also reduce the need for refrigerants, which in some cases are made from ozone-depleting gases. While funding is always important, the main federal contribution was NRCan's expertise, which played a key role in the city's decision to proceed, to the benefit of Toronto and eventually other municipalities.

Ottawa Energy and La Corporation de l'Écomusée

Making small hydro more efficient

Where rivers and streams are abundant, small-hydro generation has long been identified as a source of pollution-free electricity, although its application has been limited largely due to economic factors. There is a tremendous opportunity to use new design approaches and technology applications to increase the efficiency and attractiveness of small-hydro generating stations in Canada and elsewhere.

Two locations in Ottawa's National Capital Region, one out of use for 30 years and the other operating with outdated equipment, are demonstrating a new approach to upgrading small hydroelectric plants. With the assistance of NRCan's Renewable Energy Technology Program, these TEAM projects use innovative technology incorporating new governor systems and advanced turbines. By drastically improving economic viability, they are encouraging other operators in Canada and abroad to upgrade or rebuild their obsolete or shutdown plants. This retrofit option will reduce the need for expensive new installations and avoid the replacement of old hydro facilities with plants that use GHG-emitting fossil fuels.

EcoSmart Partners

Reducing the environmental impacts of cement

With one tonne of carbon dioxide produced for every tonne of cement made, cement production accounts for about eight percent of global emissions of GHGs. Cement production itself represents more than 90 percent of the energy used to make concrete. To put this in perspective, a car travelling 24 million kilometres emits 6,000 tonnes of carbon dioxide – a similar amount to that embodied in the concrete of a typical high-rise apartment building. Replacing cement in concrete structures with materials with lower environmental impacts could dramatically reduce GHG emissions.

Based on NRCan CANMET long-term R&D, one such replacement material is fly ash. This industrial waste product is the subject of TEAM- and EC-sponsored demonstrations in Vancouver. Working with EcoSmart Partners, concrete made with up to 50 percent fly ash has been successfully used in trials in several projects in the area. Besides its GHG emissions reduction benefits, the new material is more durable than conventional concrete, thus reducing the need for reconstruction and ongoing maintenance, and eliminating industrial waste that would otherwise be disposed of in landfill. Moreover, it is much less expensive than the cement it replaces. This is a winning combination, which explains why those involved in the demonstrations feel that EcoSmart concrete has excellent prospects for wider adoption.

Kinectrics and Siemens-Westinghouse

Prototype fuel cell heat and power plant

The process that produces electricity from solid oxide fuel cells also generates heat. This heat can be a useful by-product if it can be captured and utilized at a reasonable cost. To demonstrate the feasibility of such a process, TEAM and NRCan's Industrial Energy R&D Program have invested in a Siemens-Westinghouse project with Kinectrics (formerly Ontario Power Technologies) to build the world's largest solid oxide fuel cell generator (250 kWe) that combines electricity production with space and water heating.

Through its highly efficient conversion of fuel, use of hydrogen-rich natural gas, and the elimination of energy losses from power distribution, the plant has the potential to reduce GHG emissions by 57 percent compared to conventional coal-fired generating plants. A commercial version of this plant would be even more attractive to run because it would have the additional advantages of low operating and maintenance costs and could also be modified to use alternative fuels such as propane or diesel.

A separate but linked TEAM project brings together the NRC's Industrial Research Assistance Program and a number of small technology developers on various support elements of this project.

GFI Control Systems Inc.

Making gasoline and diesel engines run cleaner

Fossil fuel-burning vehicles, which emit GHGs and pollute the atmosphere, have been the focus of considerable research aimed at reducing these impacts, particularly in large urban centres. TEAM and Technology Partnerships Canada are funding a project that will enable GFI to develop alternative fuel control technology for sequential multi-point fuel injection (SMPI) engines, which are used in most vehicles manufactured today. This project also involves the development of specialized fuel system components for use in hydrogen-powered fuel cell vehicles.

The investment will lead to environmental benefits in the form of reduced GHG and other polluting emissions, and will put Canada in a very good position to capture some of the developing markets for this innovative technology.

"This investment allows GFI to maintain a leadership role in advancing new clean vehicle technologies."

Lloyd Austin, President, GFI Control Systems

Iogen Corporation and PetroCanada

Ethanol production from biomass

Bioethanol – ethanol made from biomass such as wheat straw – has the potential to substantially reduce GHG emissions not only because it burns much more efficiently than gasoline in automobile engines, but also due to the emission reduction potential over the entire manufacturing process. Among other advantages, the fuel requires minimal changes to cars and gasoline stations, enhances engine performance and reduces engine deposits.

Historically, it has not been possible to produce ethanol in an economically viable manner. This has constrained its widespread adoption as a fossil fuel substitute. However, Iogen has developed a technology for producing ethanol that promises to be both economical and energy efficient. It uses enzymes to break down cellulose – typically farm waste products such as straw and oat hulls – into sugars that can be inexpensively converted to ethanol.

Based on a long-term research effort by Iogen, supported by NRCan and Agriculture and Agri-Food Canada (AAFC), TEAM and Technology Partnerships Canada are supporting the production of bioethanol from a wide variety of biomass. Iogen and its partner, PetroCanada are leading the project. Their goal is to make bioethanol available at a viable price. Commercial bioethanol plants could revitalize rural communities across the country, providing farmers with new markets and creating additional direct and indirect employment opportunities.

QuestAir Technologies Inc.

Helping to make zero-emission vehicles a reality

Over the past eight years, QuestAir has developed a unique technology that separates the oxygen from the other gases in an air stream that uses just one percent of the space of traditional systems, at a much lower cost. NRCan's Transportation Energy Technologies Program has provided R&D support throughout the development period. The Department of National Defence (DND) also contributed to this R&D effort. The technology can be used successfully with fuel cells: by using enriched oxygen instead of air, fuel cell efficiency can be improved by between 25 and 30 percent. Based on QuestAir's successful, long-term effort, TEAM and Technology Partnerships Canada have invested in a major project that will put the finishing touches on this technology and help the company become the world leader in this field.

QuestAir is developing dedicated oxygen and hydrogen purifiers that are efficient, competitive and meet the packaging needs of fuel cell systems produced by the leading company in the field, Ballard Power Systems. The government investment has also helped the company to design an oxygen and hydrogen purification system that can increase the operating efficiency of high-temperature fuel cell systems. Another success has been the design and demonstration of a compact industrial-sized pilot plant that reduces the production costs of large volumes of oxygen. This will be valuable as the removal of nitrogen from feed air creates nearly pure carbon dioxide for sequestration. Pure oxygen also increases thermal efficiency, and eliminates the generation of nitrogen oxides.

NATION BUILDING

One of Canada's strengths is its economic diversity. Our mixed economy has attracted a wide spectrum of entrepreneurs and investors working in communities across the country, creating new opportunities through economic diversification. Many of these entrepreneurs also have developed linkages with other countries, helping Canada to contribute effectively to international development and growth.

TEAM projects reflect this diversity and demonstrate how all Canadians have a stake in working together for our mutual betterment. The projects in this section illustrate the regional and international significance of TEAM projects in providing important seed money to catalyze environmental improvements with local economic spin-offs across Canada and around the world. In lowering GHG emissions, the medium and long-term effects of TEAM have no boundaries; however, the immediate benefits – both economic and social – are local.

Ontario Centre for Environmental Technology Advancement

Optimizing manufacturing processes to reduce energy consumption and GHG emissions

The Eco-Efficiency Innovation (EEI) Program is a unique initiative that helps small and medium-sized companies optimize plant processes and reduce energy, materials and water usage through the implementation of high-return investment projects. Designed specifically for manufacturing plants, the EEI approach identifies opportunities for companies to make eco-efficiency improvements by retrofitting their plants with state-of-the art process equipment. The program has been offered to companies in the food and beverage, automotive parts, plastic, and chemical manufacturing sectors, and is expanding to other sectors.

The Ontario Centre for Environmental Technology Advancement is providing overall management and delivery of EEI in partnership with the NRC's Industrial Research Assistance Program, the Business Development Bank of Canada and NRCan's Office of Energy Efficiency. To date, over $10 million in investment projects have been identified at 29 facilities, representing a potential of more than more than 20,000 tonnes of reduced CO_2 emissions per year.

British Columbia Institute of Technology, BC Hydro and others

Using photovoltaic cells as building materials – Building Integrated Photovoltaics

Electricity consumption by residential, institutional and commercial buildings accounts for about 30 percent of the energy demand in Canada. One environmentally appropriate option for supplying this type of electricity is the photovoltaic cell. Using readily available materials to generate electricity directly from sunlight without noise or pollution, photovoltaic cells have long been used in the aerospace industry and in remote locations, but their more widespread adoption has been limited by high capital investment costs.

In Burnaby, B.C., through a TEAM/Canada Mortgage and Housing Corporation (CMHC) investment, a group of private and public sector organizations is investigating a creative solution to the problem: using photovoltaic cells to play a dual role as both aesthetically-pleasing building materials and electricity generators. They are using a technology known as Building Integrated Photovoltaics (BIPV) that incorporates photovoltaic panels into building facades or roofs. This project is providing valuable information on how BIPV operates and how it should be installed to maximize electrical and construction performance. It will contribute significantly to the huge and growing worldwide market for innovative and cost-effective solar photovoltaic applications.

Hydro-Québec, Bell Canada, Canada Post Corporation, Cities of Montréal and St. Jérôme, Les Services électrique Blanchette, Ministère des Transports du Québec

Cleaner urban air from electric vehicles

Transportation is a major source of GHG emissions and air pollution in urban areas because most vehicles are powered by engines that burn fossil fuels. Depending on the source of generation, electricity can be a cleaner alternative, especially if the cost of batteries can be reduced and their capacities increased. However, even when these problems are solved, electric-powered vehicles still need adequate battery recharging facilities at the right locations and at the right price.

In 1999 Hydro-Québec and its partners brought together a TEAM, EC and Développement Economique Canada (DEC) project to demonstrate the operational requirements of a network of electrical vehicle (EV) users in Montréal. Transport Canada and Department of National Defence also participated in the project. The initiative was designed to test the performance of the vehicles and the refuelling infrastructure and show that battery-powered vehicles, with an adequate infrastructure, are a technical and cost-effective solution for vehicle fleets in an urban environment.

The project has generated greater awareness among Québec policy makers and the general public of the environmental benefits of EVs. A Ford dealership has been accredited as the first official supplier of EVs in Canada and the first public/private EV charging infrastructure has been established in Montréal. These concrete results help to quantify GHG reduction benefits resulting from the implementation of EV infrastructure; define what would be needed to support the broader commercial introduction of these vehicles in Canada; and identify the substantial contribution to improving the quality of urban air.

City of Sudbury and Toromont

District heating and cooling to save energy

The surplus heat produced during power generation and industrial processes is often wasted, despite its valuable energy content. In Sudbury, this wasted energy is being captured in a district heating system that replaces the individual heating and cooling plants of several buildings in the downtown core.

This project, which includes contributions from NRCan's Community Energy Systems Program, is a combined heat and power "cogeneration" plant. The plant takes advantage of improved technologies to capture and use waste heat, thereby reducing fossil fuel consumption and carbon dioxide emissions, in this case by more than 21,000 tonnes per year. Information from this project has already been used to improve the management of existing and future community energy plants, leading to the more widespread adoption of district heating and cogeneration with their accompanying GHG emissions reduction benefits.

Saskatchewan Research Council/PRECARN

Better control systems for alternative-fuel vehicles

Reducing the costs of vehicles operating on natural gas and fuel cells will make them more competitive with conventional vehicles and therefore more attractive to potential buyers. To help meet this objective, TEAM, NRCan's Transportation Energy Technologies Program and Precarn are supporting a project to develop intelligent control systems for these vehicles. New computer software for the monitoring and control of the gaseous injection and fuel storage systems in these vehicles will help make the transition from conventionally powered vehicles to natural gas and hydrogen vehicles simpler, safer and more efficient, thus making them less costly to purchase and operate.

The project's resulting successes will reduce GHG emissions and position Canadian technologies at the forefront in this field. Canada will be able to market the technology worldwide while creating new intellectual property and jobs in the high-tech sector.

Town of Watson Lake, Yukon Territorial Government and private partners

Capturing waste heat for space heating

Despite its cost and environmental impacts, diesel oil is used extensively for power generation in Northern Canada, largely because there are few alternatives. As with many other electricity plants, only some of the heat from this fuel is used for generation and, in the case of diesel plants, as much as 60 percent is discharged into the air as waste. The need for environmental improvement is clear.

With the assistance of NRCan's Community Energy Systems Program and TEAM, a community energy system is being set up in Watson Lake that recovers the waste heat from a local power station and uses it to heat several buildings. The system will save diesel oil and reduce carbon dioxide and other emissions because many existing oil-burning furnaces will no longer be needed. Substantial reductions in GHG emissions and air pollution will result from the adoption of this technology, and lower operating costs will be realized in areas where buildings must be heated for a large part of the year.

Powerbase Automation Systems Inc.

Making small-hydro plants more efficient in China

The environmental benefits of small-hydro technology coupled with its improved technical and economic viability are making it an increasingly attractive renewable energy source around the world. Canada is at the forefront of many of the improvements taking place in this field, as exemplified by the equipment and know-how being applied by Powerbase in this project.

With support from TEAM and NRCan's Renewable Energy Technologies Program, the company is installing five of its automated turbine control units in small-hydro plants in China. The project will improve the plant efficiency and, by displacing energy that would otherwise be produced by coal, lower GHG emissions. A successful outcome of this trial will trigger plans to extend the technology to 55 other plants in China. This will provide economic benefits both in Canada and in the participating communities.

CFS Alternative Fuels/Vancouver Island Capital Region District

Separating and purifying landfill gases with cryogenic processing

Landfill gas, generated by decomposing organic material in garbage dumps, contains methane and carbon dioxide – two GHGs that can be put to good use if captured and purified. This pilot project, using technology developed in part at the University of Victoria, has demonstrated a system to process some of the gas generated by the Hartland Landfill near Victoria, British Columbia. Through TEAM and support from NRCan's Renewable Energy Technologies Program, the project has proven that using cryogenic (very low-temperature) gas separation and liquefaction technology is a cost-effective way to convert landfill gas into liquefied natural gas and industrial grade carbon dioxide.

The process has several benefits in addition to reducing GHGs. The methane produced is a clean alternative fuel source that can replace less environmentally acceptable fuels, and the converted carbon dioxide can be used in greenhouses, food processing and in many other applications as an alternative to the commercially produced gas normally used. The success of the project has already led to the formation of new business partnerships and additional investments to capitalize on the potential of this innovative technology.

S.C.P. Group, Lamjung Electricity Development Company

Hydropower in Nepal

Hydroelectricity is usually associated with huge dams across large bodies of water. Increasingly, however, smaller hydroelectric generating facilities are being considered. These smaller units have the advantages of the larger scale plants – producing clean and renewable energy – but can be more easily blended into the landscape and are therefore less disruptive to wildlife and human communities. Canadian companies have significant and growing expertise in this field. Their innovative technology has reduced the costs of small hydro so that it now holds tremendous promise as a major source of clean new power in Canada and abroad.

S.C.P. is working closely with NRCan's Renewable Energy Technologies Program and the local electricity company in a project to develop a small-hydro plant at a site on the Khudi River 150 kilometres from Kathmandu, Nepal, that will generate over 25,000 MWh a year. It will first be used to replace thermal generation and then to extend electricity distribution to a population that currently relies on wood fuel and residues for its energy. Once the small-hydro plant becomes fully operational, this TEAM project will position Canadian expertise in a part of the world where small-hydro resources remain largely untapped and the market for electricity is largely undeveloped.

"This project is positioning our company as well as Canadian renewable energy technologies in the market in Nepal and South Asia."

François Vitez, Project leader, S.C.P. Group

Better health, cleaner environment and improved security

Canadians are aware of the strong linkage between their health and the quality of the water they drink and the air they breathe. The positive correlation between energy-efficiency, GHG mitigation and the overall quality of the natural environment makes TEAM projects attractive from many angles. These projects are wise and timely investments because they are developing cleaner energy options, reducing our reliance on scarce resources, improving the quality of life of Canadians, and stimulating the economy.

There is another potential advantage from GHG-reduction efforts. As we reduce our dependence on conventional energy technologies and fuels, we gain greater control of our economy and reduce the risk of supply-side uncertainties. By improving the economics and environmental performance of conventional energy supplies, future generations of Canadians will be able to enjoy the positive benefits of these precious resources. Moreover, by investing in renewable energy sources, communities and individuals have a greater voice in energy-related matters.

The projects highlighted in this section show how TEAM achieves not just fiscal but also social leverage by investing in projects that fulfil their main GHG-reduction mandates, and at the same time, result in better health, a cleaner environment, and improved security.

Blossom Agritech Ltd., LRPM -Sunset Solar Systems, AWMC Management Corp/PDK Projects Inc., IWS Integrated Waste Systems, Cleenit-Greenit Composting Systems, CETAC West

Reducing the environmental impacts of hog farms

Hog farms with improper manure management systems have major adverse impacts on water, air, and soil. These pose a considerable challenge to this expanding industry. A TEAM and Western Economic Development (WED) financial investment and AAFC expertise are supporting a demonstration of technologies designed to mitigate these problems. Five companies are installing a variety of new manure-management systems in working farms in order to help hog producers make informed decisions on appropriate solutions for their particular operations.

The new systems, which are simple to use, cost-effective, and do not require a complicated infrastructure, are expected to provide many benefits. These include considerably lower GHG emissions (notably methane), cleaner waste, odour reduction, lower water use, and opportunities for improved nutrient management in land application.

Alberta Research Council consortium

Using carbon dioxide emissions to produce a valuable energy source

The reserves of oil and gas needed to supply the energy for growing global development are dwindling. In addition to expanding renewable forms of energy, new approaches to sustainable energy production are needed in the oil, gas and coal sectors. One innovative example is a project by the Alberta Research Council, with support from TEAM and EC. The Council is leading a consortium of 17 partners in a demonstration project in Fenn-Big Valley to assess how to exploit the rich supplies of methane trapped in Alberta's deep and unmineable coal beds.

The project uses Enhanced Coalbed Methane Recovery technology to inject carbon dioxide or flue gas (carbon dioxide and nitrogen) into the coal beds, where it is adsorbed by the coal and stored in the underground seams. The methane that is displaced can then be captured and used as a source of energy. If this technology is shown to be successful, a possible application would be to set up power plants near the coal beds and inject the carbon dioxide they produce into the coal beds to produce methane that can then be used to fuel the plants – a cycle in which virtually no carbon dioxide would be released into the atmosphere.

Because there is an abundance of suitable coal beds in North America, and in countries such as China, the process has the potential to be widely applicable. If adopted, it would have a significant impact on GHG reduction from fossil fuel production and use.

"It's exciting to see our industrial clients understand the important role of business in environmental improvement."

"We have been able to get further support due to TEAM support. In fact, we could not have done it without you."

Kirstin Castro-Wunsch, P.Eng., Principal, KC Environmental Group Ltd

KC Environmental Group Ltd., CETAC West

Converting residential and industrial organic waste to compost

Households and industry are huge generators of organic waste products that, if not properly treated, decompose in a manner that emits GHGs and causes problems with smog and odours. This TEAM/Western Economic Development/Environment Canada project uses the *Cleanit Greenit System* to aerobically treat organic waste from industry and municipalities in Spruce Grove, Alberta, converting it into commercially usable, Grade A compost for use in landscaping. The project participants are also seeking new ways to deal with some of the industrial by-products that cannot be composted as yet. The plant has been so successful that it is well on the way to becoming a self-sustaining and expanding business.

Syncrude Canada Ltd. and the Canadian Oil Sands Network for Research and Development

Treatment of oil sands waste

Even though the waste products generated at mining sites – known as tailings – are an inevitable result of the processes used, good management practices can reduce their environmental damage. The oil sands extraction process currently used in the Fort McMurray project is typical in that it produces tailings that are stored as a slurry in special ponds until they settle and can be discarded. The tailings are especially fine, so the settling takes a long time in very large containment ponds.

Based on the results of a long-term federal, provincial and industrial R&D collaboration, WED, TEAM and NRCan's Western Research Centre are providing support for the demonstration of new technology that virtually eliminates the need for settling ponds. By thickening the tailings into a paste, the total volume of tailings can be reduced and reclaimed more quickly, thus requiring less energy. This means that lower GHG emissions will result from the reduced release of methane, less carbon dioxide will be produced because of the energy savings, and the possibility of other contaminant releases will be limited. This innovative technology will also improve the viability of oil sands operations, thus boosting the economy of the area.

Mikro-Tek, INFOR

Improving the ability of trees to absorb carbon dioxide in Chile

Carbon sequestration is a natural process whereby trees and other plants capture and slow the release of carbon dioxide into the atmosphere. In this TEAM/Industry Canada Sustainable Cities Program project, Mikro-Tek, a Canadian environmental technology company, is collaborating with INFOR, a Chilean forestry research institute, to demonstrate a technology designed to increase the rate of carbon sequestration in forests. Before being planted, seedlings are innoculated with naturally occurring fungi to increase their capacity to absorb moisture and nutrients from the soil. As a result, higher survival and growth rates will lead to an increase in sequestered carbon and a corresponding lower proportion of GHGs in the atmosphere.

The experiments are taking place in Chile, where the temperate climate allows for fast assessment of the results. If the inoculation proves to be successful, it will then be applied to Canadian tree planting.

ēKOCOMFORT™ Home Comfort Systems Project

Developing products and the market for new residential ventilation, space and water heating systems

The vast majority of homes use separate appliances for ventilation, space and water heating. A more efficient alternative is to integrate all the operations into one multi-purpose system, but to date such integration has been too expensive to be widely adopted. Until recently, most members of the building equipment industry believed that although this integrated approach holds great promise, the business risks of independently overcoming the obstacles to developing these products are too high.

In 1999 NRCan's Buildings Energy Technology Program and TEAM provided the coordination and catalytic investment that allowed a number of Canadian manufacturers to combine their expertise and equipment in the development of six models of integrated, highly efficient appliances. This innovative partnership, with a total of 17 companies and associations, and financing from TEAM and the National Research Council's (NRC) Industrial Research Assistance Program, is now ready to commercialize new, high-performance systems for sale in Canada and the rest of the world.

Natural gas-fired equipment ratings do not currently consider electrical consumption. ēKOCOMFORT™ products are designed not only to use natural gas efficiently, but also to cut electricity costs by 50 percent over typical current practice. The technology is expected to provide consumers with a saving of about $200 on an annual electricity bill, and reduce GHG emissions.

Polymarin-Bolwell Composites Inc.

Reducing production costs for an environmental benefit

As the world looks for alternative, non-polluting and renewable energy sources, wind energy is becoming increasingly popular. The recent federal tax incentives for wind energy will dramatically increase its use over the next few years. With support from NRCan's Renewable Energy Technologies Program, Polymarin-Bolwell Composites (PBC) has developed its specialized blade-making technology and anticipates becoming a major supplier of blades to both domestic and international markets.

The new manufacturing techniques that PBC has developed for generic wind turbine blades are now also being applied on other glass fibre products PBC manufactures. These techniques have decreased production and labour costs, and have significantly improved the environmental working conditions for employees, due to a 95 percent reduction in the use of harmful solvents and waste air emissions in the plant. The company has already been able to find other applications for the manufacturing process and, as a result, has become a primary supplier to manufacturers of aircraft flight simulators.

"There is no comparison. The process does not require us to wear masks or get in touch with the resin. The whole working environment has improved dramatically."

Ernie Smith, Specialist, Polymarin-Bolwell Composites Inc.

GHG reduction

Becoming Climate Change SMART

A cornerstone of TEAM's success is the rigorous GHG review process that all proposals must pass before obtaining funding. A true measure of TEAM's progress towards reducing GHGs will be evident in the results from the recently implemented System of Measurement And Reporting to TEAM (SMART). In this respect, TEAM is a front-runner in providing the knowledge and tools to government and private sector partners to become climate change "SMART."

TEAM-designed SMART is a simple and inexpensive approach to provide a clear and accurate measure of the technical performance and GHG reductions of TEAM projects. Companies benefit by establishing credibility, gaining experience, showing leadership, building competitive advantage, and developing a network of partners and relationships prepared to participate in future climate change initiatives. The Government of Canada benefits through the confidence and knowledge that its investments have real-world results, are fiscally responsible, and reduce risks associated with climate change.

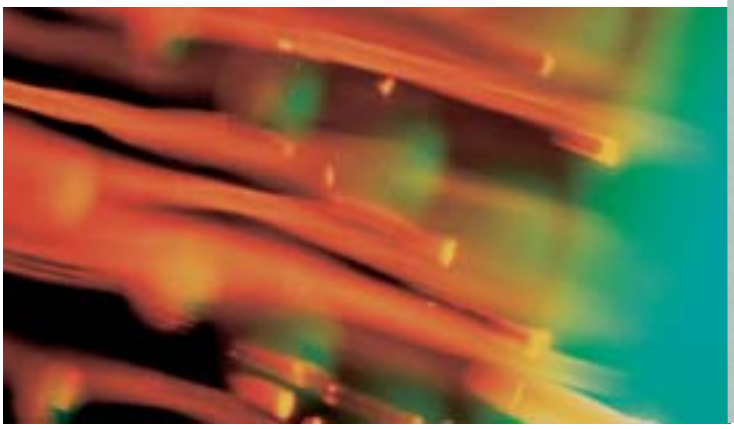
Several projects from TEAM Phase I (1998-2001) are establishing demonstrable results and TEAM is now able to begin to engage these projects through the SMART procedure. The results of SMART reports will benefit companies and both new and ongoing projects.

TEAM, the Voluntary Challenge Registry, and Partners for Climate Protection

TEAM assists its partners in becoming leaders in GHG reporting – the first step in beginning to reduce GHG emissions – and thereby encourages the commercialization of innovative GHG-mitigation technologies.

All TEAM project proponents are required to register with the federal Voluntary Challenge Registry (VCR) operated by VCR Inc., or with the Partnership for Climate Protection (PCP). The VCR includes public records of the action plans and progress reports that form the basis for planned GHG-emission reduction activities by organizations, individuals and groups throughout Canada. PCP is a group of municipal and regional governments across Canada working together to reduce GHG emissions produced locally by building capacity and partnerships, supporting champions, providing and ensuring access to information, facilitating involvement, and quantifying GHG emissions.

Through these important links, TEAM has contributed significantly to the formation of new partnerships in finding more ways to reduce GHG emissions, thereby compounding the achievements of TEAM.



TEAM project pipeline

TEAM continues to demonstrate technology early action measures in several sectors. Innovative proposals continue to feed the TEAM "project pipeline," leading to new project investments that are leveraged among a diversity of partners and sectors. Recently approved projects cover a broad range of GHG-mitigation technology, in areas such as "clean coal," pulp and paper, waste treatment, energy efficiency, residential energy systems, bio-diesel fuel systems, photovoltaic solar homes, and energy-efficient technologies for agriculture.

Mariah Energy

GHG assessment of small-turbine technology for cogeneration

This completed TEAM project was supported through the NRC Industrial Research Assistance Program. A joint Canada-U.S. technical performance assessment of the Mariah Energy micro-turbine system, which provides electricity and heat to residential and commercial buildings, has yielded a number of exciting results. In comparison with electricity generated from a mixture of sources in Alberta, the assessment reported a total unit efficiency of over 78 percent and a reduction of 55 percent CO_2 and 97 percent NOx. These reductions could occur due to the use of waste heat and indirect emissions reductions from grid electricity.

This confirmation of the viability of this technology is expected to have tremendous environmental and economic benefits for Canada. The results from this assessment will also be used to develop guidelines that will help to optimize the performance of cogeneration plants in Canada and elsewhere. Furthermore, the collaborative nature of this assessment, conducted jointly with the US Environmental Protection Agency, opens a valuable government-to-government link between our two countries and should improve Mariah's access to the US market.

APPENDICES

TEAM Projects

Title/Description	Project Investments ($K) Total	TEAM/CCAF	Other Government of Canada
Demonstration of production of ethanol from agricultural waste and crops	$ 25,309	$ 4,980	$ 4,987
Montreal 2000 project on electric vehicles	$ 2,400	$ 420	$ 100
Packaged hydrogen supply for fleet use	$ 17,700	$ 1,500	$ 5,541
Small hydro control systems (China)	$ 3,349	$ 557	$ 260
Vehicle natural gas conversion technology & infrastructure (Romania)	$ 993	$ 515	$ 120
Personal hydrogen refueling appliance	$ 4,025	$ 2,123	$ 375
Conversion of auto rickshaws to natural gas (Pakistan)	$ 1,244	$ 347	$ 235
Toronto Renewable Energy Co-op wind power	$ 1,549	$ 347	$ 121
Gas turbines for bio-oil	$ 4,024	$ 667	$ 1,265
Separating oxygen from air	$ 14,135	$ 1,500	$ 3,447
Residential Advanced Integrated Mechanical Systems (ëKOCOMFORT™)	$ 13,985	$ 2,900	$ 715
Municipal solid waste digestion for power production	$ 27,220	$ 2,725	$ 4,080
Sudbury cogeneration district energy	$ 14,500	$ 545	$ 200
Development of high grade pelletized activated carbon	$ 1,157	$ 434	$ 145
Green diesel from pyrolysis oil	$ 410	$ 156	$ 50
Energy efficiency demonstrations (Brazil)	$ 1,947	$ 585	$ 132
Coal bed methane	$ 15,300	$ 2,250	$ 750
Solid oxide fuel cell materials	$ 550	$ 163	$ 94
Micro-turbine cogeneration for heat & electricity	$ 668	$ 113	$ 38
Solar PV for developing & developed countries (China)	$ 10,426	$ 3,267	$ 847
Building Integrated Photovoltaics	$ 300	$ 110	$ 40
MAP extraction of edible oils	$ 7,987	$ 1,987	$ 400
Intelligent control systems for fuel cell and natural gas vehicles	$ 2,945	$ 765	$ 350
Solid oxide fuel cell combined heat & power demonstration	$ 17,280	$ 1,119	$ 373
Solid oxide fuel cell balance of plant development	$ 1,600	$ 378	$ 200
Landfill methane recovery bioreactor (Egypt)	$ 1,740	$ 760	$ 140
Natural gas motorcycles (Egypt)	$ 1,410	$ 580	$ 110
Cryogenic processing of landfill gas to high value products	$ 1,091	$ 563	$ 210
On-farm demonstration of manure treatment technologies	$ 459	$ 84	$ 400
Development of PEM fuel cell powered 50kW and 10kW generators	$ 6,078	$ 1,678	$ 400
Watson Lake district energy	$ 750	$ 109	$ 28
Community solar water heating	$ 5,346	$ 760	$ 231
Next generation gaseous fuel control program	$ 19,500	$ 1,142	$ 5,358
Small-engine technology development	$ 27,294	$ 1,000	$ 8,280
Residual heat recovery from diesel power generation	$ 1,440	$ 408	$ –
Toronto deep lake cooling	$ 110,150	$ 1,150	$ –
Small and medium enterprise eco-efficiency	$ 3,996	$ 578	$ 624
High capacity compressed H_2 storage	$ 1,044	$ 534	$ 150
Oil sands thermal solvent process	$ 697	$ 189	$ 8
Szego mill process	$ 854	$ 324	$ 108
Plasma heat & surface treatment	$ 2,686	$ 859	$ 286

Title/Description	Project Investments ($K)		
	Total	TEAM/CCAF	Other Government of Canada
High-volume fly ash roller compacted concrete	$ 743	$ 315	$ 48
Multi-country solar drying (India, Panama, Costa Rica, and others)	$ 1,583	$ 583	$ 175
Energy from waste cell technology (Argentina)	$ 2,280	$ 987	$ 240
Forestry seedling inoculation (Chile)	$ 2,767	$ 872	$ 155
High volume supplementary cementing materials in concrete construction	$ 27,589	$ 257	$ 106
Energy-efficient fuel ethanol plant	$ 47,500	$ 1,188	$ 375
MARVEL composting technology	$ 460	$ 200	$ 55
Low head hydro (Poland)	$ 12,151	$ 746	$ 245
Advanced natural gas technologies	$ 11,598	$ 787	$ 262
Hybrid electric bus	$ 28,190	$ 1,000	$ 7,457
Energy efficiency and renewable energy (Russia)	$ 3,316	$ 354	$ 2,072
Development of new process for generic wind turbine blades	$ 1,791	$ 960	$ –
Paste technology (thickened oil sands fine tailings)	$ 2,272	$ 607	$ 15
Co-composting of industrial/municipal waste	$ 1,786	$ 336	$ 190
Morgan Falls small hydro electric demonstration	$ 943	$ 400	$ 72
Life cycle assessment techniques to reduce GHG emissions from buildings	$ 765	$ 225	$ 90
VAPEX engineering and economics for heavy oil recovery	$ 315	$ 65	$ 38
Gas infusion technology for wastewater treatment facilities	$ 1,554	$ 620	$ 269
Small hydro development (Nepal)	$ 7,530	$ 680	$ 100
Hydrocarbon refrigerant (Cuba)	$ 337	$ 152	$ 40
Systems for the rapid cooling of foods in commercial kitchens	$ 4,989	$ 803	$ 250
Development of a Canadian 10 kW and 60 kW wind turbine	$ 2,246	$ 999	$ 162
Projects for development of an adopt-a-roof solar thermal technology program	$ 230	$ 82	$ 42
Development of an aluminum production automated anode replacement system	$ 4,883	$ 803	$ 350
Green roof infrastructure-technology demonstration	$ 840	$ 320	$ 105
Thermal solvent process extension	$ 357	$ 92	$ –
Fuel cell enabling electronics	$ 9,275	$ 2,605	$ 1,500
New membrane platform for water & wastewater treatment	$ 4,075	$ 1,575	$ 500
Natural gas vehicle home refueling appliance	$ 9,030	$ 1,036	$ 1,983
EcoSmart concrete	$ 154,551	$ 1,090	$ 720
Biodiesel bus demonstration	$ 3,701	$ 436	$ 100
High Pressure Direct Injection (HPDI) natural gas engines	$ 2,265	$ 805	$ 250
Biomass gasification system for greenhouse applications	$ 765	$ 335	$ 60
Bio-diesel technology process demonstration unit development	$ 1,228	$ 465	$ 138
Improved cellulase enzymes for fuel ethanol production	$ 5,475	$ 1,875	$ 900
Neighborhood rehabilitation and energy efficiency demonstration (China)	$ 7,297	$ 980	$ 365
Anaerobic-aerobic wastewater treatment in the pulp and paper industry	$ 19,798	$ 2,348	$ 750
Demonstration project for peak electrical power generation (Brazil)	$ 1,988	$ 797	$ 180
Energy efficiency pervaporation technology	$ 1,058	$ 350	$ 102
Air-cooled twin turbine refrigerant compressor	$ 9,598	$ 1,506	$ 478
Advanced clean coal technology to new and existing coal-fired power plants	$ 4,998	$ 1,000	$ 666
	$779,654	**$72,806**	**$ 62,802**

TEAM Places in Canada

Arviat, NU
Boucherville, QC
Burnaby, BC
Calgary, AB
Cambridge, ON
Carleton Place, ON
Chatam, ON
Chicoutimi, QC
Cornwall, ON
Dartmouth, NS
Delta, BC
Deschambault, QC
Dorval, QC
Edmonton, AB
Fenn Big Valley, AB
Fergus, ON
Fort McMurray, AB
Fort McPherson, NT
Fredericton, NB
Gatineau, QC
Grand Prairie, AB
Vancouver, BC
Guelph, ON
Hinton, AB
Kitchener, ON
Lambton, ON
Lennox, ON
London, ON
Matane, QC
Merrickville, ON
Mississauga, ON
Montreal, QC
Nanticoke, ON
Ottawa, ON
Oakville, ON
Orangeville, ON
Oxford Country, ON
Perth, ON
Port Alberni, BC
Quebec City, QC
Regina, SK
Saskatoon, SK
Shawinagan, QC
Spruce Grove, AB
Sudbury, ON
Timmins, ON
Tiverton, ON
Toronto, ON
Victoria, BC
Waterloo, ON
Watson Lake, YK
Windsor, ON
Winnipeg, MB

TEAM Places in Other Countries

Brazil
Argentina
Chile
China
Costa Rica
Cuba
Egypt
India
Pakistan
Panama
Poland
Romainia
Russia

Private Companies and Organizations

A.E Concrete Precast Products Ltd.
AFS
Agile Systems
Air Liquide Canada Inc. (ALC)
Alberta Energy Company
Algonquin Power Systems
AMEC Earth and Environmental
Amoco Canada Petroleum Company Limited
Architectura
Architecture Alliance
Artian Construction
Arviat Development Corporation (ADC)
AS Moore Consulting
ATCO Power Canada Ltd.
ATHENA Sustainable Materials Institute
ATS Automation Tooling System, Inc.
AWMC Management Corp
B.C. Gas International (Canada)
Baker Mcgarva Hart Architects
BC Building Corporation
BC Gas
BC Hydro
BC Ready-Mixed Concrete Association
BC Vegetable Growers
Business Development Bank of Canada
BDCL Design Group Ltd.
BIOX Corporation
Blossom Agritech Ltd.
British Petroleum
Burlington Resources
Busby and Associates Architects
Café Duran (Panama)
Cairo Solid Waste Management Authority (CSWMA)
Canadian Clean Power Coalition
Canadian Electrical Association
Canadian Environment Industry Association (CEIA)
Canadian Hydro Control Systems Inc. (CHCS)
Canadian Manufactured Housing Association
Canadian Portland Cement Association
Canadian Renewable Fuels Association
CanAmera Foods
Cement Association of Canada
CEMEX (Mex.)
Central Canadian Structures
Centre d'Expérimentation des Véhicules Electriques du Québec
CFS Alternative Fuels Inc.
Charonic Canada Inc. (CCI)
Chessen Group Inc.
Chesterman Property Group
Chevron Canada Resources Ltd.
Chreod Ltd.
Cominco
Commercial Alcohols Inc. (CAI)
Commonwealth Historic Resource Management Ltd.
Computalog
CONDER (Brazil)
Conestoga-Rovers & Associates (CRA)
Confederaco Nacional da Industria (CNI), Brazil
Con-Force Structures Ltd.
Conserval Engineering
Consortium for Research on Renewable Industrial Materials
Cooke and Dennison
Coordinación Ecológica Area Metropolitana Sociedad del Estado
Corporacion Peters (Costa Rica)
CQRDA
CryoFuel System Inc.
Cummings Cockburn
Cummins, Inc.
Dacia (Romania)
David Suzuki Foundation
De Boer
Dendron Resource Surveys Inc
Dessau
Distell Company Ltd.
DSE Associates
Dynamotive
Dynetek
Eastern Power Development Corp.
ECO Fuels
Egyptian Light Transportation Manufacturing Company
Egyptian Motorcycles and Bicycles Company (EBC)
Enbridge Consumers Gas
ENERCON (Pakistan)
Enerkem
Enermodal
EnerWorks
ENSI Canada
Ensyn Technologies
EPCOR Utilities
EPRI
ESI Ecosystem International
Exocafe (Brazil)
Fast & Epp Partners
Ferguson, Simek, Clark
Fielding Chemical Technologies Inc.
Fine Line
Fleetline Products Ltd.
Flynn Canada
Ford Motor Company (US)
Forintek Canada Corp.
Fracmaster
Fraunhofer USA
Garland Canada
General Comminution Inc. (GCI)
GFI Control Systems
Global Change Strategies International Inc.
Global Earth Products (GEP)
Glotman – Simpson Engineers
Golder Associates
Gulf Canada Resources Ltd.
Gwich'in Development Corporation
H.R. West Holdings Inc.
Haebler Construction
Heating, Refrigeration and Air Conditioning Institute of Canada (HRAI)

Private Companies and Organizations

Husky Oil Operations Ltd.
Hydro Quebec
Hydrocarbon Development Institute (Pakistan)
Hydrogenics Corporation
Imperial Oil Resources Ltd.
Industrial Roof Consultant
Innovatech
Instituto Forestal (INFOR- Chile)
Integrated Control Devices Ltd.
International Center for Sustainable Cities
inVentures Technologies Inc.
Iogen
KC Environmental Group Ltd.
Kinectrics
Lafarge Canada
Lauralco
Ledcor Industries Limited
Levelton Engineering Ltd.
Limpieza Urbana S.A. (LIMSA)
LIMPURB
Linamar Corporation
Local Rural Stewardship Networks
LPP Manufacturing Inc.
Luscar
MacIntyre Management Consultants Inc.
Malahat Systems Corporation (MSC)
Mariah Energy
Matrix Solar Technologies
MBR Research
Mikro-Tek
Mobil Oil Canada
Morgan Falls Power
Musson Cattell MacKay Architects
FuelMaker Corporation
GIK Technical Institute (Pakistan)
NEG-Micon Canada
Norcan Hydraulic Turbines
Northstar Energy
Northwest Territories Power Corporation (NWTPC)
Norvik Traction
Nova Scotia Power Inc.
Novelek
Nutech Energy Systems Inc.
Ocean Construction Supplies Ltd.
Omega Farms
Ontario Centre for Environmental Technology Advancement
Ontario Power Generation
Ontario Trillium Foundation
Orenda Aerospace
Orion Bus Industries
Osoyoos Indian band Development Corp.
Ottawa Hydro
PanCanadian Resources
Pembina Institute
Petro-Canada Ltd.
Phillips Farevaag Smallenberg
Polymarine Huron Composites
Portland Cement Association (U.S.)
Powertech Labs
Pozzolanic International
Precision Drilling
Prime Environmental Systems Inc.
QuestAir Technologies
R.J. Burnside International Ltd (BIL)
Rage Farms
Raja Group (Pakistan)
Ranger Oil Ltd.
RDII Utilities Consulting and Technologies Inc.
Refrigerant Services Inc. (RSI)
Renaissance Energy Ltd.
Romgas (Romania)
Rose Technology
Rothsay Recycles Inc.
RWDI
Sairem
Sask Power
Saskatchewan Power Corp.
Save Energy Inc.
Schroeder Properties
Seaway Valley Farmers Energy Co-operative Inc.
Shell Canada
Sherex/OPW Inc.
Sheridan Nurseries
Siemens-Westinghouse
Soprema Canada
Sorentec Ltée.
Soybean Growers of Ontario
SRI Homes International
STAS
Stelco Steel
Stuart Energy Systems Inc.
Sudbury Hydro
Suncor Energy
Sundor Glass
Sunset Solar Systems
Swiderski Engineering
Syncrude
Tata Tea Corporation (India)
TCPL
TechnoCarb
Tecna S.A.
Tembec
Tescor
Thomson and Howe Energy Systems
Tilbury Cement Limited
Tirino Corporation
TMC Environmental (TMC)
Toromont Energy
Toronto District Heating Corporation (TDHC)
Toronto Renewable Energy Co-operative (TREC)
TransAlta Utilities
Trimac Transportation
Turbocor Inc.
UMA
Unilux Manufacturing Ltd.
Union Gas Limited
Urban Ecology Design Collaborative
Vebcam Metal Products Ltd.
Venmar Ventilation
Vergnet S.A.
Wascana Energy Ltd.
Water and Earth Science Associates Ltd. (WESA)
World Business Council for Sustainable Development
Wenvor Technologies Inc
Westmar Consultants
Westport Innovations
Whitby Hydro
Willis Energy services Ltd.
Wunsch Engineering Ltd.
YMCA Wellness Centre
Yugo-Tech (Canada)
Yukon Electrical Company Ltd. (YECL)
Zenon Environmental Inc.

Federal Partner Programs and Departments

Agriculture and Agri-Food Canada (AAFC)

Agricultural Adaptation Council

Canada Economic Development – Idea SME Program

Canada Economic Development – Quebec Region

Canadian Adaptation and Rural Development (CARD)

Canadian Mortgage and Housing Corporation (CMHC)

Canadian International Development Agency (CIDA)

Department of Foreign Affairs and International Trade – Clean Development Mechanism & Joint Implementation Office (CDM/JI)

Environment Canada – Air Pollution Prevention Directorate

Environment Canada – Commercial Chemicals Division

Environment Canada – Emissions Research and Emissions Division

Environment Canada – Environmental Protection

Environment Canada – Environmental Technology Advancement Program

Environment Canada – Environmental Technology Centre

Environment Canada – Microwave-Assisted Processes (MAPTM) Division

Environment Canada – Regional Offices

Environment Canada – Refrigerant Management Plan (RMP)

Industry Canada – International Trade Fund

Industry Canada – Canadian Office for Technology Exchange in the Environment (COTE)

Industry Canada – Sustainable Cities Office

National Research Council – Industrial Research Assistance Program (IRAP)

National Research Council – Institute for Chemical Process and Environmental Technology (ICPET)

Natural Resources Canada – Bioenergy Development Program

Natural Resources Canada – Buildings Energy Technology Program

Natural Resources Canada – Canadian Centre for Remote Sensing

Natural Resources Canada – Emerging Technologies Program

Natural Resources Canada – Renewable Energy Program (CANMET Energy Diversification Research Laboratory)

Natural Resources Canada – Industry Energy Research and Development (IERD) Program

Natural Resources Canada – Office of Energy Efficiency

Natural Resources Canada – Program of Energy Research and Development (PERD)

Natural Resources Canada – Renewable Energy Deployment Initiative (REDI)

Natural Resources Canada – Renewable Energy Technologies Program

Natural Resources Canada – Transportation Energy Technologies Program

Natural Resources Canada – CANMET Western Research Centre

Public Works and Government Services Canada

Technology Partnerships Canada

Transport Canada

Western Economic Diversification

Other Governments, Government Agencies, and Research Institutions in Canada and Abroad

Alberta Department Of Energy

Alberta Energy Research Institute

Alberta Research Council

Balochistan EPA (Pakistan)

BC Government – Green Economy Secretariat

BC Ministry of Land, Water, and Air Protection

BC Research

BC Trade & Investment

BCIT

City of Gatineau

City of Grande Prairie

City of Sudbury

City of Toronto

Dal Tech

Federation of Canadian Municipalities

German Government

Government of Ontario

Greater Vancouver Regional District

Hangzhou International Centre (China)

Hangzhou Regional Centre (China)

Ministère des Ressources naturelles du Québec

Netherlands Organization for Applied Scientific Research (TNO)

Ontario Clean Water Agency

Ontario Ministry of the Environment

Ontario Ministry of Agriculture, Food and Rural Affairs – CanAdapt

Pakistan Environmental Protection Agency

Petroleum Technology Research Centre

Qingdao Municipal Government (China)

Russian Association of Energy Efficiency Demonstration Zones

Saskatchewan Energy and Mines

Saskatchewan Research Council

Société de transport de la Communauté urbaine de Montréal

Toronto Atmospheric Fund

Town of Devon

Town of Watson Lake

UK Department of Trade & Industry

University of British Columbia

University of Saskatchewan

US Department of Energy

US EPA Greenhouse Gas Technology Verification Center

Vancouver Island Capital Regional District (CRD)

Yukon Territorial Government