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Climate Change Solutions:



CANADIAN CAPABILITIES

Canada

Climate Change Solutions:



Prepared by

SENES CONSULTANTS LIMITED
for

**ENVIRONMENTAL AFFAIRS BRANCH,
INDUSTRY CANADA**

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TABLE OF CONTENTS

1.0	SCOPE AND PURPOSE	4
2.0	INTRODUCTION	5
3.0	INDUSTRIAL OPPORTUNITIES AND THE KYOTO PROTOCOL	6
4.0	CANADIAN CLIMATE CHANGE SOLUTIONS	7
4.1	Climate Change Services	7
4.2	Power Generation Technologies	14
4.2.1	Conversion of Coal to Gas/Oil Fired Plants	14
4.2.2	Industrial Cogeneration	14
4.2.3	Biomass Fired Power Generation	14
4.2.4	Small Scale Hydro	14
4.2.5	Combined Cycle Power Plants	14
4.2.6	Municipal Solid Waste Combustion	15
4.2.7	Wind Energy	15
4.2.8	Efficient Electrical Transformers	15
4.2.9	Fuel Cells	15
4.2.10	Water Electrolytic Hydrogen Fuel	15
4.2.11	Photovoltaic Systems	15
4.2.12	Integrated Gasification Combined Cycle	15
4.2.13	Solar Thermal Electricity	16
4.2.14	Tidal Energy	16
4.3	Transportation Technologies	27
4.3.1	Alternate Fuels (e.g. ethanol, methanol)	27
4.3.2	Alternate Fuel Vehicles (e.g. natural gas, hybrid, fuel cells)	27
4.3.3	Lighter Vehicle Bodies	27
4.3.4	Efficient Jet Engines	27
4.3.5	Advanced Traffic Management Systems	28

4.4	Industrial Energy Systems	33
4.4.1	Efficient Electric Motors	33
4.4.2	Distillation Control Systems	33
4.4.3	Continuous Pulp Digesters	33
4.4.4	Mechanical Dewatering	33
4.4.5	Biofiltration of Gases	33
4.4.6	Biodiesel	33
4.5	Building Systems	36
4.5.1	Pulse Combustion Boilers	36
4.5.2	Heat Pump Water Heaters	36
4.5.3	Pelletized Biomass Combustion	36
4.5.4	Solar Water Heaters	36
4.5.5	Geothermal Heat Pumps	36
4.5.6	Energy Management Systems	36
4.5.7	Lighting Controls	36
4.5.8	Electronic Ballasts	36
4.5.9	Compact Fluorescent Lights	37
4.5.10	Energy Efficient Appliances	37
4.5.11	Energy Efficient Windows	37
4.5.12	Advanced Insulation Systems	37
4.6	Industrial Non-Energy Systems	42
4.6.1	Aluminum Smelter Anodes	42
4.6.2	Gas Membrane Separators	42
4.6.3	Use of CO ₂ in Urea Production	42
4.6.4	Substitutes for Clinker in Cement	42
4.6.5	Capture and Recycling of Fluorinated Compounds	42
4.6.6	Aluminum Smelter Control Systems	43
4.6.7	Alternative Magnesium Cover Gas	43
4.6.8	Alternative Refrigerants	43
4.7	Biological Systems	46
4.7.1	Collection and Use of Landfill Gas	46
4.7.2	Aerobic Composting of Manure	46
4.7.3	Anaerobic Digesters Systems (e.g. Industrial Waste, Manure)	46
4.7.4	Air Seeders	46
4.7.5	Livestock Feed Additives	46

4.8	Sinks And Reservoirs Technologies	51
4.8.1	Reforestation and Afforestation.	51
4.8.2	Forest Management	51
4.8.3	Enhanced Oil Recovery	51
5.0	ABBREVIATIONS	54
6.0	INDEX	55

SCOPE AND PURPOSE

This publication was developed to demonstrate the capabilities of the Canadian environmental industry in developing climate change solutions.

By no means exhaustive, it is hoped that this document provides the reader with an indication of the breadth of Canadian technologies, products and services available – or under development – to reduce greenhouse gas (GHG) emissions.

This publication features energy and non-energy alternatives and profiles leading edge, Canadian, multi-disciplinary, environmental services companies and applied technology-providers that work towards reducing GHG emissions. Some of the cutting edge technologies described herein (e.g. alternatives to sulphur hexafluoride as a cover gas in the production of magnesium) are as yet only in the early stages of research and development. Nevertheless, they will serve to inform the reader and demonstrate that Canadian climate change solution development is spanning all sectors and seeking to address a wide range of problems.

Over 200 solution providers, both companies and organizations, are profiled within. These organizations are focused on meeting present and future needs while ensuring protection of the environment. This sustainable development approach to climate change is imperative if we are to mitigate the effects of global warming.

For the purposes of this document, the Canadian solutions available to address climate change have been organized into eight categories. The first category consists of climate change services and profiles organizations that offer consulting, strategic advice and guidance, environmental assessment, and research and development. The remaining seven categories are power generation technologies, transportation technologies, industrial energy systems, building systems, industrial non-energy systems, biological systems, and sinks and reservoirs technologies.

Those interested in further information about Canadian climate change solution-providers or the Canadian environmental industry in general can consult:

ENVIRONMENTAL AFFAIRS BRANCH

Industry Canada
235 Queen St.
Ottawa, Ontario
K1A 0H5

2/ Email: enviro@ic.gc.ca (b)
Website: <http://strategis.ic.gc.ca/environment> (b)
Fax: 1-613-952-9564

Canadian Environmental Solutions (CES) –

A comprehensive database of environmental goods, services, and technologies, including a full range of export-ready climate change solutions.
<http://www.strategis.ic.gc.ca/>

Canadian Environment Industry Association

(CEIA) – Canada's national business association representing the environment industry.
<http://www.ceia-acie.ca/>

INTRODUCTION

WHAT IS CLIMATE CHANGE?

The earth's atmosphere is a complex mixture of gases that forms a protective envelope around the earth to help maintain the unique conditions necessary to support life. The atmosphere permits the entry of shortwave radiation from the sun to warm the earth's surface and enable photosynthesis. It also allows the escape of longwave radiation generated by the earth and its natural processes, thereby ensuring that optimal conditions are maintained.

The atmosphere's absorption of longwave radiation (the greenhouse effect) upsets the global balance of energy in the system. By reducing the amount of longwave radiation that can escape the earth's surface, global warming can ensue. Scientists in general agree that rising levels of GHGs will result in climate change, and climate models predict that the earth's average temperature will rise by up to 3.5°C by the year 2100. This increase in the earth's average temperature could have significant environmental effects that will have both local and global impacts. For example, melting of the polar ice caps could increase the mean sea level by 15-95 cm by the turn of the century. This would devastate low-lying island states and coastal areas, causing significant social and economic repercussions. Global warming could also lead to an increase in the average temperature of the earth's oceans, which play an important role in regulating the climate system. Climate change could also result in shifting ecosystems and agricultural zones, thus severely impacting forests, deserts, wetlands, and biodiversity.

There are six types of GHG emissions:

- Carbon dioxide (CO₂);
- Methane (CH₄);
- Nitrous oxide (N₂O);
- Hydrofluorocarbons (HFCs);
- Perfluorocarbons (PFCs), and
- Sulphur hexafluoride (SF₆).

Some of these gases (CO₂, CH₄, and N₂O) occur naturally as a result of respiration, methanogenesis and denitrification, respectively. The concentrations of these gases released by these processes are an integral part of the earth's natural balance and do not contribute to climate change. The concentration of emissions generated by fossil fuel combustion and agricultural practices makes a significant contribution to the cycling of carbon and nitrogen in the natural environment. These emissions, coupled with the anthropogenic GHGs (HFCs, PFCs and SF₆), are creating a greenhouse effect that the earth is unable to counter without upsetting the natural environmental balance that is so important to maintaining the earth's unique life support system.

The concentrations of GHGs in the atmosphere that are contributing to climate change are the result of actions for and by people from around the world, including Canada.

THE CANADIAN RESPONSE

Climate change is a global problem that requires innovative solutions and technologies that will enable all individuals to contribute to reducing GHG emissions. This problem is providing industry with unique challenges and opportunities as it strives to meet the demands of an increasingly environmentally conscious customer base. In Canada, this has spawned the Canadian Environmental Industry Sector, which employs some 221,000 people in approximately 6,400 environmental firms. These firms provide technologies and services to all environmental markets including consulting and engineering, water treatment/management, process and prevention technology, instrument and analysis, air pollution and control, and waste management. This employment sector is the third largest in Canada and continues to grow. The field of environmental energy is particularly robust and will likely have the greatest impact on climate change since energy use is such a vital part of society.

INDUSTRIAL OPPORTUNITIES AND THE KYOTO PROTOCOL

In December 1997, 160 countries negotiated the Kyoto Protocol. This landmark agreement enables industrialized countries to achieve GHG emission reduction targets through both domestic and international actions. The international mechanisms include the International Emissions Trading (IET), the Clean Development Mechanism (CDM), and the Joint Implementation (JI).

The Clean Development Mechanism (CDM) allows for GHG emissions reduction projects to be undertaken in developing countries where they have the added benefit of contributing to the sustainable development of that country. The Joint Implementation (JI) and International Emissions Trading mechanisms allow for the receipt and transfer of international emissions credits to assist industrialized countries in meeting their reduction targets.

The global benefit of reducing GHG emissions is the same no matter where in the world the reduction is made; although emission reduction costs vary by location. This inverse cost-benefit relationship for some areas of the world will most likely prove to be a market driver for the development of climate change solutions and for the reduction of GHG emissions.

Canada has established a CDM & JI office to enhance Canada's capacity to take advantage of these opportunities. For more information, contact:

CANADA'S CDM&JI OFFICE

Department of Foreign Affairs
and International Trade

125 Sussex Drive

Ottawa, Ontario

K1A 0G1

Tel.: (613) 944-3032

Fax: (613) 944-0064

E-mail: cdm.ji@dfait-maeci.gc.ca

Website: www.dfait-maeci.gc.ca/cdm-ji/

format

CANADIAN CLIMATE CHANGE SOLUTIONS

Climate Change Services 4.1

Providers in the climate change services sector offer a wide range of services such as consulting, strategic advice and guidance, environmental assessment, research and development, marketing, technology advancement, training and education, and information management. These providers and their services are multi-disciplinary in nature and form a bridge linking many of the key areas described in the other seven categories.

This broad category of climate change solutions providers is an important part of energy management solutions that can bring about the GHG emission reductions necessary to meet reduction targets. Only by taking the life cycle management approach advocated by these providers, and by achieving the active participation of all members of society can we hope to achieve sustainable development.



4.1 CLIMATE
CHANGE SERVICES

By no means exhaustive, it is hoped that this document provides the reader with an indication of the breadth of Canadian technologies, products and services available – or under development – to reduce greenhouse gas (GHG) emissions.

CLIMATE CHANGE SERVICES

Albarrie Canada Limited

85 Morrow Road
Barrie, ON, Canada L4N 3V7
www.albarrie.com

Offers a wide range of products in support of filtration, geosynthetics and process engineering based on fiber petrochemical technology.

Alberta Energy Company

3900 - 421 Seventh Ave. S.W.,
Calgary, AB, Canada T2P 4K9
www.aec.ca

An independent oil, gas and natural gas exploration and development company with national and international interests in pipeline transportation and gas storage and processing capabilities.

Alternative Fuel Systems Inc.

7944 - 10th Street N.E.
Calgary, AB, Canada T2E 8W1
<http://www.altfuelsys.com/>

Provides research, development, engineering, testing and commercialization of clean air technologies including high performance natural gas engine systems, natural gas systems for forklift trucks and ice resurfacers, multistage pressure regulators and a range of other catalytic products.

Balchip Corporation

2995 Bathurst Street
Toronto, ON, Canada M6B 3B3
<http://www.balchip.com/>

Researches, develops and markets organic based fuel additives & lubricants. Products are non-toxic and cleaners and water treatments are 100% bio-degradable.

Beak International

14 Abacus Road
Brampton, ON, Canada L6T 5B
<http://www.beak.com>

Provides environmental planning, assessment and problem solving services. Areas include forest, fisheries, wildlife and wetland management, water quality, environmental review and permitting, threatened and endangered species, habitat conservation, ecological risk assessment and watershed analysis.

CanAmera Foods

14711-128th Avenue
Edmonton, AB, Canada T5L 3H3
www.canamera.ca

Manufactures and distributes edible-oil and oilseed based products for retail and commercial markets.

Cantox Environmental

18th Floor,
840 7th Ave. SW
Calgary, AB, Canada T2P 3G2
<http://cantoxenvironmental.com/>

Provides consulting services in interpretive toxicology, health and environmental risk assessment, litigation and regulatory affairs and scientific communication.

Chessen Group Inc.

4540 Eastgate Parkway, Unit #5
Mississauga, ON, Canada L4W 3W6
www.chessen.com

Provides research and development of surface material, thin-film and deposition technologies and systems for metals, ceramics, glass and plastics.

Clean Air Canada Society

Environmental Law Centre
University of Victoria
Victoria, BC, Canada V8W 2Y2
<http://www.cleanair.ca>

This society advocates and fosters citizen and community participation in decision making processes related to climate change, and supports a website managed by environmental law students.

Clean Nova Scotia

126 Portland St.
Dartmouth, NS, Canada B2Y 1H8
<http://www.clean.ns.ca>

A non-profit environmental education organization that provides information and resources regarding climate change, waste reduction, litter abatement and materials exchange.

Conor Pacific

1800-1500 West Georgia Street
Vancouver, BC, Canada V6G 2Z6
<http://www.conorpac.com>

Provides a complete range of services related to environmental services and technologies, brownfield development, water/wastewater treatment and risk assessment and asset management.

Conserval Engineering Inc.

200 Wildcat Rd.
Toronto, ON, Canada M3J2N5
www.solarwall.com

Markets the SOLARWALL large building solar heat system for apartment buildings, industrial plants and warehouses, commercial buildings, crop drying, residential applications.

Delcan Corporation

133 Wynford Drive
North York, ON, Canada M3C 1K1
<http://www.delcan.com>

Provides consulting services and innovative solutions to clients in major project management, Intelligent Transportation Systems (ITS) and urban infrastructure, environmental engineering, and civil engineering and architecture.

Dundee Securities Corporation

Suite 3424, Four Bentall Centre
1055 Dunsmuir Street, P. O. Box 49207
Vancouver, BC, Canada V7X 1K8
www.dundeewealth.com

An independent, fully integrated, research-driven investment dealer with extensive institutional and retail distribution capabilities, committed to providing value-added research and advisory services.

Energy Advantage

690 Dorval Drive
Oakville, ON, Canada L6K 3W7
<http://www.energyadvantage.com>

Provides commercial, industrial and institutional clients with energy management services. Areas include natural gas, petroleum fuels, electricity and energy utilization.

Environmental Services Association of Alberta (ESAA)

1710, 10303 Jasper Avenue
Edmonton, AB, Canada T5J 3N6
<http://www.esaa.org/>

A non-profit industry organization that facilitates the development of environmental industries by promoting technology, human resources and sustainable development. Hosts an online catalogue of products and services providers that help reduce GHG emissions
<http://www.ghgshowcase.com/>.

Enviros RIS

161 Eglinton Ave. East
Suite 200
Toronto, ON, Canada M4P 1J5
<http://www.risltd.com>

Consultants specializing in environmental issues and technologies related to climate change, energy conservation, sustainable development, environmental training, and waste management and minimization.

Gartner Lee

140 Renfrew Drive, Suite 102
Markham, ON, Canada L3R 6B3
<http://www.gartnerlee.com>

Consultants in environmental planning, waste management, environmental site assessment and remediation.

Giffels Associates

30 International Blvd.
Toronto, ON, Canada M9W 5P3
<http://www.giffels.com>

Provides engineered solutions to government, industry, institutions etc. Services include engineering, architectural financing and construction management, infrastructure, process design and information technology.

Global Change Strategies International

150 Isabella Street,
Suite 305
Ottawa, ON, Canada K1S 1V7
<http://www.gcsi.ca>

An information and strategic advice organization with expertise in political, scientific, technological, economic and business issues as they relate to climate change, air quality, extreme events, biodiversity, & water quality and resources. Provides a wide range of services tailored to meet specific client needs.

Global FACMAN Enterprises Inc.

12180 Chemin du Golf
Montreal, QC, Canada H4K 1S5
www.globalmvo.com

A consortium of companies that provides a complete range of energy performance contracting services for the development of infrastructure outside Canada.

Golder Associates

1796 Courtwood Crescent
Ottawa, ON, Canada K2C 2B5
<http://www.golder.com/>

Provides consulting engineering services including planning, design, construction management and operations management to a wide range of clients on small hydro, urban development, infrastructure, hydrology, water resource, transportation and environmental projects.

Greater Vancouver Regional District

4330 Kingsway
Burnaby BC, Canada V5H 4G8
www.gvrd.bc.ca

A partnership of municipalities that delivers essential utility services from regional sources.

GreenWare Environmental Systems Inc.

145 King Street East, Suite 200
Toronto, ON, Canada M5C 2Y8
<http://www.greenware.com>

Develops and markets environmental management information systems. Provides software, training and management services for environmental management, audit and reporting including ISO 14000 compliance.

Hatch Associates

2800 Speakman Drive
Mississauga, ON, Canada L5K 2R7
<http://www.hatch.ca>

Provides technical and strategic services in diverse areas including environmental technologies, metals, mining and mineral processing, sustainable development, transportation, engineering, project and construction management, and consulting to management.

HRAI

5045 Orbitor Drive, Building 11, Suite 300
Mississauga, ON, Canada L4W 4Y4
www.hrai.ca

A non-profit trade association of manufacturers, wholesalers and contractors in the heating, refrigeration and air conditioning industry.

Hydro-Quebec

www.hydroquebec.com

Produces and distributes hydro-electric power using ISO 14001 compliant Environmental management Systems.

ICF Consulting

277 Wellington Street West, Suite 701
Toronto, ON, Canada M4W 3E4
<http://www.icfconsulting.com/>

Sustainable management of natural, physical, economic and community resources. Provides advisory services and products to government, private corporations and international organizations to assist in strategy and policy analysis, project implementation and project evaluation in the environmental, energy, economic and community development and transportation fields.

Institute for Integrated Energy Systems (IESVic)

University of Victoria
P. O. Box 3055, Station CSC
Victoria, BC, Canada V8W 3P6
www.lesvic.uvic.ca

Promotes feasible paths to sustainable energy systems by developing new technologies and perspectives to overcome barriers to the widespread adoption of sustainable energy.

Jacques Whitford

3 Spectacle Lake Drive
Dartmouth, NS, Canada B3B 1W8
<http://www.jacqueswhitford.com/>

Provides a wide range of services in environmental protection, remediation and analysis, geotechnical/materials engineering and risk management.

JTU Consulting Inc.

75 Wimbledon Road
Guelph, ON, Canada N1H 7V7
<http://www.jtu.com>

Provides consulting and custom development services in information management.

KPMG LLP

777 Dunsmuir Street
P. O. Box 10426
Vancouver, BC, Canada V7Y 1K3
www.kpmg.ca

A Canadian accounting, tax and financial advisory firm that provides risk management, tax saving strategies and growth strategies to a wide range of clients.

Levelton Engineering Ltd.

#150 - 12791 Clarke Place
Richmond, BC, Canada V6V 2H9
www.levelton.com

A multi-disciplinary consulting firm that provides engineering and scientific services to the materials, infrastructure corrosion, building, environment, chemistry and geotechnical sectors.

Linamar Corporation (LPP)

Guelph, ON, Canada
www.linamar.ca

Research and development of cleaner-running small gasoline engines.

Marbek Resource Consultants

500 - 1355 Bank Street
Ottawa, ON, Canada K1H 8K7
<http://www.marbek.ca>

Provides a wide range of environmental consulting services to government, utilities, industry and industry associations, non-government organizations, research agencies and development banks in energy management, sustainable development and long-term development assistance projects.

McCarthy Tétrault LLP

P. O. Box 10424 Pacific Centre
Suite 1300 — 777 Dunsmuir Street
Vancouver, BC, Canada V7Y 1K2
www.mccarthy.ca

Provides a full range of legal services to a wide variety of clients.

National Bank Financial Inc.

130 King Street West
Suite 3200, P. O. Box 21
Toronto, ON, Canada M5X 1J9
www.nbfinc.com

NBF's Power Technology team works to match strategic, institutional and individual investors with leading power technology opportunities from emerging private companies to well-known public corporations.

Northern Climate Exchange

c/o Northern Research Institute
Yukon College
Whitehorse, YT, Canada Y1A 5K8
<http://www.taiga.net/nce/>

An exchange-point organization dedicated to the advancement of climate change knowledge in the north. This National Centre of Excellence provides a focal point for research and development of new technologies, facilitates the exchange of knowledge regarding sustainability in the north, and maintains a database of information on climate change impacts in the circumpolar north.

OCETA

63 Polson Street, 2nd Floor
Toronto, ON, Canada M5A 1A4
www.oceta.on.ca

A non-profit organization that assists in the commercialization of environmental solution applications, technologies, products and processes.

Peck & Associates

1560 Bayview Ave. Suite 305
Toronto, ON, Canada M4G 3B7
www.greenroofs.ca

Provides policy and program development services to a wide range of clients in support of urban sustainability and the development and diffusion of sustainability technologies.

Petroleum Technology Research Centre

Regina, SK, Canada
www.ptrc.ca

An organization involved in basic and applied research and development of petroleum technologies.

Resource Futures International

858 Bank Street, Suite 103
Ottawa, ON, Canada K1S 3W3
www.rfi.on.ca

Provides specialist services in environmental policy analysis, management, assessment, institutional strengthening and communication strategies.

RWDI West Inc.

Consulting Engineers
Suite 1800, 840-7th Avenue S.W.
Calgary, AB, Canada T2P 3G2
www.rwdi.com

Provides a wide range of architectural/engineering and industrial process services to industry in meeting their air, noise, environmental quality requirements in a cost effective manner.

Saskatchewan Research Council

125 - 15 Innovation Blvd.
Saskatoon, SK, Canada S7N 2X8
www.src.sk.ca

Promotes research, development, innovative science and technology transfer in the biotechnology, energy, environment, forestry, international, mining and petroleum sectors.

SENES Consultants Limited

121 Granton Drive, Unit 12
Richmond Hill, ON, Canada L4B 3N4
<http://www.senes.on.ca>

Specialists in Energy, Nuclear and Environmental Sciences. This environmental consulting firm provides a wide range of services and expert advice to government, industry, industrial associations and public interest groups both domestically and abroad.

PROVIDER

PROFILE

SNC Lavalin

2, Place Felix Martin,
10th Floor
Montréal, QC, Canada H2Z 1Z3
<http://www.snc-lavalin.com/>

An engineering and construction firm that provides engineering, procurement, construction, project management and project financing services to government and a wide range of industry sectors.

STAS Limited

1846 Outarde
Chicoutimi, QC, Canada G7K 1H1
www.stas-unigec.com

An entrepreneurial company that specializes in the commercialization of research and development technologies in the aluminum, mines and pulp and paper sectors.

Suncor Energy Incorporated

Corporate Office
P.O. Box 38, 112 - 4 Avenue S.W.
Calgary, AB, Canada T2P 2V5
www.suncor.com

An integrated energy services company that is involved in the exploration, mining, extraction, refining and marketing of oil and natural gas and the development of alternative and renewable energy sources.

Syncrude Canada Limited

PO Bag 4023
Fort McMurray, AB, Canada T9H 3H5
www.syncrude.com

A major oil producing company that conducts research into optimization of oil sands extraction processes.

The Delphi Group

428 Gilmour
Ottawa, ON, Canada K2P 0R8
www.delphi.ca

A private Canadian environment and clean energy market research and business development company, which helps clients and partners capitalize on business opportunities created by global environmental and energy challenges.

The GLOBE Foundation of Canada

504-999 Canada Place
Vancouver, BC, Canada V6C 3E1
<http://www.globe2002.com>

The foundation sponsors an international conference and trade fair to provide a marketplace for environmental solutions and to foster sustainable development in business. The conference is held biannually in Vancouver BC.

Torrie Smith Associates

Unit 108, 95 Beech Street
Ottawa, ON, Canada K1S 3J7
www.torriesmith.com

Develops software for government and corporations for calculating GHG and emissions reductions. Provides analysis, technical and policy services to communities seeking to reduce GHGs.

Westcoast Energy Inc.

1333 West Georgia Street
Vancouver, BC, Canada V6E 3K9
<http://www.westcoastenergy.com>

A network of operations in natural gas gathering, processing, transmission, storage and distribution, electrical power generation, international, financial and information technology, and energy services businesses. Provides new energy development services with a focus on sustainable development.

Woodrising Consulting

83 Scott Street
Belfountain, ON, Canada L0N 1B0
<http://www.woodrising.com>

Specialists in GHG emissions management. Services include project management, communications, sales and marketing in carbon sequestration, land use change, forestry activities and landfill gas generation and capture.

4.2 Power Generation Technologies



Canada has strong fabrication, customization and construction capabilities in the area of coal conversion. Canada also has strong independent power producers tied to natural gas supply. There are several large Canadian companies producing component parts for cogeneration technologies such as steam generators, steam turbines and electrical generators. Small companies in niche areas supply renewable energy.

4.2.1 CONVERSION OF COAL TO GAS/OIL FIRED PLANTS

Power plants can reduce their GHG emissions by almost half by switching from coal to gas or to oil, both of which emit less CO₂ per energy unit. While this traditional climate change technology continues to be an effective alternative, emerging technologies that can reduce the level of emissions associated with the combustion of coal will become increasingly popular as fossil fuel reserves dwindle. For example, the use of lime during coal combustion can reduce sulphur dioxide and N₂O emissions, which contribute to ozone depletion and acid rain in addition to climate change.

4.2.2 INDUSTRIAL COGENERATION

Emissions from power plants using fossil fuels have a significant impact on air quality. The release of CH₄, a GHG, from landfill sites also contributes to global warming. Industrial cogeneration is a new technology that seeks to address these problems in a cost-effective manner, making it an attractive option from both a financial and environmental perspective. Industrial stack emissions or landfill CH₄ are collected and used as fuel to generate electrical power and thermal energy, which may be used to meet local needs, or as a source of revenue.

4.2.3 BIOMASS FIRED POWER GENERATION

Landfill wastes generate large volumes of CH₄ gas and thus contribute significantly to climate change. With the high demand for and increasingly limited availability of landfill sites new technologies to deal with the masses of waste generated in urban areas is imperative. Biomass fired power generation is a technology designed to reduce the volume of wastes destined for landfill by using them as a fuel source for generating electrical and thermal energy. Reductions in GHGs accrue from reducing the amount of wastes destined for landfill, a source of CH₄, and reduced dependence on fossil fuels for power generation.

4.2.4 SMALL SCALE HYDRO

One of the many advantages that emerging climate change technologies have is that they often address environmental problems that fall outside the realm of GHG reduction. Small scale hydro is one such technology that represents an alternative/renewable source of energy that has a much smaller environmental impact than do costly hydroelectric dams. The technology is well suited to areas where rivers are steep and water flow is continuous, and may be designed to address other water needs such as local irrigation. Water storage may be used to supplement fluctuating flows where the terrain is level.

4.2.5 COMBINED CYCLE POWER PLANTS

Combustion boilers typically have low efficiencies; hence emissions per unit of energy ratios are high. Combined cycle power plants address this by recovering the heat energy lost to exhaust during combustion and using it to generate steam power for producing electricity. This climate change technology is best suited for cogeneration facilities and fossil fuel powered plants that can be converted to biofuels for additional GHG savings.

4.2.6 MUNICIPAL SOLID WASTE COMBUSTION

The disposal of municipal solid wastes as landfill is a costly endeavor that contributes to climate change through the production of landfill gases. Technologies that reduce costs while reducing GHG emissions are attractive options to existing waste management practices. Combustion of municipal solid wastes fills this need by reducing the volumes of waste sent to landfill and reducing the need for fossil fuels for generating heat and electricity. As an added bonus, electrical power in excess of local needs could be used as a source of revenue and the CO₂ produced by the combustion process could be used to enhance greenhouse food production.

4.2.7 WIND ENERGY

Large-scale production of electricity relies upon the use of conventional energy sources such as fossil fuel combustion, hydroelectric and nuclear power generation, all of which have an impact on the environment and climate change. Wind energy is an unconventional source of power that is emerging as a climate change technology that can realize significant reductions in CO₂. Emissions of sulphur and N₂O that contribute to urban smog are also eliminated. The portability of this technology makes it amenable to rural and remote areas that do not have ready access to conventional sources of electrical power.

4.2.8 EFFICIENT ELECTRICAL TRANSFORMERS

Efficient electrical transformers are designed to increase electrical transfer efficiency during voltage reductions, thereby reducing the amount of fossil fuels required for the production of electricity. Designed for medium and high voltage transmission and distribution systems, transformers are generally custom designed and manufactured according to specific needs.

4.2.9 FUEL CELLS

Fuel cells convert the energy from hydrogen rich fuels such as natural gas, propane or methanol, into electricity by electrochemically combining hydrogen with oxygen to generate heat and water. This climate change technology recovers the energy contained in the fuel without combustion, thereby eliminating the production of GHGs as a by-product of electrical power generation. Fuel cells are particularly well suited to address the problem of GHG emissions from mobile sources and, as the technology continues to develop, they

may revolutionize the transportation industry. Fuel cells can also be used for stationary power generation for institutions, residential sub-divisions, or industries through the use of multiple units that are designed to meet specific needs.

4.2.10 WATER ELECTROLYTIC HYDROGEN FUEL

Water electrolytic hydrogen fuel production and utilization has the potential to be a zero emission climate change technology. The electrolysis of water generates highly purified elemental oxygen and hydrogen, which can be recovered for commercial use or vented to the atmosphere as non-GHGs. Hydrogen fuel produced in this manner does not contain sulphur or other contaminants, and makes an ideal fuel for internal combustion engine and fuel cell technologies. Steam is the only by-product generated by the use of this fuel. Furthermore, when the energy required for electrolysis is obtained from solar or wind sources, there are no GHG emissions associated with either the production or utilization of water electrolytic hydrogen fuel.

4.2.11 PHOTOVOLTAIC SYSTEMS

Most climate change power generation technologies seek to deliver electricity from renewable resources in an efficient and cost-effective manner. Photovoltaic systems rely upon solar energy for power generation. Systems can be developed for a broad scale of applications in both remote and urban areas. In urban areas this zero emission technology can be used to supplement energy needs in buildings, institutions or industry, thereby reducing fossil fuel emissions associated with central power generation plants. In remote areas, small-scale systems can be used to generate the power required to produce electricity for wastewater treatment, pumping water and other needs. Solar power is completely renewable and, because it is converted into thermal energy, highly efficient. Savings derived from energy conservation make photovoltaic systems cost effective.

4.2.12 INTEGRATED GASIFICATION COMBINED CYCLE

Coal fired power generation plants, like other combustion boiler plants, have poor energy efficiency due to heat lost in the exhaust. Integrated gasification combined cycle technology reduces sulphur dioxide and CO₂ gas emissions by hot-gas heat extraction and combustion of recovered gases. Even though erosion and corrosion problems make it a costly alternative to other climate

change technologies, new materials and coatings are improving efficiency and making retrofitting of existing boilers for low NO_x processes more attractive.

4.2.13 SOLAR THERMAL ELECTRICITY

Traditional power generation technologies rely upon combustion to generate heat that can be used to produce electricity. Solar thermal electricity generation is based upon the same principles and differs only in that the heat source is not co-located with the power generation equipment. Rather, the thermal energy from combustion is collected from the sun via plates and then transferred to thermal generators to produce electricity. As a climate change technology, solar thermal electricity is ideal because GHG emissions are nil and the renewable energy source is available anywhere without the need for transfer (pipeline, transportation, etc.) technologies.

4.2.14 TIDAL ENERGY

Hydroelectric dams use the flow of river water to drive turbines that generate electricity. Tidal electricity generation operates in a similar manner using the kinetic energy stored in tides to drive hydroelectric turbines. Dams constructed across estuaries can be designed to generate electricity on one or both of the flood or ebb sides. Project costs are similar to those associated with hydroelectric dams, however, because the energy source is completely renewable, energy conservation savings can offset capital costs.

By no means exhaustive, it is hoped that this document provides the reader with an indication of the breadth of Canadian technologies, products and services available – or under development – to reduce greenhouse gas (GHG) emissions.

CONVERSION OF COAL TO GAS/OIL FIRED PLANTS

Joe Ng Engineering Ltd.

176 Shaw Street
Hamilton, ON, Canada L3L 3P7
info@jnepeng.com

Offers consulting, project management and capital equipment services for a complete range of environmental engineering projects. Specialists in the relocation of pre-owned plant and machinery.

INDUSTRIAL COGENERATION

ABC Power and Boiler Inc.

210-1400, boulevard
Saint-Bruno, QC, Canada J3V 6B9
abcenergie@info-genie.com

Design, construction and start-up of boilers, power plants, cogeneration facilities and energy recovery systems for industry, buildings, utility and pharmaceuticals sectors.

Aldworth Engineering Inc.

85 Curley Drive, Bureau 103
Toronto, ON, Canada M3A 2P8
staff@aei.egate.net

Provides consulting engineering services in energy efficiency/cogeneration, waste management, water/wastewater treatment, landfill gas utilization, environmental protection and pollution control for all industrial sectors.

Mariah Energy Corporation

Unit 12, 1922 9th Avenue S.E.
Calgary, Alberta
Box 6044 Station A
Calgary, AB, Canada T2H 2L3
www.mariahpower.com

Manufactures and distributes Micro-Utility units for multi-unit residential, commercial, industrial, medical, and recreational facilities.

Northwest Territories Power Corporation

4 Capital Drive
Hay River, NT, Canada X0E 1G2

A progressive energy supply company that produces and distributes electricity generated by hydro, diesel and natural gas.

Toromont Energy Ltd

151 Corstae Avenue,
Concord, ON, Canada L4K 4Y2
jfrank@toromont.com

Provides design engineering, construction management and plant operations services for combined cycle, cogeneration and biomass combustion technologies to the alternative energy and electrical power utilities sectors.

BIOMASS FIRED POWER GENERATION

Advanced Thermodynamics Corporation

103 Metig Street
Sault Ste. Marie, ON, Canada P6A 5K9
atc.tech@sympatico.ca

Designs and manufactures all types of generators for government, aerospace/defence, automotive/motor vehicles, metals/minerals and transportation/storage sectors. In addition to conventional fuels the generators may be wind power or biomass fuel systems.

Cape Breton Environmental Systems

90 Riverview Drive
P. O. Box 26
Sydney, NS, Canada B1P 6G9

Provides design, engineering and operation services of the patented Waste-to-Energy technology for the controlled combustion of municipal solid and biomedical wastes. Client sectors include government, buildings and health/pharmaceutical industries.

PROVIDER

PROFILE

Dutch Industries Ltd.

P.O. Box 568
Pilot Butte, SK, Canada S0G 3Z0
<http://www.dutchind.com>

Offers a wide range of products in support of environmentally sustainable agriculture operations and alternative energy options for farm, cottage and rural water needs. Complete product lines for conservation tillage practices and wind power generation.

ENERKEM Technologies Inc.

414 McGill #204
Montreal, QC, Canada H2Y 2G1
<http://www.enerkem.com>

Develops small-scale environmental energy plants with a focus on biomass fired power generation. Key areas include thermochemical and catalytic conversion processes and aqueous/steam fractionation technologies for the alternative energy, biotechnology, science, research and development, and waste management/ remediation sectors.

Pacific Institute for Advanced Study

936 Thermal Drive
Coquitlam, BC, Canada V3J 6R8
<http://www.sway.com/~pacific>

A world leader in the development and commercialization of climate change reduction/cleaner production technologies such as solar, wind, micro hydroelectric and biomass energy systems. It provides services/technologies to many sectors of the global economy including oil/gas, mining, forestry, agriculture, aquaculture, transportation and all three levels of government.

Thermal Energy International Inc.

36 Bentley Avenue, 2nd Floor,
Nepean, ON, Canada K2E 6T8
<http://www.thermalenergy.com>
thermal@istar.ca

Custom designs, engineers, manufactures, and installs FLU-ACE Systems for pollution control and heat recovery. Power/heat generated from renewable or non-renewable sources. Technology suitable for a wide range of industries and institutional or residential facilities.

Toromont Energy Ltd

151 Corstate Avenue
Concord, ON, Canada L4K 4Y2
jfrank@toromont.com

Provides design engineering, construction management and plant operations services for combined cycle, cogeneration and biomass combustion technologies to the alternative energy and electrical power utilities sectors.

Winter Gardens Energy Recovery Systems

9904- 210th Street NW
Edmonton, AB, Canada T5T 5X9
flobel@hotmail.com

Provides waste to energy recovery systems for agriculture, power generation and greenhouse food production operations. A biomass gasifier diverts municipal solid waste from landfill to generate electricity, heat and CO₂ for plant growth.

SMALL SCALE HYDRO

Cumming Cockburn Ltd.

65 Allstate Parkway
Suite 300
Markham, ON, Canada L3R 9X1
<http://www.cumming-cockburn.com>

Provides consulting engineering services including planning, design, construction and operations management to a wide range of clients. Areas of expertise include small hydro, urban development, infrastructure, hydrology, water resource, transportation and environmental projects.

ESI Ecosystem International

4700, de la Savane, suite 211
Montreal, QC, Canada H4P 1T7
www.esiltd.ca

Provides research and development, planning, design engineering, pre-contract, contract administration, quality insurance, basic care plan and field services to national and international clients.

PROVIDER

PROFILE

Pacific Institute for Advanced Study

936 Thermal Drive
Coquitlam, BC, Canada V3J 6R8
<http://www.sway.com/~pacific>

The Institute is a world leader in the development and commercialization of climate change reduction/cleaner production technologies such as solar, wind, micro hydroelectric and biomass energy systems. It provides services/technologies to many sectors of the global economy including oil/gas, mining, forestry, agriculture, aquaculture, transportation and all three levels of government.

Powerbase Automation Systems Inc.

150 Rosamond Street
Carleton Place, ON, Canada K7C 1V2
www.powerbase.com

Designs, manufactures and markets automation control systems for small hydro power generation systems.

Seaforth Engineering Group Inc.

302-780 Windmill Road
Dartmouth, NS, Canada B3B 1T3
dlombardi@seafortheng.ca

Provides consulting engineering services with specialization in renewable energy systems, ocean mapping, ship management and maintenance systems. Development of wind turbine energy systems in remote areas. Development of small hydro and fish passage technology projects.

Swiderski Engineering

901 Bank Street
Ottawa, ON, Canada K1S, 3W5
jacek@achilles.net

This company is active in the small and medium hydropower industry and provides custom water turbine designs based on Computational Fluid Dynamics. Solutions for power plant upgrades and new turbine designs are provided.

COMBINED CYCLE POWER PLANTS

Orenda Aerospace Corporation

3160 Derry Road
Mississauga, ON, Canada L4T 1A9
<http://www.orenda.com/>

Provides a diverse range of products and services to the aerospace/defence, manufacturing/processing, metals/minerals and petroleum industries. Combined cycle power generation using gas and steam turbines.

Toromont Energy Ltd

151 Corstate Avenue
Concord, ON, Canada L4K 4Y2
jfrank@toromont.com

Provides design engineering, construction management and plant operations services for combined cycle, cogeneration and biomass combustion technologies to the alternative energy and electrical power utilities sectors.

MUNICIPAL SOLID WASTE COMBUSTION

Aldworth Engineering Inc.

85 Curley Drive, Bureau 103
Toronto, ON, Canada M3A 2P8
staff@aei.egate.net

Provides consulting engineering services in energy efficiency/cogeneration, waste management, water/wastewater treatment, landfill gas utilization, environmental protection and pollution control for all industrial sectors.

CANMET Metals Technology

568 Booth Street
Ottawa, ON, Canada K1A 0E4
<http://www.nrcan.gc.ca/mms/canmet-mtb/>

Provides research and development of new technologies for reducing GHG emissions from power generation plants. In partnership with the utilities sector, recommends new materials for integrated Gasification Combined Cycle technologies.

PROVIDER

PROFILE

Cape Breton Environmental Systems

90 Riverview Drive
P. O. Box 26
Sydney, NS, Canada B1P 6G9

Provides design, engineering and operation services of the patented Waste-to Energy technology for the controlled combustion of municipal solid and biomedical wastes. Client sectors include government, buildings and health/pharmaceutical industries.

Dutch Industries Ltd.

P.O. Box 568
Pilot Butte, SK, Canada S0G 3Z0
<http://www.dutchind.com>

Offers a wide range of products in support of environmentally sustainable agriculture operations and alternative energy options for farm, cottage and rural water needs. Complete product lines for conservation tillage practices and wind power generation.

Heuristic Engineering Inc.

112-3755 West 6th Ave.
Vancouver, BC, Canada V6R 1T9
<http://www.heuristicengineering.com>

Installation and commissioning of EnvirOcyclor, a two stage combustor that operates on wet or solid wastes such as wood or agricultural residues, landfill wastes, poultry litter, sewage sludge and shredded tires or industrial wastes. A two-stage gasifier is currently under development.

Winter Gardens Energy Recovery Systems

9904- 210th Street NW
Edmonton, AB, Canada T5T 5X9
flobel@hotmail.com

Provides waste to energy recovery systems for agriculture, power generation and greenhouse food production operations. A biomass gasifier diverts municipal solid waste from landfill to generate electricity, heat and CO₂ for plant growth.

WIND ENERGY

Advanced Thermodynamics Corporation

103 Metig Street
Sault Ste. Marie, ON, Canada P6A 5K9
atc.tech@sympatico.ca

Designs and manufactures all types of generators for government, aerospace/defence, automotive/motor vehicles, metals/minerals and transportation/storage sectors. In addition to conventional fuels the generators may be wind power or biomass fuel systems.

Helimax Energy Inc.

5215 rue Berri Bureau 3000
Montreal, QC, Canada H2J 2S4

Renewable energy projects: wind; solar, biomass, hydro; with specialization wind projects.

Matrix Energy Inc.

16807 Hymus Boulevard
Kirkland, QC, Canada H9H 3L4
www.matrixenergy.ca

Supplies/install solar energy based equipment for government, agriculture, utilities, electronics/telecommunications, pharmaceutical/health, tourism/recreation and transportation/storage sectors.

Pacific Institute for Advanced Study

936 Thermal Drive
Coquitlam, BC, Canada V3J 6R8
<http://www.sway.com/~pacific>

A world leader in the development and commercialization of climate change reduction/cleaner production technologies such as solar, wind, micro hydroelectric and biomass energy systems. It provides services/technologies to many sectors of the global economy including oil/gas, mining, forestry, agriculture, aquaculture, transportation and all three levels of government.

PH Composites Inc.

Huron Industrial Park, Building 3
Huron Park, ON, Canada N0M 1Y0
www.composites.on.ca

Develops and manufactures composite structures comprised of Fiber-Reinforced Plastic (FRP) products for the wind energy, aerospace, recreational and industrial sectors.

PROVIDER

PROFILE

Sambrabec Inc.

5756 Avenue Deom
Montreal, QC, Canada H3S 2N4

Manufactures wind turbine and hybrid energy systems

Seaforth Engineering Group Inc.

302-780 Windmill Road
Dartmouth, NS, Canada B3B 1T3
dlombardi@seafortheng.ca

Provides consulting engineering services with specialization in renewable energy systems, ocean mapping, ship management and maintenance systems. Development of wind turbine energy systems in remote areas. Development of small hydro and fish passage technology projects.

Trillium Windmills Inc.

250 Angus Point Road, R.R. #1
South River, ON, Canada POA 1X0
<http://www.trillumwindmills.com>

Distributes Rutland wind generators and Koenders windmills for government, agriculture, alternative energy, buildings, utilities, fisheries/aquaculture and water/wastewater sectors.

Zephyr North

4034 Mainway
Burlington, ON, Canada L7M 4B9

Consulting firm that provides wind resource assessment services to alternative energy, electric power utilities and oceans and marine sectors. Exclusive distributor of MS-Micro software package capable of modeling wind flow in complex terrain.

EFFICIENT ELECTRICAL TRANSFORMERS

Insoil Canada Limited

231 Hampshire Place NW
Calgary, AB, Canada T3A 4Y7
<http://www.insoil.ca>

Provides research, development and testing of environmentally friendly technologies for Electric Power Utilities requiring efficient electrical transformers.

FUEL CELLS

Agile Systems Incorporated

Agile Systems Inc
575 Kumpf Drive
Waterloo, ON, Canada N2V 1K3
www.agilesys.com

Designs, manufactures and markets digital power and control solutions for the automation, transportation and energy sectors.

Astris Energy Inc.

2175-6 Dunwin Drive
Mississauga, ON, Canada L4L 1X2
<http://www.astrisfuelcell.com/>

Develops alkaline fuel cell generators for transportation, portable power generators and co-generators.

Ballard Power Systems

9000 Glenlyon Parkway
Burnaby, BC, Canada V5J 5J9
<http://www.ballard.com>

Develops proton exchange membrane fuel cell power systems for government, aerospace/defence and building sectors. Provides energy efficient motors for stationary electric power generation, transportation applications and portable power packages.

Cellex Power Products Inc.

Suite 220 – 13155 Delf Place
Richmond, BC, Canada V6V 2A2
www.cellexpower.com

Develops fuel-cell based power products for use in industrial and premium power applications.

Chrysalix Energy Limited Partnership

3250 East Mall
Vancouver, BC, Canada V6T 1W5
www.chrysalix.com

Offers both funding and a variety of valuable services to client companies developing technologies, products and services in all aspects of the evolving fuel cell industry.

PROVIDER

PROFILE

Energy Ventures Inc.

Bldg M-16, 1500 Montreal Road
Ottawa, ON, Canada K1A 0R6
www.energyvi.com

Canadian technology company in the portable power (rechargeable battery and fuel cell) technology sector.

FatPower Inc.

Suite 1, 1339 — 40th Ave. N. E.
Calgary, AB, Canada T2E 8N6
www.hy-drive.com

Provides an ongoing development program focused on fuel cell related technology applications as infrastructure expands and markets develop.

Fuel Cell Technologies Ltd.

20 Binnington Court
Kingston, ON, Canada K7M 8S3
www.fuelcelltechnologies.ca

Advanced fuel cell power system integrator, that specializes in research and development of fuel cell systems.

Fuel Cells Canada

3250 East Mall
Vancouver, BC, Canada V6T 1W5
www.fuelcellscanada.ca

A non-profit industry association that provides services and support of Canadian corporations, educational institutions and business alliances promoting, development, demonstrating and deploying fuel cell and related products and services in Canada.

Global Thermoelectric Inc.

4908 52nd Street SE
Calgary, AB, Canada T2B 3R2
www.globalte.com

Leading manufacturer and distributor of thermoelectric generators for remote power applications. Leader in commercialization of solid oxide fuel cell (SOFC) technology with a focus on residential cogeneration, auxiliary power for automotive applications and small scale industrial uses.

Greenlight Power Technologies Inc.

209 — 9865 West Saanich Road
Sidney, BC, Canada V8L 5Y8
www.greenlightpower.com

Global supplier of testing and diagnostic equipment to the fuel cell industry.

H Power Enterprises of Canada Inc.

1069 Begin
St-Laurent, QC, Canada H4R 1V8
www.hpower.com

Leading fuel cell development company and one of the first providers to complete a commercial sale of a proton exchange membrane (PEM) fuel cell system.

Hydrogen Research institute

Université du Québec à Trois-Rivières
3351 des Forges, P. O. Box 500
Trois-Rivières, QC, Canada G9A 5H7
www.uqtr.quebec.ca/IRH

A research and development unit of the Université du Québec à Trois-Rivières that focuses on the domains of storage, safety and use of hydrogen and fuel cells.

Hydrogenics Corporation

5985 McLaughlin Road
Mississauga, ON, Canada L5R 1B8
www.hydrogenics.com

Develops integrated PEM fuel cell systems including associated diagnostic and control equipment. Design and commercialization of the Proton Exchange Membrane (PEM) fuel cell for the alternative energy, automotive/motor vehicles and power utilities sectors.

Kinectrics Inc.

800 Kipling Avenue
Toronto, ON, Canada M8Z 6C4
www.kinectrics.com

Specialists in designing, specifying, procuring and assembling of balance of plant for commercial and residential fuel cells.

PROVIDER	PROFILE
MagPower Systems Inc. Suite 340 – 6165 Highway 17 Delta, BC, Canada V4K 5B8 www.magpowersystems.com	Develops primary, secondary, standby alternative and emergency power sources based on hydrogen in metal-air fuel cells.
Matrix Energy Inc. 16807 Hymus Boulevard Kirkland, QC, Canada H9H 3L4 www.matrixenergy.ca	Supplies/installs solar energy based equipment for government, agriculture, utilities, electronics/telecommunications, pharmaceutical/health, tourism/recreation and transportation/storage sectors.
National Research Council of Canada 3250 East Mall Vancouver, BC, Canada V6T 1W5 www.nrc.ca/icvan	Develops core competencies relevant to the long-term strategic technology needs of Canadian fuel cell industry.
NORAM Engineering and Constructors Ltd. 200 Granville Street, Suite 400 Vancouver, BC, Canada V6C 1S4 www.noram-eng.com	Develops, commercializes and supplies hydrogen delivery systems, energy storage and hydrogen handling expertise to the chemical, plastics, and resource industries worldwide.
Ontario Power Generation 700 University Avenue Toronto, ON, Canada M5G 1X6 www.opg.com	Involved in the construction and operation of the world's largest pre-commercial solid oxide fuel cell combined heat and electric power plant.
Placan Fuel Cell Co. Ltd. 8624 Commerce Court Burnaby, BC, Canada V5A 4N6 www.placan.com	Develops technologies for prototyping, manufacturing and testing Proton Exchange Membrane (PEM) fuel cell stacks and power systems ranging from 100W to 5 kW.
Pathway Design & Manufacturing Inc. 111 – 7400 MacPherson Avenue Burnaby, BC, Canada V5J 5B6 http://www.pathway-design.com/	Custom supplier to the fuel cell industry, that specializes in the design and manufacture of plastic products.
Pivotal Power 150 Bluewater Road Bedford, NS, Canada B4B 1G9 www.kbelectronics.ns.ca	Provides power electronics engineering services and products to the fuel cell industry.
QuestAir Technologies 6961 Russell Avenue Burnaby, BC, Canada V5J 4R8 http://www.questorinc.com	Gas separation process based on pressure swing adsorption techniques using rotary valve technology and active adsorbents (Zeolites). Compact units suitable for transportation applications or industrial off-gas recovery. Enables hydrogen gas recovery, fuel cell technology, air emissions reduction and compliance in a wide range of industrial sectors.
Reonac Energy Systems Inc. 180, Avenue du Voyageur Pointe-Claire-Dorval, QC, Canada H9R 6A8 www.reonac.com	Supplies all industrial sectors of stand-alone photovoltaic systems that operate on collected solar power only.

PROVIDER

PROFILE

Siemens Canada Limited
www.siemens.ca

Researches and develops innovative technologies in the health, information/communication, industry, energy/power, transportation and lighting sectors.

The Armstrong Monitoring Corporation
215 Colonnade Road South
Ottawa, ON, Canada K2E 7K3
www.armstrongmonitoring.com

ISO-9001 Registered manufacturer of high quality gas sensing apparatus, meeting the needs of the fuel cell and hydrogen industries.

Westaim Ambeon
(a division of Westaim Corporation)
10102 114th Street
Fort Saskatchewan, AB, Canada T8L 3W4
www.westaimambeon.com

Composite material technologies for advanced power generation and electronic applications.

WATER ELECTROLYTIC HYDROGEN FUEL

Hydrogen Systems Inc.
555 Rene-Levesque Blvd. W., Suite 750
Montreal, QC, Canada H2Z 1B1
http://www.hydrogensystems.com/

Produces hydrogen generators (electrolysers) for renewable energy.

NORAM Engineering and Constructors Ltd.
200 Granville Street, Suite 400
Vancouver, BC, Canada V6C 1S4
www.noram-eng.com

Develops, commercializes and supplies hydrogen delivery systems, energy storage and hydrogen handling expertise to the chemical, plastics, and resource industries worldwide.

Reonac Energy Systems Inc.
180, Avenue du Voyageur
Pointe-Claire-Dorval, QC, Canada H9R 6A8
www.reonac.com

Supplies all industrial sectors of stand-alone photovoltaic systems that operate on collected solar power only.

Stuart Energy Systems Inc.
122 The West Mall
Toronto, ON, Canada M9C 1B9
http://www.stuartenergy.com/

Hydrogen generator supplier and developer of water electrolysis technologies. Stuart energy systems products provide a source of renewable energy while eliminating GHG emissions for the automotive/motor vehicles, alternative energy, electrical utilities, environmental and transportation/storage sectors.

PHOTOVOLTAIC SYSTEMS

Matrix Energy Inc.
16807 Hymus Boulevard
Kirkland, QC, Canada H9H 3L4
www.matrixenergy.ca

Supplies/install solar energy based equipment for government, agriculture, utilities, electronics/telecommunications, pharmaceutical/health, tourism/recreation and transportation/storage sectors.

Reonac Energy Systems Inc.
180, Avenue du Voyageur
Pointe-Claire-Dorval, QC, Canada H9R 6A8
www.reonac.com

Supplies all industrial sectors of stand-alone photovoltaic systems that operate on collected solar power only.

PROVIDER	PROFILE
Sunmotor Group 104, 5037 - 50 Street Olds, AB, Canada T4H 1R8 http://www.sunpump.com/	Designs and installs photovoltaic solar pumping systems for agricultural, environmental and tourism/recreational applications. Systems also suitable for remote pumping of potable water in rural locations.
INTEGRATED GASIFICATION COMBINED CYCLE	
CANMET Metals Technology 568 Booth Street Ottawa, ON, Canada K1A 0E4 http://www.nrcan.gc.ca/mms/canmet-mtb/	Researches and develops new technologies for reducing GHG emissions from power generation plants. In partnership with the utilities sector recommends new materials for integrated Gasification Combined Cycle technologies.
SOLAR THERMAL ELECTRICITY	
ATS Automation Tooling Systems Inc. 250 Royal Oak Road, Box 32100 Preston Centre Cambridge, ON, Canada N3H 4R7 http://www.atsautomation.com	Designs & builds factory automation systems for a variety of industries including telecommunications, semiconductor, fiber optics, automotive computers, solar energy & consumer products. Manufacturer of plastics and metal precision components for producing and testing solar cells and modules.
Matrix Energy Inc. 16807 Hymus Boulevard Kirkland, QC, Canada H9H 3L4 www.matrixenergy.ca	Supplies/installs solar energy based equipment for government, agriculture, utilities, electronics/telecommunications, pharmaceutical/health, tourism/recreation and transportation/storage sectors.
Pacific Institute for Advanced Study 936 Thermal Drive Coquitlam, BC, Canada V3J 6R8 http://www.sway.com/~pacific	A world leader in the development and commercialization of climate change reduction/cleaner production technologies such as solar, wind, micro hydroelectric and biomass energy systems. It provides services/technologies to many sectors of the global economy including oil/gas, mining, forestry, agriculture, aquaculture, transportation and all three levels of government.
Reonac Energy Systems Inc. 180, Avenue du Voyageur Pointe-Claire-Dorval, QC, Canada H9R 6A8 www.reonac.com	Supplies all industrial sectors of stand-alone photovoltaic systems that operate on collected solar power only.
Soltrac International Inc. 1650, rue Notre Dame St-Sulpice, QC, Canada G5W 3V5	Manufactures solar energy collection equipment that uses state changes in freon gas as the thermal energy conversion system. Client sectors include commercial, residential and institutional buildings and all levels of government.
Toromont Energy Ltd 151 Corstate Avenue Concord, ON, Canada L4K 4Y2 http://www.toromontenergy.com	Provides design engineering, construction management and plant operations services for combined cycle, cogeneration and biomass combustion technologies to the alternative energy and electrical power utilities sectors.

PROVIDER**PROFILE****Ultra-Sun Solar Industries Inc.**

138 Garden Crescent
Hamilton, ON, Canada L8V 4T4

Manufactures flat plate thermal solar collectors and liquid to liquid heat exchangers. A full range of systems from small residential to large commercial/industrial is available.

TIDAL ENERGY**Blue Energy Canada Inc.**

21 Water Street, Suite 300
Vancouver, BC, Canada V6B 1A1
<http://www.blueenergy.com>

Develops the Blue Energy power systems that harness the kinetic energy stored in ocean currents, tides and natural river flow. Services all sectors in the installation of large scale electric power generation facilities.

There are many modes and types of transportation, but most GHG mitigation technologies are focused on improving the efficiency of light-duty gasoline vehicles and the energy efficiency of jet aircraft. A strong Canadian auto parts design and manufacturing sector has developed and is concentrated in southern Ontario. Canada has the world's fourth largest aviation industry, manufacturing executive & commuter jet aircraft and jet engines. There are various combinations of alternative fuel vehicles covering three technology areas: i) internal combustion engines using natural gas, ethanol, methanol, or hydrogen; ii) fuel cells using methanol or hydrogen; and; iii) electric vehicles (batteries; charging systems; motors and electric controllers). Considerable research on advanced vehicle propulsion systems such as fuel cells has put Canadian technology into the front lines. Canada is developing its ethanol fuel markets and has a good position on hydrogen fuel cell development. Enzyme technology that will convert biomass waste into ethanol will be central to this. Many small Canadian companies are currently producing conversion systems for fleet vehicles.

4.3.1 ALTERNATE FUELS (E.G. ETHANOL, METHANOL)

The use of fossil fuels in transportation represents a major source of CO₂ and N₂O emissions. A wide range of alternate fuels have been developed and are gaining market acceptance as improvements in production technologies bring prices in line with conventional fossil fuels. Because alternate fuels are often made from renewable sources, many of which would otherwise contribute to climate change, their availability in the future will not be subject to the same vagaries as is the petroleum industry. For example, biodiesel produced from vegetable oil can be used in existing engines to reduce CO₂ emissions by improved internal combustion. Alcohol fuels such as ethanol and methanol are currently blended with gasoline and are considered replacement fuels that can reduce emissions and increase octane levels. Their future potential as alternative fuels rests with the fact that they can be made from renewable sources so that economical production and utilization technologies need only be developed for them to gain widespread market acceptance. Natural gas and propane are petroleum based alternative fuels and P-series fuel is a blend of ethanol, methyltetrahydrofuran, pentanes and butane. When liquid

hydrogen is used as fuel, water is the only vehicle emission produced. Electricity and solar power are particularly attractive as alternative fuels in that no GHG emissions are produced.

4.3.2 ALTERNATE FUEL VEHICLES (E.G. NATURAL GAS, HYBRID, FUEL CELLS)

GHG emissions from mobile sources are a significant contributor to climate change. Technologies developed to reduce vehicle emissions while remaining competitive in this high demand market are starting to emerge. True alternative fuel vehicles available today include those using only compressed natural gas (CNG), liquid petroleum gas (LPG) or electricity (battery and/or fuel cells). Hybrids such as CNG/LPG bi-fuel, flexible fuel and hybrid electric vehicles are also available, and combine alternative fuel technologies with conventional gasoline engines. In addition to new vehicles, a variety of CNG and LPG conversion kits for existing vehicles are available, and can help to reduce the costs associated with meeting target GHG emission levels.

4.3.3 LIGHTER VEHICLE BODIES

Lighter vehicle bodies improve mileage and thus reduce GHG emissions by increasing the power to weight ratio. Aluminum and plastic have traditionally been used in the construction of lighter vehicle bodies. This trend may change, however, with the development of new lightweight high-strength steels that do not contribute to increased vehicle costs.

4.3.4 EFFICIENT JET ENGINES

Increased fuel efficiency is the principle goal of climate change technologies in the aerospace industry. The Ultra High Bypass (UHB) engine developed by General Electric showed significant fuel savings over conventional aircraft, however, serious noise problems preclude its commercial development. Nevertheless, the need for a reduction in air emissions by the aviation industry and the cost benefits that accrue from improved fuel efficiency are empowering research and development in the field. The adoption of more efficient and cost effective reciprocating engines for small aircraft demonstrates that even small reductions in GHG emissions can be important when sufficient markets exist for the new technology.



4.3.5 ADVANCED TRAFFIC MANAGEMENT SYSTEMS

Transportation in general contributes significantly to both climate change and increased air pollution. When traffic problems such as accidents, congestion, traffic jams and inefficient vehicle flow are superimposed over basic emissions, GHG and particulate matter emissions to the atmosphere increase dramatically. Advanced traffic management seeks to address these problems by combining information processing, communications, control and electronics to improve the efficiency of transportation systems. Electronic toll collection systems are an example of how transportation efficiency can be improved electronically. Nevertheless, the inefficiency that accrues from the use of four-way traffic lights will require far more than electronics to resolve the traffic problems that currently exist in most urban areas.

By no means exhaustive, it is hoped that this document provides the reader with an indication of the breadth of Canadian technologies, products and services available – or under development – to reduce greenhouse gas (GHG) emissions.

PROVIDER PROFILE ALTERNATE FUELS

BIOX Corporation

12 Madison Avenue
Toronto, ON, Canada M5R 2S1
www.bioxcorp.com

Commercializes a biodiesel production process from recycled vegetable oils, agricultural seed oils or waste animal fats and greases.

British Columbia Hydro

6911 Southpoint Drive (E18)
Burnaby, BC, Canada V3N 4X8
www.bchydro.com
<http://www.bchydrogen.com/>

Uses renewable electricity and its extensive distribution network to produce hydrogen for industrial transportation and portable power markets.

Canadian Hydrogen Association

5 King's College Road, Suite 116
Toronto, ON, Canada M4S 3G8
www.h2.ca

A non-profit association that promotes the use and development of hydrogen energy, hydrogen energy systems and technologies and to develop the role of hydrogen energy for the purpose of improving the environment.

Canadian Renewable Fuels Association

31 Adelaide Street East
P.O. Box 398
Toronto, ON, Canada M5C 2J8
<http://www.greenfuels.org>

A non-profit organization that promotes the use of renewable biofuels for transportation. Membership includes representatives from fuel marketing, production and processing sectors, energy, forestry, agriculture and agri-business industries, engineering and environmental organizations, researchers and individuals involved in the development of alternative fuels.

Commercial Alcohols

20 Toronto Street, Suite 1400
Toronto, ON, Canada M5C 2B8
www.comalc.com

Manufactures and distributes industrial and fuel grade alcohols from corn.

DynaMotive Energy Systems Corp.

105-1700 West 75th Avenue
Vancouver, BC, Canada V6P 6G2
www.dynamotive.com

Develops fast pyrolysis technology to produce BioOil fuels from biomass.

Ensyn Technologies

Research and Development
6847 Hiram Drive
Greely, ON, Canada K4P 1A2
www.ensyn.com

Developed a Rapid Thermal Processing technology for the production of bio-oil from wood products and for petroleum upgrades.

FuelMaker Corporation

70 Worcester Road
Toronto, ON, Canada M9W 5X2
www.fuelmaker.com

Provides research and development of refuelling appliances for natural gas vehicles.

PROVIDER

PROFILE

Iogen Corporation

300 Hunt Club Road East
Ottawa, ON, Canada K1V 1C1
www.iogen.ca

Provides research and development of enzyme technologies for the production of ethanol from agricultural wastes.

Methanex Corporation

Suite 1800, 200 Burrard Street
Vancouver, BC, Canada V6C 3M1
www.methanex.com

Leader in methanol production and marketing and in the commercialization of this environment friendly fuel alternative.

ORTECH Corporation

2395 Speakman Drive
Mississauga, ON, Canada L5K 1B3
<http://www.info.ortech.on.ca>

A research and development organization that provides monitoring/assessment and compliance services. Environmental technology development in waste utilization, wastewater treatment, pollution control, energy savings and alternative fuels.

PFC eFuels Inc.

1111 West Georgia — 11th Floor
Vancouver, BC, Canada V6E 4M4
www.efuels.net

Designs, installs and services liquid natural gas stations.

Pyrovac

333 rue Franquet
Sainte-Foy, QC, Canada G1P 4C7
www.pyrovac.com

Develops and markets vacuum pyrolysis technologies for the production of alternate fuels from biomass and industrial wastes.

ALTERNATE FUEL VEHICLES

Azure Dynamics Corp.

3650 Wesbrook Mall
Vancouver, BC, Canada V6S 2L2
350 Bay Street
Toronto, ON, Canada M5H 2S6
<http://www.azuredynamics.com/>

Produces hybrid vehicle fuel systems that achieve optimal efficiency and vehicle performance while also making significant reductions in emissions and energy consumption.

CDS Research Ltd.

208-1200 Alpha Lake Road
Whistler, BC, Canada V0N 1B1
<http://www.cdsresearch.com>

Research and engineering with a focus on the development and implementation of alternative fuels for the transportation sector. Development of natural gas and hydrogen fueling systems for surface and air transportation.

Dynetek Industries Ltd.

4410 — 46 Avenue SE
Calgary, AB, Canada T2B 3N7
www.dynetek.com

Develops, produces and markets Advanced Lightweight Fuel Storage Systems for storing compressed natural gas for low emission vehicles, and compressed hydrogen for zero emission fuel cell vehicles.

ECO Fuel Systems Inc.

2-20043 92A Avenue
Langley, BC, Canada V1M 3A5
<http://www.ecofuel.com/>

Develops, manufactures and distributes alternative fuel equipment, conversion systems and components for utilities, government, corporations and public conversion centers. Computer software, training, consultation, schematics and technical support are also provided.

PROVIDER	PROFILE
FIBA Canning Inc. 2651 Markham Road Scarborough, ON, Canada M1X 1M4 http://www.fibacanning.com/fcie.htm	Develops a variety of natural gas vehicles including urban buses and refuse trucks. Development of regenerative brake technology for natural gas vehicles.
Ford Motor Company of Canada The Canadian Road P. O. Box 2000 Oakville, ON, Canada L6J 5E4 http://www.ford.ca	Manufactures a broad range of flexible fuel, natural gas, bi-fuel and electric vehicles.
General Hydrogen Corporation 13120 Vanier Place Richmond, BC, Canada V6V 2J2 www.generallyhydrogen.com	Develops technologies and invests in companies that will facilitate the development and introduction of the hydrogen infrastructure and the emergency of the Hydrogen Age.
GFI Control Systems Inc. 100 Holinger Crescent Kitchener, ON, Canada N2K 2Z3	Provides natural gas and propane vehicle conversions using a computer controlled, closed loop fuel injection system for automotive and motor vehicles.
Kraus Group Inc. 25 Paquin Road Winnipeg, MB, Canada R2J 3V9 http://www.krausind.mb.ca/	Provides a wide range of alternative fuel products such as natural gas and propane refueling station equipment, natural gas testing services and dedicated natural gas valve and fitting components.
Orion Bus Industries 350 Hazelhurst Road Mississauga, ON, Canada L5J 4T8 www.freightliner.com	Provides research and development of hybrid buses using diesel or compressed natural gas and battery power.
Quasiturbine Tronçonneuses Inc. Casier 2804 - 3535 Papineau Montréal, QC, Canada H2K 4J9 http://quasiturbine.promci.qc.ca	Develops an environmentally friendly multi-purpose engine for use with conventional and alternative fuels. Quasiturbine engine is suitable for transportation and industrial applications. As a zero vibration engine it is well suited for use in chain saws, etc., where the occurrence of vibration syndrome is a concern.
Technologies M4 Inc. 575 Rue le Breton Longueuil, QC, Canada J4G 1R9 www.tech-m4.com	Delivers solutions for highly integrated power electronics, controls and electric generator units for electric and hybrid-electric vehicles, auxiliary power units and distributed energy resources industry.
Westport Innovations Inc. 1700 West 75th Avenue, Vancouver, BC, Canada V6P 6G2 www.westport.com	Research, development and marketing of High Pressure Direct Injection technologies to enable diesel engines to use alternative fuels.

PROVIDER	PROFILE
XCELLSIS Fuel Cell Engines Inc. 3900 North Fraser Way Burnaby, BC, Canada V5J 5G1 www.xcellsis.com	Develops and manufactures hydrogen- and methanol-powered fuel cell engines for worldwide heavy-duty and light-duty transportation applications.
Yugotech Incorporated 1050 Britannia Road, East Mississauga, ON, Canada L4W 4N9 yugotech@istar.ca	Designs, manufactures, supplies and installs vehicle conversion systems (natural gas and propane) using a computer controlled sequential injection system (SEQUIN).
ADVANCED TRAFFIC MANAGEMENT SYSTEMS	
IDEC Canada, Limited Unit 22-151 Brunel Road Mississauga, ON, Canada L4Z 1X3 http://www.idec.com	Manufactures a complete line of equipment for industrial and technical applications requiring complex automated solutions. Products are ergonomic and designed for longevity, ease of use, energy efficient and low maintenance.
EFFICIENT JET ENGINES	
ORTECH Corporation 2395 Speakman Drive Mississauga, ON, Canada L5K 1B3 http://www.info.ortech.on.ca	Contract research and development organization providing monitoring/assessment and compliance/compliance services. Environmental technology development in waste utilization, wastewater treatment, pollution control, energy savings and alternative fuels.
Quasiturbine Tronçonneuses Inc. Casier 2804 - 3535 Papineau Montréal, QC, Canada H2K 4J9 http://quasiturbine.promci.qc.ca	Develops an environmentally friendly multi-purpose engine for use with conventional and alternative fuels. Quasiturbine engine is suitable for transportation and industrial applications. As a zero vibration engine it is well suited for use in chain saws, etc., where the occurrence of vibration syndrome is a concern.

Most proven industrial GHG reduction technologies focus on process changes and heat exchange efficiency to improve overall energy utilization. The sampling below is only a snapshot of the many unique technologies that can be applied to unit processes to reduce fuel for electricity consumption in Canada. Biofiltration is a promising control technology for processes that emit large off-gas volumes with relatively low concentrations of contaminants. The technology is an established method of odour control that has demonstrated success in destroying some types of VOCs, CH₄ and sulfurous odours. The main applications are in wastewater treatment, rendering plants, municipal composting, food processing, wood products and contaminated site remediation. A number of these technologies are particularly important to Canada's pulp and paper sector (pulp digesters, mechanical dewatering, and biofiltration of gases).

4.4.1 EFFICIENT ELECTRIC MOTORS

Heating, ventilation and air conditioning systems are high energy cost systems that are an integral part of the operation of a wide range of buildings. Since electrical motors power most of these systems, improvements in efficiency here will go far towards reducing GHG emissions associated with electrical power generation.

4.4.2 DISTILLATION CONTROL SYSTEMS

Crude petroleum is a complex mixture of volatiles that can be separated by heat distillation due to differences in evaporation/condensation temperatures. The purity of distilled fractions is highly dependant upon temperature distribution in the distillation columns and accurate controls are necessary to ensure a high quality product that requires no subsequent processing. Optimized distributed control system technology uses online computer system monitors to control equipment throughout the distillation process. An added advantage is a reduction in energy consumption of up to 15%, thereby reducing GHG emissions to the atmosphere.

4.4.3 CONTINUOUS PULP DIGESTERS

The first stage in pulp and paper production is the digestion of wood chips to form wood pulp. The wood chips are heated under pressure with chemicals in a digester that has traditionally been run in batch mode. Continuous pulp digesters are a cost effective alternative for large mills that require 50% less electricity than conventional batch digesters. In addition, this technology reduces the need for subsequent bleaching thereby reducing the toxicity of pulp mill effluents.



4.4.4 MECHANICAL DEWATERING

Process sludges and waste streams from a wide range of industries generally require some form of processing prior to disposal. Processing usually involves the separation of the liquid and solid fractions to reduce waste volume. Mechanical dewatering is preferable due to the high energy costs associated with thermal sludge reduction. Wastewater may be treated prior to discharge or reused depending upon the industry. Solids are disposed of in landfills or as a soil conditioner.

4.4.5 BIOFILTRATION OF GASES

Industrial, waste disposal, food processing and pharmaceutical plants emit large volumes of gases contaminated with low concentrations of pollutants. Biofiltration is a low cost climate change technology that can easily remove unwanted constituents from gaseous plumes without the need for process changes or physical plant renovations. Gases are passed through a bed of inert material where captured contaminants can undergo microorganism-assisted decay.

4.4.6 BIODIESEL

Biodiesel is a renewable energy source made from plant oils by a process known as transesterification. The methyl esters produced by this refining process make a cleaner burning fuel than petroleum diesel and can be used in conventional combustion engines with only minimal modifications. Target markets include mass transit, marine, mining applications and industrial generators.

By no means exhaustive, it is hoped that this document provides the reader with an indication of the breadth of Canadian technologies, products and services available – or under development – to reduce greenhouse gas (GHG) emissions.

EFFICIENT ELECTRIC MOTORS

Ballard Power Systems

9000 Glenlyon Parkway
Burnaby, BC, Canada V5J 5J9
<http://www.ballard.com>

Develops proton exchange membrane fuel cell power systems for government, aerospace/defence and building sectors. Provides energy efficient motors for stationary electric power generation, transportation applications and portable power packages.

Berg Chilling Systems Inc.

51 Nantucket Boulevard
Toronto, ON, Canada M1P 2N5
sales@berg-group.com

Designs and manufactures state-of-the-art process cooling equipment for the plastics, pulp and paper, graphics, metal working, chemical and food industries, among others. Technologies include renewable energy sources, energy efficient motors, variable speed drivers and other devices.

DISTILLATION CONTROL SYSTEMS

CEMCorp Ltd.

2170 Stanfield Road
Mississauga, ON, Canada L4Y 1R5
<http://www.cemcorp.com>

Provides consulting engineering services to the food processing, distillery, brewery, biotechnology and chemical processing industries using distillation processes. Services include process and equipment design, and expert advice/guidance in structural and electrical requirements, management control systems and environmental and hazard controls engineering.

CONTINUOUS PULP DIGESTERS

Tristar Industries Ltd.

7660 Vantage Way
Delta, BC, Canada V4G 1A7
<http://www.tristarind.com>

Manufactures, repairs, rebuilds, and services a complete line of process equipment for the pulp and paper, cement, mining, chemical and petrochemical industries.

MECHANICAL DEWATERING

Fournier Industries Inc.

325, blvd Frontenac
Black Lake, QC, Canada G6H 2B5

Research, development and distribution of a rotary press for the mechanical dewatering of sludges from metal/minerals, mining, water/wastewater and pulp and paper industries.

John Meunier Inc.

4105 Sartelon Street
Saint-Laurent, QC, Canada H4S 2B4
<http://www.johnmeunier.com>

Provides a complete range of technologies, equipment and management services to the potable water and wastewater treatment industries.

BIOFILTRATION OF GASES
Soconag Environmental Expertise Inc.

1751 Richardson, Suite 6143
 Montreal, QC, Canada H3K 1G6
<http://www.smartsoil.com>

Process measurement and control systems for gas and liquid flows from industrial bioreactors. Technologies include biopile bioventilation, composting, biofiltration, biogas production and drying of process wastes.

BIODIESEL
Canadian Renewable Fuels Association

31 Adelaide Street East, P.O. Box 398
 Toronto, ON, Canada M5C 2J8
<http://www.greenfuels.orgpublicinfo@greenfuels.org>

Non-profit organization promoting the use of renewable biofuels for transportation. Membership includes representatives from fuel marketing, production and processing sectors, energy, forestry, agriculture and agri-business industries, engineering and environmental organizations, researchers and individuals involved in the development of alternative fuels.

4.5 Building Systems



The building systems category includes technologies for more efficient or alternative (non fossil) thermal energy generation, technologies to reduce electricity consumption (demand side management), and technologies to reduce thermal energy losses.

4.5.1 PULSE COMBUSTION BOILERS

Conventional atmospheric and forced-draft combustion boilers are considerable sources of GHGs. Pulse combustion boilers that use alternative fuels for heating can reduce N_2O emissions by up to 90% over atmospheric boilers. Further reductions can be achieved by recirculating the exhaust gas.

4.5.2 HEAT PUMP WATER HEATERS

The energy demand for heating air and water for residential and industrial uses is high. Heat pumps are a cost-effective means of reducing energy demands by transferring the latent heat stored in the ground or in water to interior applications. These systems also function as efficient air conditioners by removal and transfer of interior heat.

4.5.3 PELLETIZED BIOMASS COMBUSTION

Residential heating systems are often inefficient, leading to increased emissions of GHGs. Newer oil or gas furnaces address this problem. Nevertheless, the use of fossil fuels in these systems means that they are still significant contributors to climate change. Pellet stoves represent an alternative to conventional furnaces that are highly efficient and use alternative fuels for additional GHG savings. Wood residues or other biomass are formed into dense pellets for use as fuel, which combusts completely thereby minimizing particulate emissions and heat loss.

4.5.4 SOLAR WATER HEATERS

Residential hot water heaters are a significant recurring household expense. Gas hot water heaters are more efficient and can reduce costs over electric heaters, but are still an important source of GHG emissions. Solar hot water heaters are a cost-effective climate change technology that has zero emissions.

4.5.5 GEOTHERMAL HEAT PUMPS

Geothermal heat pumps are an efficient cost-effective method of heating and cooling a wide range of buildings year round. Season to season variation in ground temperature is minimal compared to atmospheric variation. In winter, water circulating through the pump draws heat from the ground and transfers it to the interior of the building for warmth. In summer, the system is reversed and interior heat is drawn out of the building and transferred to the ground where it is absorbed.

4.5.6 ENERGY MANAGEMENT SYSTEMS

Energy costs represent a significant drain on building management resources. Non-critical loads, peak demand period consumption, and energy inefficiencies contribute to these high energy needs and thus to global warming. Energy management systems can reduce these costs by monitoring energy demands to shed non-critical loads, provide automatic control of equipment, provide demand-based energy usage, and provide historical energy trending and energy load profiles.

4.5.7 LIGHTING CONTROLS

Electricity costs for lighting represents a substantial maintenance expense for large buildings. Automatic lighting control systems can reduce these costs by eliminating non-critical lighting needs. Sensors detect unexpected lighting needs and provide instant illumination as required and are turned off automatically when there is no longer a demand.

4.5.8 ELECTRONIC BALLASTS

Conventional magnetic ballasts are inefficient fluorescent lighting fixtures that are prone to flicker, hum and provide poor colour rendition. Electronic ballasts are a new type of lighting fixture that are more efficient and thus able to reduce energy costs, as well as solve many of the problems associated with magnetic ballasts.

4.5.9 COMPACT FLUORESCENT LIGHTS

Grid electric lighting in public areas is a significant source of GHG emissions due to their high energy demand. Compact fluorescent lights that run on solar power represent a climate change technology that is cost effective in terms of both energy savings and installation costs. These highly efficient zero emission lights also contain solar rechargeable batteries for backup power on cloudy days.

4.5.10 ENERGY EFFICIENT APPLIANCES

With the high cost of energy and consumer demands for cost effective alternatives, manufacturers have been developing increasingly energy efficient appliances for a wide range of applications. These energy efficient appliances go beyond the conventional household appliances to include ventilation systems, heat exchangers, dehumidifiers, air recovery systems, etc.

4.5.11 ENERGY EFFICIENT WINDOWS

Windows represent a major source of heat loss from buildings, resulting in increased energy costs and GHG emissions. Energy efficient window systems address this problem through the use of low thermal conductivity materials, vinyl casements, insulating glass, improved weather-stripping to reduce air filtration, and other state of the art technologies and materials designed to provide maximum thermal efficiency.

4.5.12 ADVANCED INSULATION SYSTEMS

Thermal leakage from buildings is an important contributor of GHG emissions due to energy consumption demands. Advanced insulation systems address this problem through the use of new materials that have low thermal transfer properties. Insulation manufactured from plastics, waste newsprint, and lumber by-products have the added advantage of reducing landfill wastes. Breathable building envelopes that provide air insulation without moisture retention can also help to reduce energy costs while realizing climate change savings.

By no means exhaustive, it is hoped that this document provides the reader with an indication of the breadth of Canadian technologies, products and services available – or under development – to reduce greenhouse gas (GHG) emissions.

PROVIDER PROFILE PELLETIZED BIOMASS COMBUSTION

**Dell-Point Technologies Inc.
& Dell-Point Combustion Inc.**
3 Montmartre
Blainville, QC, Canada J7C 2Z6
<http://www.pelletstove.com>

Manufacturer of the computer equipped DC 2000 Gasifier Pellet Stove that utilizes gasification/pyrolysis/combustion technology to burn pellets comprised of wood residues. Development of central heating/cooling, hot water and energy generating systems.

SOLAR WATER HEATERS

Conserval Engineering Inc.
200 Wildcat Rd.
Toronto, ON, Canada M3J 2N5
www.solarwall.com

Markets the SOLARWALL large building solar heat system for apartment buildings, industrial plants and warehouses, commercial buildings, crop drying, residential applications.

EnerWorks Incorporated
520 Wellington Street, Unit 9
P. O. Box 3082, Station B
London, ON, Canada N6A 4J4
www.enerworks.com

Develops and markets competitively priced solar water heating appliances as an alternative to conventional gas and electric water heaters.

S. A. Armstrong Limited
23 Bertrand Avenue
Scarborough, ON, Canada M1L 2P3
www.armstrongpumps.com

Designs, engineers and manufactures circulators, hydronics, engineered products, pumps, systems, heat exchangers and expansion equipment for residential, commercial and industrial markets worldwide.

Solar Solutions RECD Inc.
1708 St. James Street
Winnipeg, MB, Canada R3H 0L3
<http://www.solarsolutions.ca>

Manufactures solar and wind driven electrical generators for a wide range of applications including energy efficient appliances and lighting, micro hydro and pumping systems, power control centers and inverters sustainable building design, composting toilets, etc.

Solcan Ltd.
126 Wychwood Park
London, ON, Canada N6G 1R7

Manufactures specialized solar equipment such as collectors, air exchangers and water heating systems. Services include design, installation, commissioning, maintenance and training.

GEOHERMAL HEAT PUMPS

Caneta Research Inc.
7145 West Credit Avenue
Suite 102, Building 2
Mississauga, ON, Canada L5N 6J7

Contract research engineering firm that provides services to government, industry and utilities with emphasis on ground-source heat pumps.

Carleton Energy Services Inc. (CESI)
3235 Southgate Rd.
Ottawa, ON, Canada K1V 7Y2

Specializes in the development and design of large-scale groundwater supply and energy systems for district heating and cooling complexes and industrial requirements.

PROVIDER

PROFILE

Earth Energy Society of Canada

Suite 1050, 130 Slater Street
Ottawa, ON, Canada K1P 6E2
<http://www.earthenergy.org>

Representatives for the ground-coupled heat pump industry that promotes geothermal heat pump technologies as a renewable energy option for government, construction and building sectors. Members active in export markets include engineering consultants and equipment manufacturers.

Faraci Engineering Ltd

19 Mager Drive West
Winnipeg, MB, Canada R2M 0R9

Consulting engineering firm for commercial, residential, institutional and industrial building sectors in the field of heat pumps.

Solar Solutions RECD Inc.

1708 St. James Street
Winnipeg, MB, Canada R3H 0L3
<http://www.solarsolutions.ca>

Manufactures solar and wind driven electrical generators for a wide range of applications including energy efficient appliances and lighting, micro hydro and pumping systems, power control centers and inverters sustainable building design, composting toilets, etc.

ENERGY MANAGEMENT SYSTEMS

ADMIC Controls

97 Glen Cameron Road
Thornhill, ON, Canada L3T 1N8

A division of Adaptive Microelectronics Ltd., that provides electronic energy management equipment and software for managing electrical and mechanical systems in the electronics and telecommunications sector. Marketing of high-efficiency natural gas boilers and co-generation systems.

Dessau-Soprin International Inc.

300-1200, boulevard St. Martin ouest
Laval, QC, Canada H7S 2E4
<http://www.dessausoprin.com>

Engineering consulting firm that provides a full range of environmental engineering services for all sectors. Services include energy and waste management, environmental assessment, monitoring and follow-up, remediation and rehabilitation, impact assessments, treatment system management, etc.

Econoler International

253, Rue Saint-Paul, bureau 200
Québec, QC, Canada G1K 8C1
<http://www.econolerint.com>

Partnering specialists for the start-up and operation of energy service companies for implementing efficiency and demand-side management projects. Provide assistance to all organizations involved in energy efficiency program implementation.

Efficiency Engineering Inc. (EEI)

155 Robinson Road
Cambridge, ON, Canada N1R 5S7

Energy management specialists in electrical and mechanical systems. Provides staffing, management and delivery services to large clients in government, electronics/telecommunications, construction, building and alternative fuels sectors.

Energy Advantage Inc.

690 Dorval Drive, Suite 400
Oakville, ON, Canada L6K 3W7
<http://www.energyadvantage.com/>

Provides complete energy management services to clients in all sectors with a focus on climate change.

PROVIDER

PROFILE

James Hooke & Associates Limited

18 Saxton Private
Ottawa, ON, Canada K2H 9P3

Consultants in energy management and technology transfer for all client sectors. Specializing in measuring, metering and monitoring technologies that include energy use accountability for managers.

Newport Energy Systems Inc.

1879 Orr Road
Mississauga, ON, Canada L5J 3Z9

Provides sales, technical and installation services to the building and manufacturing/processing sectors in upgrading/retrofitting lighting systems, electronic ballasts, louvers and lenses and occupancy sensors.

Optimum Energy Management Inc.

921 - 18 Avenue SW
Calgary, AB, Canada T2T 0H2
<http://www.oemi.com>

Energy management consulting firm that specializes in Total Energy and Emissions Management (T.E.E.M.) for government, chemicals, utilities, forestry/logging, manufacturing/processing, metals/minerals, mining and petroleum sectors.

PRECARN

Ottawa, ON
www.precarn.ca

Research and development of intelligent control systems for the manufacturing, mining, forestry, energy production, agri-food, environmental/geomatic, and medical and information technology industries.

LIGHTING CONTROLS

Solar Solutions RECD Inc.

1708 St. James Street
Winnipeg, MB, Canada R3H 0L3
<http://www.solarsolutions.ca>

Manufactures solar and wind driven electrical generators for a wide range of applications including energy efficient appliances and lighting, micro hydro and pumping systems, power control centers and inverters sustainable building design, composting toilets, etc.

Save Energy Engineering Inc.

26 Clansman Boulevard
Toronto, ON, Canada M2H 1X4
<http://www.srm-see.com>

Engineering and control manufacturer of energy management systems including the EMS 6000 microprocessor monitoring and control systems for energy management in government, construction, tourism/recreation and building sectors.

ELECTRONIC BALLASTS

Kanalfakt Inc.

50 Kanalfakt Way
P.O. Box 2000
Bouctouche, NB, Canada E0A 1G0
kflakt@nbnet.nb.ca

Manufactures specialized air movement/ventilation appliances for residential, commercial and industrial applications. Provides all services from product conception to full-scale production.

COMPACT FLUORESCENT LIGHTS

EnRel Energy Corp.

Unit 13-2485 Lancaster Rd
Ottawa, ON, Canada K1B 5L1

Develops and manufactures compact fluorescent lights, stand alone streetlights, solar security, and critical power systems.

Kanalfakt Inc.

50 Kanalfakt Way
P.O. Box 2000
Bouctouche, NB, Canada E0A 1G0
kflakt@nbnet.nb.ca

Manufactures specialized air movement/ventilation appliances for residential, commercial and industrial applications. Provides all services from product conception to full-scale production.

ENERGY EFFICIENT APPLIANCES
Hoyme Manufacturing Inc.

3843-44 Avenue
Camrose, AB, Canada T4V 3T1
<http://www.hoyme.com>

Manufactures motorized air control dampers for commercial and residential heating/ventilation industry.

James Hooke & Associates Limited

18 Saxton Private
Ottawa, ON, Canada K2H 9P3

Consultants in energy management and technology transfer for all client sectors. Specializing in measuring, metering and monitoring technologies that includes energy use accountability for managers.

Save Energy Engineering Inc.

26 Clansman Boulevard
Toronto, ON, Canada M2H 1X4
<http://www.srm-see.com>

Engineering and control manufacturer of energy management systems including the EMS 6000 microprocessor monitoring and control systems for energy management in government, construction, tourism/recreation and building sectors.

Solar Solutions RECD Inc.

1708 St. James Street
Winnipeg, MB, Canada R3H 0L3
<http://www.solarsolutions.ca>

Manufactures solar and wind driven electrical generators for a wide range of applications including energy efficient appliances and lighting, micro hydro and pumping systems, power control centers and inverters sustainable building design, composting toilets, etc.

ENERGY EFFICIENT WINDOWS
Dashwood Industries Ltd.

Highway #4
Centralia, ON, Canada NOM 1K0

Provides building products designed for energy efficiency, longevity and building code compliance. Manufacturer of prefab energy efficient doors and windows. Installation services also available.

Loewen Windows

P. O. Box 2260
Steinbach, MB, Canada R0A 2A0
<http://www.loewen.com>

Manufactures and distributes energy efficient windows and doors constructed of Douglas Fir.

ADVANCED INSULATION SYSTEMS
Dashwood Industries Ltd.

Highway #4
Centralia, ON, Canada NOM 1K0

Provides building products designed for energy efficiency, longevity and building code compliance. Manufacturer of prefab energy efficient doors and windows. Installation services also available.

4.6 Industrial Non-Energy Systems



The industrial non-energy category represents a sampling of technologies for reducing various GHGs in different industries. Ninety percent of industrial non-energy GHG emissions in Canada come from a relatively low number of large industrial plants (e.g. ammonia plants, cement plants, lime plants, aluminum smelters, magnesium smelters). Small volumes of SF₆, PFCs and HFCs come from widely distributed sources. The capture and recycling of fluorinated compounds is a technology that was developed in response to the ozone depleting substance issue. Canada has world-scale urea plants and supplies various countries. The Canadian supply of ammonia and urea is concentrated in western Canada, close to the abundant supply of inexpensive natural gas and the major fertilizer markets. Canada has a world-scale aluminum industry due to its low cost hydroelectric power.

4.6.1 ALUMINUM SMELTER ANODES

Primary aluminum production is an important source of GHGs in the form of CO₂ and PFCs. CO₂ emissions arise from carbon anode consumption and PFC emissions arise from anode over-voltage disturbances due to declining pot alumina levels. While the latter may be largely overcome by the use of process control systems, the development of anodes made of inert materials that are highly conductive yet insoluble in cryolite and unreactive with oxygen are necessary. Ceramic metal composites look promising as replacement materials, although more research and commercialization are necessary. Meanwhile, pre-baked carbon anode technologies can reduce anode consumption and are replacing the horizontal and vertical stud Söderberg technologies.

4.6.2 GAS MEMBRANE SEPARATORS

Gas membrane separators are used in industry to remove/recover hydrogen, helium and hydrocarbons, in air dehumidification and natural gas processing. Fuel cell technologies can realize performance and efficiency improvements through oxygen enrichment leading to reduced fuel stack size, weight and cost making them more amenable to replacement of combustion technologies that contribute significantly to climate change.

The use of adsorbent materials can lead to a reduction in the size of the system with a corresponding reduction in power consumption and additional cost benefits. This climate change technology also has applications in the transportation industry for electric vehicles.

4.6.3 USE OF CO₂ IN UREA PRODUCTION

The petrochemical industry is a major contributor to industrial non-energy GHG emissions. A climate change technology that seeks to address part of the problem is the use of CO₂ from ammonia plants in the production of urea fertilizers. Ammonia is produced by reacting nitrogen and hydrogen in the presence of a catalyst. Hydrogen production from CH₄ and water generates CO₂ as a by-product that may be released to the atmosphere as a GHG or sequestered in urea by reacting it with ammonia.

4.6.4 SUBSTITUTES FOR CLINKER IN CEMENT

Cement production is a significant contributor of CO₂ to the atmosphere. The major source of these emissions are from the production of clinker – the principal component of cement. Climate change technologies that seek to address this problem do so by replacing some proportion of the clinker for alternative materials. Fly ash is the most common substitute. Technologies using spent abrasives, sulphidic mine tailings and waste rock or rubber tire crumbs for specific applications are also available.

4.6.5 CAPTURE AND RECYCLING OF FLUORINATED COMPOUNDS

Refrigerant losses by refrigeration and air conditioning systems can be up to 40% annually, representing a significant source of atmospheric emissions for these GHGs. The capture and recycling of fluorinated compounds is a climate change technology that can reduce emissions while providing reduced replacement costs. Leakage detection systems, capture and recovery technologies and refrigerant recycling all help to reduce emissions and protect the environment from global warming.

4.6.6 ALUMINUM SMELTER CONTROL SYSTEMS

Aluminum smelters have a significant impact on ambient air quality and are large contributors to the presence of GHGs in the atmosphere. One of the most effective mechanisms for pollution control is to have in place effective process control and monitoring systems. These, coupled with treatment technologies that reduce or eliminate the release of toxic or environmentally unfriendly substances, are important steps towards the prevention of climate change.

4.6.7 ALTERNATIVE MAGNESIUM COVER GAS

The use of SF₆ as a cover gas by the magnesium industry is a major emission source of this GHG to the atmosphere. Emissions arise from both primary production and secondary processing where the gas functions to protect the magnesium surface from oxidation. Climate change technologies involve either a reduction in the utilization rate or replacement with alternatives such as sulphur dioxide or argon. The use of refrigerant gases such as HFC and tetrafluoroethane may also be a possibility, although additional research is required.

4.6.8 ALTERNATIVE REFRIGERANTS

Air conditioning and refrigeration are significant sources of atmospheric HFCs. Under the terms of the Montreal Protocol a global ban on the use of chlorinated fluorocarbons and HFCs will be instituted by the year 2020. Our reliance upon these compounds for cooling technologies has been the impetus for research into alternative refrigerants. HFCs with moderate to low climate change potential are preferred since they are the most efficient coolant alternatives available to date. Most of the other alternatives available have both advantages and disadvantages for different applications. Examples include hydrocarbons for domestic refrigeration, ammonia for commercial refrigeration, water-zeolite adsorption for large vehicle air conditioning, and hydrogen or helium for cryogenic systems. Technology refinements and further research in this area are necessary.

By no means exhaustive, it is hoped that this document provides the reader with an indication of the breadth of Canadian technologies, products and services available – or under development – to reduce greenhouse gas (GHG) emissions.

GAS MEMBRANE SEPARATORS

Cansolv Technologies Inc.

8475, avenue Christophe-Colomb
Suite 2000
Montreal, QC, Canada H2M 2N9

Cansolv Technologies Inc., is a process development and licensing company that markets the CANSOLV System Sulfur Dioxide (SO₂) Scrubbing Technology. The technology can be applied to flue gas desulfurization, sulfur recovery units and most gaseous process streams in the power generation, refining, natural gas, sulfuric acid, smelter and pulp & paper industries.

Enervac Corporation

Environmental Technology Group
700 Franklin Boulevard
Cambridge, ON, Canada N1R 5S9
<http://www.enervac.com>

Specialists in dehydration and filtration technologies for purification and recycling for a wide range of industrial applications.

Procedair Industries Inc.

625, avenue Président Kennedy
Montréal, QC, Canada H3A 1K2

Construction of acid gas scrubbing systems and hot gas particulate control systems for cement plants, industrial boilers, waste incinerators, steel mills and primary and secondary aluminum production industries.

USE OF CO₂ IN UREA PRODUCTION

Agrium

13131 Lake Fraser Drive
Calgary, AB, Canada T2J 7E8
<http://www.agrium.com>

Produces and markets nitrogen, phosphate, potash and sulphur based fertilizers.

Saskferco Products Inc.

Suite 215, 1874 Scarth Street
Regina, SK, Canada S4P 4B3
<http://www.saskferco.com>

Producers and distributors of granular urea and anhydrous ammonia.

SUBSTITUTES FOR CLINKER IN CEMENT

Bitumar Inc.

11-650, boulevard Metropolitan est
Montréal, QC, Canada H1B 1A5

Manufactures Ecoflex asphalt cement from crumb rubber made from scrap tires for the transportation construction and roofing industries.

San-Nor International Ltd.

96 Copernicus Boulevard
Brantford, ON, Canada N3P 1N4
sannor@hotmail.com

Develops commodity products based on post-consumer wastes, industrial production wastes and non-conventional raw materials for the chemicals, manufacturing/processing, metals/minerals and mining sectors.
Construction of concrete based low-cost housing.

Target Products Ltd.

7550 Conrad Street
Burnaby, BC, Canada V5A 2H7
<http://www.targetproducts.com/>

Produces and distributes dry concrete products using spent abrasives and foundry sands for government, chemicals, construction, utilities and mining industries.

CAPTURE/RECYCLING OF FLUORINATED COMPOUNDS**Fielding Chemical Technologies Inc.**

839 Central Parkway West
Mississauga, ON, Canada L5C 2V9
<http://www.fieldchem.com>

Provides recovery distillation, purification and recycling services for a wide range of client sectors. Reclamation and recycling of hydrocarbons, chlorinated hydrocarbons, chlorofluorocarbons, ketones, esters, alcohols and other specialty solvents.

Refrigerant Services

105 Akerley Boulevard, Unit D
Dartmouth, NS, Canada B3B 1R7
<http://www3.ns.sympatico.ca/refrigerant/>

Through joint ventures and licensing agreements provides state-of-the-art technologies for refrigerant reclamation and separation and oil dechlorination for the chemicals, building and manufacturing/processing sectors.

ALUMINUM SMELTER CONTROL SYSTEMS**Goodfellow Consultants Inc.****Goodfellow Technologies Inc.**

7070 Mississauga Road, Suite 170
Mississauga, ON, Canada L5N 7G2
<http://www.goodfell.com>

Provides environmental engineering and expert advice on indoor air quality, occupational health and safety and specialized technologies to all client sectors. Research and development, environmental assessment and audits, regulatory permitting and environmental management systems training services are also provided.

Kvaerner Chemetics Inc.

1818 Cornwall Avenue
Vancouver, BC, Canada V6J 1C7
<http://www.kvaerner.com/pulp/chemetics/>

Design, construction and commissioning of gaseous emission control systems for smelter operations. Provision of technical solutions to a wide range of environmental engineering problems for all sectors.

ALTERNATIVE REFRIGERANTS**The Institute for Chemical Process and Environmental Technology**

National Research Council Canada
Montreal Road Facility
Building M-12
Ottawa, ON, Canada K1A 0R6
<http://www.nrc.ca>

Performs research and development in the areas of materials science, membrane separation and industrial spray technologies, responsible manufacturing process, chemical characterization and systems integration and compliance.

4.7 Biological Systems



Biological systems is a broad category that includes technologies applying to landfill gas, livestock manure, livestock enteric fermentation and fertilizer applications. The common theme is that the GHGs (usually CH₄) from this category are generated or controlled by the use of biological processes. Canada has a strong agricultural sector, supported by a well-established research network.

Aerobic composting systems and anaerobic digestion systems are clear Canadian strengths.

4.7.1 COLLECTION AND USE OF LANDFILL GAS

Landfill gas emissions are a significant source of GHGs. With CH₄ concentrations of up to 50% landfill gas impacts ambient air quality and represents an explosion hazard. Collection and use of landfill gas as a feedstock for the production of electricity or in cogeneration systems can lead to reduced odour and explosion hazards while reducing CH₄ emissions and those associated with the use of fossil fuels for generating electricity. Collecting, purifying and liquefying landfill gas can produce liquefied natural gas for use as a transportation fuel and the industrial grade CO₂ by-product can also be recovered.

4.7.2 AEROBIC COMPOSTING OF MANURE

Large-scale animal feedlots generate large volumes of manure wastes that contribute to global warming through the generation of CH₄ as an off gas. Anaerobic digestion of animal wastes increases the amount of CH₄ associated with the management of feedlots. Composting is a natural recycling process that relies upon the aerobic decomposition of organic matter by communities of microorganisms. Traditional composting methods usually involve piles or windrows that may be passively or actively aerated. Agitated beds or rotating drums are also used. Self-contained aerobic composters and treatment systems involving both anoxic and aerobic processes are more recent technologies. Some of these technologies have been developed in Canada to address different needs.

4.7.3 ANAEROBIC DIGESTERS SYSTEMS (E.G. INDUSTRIAL WASTE, MANURE)

Conventional disposal of industrial or municipal sludges contribute significantly to climate change. Emissions from the treatment and storage of animal or organic wastes are also important sources of GHGs. Anaerobic digester systems are designed to use these wastes as feedstocks in the production of biogas. Systems for operation at high or low temperatures have been developed and are designed to meet specific waste management needs. End product effluents are suitable for discharge and sludge volumes for disposal in landfills or as soil conditioners are reduced.

4.7.4 AIR SEEDERS

To conserve the integrity of our agricultural lands, traditional farming methods such as tilling and monoculturing are being replaced by crop rotation and cover crop management practices. Coupled with these changes are increased equipment expenses to meet the specific needs of individual crop types. Air seeders are an example of the type of precision farm equipment that is required to meet the demands of sustainable agricultural practices in addition to addressing climate change issues. Adaptable to different seed types, the air seeder can be used to combine seed, fertilizer and herbicide applications thereby reducing exhaust emissions associated with spring planting. A direct reduction in N₂O emissions over gravity seeding practices is also obtained.

4.7.5 LIVESTOCK FEED ADDITIVES

A significant proportion of the CH₄ associated with the rearing of livestock comes from ruminants as a by-product of digestion. Improving the efficiency of digestion reduces the length of time that CH₄-producing bacteria in the ruminant are exposed to the animal feed that is required for the production of CH₄. Feed additives such as canola, coconut or other edible oils can inhibit the activity of these CH₄ producers. CH₄ formation is inhibited by the use of ionophores that can overcome bacterial adaptation when different ones are used in rotation.

By no means exhaustive, it is hoped that this document provides the reader with an indication of the breadth of Canadian technologies, products and services available – or under development – to reduce greenhouse gas (GHG) emissions.

COLLECTION AND USE OF LANDFILL GAS

Biothermica

3333, Blvd Cavendish, Suite 440
Montreal, QC, Canada H4B 2M5
www.biothermica.com

Provides development, design engineering and construction services to clients on the treatment and management of landfill gases and wastes.

Blossum Agritec

2584 James Street
Abbotsford, BC, Canada V2T 3L5

Solid/liquid separators and wastewater treatment systems for the livestock industry. End products include treated water, biogas and separated solids and sludge for composting.

CETAC-WEST

216-111 Research Drive
Saskatoon, SK, Canada S7N 3R2
<http://cetac-west.ca>

The Canadian Environmental Technology Advancement Corporation provides marketing and management services to organizations involved in the development and commercialization of new environmental technologies.

CFS Alternative Fuels Inc.

102-1709 McKenzie Avenue
Victoria, BC, Canada V8N 1A6
cafi@home.com

Cryogenic purification and liquefaction systems for the recovery of landfill, bio-digester or flare/stack gases for the petroleum and waste management/remediation sectors.

CG&S

CH2M Gore & Storrie Ltd.
255 Consumers Road,
North York, ON, Canada M2J 5B6

Provides process design, engineering, science and management services and expertise in water, wastewater, water resources, civil infrastructure, industrial, municipal and environmental sectors.

Lafleche Environmental

17125 Lafleche Road
Moose Creek, ON, Canada K0C 1W0

Develops fully integrated landfill systems for the disposal of domestic and non-hazardous solid wastes. System includes accelerated anaerobic digestion, leachate purification, collection of landfill gas and solids recycling.

R.J. Burnside & Associates Limited

15 Townline
Orangeville, ON, Canada L9W 3R4
www.rjburnside.com

Provides engineering, planning and environmental services to the agricultural, industrial/commercial, recreational, municipal, and international sectors.

AEROBIC COMPOSTING OF MANURE

ADI Systems Inc.

1113 Regent Street
Suite. 300
Fredericton, NB, Canada E3B 3Z2

Anoxic and aerobic treatment systems, solids composting and wastewater treatment technology for hog operations.

Aquasol Technologies Inc.

17307-107 Avenue
Edmonton, AB, Canada T5S 1E5
Josentc@connect.ab.ca

Provides a range of water wastewater treatment technologies including the Biological Animal Waste Treatment Process that comprises a waste collection system, aerobic and anaerobic bioreactors and CH₄ capture system.

PROVIDER

PROFILE

Blossum Agritec

2584 James Street
Abbotsford, BC, Canada V2T 3L5

Solid/liquid separators and wastewater treatment systems for the livestock industry. End products include treated water, biogas and separated solids and sludge for composting.

CETAC-WEST

216-111 Research Drive
Saskatoon, SK, Canada S7N 3R2
<http://cetac-west.ca>

The Canadian Environmental Technology Advancement Corporation provides marketing and management services to organizations involved in the development and commercialization of new environmental technologies.

Double T Equipment Manufacturing Ltd.

P.O. Box 3637
#2 East Lake Way
Airdrie, AB, Canada T4B 2B8
solutions@double-t.com

Designs, engineers, manufactures, and installs aerobic in-vessel composting systems for the agricultural, municipal waste treatment, food processing, biosolids, and pulp and paper industries. Also provides services for site remediation.

Ecofluid Systems

101-366 E. Kent Avenue
South Vancouver, BC, Canada V5X 4N6
<http://www.ecofluid.com/info@ecofluid.com>

A scaleable Upflow Sludge Blanket Filtration (USBF) aerobic/anoxic bioreactor for treating the liquid fraction of hog manure.

EKOKAN Inc.

663 Vauquelin
Rock Forest, QC, Canada J1N 1X7

Pig manure processing using aerobic filters to separate liquids from solids for treatment and production of fertilizer pellets, respectively.

Global Earth Products Inc.

R. R. #2
Utopia, ON, Canada L0M 1T0

Automated manure composting system for the management of livestock waste and crop residuals. End product is a nutrient rich organic pellet that may be used as fertilizer on-site or sold to the manufacturer.

M. J. Silver & Associates

Box 424, Station L
Winnipeg, MB, Canada
mjsilver@sprint.ca

Canadian distributor for the Hog-Mop; an automatic pig manure processing machine that produces reusable distilled water, compost and exhaust gases principally consisting of nitrogen and water vapour.

NovaTec Consultants Inc.

224 West 8th Avenue
Vancouver, BC, Canada V5Y 1N5

Anaerobic and aerobic treatment of piggery wastes. Treated water is re-used for cleaning purposes and solids are discharged to stabilization ponds for anaerobic digestion. An algal surface layer promotes aerobic conditions and reduces odors.

ANAEROBIC DIGESTERS SYSTEMS

Aquasol Technologies Inc.

17307-107 Avenue
Edmonton, AB, Canada T5S 1E5
Josentc@connect.ab.ca

Provides a range of water wastewater treatment technologies including the Biological Animal Waste Treatment Process that comprises a waste collection system, aerobic and anaerobic bioreactors and CH₄ capture system.

PROVIDER

PROFILE

Atara Corporation

9700, Henri Bourassa Ouest
St-Laurent, QC, Canada H4S 1R5
ataracor@aei.ca

Research and development, design, production, after sales service and maintenance/operation of anaerobic digesters, separators, compacter, mixers and feeders for manufacturing/processing and water/wastewater treatment industries.

Bio-Terre Systems Inc.

12 Aviation Boulevard
St. Andrews, MB, Canada R1A 3N5
dgheng@mb.sympatico.ca

Development and commercialization of ambient temperature, anaerobic waste treatment technologies.

Blossum Agritec

2584 James Street
Abbotsford, BC, Canada V2T 3L5

Solid/liquid separators and wastewater treatment systems for the livestock industry. End products include treated water, biogas and separated solids and sludge for composting.

BPR Ingénieurs-Conseils Asseau – BPR

4655, boulevard Hamel
Québec, QC, Canada G1P 2J7
bpr@riq.qc.ca

Provides a wide range of environmental engineering services to government, agriculture, construction, transportation/storage and water/wastewater treatment industries.

CETAC-WEST

216-111 Research Drive
Saskatoon, SK, Canada S7N 3R2
<http://cetac-west.ca>

The Canadian Environmental Technology Advancement Corporation provides marketing and management services to organizations involved in the development and commercialization of new environmental technologies.

CG&S

CH2M Gore & Storrie Ltd.
255 Consumers Road
North York, ON, Canada M2J 5B6

Provides process design, engineering, science and management services and expertise in water, wastewater, water resources, civil infrastructure, industrial, municipal and environmental sectors.

Eastern Power Limited

Guelph, ON, Canada

Development and demonstration of a wet-dry recycling facility for the anaerobic treatment of non-recyclable kitchen, yard, and paper waste.

Ecofluid Systems

101-366 E. Kent Avenue
South Vancouver, BC, Canada V5X 4N6
<http://www.ecofluid.cominfo@ecofluid.com>

A scaleable Upflow Sludge Blanket Filtration (USBF) aerobic/anoxic bioreactor for treating the liquid fraction of hog manure.

EIMCO Process Equipment

5155 Creekbank Road
Mississauga, ON, Canada L4W 1X2
terry.mathews@bakerhughes.com

Process equipment manufacturer for the pulp and paper, mining, industrial and municipal waste treatment sectors.

NovaTec Consultants Inc.

224 West 8th Avenue
Vancouver, BC, Canada V5Y 1N5

Anaerobic and aerobic treatment of piggery wastes. Treated water is re-used for cleaning purposes and solids are discharged to stabilization ponds for anaerobic digestion. An algal surface layer promotes aerobic conditions and reduces odors.

PROVIDER	PROFILE
Sunset Solar Systems Ltd. Box 1327, 301 Hwy #2 North Assiniboia, SK, Canada S0H 0B0	Bioremediation facilitator for manure lagoon storage facilities. The Little River Pond Mill circulates and aerates lagoons to promote biodegradation. Powered by wind or electrical energy.
TEMBEC Incorporated 800 René-Lévesque Blvd. West, Suite 1050, Montréal, QC, Canada H3B 1X9 www.tembec.ca	An integrated forest management and products company providing a wide range of wood, pulp and paper, and wood extraction products.
Winterhawk Developments Ltd. 2024 12th Avenue NW Calgary, AB, Canada T2N 1J7 wintrhwk@cia.com	Provides design and build services of sewage and wastewater treatment systems for the food processing, textile, latex production, pharmaceutical, semiconductor and municipal waste management industries.

LIVESTOCK FEED ADDITIVES

CETAC-WEST 216-111 Research Drive Saskatoon, SK, Canada S7N 3R2 http://cetac-west.ca	The Canadian Environmental Technology Advancement Corporation provides marketing and management services to organizations involved in the development and commercialization of new environmental technologies.
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Sinks involve the sequestering of GHGs through increases in the existing stock of biomass (i.e. trees, vegetation). Reservoirs involve the deliberate placement of GHGs in storage, underground in soil, oil wells or underwater in oceans.

Reforestation/afforestation and forest management practices are well known and practiced regularly in Canada due to the country's large forested regions and strong wood based products and industries. The first practice focuses on increasing the volume of forested land and the second practice focuses on increasing the density of existing land. Enhanced oil recovery using CO₂ offers a potential underground reservoir for large volumes of CO₂ from industrial sources. Canada's upstream oil and gas sector is composed of the largest energy companies in the world as well as a broad group of medium and smaller firms engaged in oil exploration and drilling and development.

4.8.1 REFORESTATION AND AFFORESTATION

The objective of this land management practice as a climate change solution is to provide low cost terrestrial carbon storage. Young trees sequester more carbon than old trees due to their more rapid growth rate. For this reason reforestation following harvesting or afforestation of low productivity lands can provide CO₂ emissions reduction benefits. Activities in this area include development of comprehensive forest/land management practices, site clearing and preparation, and basic and advanced silviculture.

4.8.2 FOREST MANAGEMENT

Forests are unique in that they participate in all three facets of climate change; i.e., as a source, sink and reservoir. Forest product decomposition and burn, forest fires and the conversion of forests to urban or agricultural applications are all sources of forest related CO₂ emissions. Photosynthesis sequesters atmospheric CO₂ enabling forests to act as sinks and the storage of fixed carbon in vegetation and detritus represents a major reservoir in the carbon cycle. Forest management aims to strike a balance between values that place conflicting demands on forest resources. Socio-economics, biodiversity, environmental protection, climate change, industry, ownership issues, and sustainable development all influence how forest resources are used. Only through the use of sound forest management practices can the health and density of future forests be increased, thereby assuring that forests and their associated wealth are maintained for future generations.



4.8.3 ENHANCED OIL RECOVERY

New technologies that address multiple issues have the greatest potential for exploitation. The use of CO₂ for enhanced oil recovery is an example of such a technology. In climate change terms the collection of industrial flue gases that are rich in CO₂ reduces emissions of this important GHG. Injection of these gases into oil reservoirs sequesters the CO₂ resulting in enhanced oil recovery. Since the reservoir acts as a sink by sequestering CO₂ and the process reduces emissions GHG reduction benefits accrue on two fronts. The enhanced oil recovery is also a benefit due to depleting reserves that must bear out the transition period to widespread adoption of alternative technologies to the use of fossil fuels.

By no means exhaustive, it is hoped that this document provides the reader with an indication of the breadth of Canadian technologies, products and services available – or under development – to reduce greenhouse gas (GHG) emissions.

REFORESTATION AND AFFORESTATION

Carrier-Sekani Tribal Council

1460 6th Avenue
Prince George, BC, Canada V2L 2N2
<http://www.cstc.bc.ca>
merickso@cstc.bc.ca

Natural resource management services, environmental assessments and traditional ecological knowledge training.

Meadow Lake Tribal Council

P.O. Box 1360
Meadow Lake, SK, Canada S0M 1V0

Provides forest and natural resources management consulting services, training in forest management and traditional environmental knowledge and geographic information systems.

Mikro-Tek

115 Sandy Falls Road
Timmins, ON, Canada P4N 7C3

Markets naturally occurring mycorrhizal fungi for use in forestry silviculture, mine/land reclamation and agricultural markets.

Mistik Management

P.O. Box 9060
Meadow Lake, SK, Canada S9X 1V7
mistik@mistik.sk.ca

Provides services in forest management, co-management, wildlife and ecosystem preservation, traditional knowledge and training.

Northshore Tribal Council

P.O. Box 2049
1 Industrial Road, Lakewood Place
Blind River, ON, Canada P0R 1B0

Forest management plans and advisory services, economic development, site preparation and surveys, silviculture and brushing, thinning and mending services.

Shuswap Nation Tribal Council

355 Yellowhead Highway
Kamloops, BC, Canada V2H 1H1

Provides integrated resource management services to government and the forestry/logging and fisheries/aquaculture sectors.

FOREST MANAGEMENT

Alberta Research Council

250 Karl Clark Road
Edmonton, AB, Canada T6N 1E4
<http://www.arc.ab.ca>

Through partnering and technology transfer provides research and development and advisory services in agriculture, biotechnology, manufacturing, energy, forestry, environment and information technology.

Carrier-Sekani Tribal Council

1460 6th Avenue
Prince George, BC, Canada V2L 2N2
<http://www.cstc.bc.ca>
merickso@cstc.bc.ca

Natural resource management services, environmental assessments and traditional ecological knowledge training.

FORCE/Robak Associates Ltd

P.O. Box 1146, Station A
Fredericton, NB, Canada E3B 5C2
robakf@nbnet.nb.ca

Provides integrated and sustainable forest management services to government, industry, universities and individual clients.

PROVIDER	PROFILE
Meadow Lake Tribal Council P.O. Box 1360 Meadow Lake, SK, Canada S0M 1V0	Provides forest and natural resources management consulting services, training in forest management and traditional environmental knowledge and geographic information systems.
Mistik Management P.O. Box 9060 Meadow Lake, SK, Canada S9X 1V7 mistik@mistik.sk.ca	Provides services in forest management, co-management, wildlife and ecosystem preservation, traditional knowledge and training.
Northshore Tribal Council P.O. Box 2049 1 Industrial Road, Lakewood Place Blind River, ON, Canada P0R 1B0	Forest management plans and advisory services, economic development, site preparation and surveys, silviculture and brushing, thinning and mending services.
Shuswap Nation Tribal Council 355 Yellowhead Highway Kamloops, BC, Canada V2H 1H1	Provides integrated resource management services to government and the forestry/logging and fisheries/aquaculture sectors.

ENHANCED OIL RECOVERY

Alberta Research Council 250 Karl Clark Road Edmonton, AB, Canada T6N 1E4 http://www.arc.ab.ca	Through partnering and technology transfer provides research and development and advisory services in agriculture, biotechnology, manufacturing, energy, forestry, environment and information technology.
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ABBREVIATIONS

CDM	Clean Development Mechanism
CES	Canadian Environmental Solutions
CH ₄	Methane
CNG	Compressed natural gas
CO ₂	Carbon dioxide
GHG(s)	Greenhouse gas(es)
HFCs	Hydrofluorocarbons
IET	International Emissions Trading
ITS	Intelligent Transportation Systems
JI	Joint Implementation
LPG	Liquid petroleum gas
N ₂ O	Nitrous oxide
PFCs	Perfluorocarbons
SF ₆	Sulphur hexafluoride

INDEX

A

ABC Power and Boiler Inc.	17
ADI Systems Inc.	47
ADMIC Controls.	39
Advanced Thermodynamics Corporation ..	17, 20
Agile Systems Incorporated.	21
Agrium.	44
Albarrie Canada Limited.	8
Alberta Energy Company.	8
Alberta Research Council.	52, 53
Aldworth Engineering Inc.	17, 19
Alternative Fuel Systems Inc.	8
Aquasol Technologies Inc.	47, 48
Astris Energy Inc.	21
Atara Corporation.	49
ATS Automation Tooling Systems Inc.	25
Azure Dynamics Corp.	30

B

Balchip Corporation.	8
Ballard Power Systems.	21, 34
Beak International.	8
Berg Chilling Systems Inc.	34
Bio-Terre Systems Inc.	49
Biothermica.	47
BIOX Corporation.	29
Bitumar Inc.	44
Blossum Agritec.	47, 48, 49
Blue Energy Canada Inc.	26
BPR Ingénieurs-Conseils Asseau – BPR.	49
British Columbia Hydro.	29

C

Canadian Hydrogen Association.	29
Canadian Renewable Fuels Association ...	29, 35
CanAmera Foods.	8
Caneta Research Inc.	38
CANMET Metals Technology.	19, 25
Cansolv Technologies Inc.	44
Cantox Environmental.	8
Cape Breton Environmental Systems.	17, 20
Carleton Energy Services Inc. (CESI).	38
Carrier-Sekani Tribal Council.	52
CDS Research Ltd.	30
Cellex Power Products Inc.	21
CEMCORP LTD.	34
CETAC-WEST.	47, 48, 49, 50
CFS Alternative Fuels Inc.	47
CG&S.	47, 49
Chessen Group Inc.	8
Chrysalix Energy Limited Partnership.	21
Clean Air Canada Society.	8
Clean Nova Scotia.	9
Commercial Alcohols.	29
Conor Pacific.	9
Conserval Engineering Inc.	9, 38
Cumming Cockburn Ltd.	18

D

Dashwood Industries Ltd.	41
Delcan Corporation.	9
Dell-Point Technologies Inc.	38
Dessau-Soprin International Inc.	39
Double T Equipment Manufacturing Ltd.	48
Dundee Securities Corporation.	9

Dutch Industries Ltd.	18, 20
DynaMotive Energy Systems Corp.	29
Dynetek Industries Ltd.	30

E

Earth Energy Society of Canada	39
Eastern Power Limited	49
ECO Fuel Systems Inc.	30
Ecofluid Systems.	48, 49
Econoler International	39
Efficiency Engineering Inc. (EEI)	39
EIMCO Process Equipment	49
EKOKAN Inc.	48
Energy Advantage.	9
Energy Advantage Inc.	39
Energy Ventures Inc.	22
ENERKEM Technologies Inc.	18
EnerWorks Incorporated	38
Enervac Corporation.	44
EnRel Energy Corp.	40
Ensyn Technologies.	29
Environmental Services Association of Alberta (ESAA)	9
Enviros RIS	9
ESI Ecosystem International	18

F

Faraci Engineering Ltd.	39
FatPower Inc.	22
FIBA Canning Inc.	31
Fielding Chemical Technologies Inc.	45
FORCE/Robak Associates Ltd.	52
Ford Motor Company of Canada	31
Fournier Industries Inc.	34
Fuel Cell Technologies Ltd.	22
Fuel Cells Canada.	22
FuelMaker Corporation	29

G

Gartner Lee	9
General Hydrogen Corporation.	31
GFI Control Systems Inc.	31
Giffels Associates	10
Global Change Strategies International	10
Global Earth Products Inc.	48
Global FACMAN Enterprises Inc	10
Global Thermoelectric Inc.	22

Golder Associates	10
Goodfellow Consultants Inc.	45
Goodfellow Technologies Inc.	45
Greater Vancouver Regional District	10
Greenlight Power Technologies Inc.	22
GreenWare Environmental Systems Inc.	10

H

H Power Enterprises of Canada Inc.	22
Hatch Associates.	10
Heuristic Engineering Inc.	20
Helimax Energy Inc.	20
Hoyme Manufacturing Inc.	41
HRAI.	10
Hydrogen Research institute	22
Hydrogen Systems Inc.	24
Hydrogenics Corporation	22
Hydro-Quebec	10

I

ICF Consulting	11
ICPET.	45
IDEC Canada, Limited.	32
Insoil Canada Limited,	21
Institute for Integrated Energy Systems (IESVic)	11
Iogen Corporation	30

J

Jacques Whitford	11
James Hooke & Associates Limited	40, 41
Joe Ng Engineering Ltd.	17
John Meunier Inc.	34
JTU Consulting Inc.	11

K

Kanalflakt Inc.	40
Kinectrics Inc.	22
KPMG LLP	11
Kraus Group Inc.	31
Kvaerner Chemetics Inc.	45

L

Lafleche Environmental	47
Levelton Engineering Ltd.	11
Linamar Corporation (LPP)	11
Loewen Windows	41

M

M. J. Silver & Associates	48
MagPower Systems Inc.	23
Marbek Resource Consultants	11
Mariah Energy Corporation	17
Matrix Energy Inc.	20, 23, 24, 25
McCarthy Tétrault LLP	11
Meadow Lake Tribal Council	52, 53
Methanex Corporation	30
Mikro-Tek	52
Mistik Management	52, 53

N

National Bank Financial Inc.	12
National Research Council of Canada	23
Newport Energy Systems Inc.	40
NORAM Engineering and Constructors Ltd.	23, 24
Northern Climate Exchange	12
Northshore Tribal Council	52, 53
Northwest Territories Power Corporation	17
NovaTec Consultants Inc.	48, 49

O

OCETA	12
Ontario Power Generation	23
Optimum Energy Management Inc.	40
Orenda Aerospace Corporation	19
Orion Bus Industries	31
ORTECH Corporation	30, 32

P

Pacific Institute for Advanced Study	18, 19, 20, 25
Palcan Fuel Cell Co. Ltd.	23
Pathway Design & Manufacturing Inc.	23
Peck & Associates	12
Petroleum Technology Research Centre	12
PFC eFuels Inc.	30
PH Composites Inc.	20
Pivotal Power	23
Powerbase Automation Systems Inc.	19
PRECARN	40
Procedair Industries Inc.	44
Pyrovac	30

Q

Quasiturbine Tronçonneuses Inc.	31, 32
QuestAir Technologies	23

R

R.J. Burnside & Associates Limited	47
Refrigerant Services	45
Reonac Energy Systems Inc.	23, 24, 25, 26
Resource Futures International	12
RWDI West Inc.	12

S

S. A. Armstrong Limited	38
Sambrabec Inc.	21
San-Nor International Ltd.	44
Saskatchewan Research Council	12
Saskferco Products Inc.	44
Save Energy Engineering Inc.	40, 41
Seaforth Engineering Group Inc.	19, 21
SENES Consultants Limited	12
Shuswap Nation Tribal Council	52, 53
Siemens Canada Limited	24
SNC Lavalin	13
Soconag Environmental Expertise Inc.	35
Solar Solutions RECD Inc.	38, 39, 40, 41
Solcan Ltd.	38
Soltrac International Inc.	25
STAS Limited	13
Stuart Energy Systems Inc.	24
Suncor Energy Incorporated	13
Sunmotor Group	25
Sunset Solar Systems Ltd.	50
Swiderski Engineering	19
Syncrude Canada Limited	13

T

Target Products Ltd.	44
Technologies M4 Inc.	31
TEMBEC Incorporated	50
The Armstrong Monitoring Corporation	24
The Delphi Group	13
The GLOBE Foundation of Canada	13
Thermal Energy International Inc.	18
Toromont Energy Ltd	17, 18, 19, 25
Torrie Smith Associates	13
Trillium Windmills Inc.	21
Tristar Industries Ltd.	34

U

Ultra-Sun Solar Industries Inc. 26

W

Westaim Ambeon 24

Westcoast Energy Inc. 13

Westport Innovations Inc. 31

Winter Gardens Energy Recovery Systems . 18, 20

Winterhawk Developments Ltd. 50

Woodrising Consulting 13

X

XCELLSIS Fuel Cell Engines Inc. 32

Y

Yugotech Incorporated 32

Z

Zephyr North, 21

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