



# **Canada at a Glance**

## **Sustainable Technologies**







Natural disasters are becoming all too common, and in most cases there is no denying the role of human activity. Climate change – arguably the greatest threat to humankind today – is the root cause of many of these disasters. Over the past 100 years, increasing concentrations of human-produced greenhouse gases (such as carbon dioxide, methane and nitrous oxide) in the atmosphere have contributed significantly to rising global temperatures. The impact is evident around the world: the Larsen B ice shelf collapse in Antarctica, wildfires in southern Europe, the thawing of western Siberia and the recent tornado in Birmingham.

The Western world, with 17 per cent of the world's population, currently consumes 52 per cent of total global energy, while China – with the same population percentage – consumes only 13 per cent of world energy. Given that China's economy is growing at a rate of 8.7 per cent a year, and with economic progress in other developing countries, global energy consumption is expected to increase by 40 to 50 per cent by 2010, with an associated increase in carbon dioxide emissions of 50 to 60 per cent.





'BUDGET 2005 TAKES AN IMPORTANT STEP IN LONG-TERM COLLABORATION BETWEEN THE GOVERNMENT OF CANADA AND THE CANADIAN ENVIRONMENTAL TECHNOLOGY SECTOR. IN ALL, BUDGET 2005 INVESTS AN ADDITIONAL \$1.75 BILLION TO SUPPORT ENVIRONMENTAL TECHNOLOGIES OVER THE NEXT FIVE YEARS TO FURTHER DEVELOP CANADA'S COMPETITIVENESS IN A GLOBAL MARKET POISED FOR EXPONENTIAL GROWTH.'

INDUSTRY MINISTER  
DAVID EMERSON,  
FEBRUARY 28, 2005

Climate change isn't the only environmental challenge we face: our cities are growing rapidly. Bigger cities consume more resources, generate more waste, and report higher incidences of pollution-related infections and deaths. In Western Europe, the number of asthma sufferers has more than doubled, while in Tokyo, rapid urbanisation has caused local temperatures to outpace global warming by a factor of four: summer temperatures now regularly reach 40 degrees Celsius with road surface temperatures topping 60 degrees.





It is clear that the global community cannot continue to develop economically without acknowledging and adapting to the growing threat to our natural environment. As a result, fundamental changes continue to take place in the way we manage economic development. The strategy is one of sustainable development and signifies a realisation that the resources of the world are finite. Essential to the success of this strategy are the new technologies being developed to reduce energy consumption and combat the environmental havoc already wreaked on the world at large.

When it comes to environmental damage, no country can claim to be entirely blameless. Recognising the role its practices have had to play in climate change, Canada was one of the first countries to sign the Kyoto Protocol, on April 29, 1998, before ratifying it in 2002. Canada has also recently announced Project Green, a national plan to create a healthier environment and stronger economy by combining the efforts of government, non-governmental organisations, businesses and all Canadians to build a more sustainable future. The first phase of Project Green – Moving Forward on Climate Change: A Plan for Honouring Our Kyoto Commitment – was launched in April 2005.

## GOVERNMENT LEADS THE WAY

The Government of Canada realises that the best way to effect change is to lead by example. Through its Federal House in Order initiative, the 11 departments and agencies that account for 95 per cent of federal emissions are working toward collectively reducing



their greenhouse gas (GHG) emissions by 31 per cent from 1990 levels by 2010. The government is now turning to Canadian citizens to do their part through the One-Tonne Challenge, which asks each individual to make changes in their daily lives with the aim of reducing GHG emissions by one tonne per person per year.

In 2001, the Government of Canada provided \$550 million to launch Sustainable Development Technology Canada (SDTC), a not-for-profit foundation that finances and supports the development and demonstration of clean technologies that can improve air, water and soil quality and reduce the effects of climate change. To date, SDTC has completed six funding rounds and allocated a total of \$132 million to 61 projects. That amount has been leveraged with an additional \$347 million in funding from other project partners for a total project value of \$479 million.

## **HYDROGEN SOLUTION WILL DRIVE ECONOMY**

With oil prices spiralling there is an urgent need to look for alternative fuel sources. One solution lies in fuel cells, which produce electricity using a combination of hydrogen and oxygen, with the only by-product being water. When a combination of renewable energy sources (such as wind, solar and geothermal) is used to produce the hydrogen, the resulting sustainable cycle evens out the supply peaks and troughs associated with wind and solar farms. Canada, as a leading developer of the technology, is working toward this future.



## FUEL CELL TECHNOLOGY ADVANCES

The National Research Council (NRC)'s Institute for Fuel Cell Innovation in Vancouver is home to the nation's Fuel Cell Program. In collaboration with industry, universities and other government agencies, the program provides research and innovation support in areas critical to the growth of the fuel cell sector, such as fuels research, system integration and manufacturing, and component development. It supports Canadian fuel cell companies through R&D in state-of-the-art facilities across Canada.

The innovative Hydrogen Highway™ in British Columbia is one of the program's recent projects. Under this project, which aims to accelerate the commercialisation of hydrogen and fuel cell technologies, a consortium of organisations has come together to design, build, operate, test and evaluate a hydrogen fuelling infrastructure along a corridor linking Vancouver and Whistler. Targeted for full implementation by the 2010 Olympic and Paralympic Winter Games, the project will be a





Dynetek Industries hydrogen fuel tanks

showcase of sustainable transportation, creating a hydrogen highway that will enable visitors to travel between the Vancouver Airport and Whistler using fuel cell vehicles. The Hydrogen Highway™, along with a number of other initiatives, should help to make the 2010 Winter Olympics the greenest and most environmentally friendly of the modern Olympiads.

## WIND-HYDROGEN VILLAGE

On Canada's opposite coast, Technology Partnerships Canada is funding a wind-hydrogen village. The \$10.3-million project on Prince Edward Island, undertaken by Hydrogenics Corporation and Prince Edward Island Energy Corporation, is designed to demonstrate energy solutions and opportunities for local communities. Wind energy will be the primary energy source, producing hydrogen to provide backup and primary electricity for industry, farms and households as well as hydrogen fuel for transport. A range of engine technologies will be showcased, including fuel cells and purpose-built and retrofitted hydrogen internal combustion engines. The community-based project will be easily replicable in other areas of Canada and around the world.





Courtesy of Canadian Wind Energy Association (CanWEA)



## COMMITMENT TO WIND POWER

Wind is the fastest growing source of electricity in the world. Across Canada, wind-generated electricity is being applied to provide clean and effective power to homes and businesses.

Canada currently derives less than one per cent of its total energy from wind. But with its vast open prairies and mountainous regions, it has the potential to derive more than 20 per cent – enough to provide electricity for 3.5 million homes, according to the Canadian Wind Energy Association (CanWEA). CanWEA, a not-for-profit organisation that supports the development of wind energy in Canada, aims to secure enough investment in wind energy to ensure that by 2010 wind is the source of five per cent of Canada's electricity.



## **CLEAN TECHNOLOGIES FUEL THE ECONOMY**

TECHNOLOGIES THAT REDUCE GREENHOUSE GAS EMISSIONS ARE BECOMING AN IMPORTANT PART OF THE CANADIAN ECONOMY. ACCORDING TO STATISTICS CANADA'S 2002 ENVIRONMENT INDUSTRY SURVEY, CANADIAN ENVIRONMENTAL BUSINESSES EARNED \$370.3 MILLION IN REVENUES FROM THE SALE OF CLEAN TECHNOLOGIES IN 2002, A 30 PER CENT INCREASE FROM THE REPORTED LEVEL IN 2000. THESE TECHNOLOGIES INCLUDE INDUSTRIAL EQUIPMENT, SYSTEMS AND PROCESSES THAT REDUCE OR PREVENT THE RELEASE OF GASES INTO THE ATMOSPHERE.

FUEL-CELL AND ALTERNATIVE-FUEL TECHNOLOGY REVENUES ACCOUNTED FOR CLOSE TO ONE THIRD OF TOTAL REVENUES FROM EMISSION-REDUCING TECHNOLOGIES IN 2002, OR \$118.1 MILLION. DURING THE SAME YEAR, SALES OF SOLAR AND WIND ENERGY SYSTEMS AND EQUIPMENT REACHED \$112 MILLION. ADDITIONAL REVENUES OF \$8.6 MILLION WERE DERIVED FROM SYSTEMS AND EQUIPMENT FOR CARBON-NEUTRAL APPLICATIONS PRODUCING HEAT OR ELECTRICITY SUCH AS CO-GENERATION, METHANE CAPTURE AND USE, AND WASTE-TO-ENERGY SYSTEMS.

CLEAN TECHNOLOGIES USED IN INDUSTRIAL PROCESSES, INCLUDING INTEGRATED PROCESS AND MATERIALS RECOVERY TECHNOLOGIES, EARNED BUSINESSES \$13.1 MILLION IN 2002 (SOURCE: STATISTICS CANADA).

Ontario and Quebec currently have the largest capacity to produce wind power with about 1,600 megawatts planned or under construction. Alberta has also established a number of new projects in the past 12 months, including a major wind farm at Summerview, built by Vision Quest Windelectric.

## **BIOMASS: WASTE NO LONGER WASTED**

Burning biomass is one way of converting it into energy. However, by transforming it into flammable liquids and gases, such as ethanol (ethyl alcohol) and methane, it is possible to produce a more environmentally friendly energy source. Iogen Corporation of Ottawa has developed a technology – used to power the G8 leaders' cars at the 2005 Gleneagles Summit – that takes waste straw and wood residues and converts them into ethanol, which can be used as an alternative to petrol or an additive to diesel. The use of ethanol rather than petrol can reduce GHG emissions by 90 per cent.



Rotting organic matter – from municipal and farm waste, for example – produces significant quantities of methane. Rather than escaping to the atmosphere, however, this methane can now be captured and used to fuel electricity generators. The approach has an additional benefit in that the burning process converts the methane into carbon dioxide, which is 20 times less potent as a GHG than the original methane.

The Alberta Research Council (ARC) and Highmark Renewables have been developing innovative ideas for the use of methane. They have developed a technology for use by Highland Feeders, one of Canada's largest cattle-raising operations, whereby high-solid manure is converted in a sustainable cycle into energy, bio-based fertilisers and water that can be used for irrigation. ARC is currently adapting this technology to include other biomass sources, such as liquid manure, food processing waste, rendering materials and municipal wastes.





Some of the power produced at Highland Feeders, about 200 to 300 kilowatts, is being used to power the cattle-raising operation. The remaining power, about 700 kilowatts, services about 700 households in local farming communities.

## **SONIC'S ENVIRONMENTAL SOLUTION TO PCBs**

Urban regeneration continues to move up the agenda of concerns in towns and cities around the world. In the UK, for example, the need for regeneration has become particularly acute in the densely populated southeast. One of the challenges of urban regeneration is making old industrial sites suitable for human habitation, which often involves the safe removal of persistent organic pollutants and in particular polychlorinated biphenyls (PCBs).

Sonic Environmental Solutions Inc. of Vancouver has developed a way to remove PCBs from soil cheaply and efficiently without incineration, which can spread unburned PCBs beyond the immediate area. The company's solution is a sonic generator that can smash soil solids into smaller particles that release the PCBs. The PCBs are destroyed using a sodium and chlorine solvent, and the soil is separated from the solvent before being cleaned with water. The solvent and water are recycled, while the clean soil can be returned to its original site.

## **HOMES GET BIOTECH MAKEOVER**

Products such as countertops made from hemp, cupboards made from wheat straw and carpets made from cornstarch may soon be common features of Canadian homes.



Last April, Dow AgroSciences Canada Inc., the Council for Biotechnology Information and BioProducts Canada launched The Green Kitchen: Taste and Touch the Future, an interactive exhibit that aims to change the way consumers think about crops. At the exhibit, visitors can see first-hand how common Canadian crops are being turned into environmentally friendly fibre. Consumers can also sample biotech foods that Canadian farmers have been growing for the past decade, using practices that consume less fuel and involve less soil erosion.



*Minimal environmental impact at an EnCanada wellhead, Alberta  
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## UNDERGROUND CARBON SINKS

The Government of Canada is investing \$6.75 million in a carbon sequestration project to help Saskatchewan's oil and natural gas industries while also contributing to climate change solutions. The funding will go toward the second phase of the project, which is being carried out at EnCana's enhanced oil recovery site in Weyburn, Saskatchewan.

The first phase of the project, which ended in 2004, was run under the auspices of the International Energy Agency, with funding from public and private sector partners. The report from this phase concluded that geological conditions in the field are favourable for the long-term storage of carbon dioxide and that injecting the gas underground also aids the recovery of oil from a partially depleted reservoir.

The second phase will provide information that will be used in developing a regulatory framework and to help assure the public that underground carbon dioxide storage is safe and secure over the long term.



## Is LUNAR THE NEW HYDRO?

Canada has more fresh water in its lakes and rivers than any other country in the world, with many of its largest rivers used to produce electricity. In fact, 61 per cent of Canada's electricity is hydroelectricity. But hydroelectric generation is not without its problems, since it has an ecological impact on our rivers.

There is great promise, however, in harnessing tidal energy. Tidal energy exploits the natural rise and fall of coastal tidal waters caused by the interaction of the gravitational fields of the sun and moon. With one of the largest tidal ranges in the world – sometimes reaching 21 feet in elevation – the Bay of Fundy in Nova Scotia has huge potential as a clean renewable source of energy. Annapolis Tidal Generating Station has been harnessing this energy, feeding power directly into the Nova Scotia Power

Annapolis Tidal Generating Station





Corporation's grid. Using the largest Straflo turbine in the world, Annapolis Tidal can produce more than 30 million kilowatt hours of 'lunar' electricity per year – enough to power 4,000 homes.

## A LONG HISTORY OF ENERGY-EFFICIENT HOUSING

When it comes to saving energy in housing design, Canada already has a proven track record, with much of the innovation in the construction industry supported by the National Research Council's Institute for Research in Construction (NRC-IRC). NRC-IRC develops and maintains the core skills and knowledge critical to the industry while supporting the commercialisation of leading-edge technologies and encouraging sustainability in the building sector.







The first step in minimising damage to the environment came from a Canadian concept called the Super E house, which saves energy during construction and occupation as well as by employing as many recycled materials as possible.

Natural Resources Canada initially developed the Super E house program to provide comfortable, energy-efficient homes. High-performance windows and doors and a continuous air and moisture barrier system in the building envelope are some of the features that limit air leakage. This barrier system, together with high-efficiency heating, hot water, cooling and ventilation equipment, enables homeowners to benefit from greater comfort and lower energy costs. The Super E program also





approves a growing list of environmentally friendly products, including fibreglass insulation made from recycled glass, drywall made from recycled gypsum and paper, and low water consumption toilets and showerheads.

This design concept can now be taken a stage further using solar energy – a virtually unlimited energy source. In June 2005, the Alberta Research Council completed a pilot study to identify a more efficient technology for insulating homes. Researchers found that, by combining direct solar collection and heat storage technology with an existing structural insulated panel system, they could reduce energy consumption for space heating by 48 per cent.

Canada is now embarking on the first phase of an initiative that will lead to housing that on an annual basis, has zero net consumption of energy for heating and electricity. Launched in July 2005, this government-industry partnership envisions an initial demonstration project that would see ‘net zero’ energy homes integrated into sustainably planned communities across Canada.







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