



Government
of Canada Gouvernement
du Canada

Canada

CHARTING THE COURSE

A PROGRAM ROADMAP FOR CANADA'S
TRANSITION TO A HYDROGEN ECONOMY

A PUBLICATION OF THE
GOVERNMENT OF CANADA'S
HYDROGEN AND FUEL CELL
COMMITTEE (H₂FCC)

This publication is available upon request in multiple formats. Please contact:

Information Distribution Centre
Communications and Marketing Branch
Industry Canada
Room 268D, West Tower
235 Queen Street
Ottawa ON K1A 0H5

Tel.: (613) 947-7466
Fax: (613) 954-6436
E-mail: publications@ic.gc.ca

Office of Coordination and Technical Information
CANMET Energy Technology Centre
Natural Resources Canada
13th Floor
580 Booth Street
Ottawa ON K1A 0E4

Tel.: (613) 996-6220
Fax: (613) 947-1016
E-mail: rlubin@nrcan.gc.ca

This publication is also available electronically on the World Wide Web in HTML format at the following address: www.hydrogeneconomy.gc.ca

Aussi offert en français sous le titre *Tracer la route à suivre : Feuille de route pour la transition du Canada vers une économie basée sur l'hydrogène.*

**Charting the Course:
A Program Roadmap for Canada's Transition to a Hydrogen Economy.**

Revised August 2005

Cat. No. Iu44-14/2004E
ISBN 0-662-37230-1
54159E
©2004

Contents:



THE HYDROGEN ECONOMY: OPPORTUNITIES FOR CANADA	2
ABOUT THE TRANSITION TO A HYDROGEN ECONOMY	3
MAXIMIZING CANADA'S ADVANTAGE THROUGH PARTNERSHIPS	4
CANADA'S HYDROGEN AND FUEL CELL COMMITTEE (H ₂ FCC)	5
COLLABORATIVE EFFORTS	6
A PROGRAM ROADMAP	8
APPENDIX A: PROGRAM DETAILS	10
APPENDIX B: H ₂ FCC MEMBER DEPARTMENTS	15

CANADIANS, as stewards of vast geography and abundant resources, feel a keen sense of responsibility to help the world meet the environmental challenge.

And in so doing, to show how this challenge can be turned to advantage through leadership in “green technologies”; through more energy-efficient transportation and housing; and through non-polluting industrial processes. All of which will stimulate innovation, new market opportunities, and cleaner communities.

Speech from the Throne, 2004

Canada’s Hydrogen and Fuel Cell Committee (H₂FCC) is a partnership of federal departments working together with industry and academia to help facilitate and co-ordinate the continuing development and commercialization of Canadian-made technologies built for the hydrogen economy.

Its mission: to strengthen and enhance Canada’s leadership position in hydrogen and fuel cell technologies, maximizing their social, economic and environmental benefits for all Canadians.

THE HYDROGEN ECONOMY: OPPORTUNITIES FOR CANADA

Enter the hydrogen economy—an era in which hydrogen and fuel cells will answer clean energy needs for everything from small electronics to automobiles and buildings. This new energy paradigm presents Canada with an array of social, environmental and economic opportunities including enhanced utility of our energy resources, expanding markets for Canadian technologies and cleaner air to breathe.

Canadian companies are recognized worldwide for leading the development of hydrogen and fuel cell systems—technologies that produce, store and put hydrogen to work. In the hydrogen economy, advanced Canadian technologies will be employed to convert energy derived from primary sources into hydrogen, thereby utilizing it as a common carrier to bring energy to a wide variety of applications. Canada's opportunity is clear: to become a country known for innovation and as a global provider of hydrogen energy solutions.

How will the world satisfy its ever-increasing demand for energy and at the same time address concerns related to people's health, the environment and energy security? With global energy consumption forecasted to rise 60 per cent by the year 2020, it is clear that the world needs energy systems that are more efficient and environmentally sustainable.

"Even for the countries that did not sign the Kyoto Protocol, it is clear that the new regime will change the way we think, and will stimulate the world's demand for clean energy. It is also clear that, no matter what happens in the first phase, the world cannot meet the objectives of Kyoto's second phase without a technological revolution."

—Prime Minister Paul Martin



Milestones: Highlights from more than 20 years of Canadian partnership-driven innovation

1978 The Government of Canada begins providing support to Canadian companies and universities pioneering fuel cell and hydrogen technologies. Over the years, an ever-broadening array of federal departments works with Canadian companies, universities and provincial bodies to make Canada's vision of a world-leading hydrogen and fuel cell industry a reality.

ABOUT THE TRANSITION TO A HYDROGEN ECONOMY

Hydrogen: Plentiful, Clean and Versatile

Hydrogen is the earth's cleanest and most abundant energy carrier—an energy source that can help the world address issues related to air pollution, climate change and energy reliability and security. Hydrogen can be extracted from feedstock including fossil fuels and chemicals. It can also be produced using renewable resources such as solar, wind, hydro-electricity and biomass.

Putting Hydrogen to Work

Hydrogen can be utilized many different ways. Fuel cells, for example, convert the chemical energy of hydrogen or other hydrogen rich fuels (such as methanol or natural gas), into electricity in an efficient, non-combustive process that results in few to no emissions. Fuel cell architecture is highly adaptable and can be scaled to power devices ranging from microelectronics, handheld computers and cell phones to automobiles and buildings. Hydrogen-powered internal combustion engines (ICEs) and turbines also present potentially viable, low-emission systems that can put hydrogen fuel to good use.



Social, Environmental and Economic Benefits

The domestic use and export of Canadian hydrogen and fuel cell technologies has already begun to help Canada expand its international competitiveness and knowledge-based economy. The widespread application of hydrogen and fuel cell technologies in Canada will improve air quality and reduce greenhouse gas (GHG) emissions that cause climate change, helping Canada meet its sustainability objectives and targets under the Kyoto Protocol.

Employing these technologies at home will also support Canada's drive to use its cities as launch pads for Canadian products with global market potential.

Challenges

A number of challenges need to be overcome in the transition to a hydrogen economy. These challenges are largely related to technology performance and market acceptance. Industry, in collaboration with government, is turning these challenges into business opportunities and accelerating the transition to a hydrogen economy.

1993 Launch of the world's first fuel cell transit bus. Phase 1 partners include Ballard, Natural Resources Canada (NRCan), the Government of British Columbia and SAIC Canada. Ballard, NRCan, the Government of British Columbia and the South Coast Air Quality Management District collaborate on the second phase. The world's first photovoltaic hydrogen filling station is introduced through a partnership involving the University of California (Riverside), Electrolyser Corp. (now Hydrogenics) and NRCan.

MAXIMIZING CANADA'S ADVANTAGE THROUGH PARTNERSHIPS

Canadian scientists, engineers and entrepreneurs have been pursuing the development of fuel cells and related technologies for the production, storage and distribution of hydrogen for more than 20 years. Over this time period, the Government of Canada has provided over \$200 million in support, helping Canadian companies emerge among the world's leaders in the development of these revolutionary energy systems.

In 2003, the Government of Canada built on its previous investments by announcing a further \$215-million commitment to encourage the development of innovative technologies that can reduce GHGs. Building on current support, Canada's new investment translates into approximately \$70 million per year over the next five years to help fund continued research and development, hydrogen infrastructure expansion, and technology demonstration and early adoption. Ensuring that these funds are allocated wisely and deliver maximum value to Canada is the business of Canada's Hydrogen and Fuel Cell Committee (H₂FCC)—a partnership of federal departments that work together with industry and academia to help facilitate and coordinate the continuing development and commercialization of Canadian technologies built for the hydrogen economy.

Going Forward, Canada's Priorities are Clear

H₂FCC's key objectives include the development of a coordinated, national strategy that will include strategic action related to research and development, market demonstration and programs to encourage technology "early adoption."

Canadian governments are also examining other elements of a long-term strategy for the hydrogen economy, including the development of: internationally accepted codes and standards, infrastructure and supply chains; skills and knowledge related to new technologies and processes; supportive fiscal and marketplace framework policies; awareness among Canadians; and relationships with international partners to accelerate the transition to a hydrogen economy.

Milestones: Highlights from more than 20 years of Canadian partnership-driven innovation

1996 A Technology Partnerships Canada investment helps create the Ballard PEM Fuel Cell Power Plant project, enabling Ballard to advance research on PEM fuel cell technology.

CANADA'S HYDROGEN AND FUEL CELL COMMITTEE H₂FCC

Co-chaired by NRCan, the federal department responsible for energy policies, and by Industry Canada, which is responsible for industrial development, the H₂FCC is comprised of a wide range of federal departments and agencies whose programs and services together provide industry with support across the innovation spectrum—from basic research and development through to commercialization. The Committee oversees and integrates Canada's hydrogen and fuel cell related programs and activities and provides strategic advice to department administrators and senior program managers. H₂FCC and its members provide advocacy and advice; supportive infrastructure; international partnerships; coordination, communications and outreach; and social, environmental and economic analyses. Guided in part by the strategies and recommendations outlined in Canada's Fuel Cell Commercialization Roadmap (2002) and working with public-and private-sector partners domestically and internationally, H₂FCC members are actively involved in a number of initiatives including:

- accelerating technology research, development and demonstration;
- performing social, environmental, marketplace and policy analyses;
- developing regulatory frameworks and facilitating codes and standards;
- leading communications and outreach programs;
- promoting technology diffusion and commercialization;
- fostering infrastructure development including fuelling pathways;
- establishing advanced training programs for skilled workers;
- encouraging the growth of supply chain and manufacturing capabilities; and
- stimulating interest of capital markets.



H₂FCC Member Organizations

Agriculture and Agri-Food Canada	Natural Resources Canada (NRCan)
Canada Economic Development for Quebec Regions	Natural Sciences and Engineering Research Council of Canada (NSERC)
Defence R&D Canada (DRDC)	Public Works and Government Services Canada (PWGSC)
Department of Finance	Social Sciences and Humanities Research Council Canada (SSHRC)
Department of National Defense (DND)	Sustainable Development Technology Canada (SDTC)
Environment Canada (EC)	Technology Early Action Measures (TEAM)
Export Development Canada (EDC)	Technology Partnerships Canada (TPC)
Foreign Affairs Canada (FAC)	Transport Canada (TC)
Health Canada (HC)	Western Economic Diversification Canada (WD)
Indian and Northern Affairs Canada (INAC)	
Industry Canada (IC)	
International Trade Canada (ITCan)	
National Research Council Canada (NRC)	

1997 NRCan, Stuart Energy, Ballard and BC Hydro install Canada's first hydrogen fuelling system at BC Transit.

1998 NRCan, Industry Canada, Environment Canada and Transport Canada join Ballard to ship first prototype fuel cell engine to the Ford Motor Company. NRCan, Ballard and Dynetek Industries work together to test Dynetek 3600-psi cylinders in Ballard P3 fuel cell bus demonstrations in both Vancouver and Chicago.

COLLABORATIVE EFFORTS



Programs to support technology demonstration, build infrastructure and encourage commercial adoption at home and abroad.

Fuel Cell Vehicles to Travel Canadian Hydrogen Highways

In 2004, the Ford Motor Company, Fuel Cells Canada, Government of Canada and the Government of British Columbia set in motion the Vancouver Fuel Cell Vehicle Program, Canada's first demonstration of fuel cell cars in real-world fleet applications. The multi-year program will put Ford Focus fuel cell vehicles in the hands of real drivers in real-world applications, enabling the evaluation and improvement of automobile technologies as well as a variety of hydrogen refuelling pathways and systems. In a separate initiative, provincial utility BC Hydro, Fuel Cells Canada, Methanex Corporation, NRCan, NRC and the Government of British Columbia are working together to build a Hydrogen Highway™, a major initiative to expand the province's existing hydrogen refuelling infrastructure.

h₂EA - Early Adopters Program

Technology Partnerships Canada's Hydrogen Early Adopters Program (h₂EA) is a \$50-million, five-year initiative to foster the early adoption of hydrogen technologies. The program will demonstrate and support new concepts, such as "hydrogen highways" and "hydrogen villages"; develop hydrogen infrastructure, codes and standards, skilled resources and an integrated supply chain; and accelerate acceptance of hydrogen technologies.

Leadership in Codes and Standards

H₂FCC members, including the Canadian Transportation Fuel Cell Alliance (CTFCA), are defining specifications and methodologies for testing and evaluation protocols for fuel cell and hydrogen technologies, as well as helping develop codes and standards that will facilitate the installation and use of hydrogen and fuel cell systems. Canada is an advocate for international standards for hydrogen production, distribution and storage technologies, and is working with concerned stakeholders worldwide. Canada has been providing the Chair and the Secretariat to support the activities of ISO Technical Committee (TC) 197 for Hydrogen Technologies. Several Canadian companies are represented on the many working groups and sub-committees of ISO TC 197 for hydrogen and IEC 105 for fuel cells.

Through the Canadian Hydrogen Association, Canada joined the United States and Japan in 2003 to establish the Partnership for the Advancement of the Transition to Hydrogen (PATH), an alliance promoting the importance of international standards in the development of the hydrogen economy.

Milestones: Highlights from more than 20 years of Canadian partnership-driven innovation

2001 NRCan and the Technology Early Action Measures fund join Ontario Power Generation Inc., Siemens Westinghouse and the U.S. Department of Energy to build and demonstrate the world's largest pre-commercial solid oxide fuel cell combined heat and power system. The 250-kW unit can produce electricity and heat for a small community.

International Co-operation

In 2003, Canada joined the US-led International Partnerships for the Hydrogen Economy (IPHE), which aims to enhance collaboration on fuel cell technologies and coordinate international efforts to develop a global hydrogen economy.

Fuel Cells Canada also signed a Memorandum of Understanding (MOU) with the US Fuel Cell Council, the Fuel Cell Commercialization Conference of Japan, and the World Fuel Cell Council/Fuel Cell Europe—organizations that collectively represent more than 300 businesses, research institutions and others interested in fuel cells and hydrogen. The agreement concerns international co-operation and collaboration on significant aspects of commercialization including technical co-operation, information exchange, advocacy, harmonized product specifications and safety standards.

Canada is also involved in such key initiatives as the North American Energy Working Group, the International Energy Agency and the Asia-Pacific Economic Cooperation Energy Working Group. Furthermore, Natural Resources Canada and the US Department of Energy have signed an MOU regarding collaboration for Energy R&D, under which an Implementing Agreement for Fuel Cells exists. Recent discussions between countries indicate an interest in expanding this to include Hydrogen R&D.

Canada is participating in an Organisation for Economic Co-operation and Development (OECD) Energy Working Group that is developing a multinational case study on energy sector innovation. Eight countries are involved in the study including Germany, Japan, Korea, France, Norway, Italy and the U.S. The purpose is to examine drivers of innovation and knowledge creation, diffusion and exploitation, private/public partnerships, intellectual property rights, effects of globalization and systemic influences on innovation. The report, scheduled for publication in 2005, also examines the potential social, environmental and economic returns from investments in energy R&D and innovation.



2002 Industry Canada, Fuel Cells Canada and PriceWaterhouse Coopers announce the Canadian Fuel Cell Commercialization Road Map, a project involving 45 stakeholder organizations that identifies roadblocks and charts a path for the commercialization of hydrogen and fuel cell technologies.

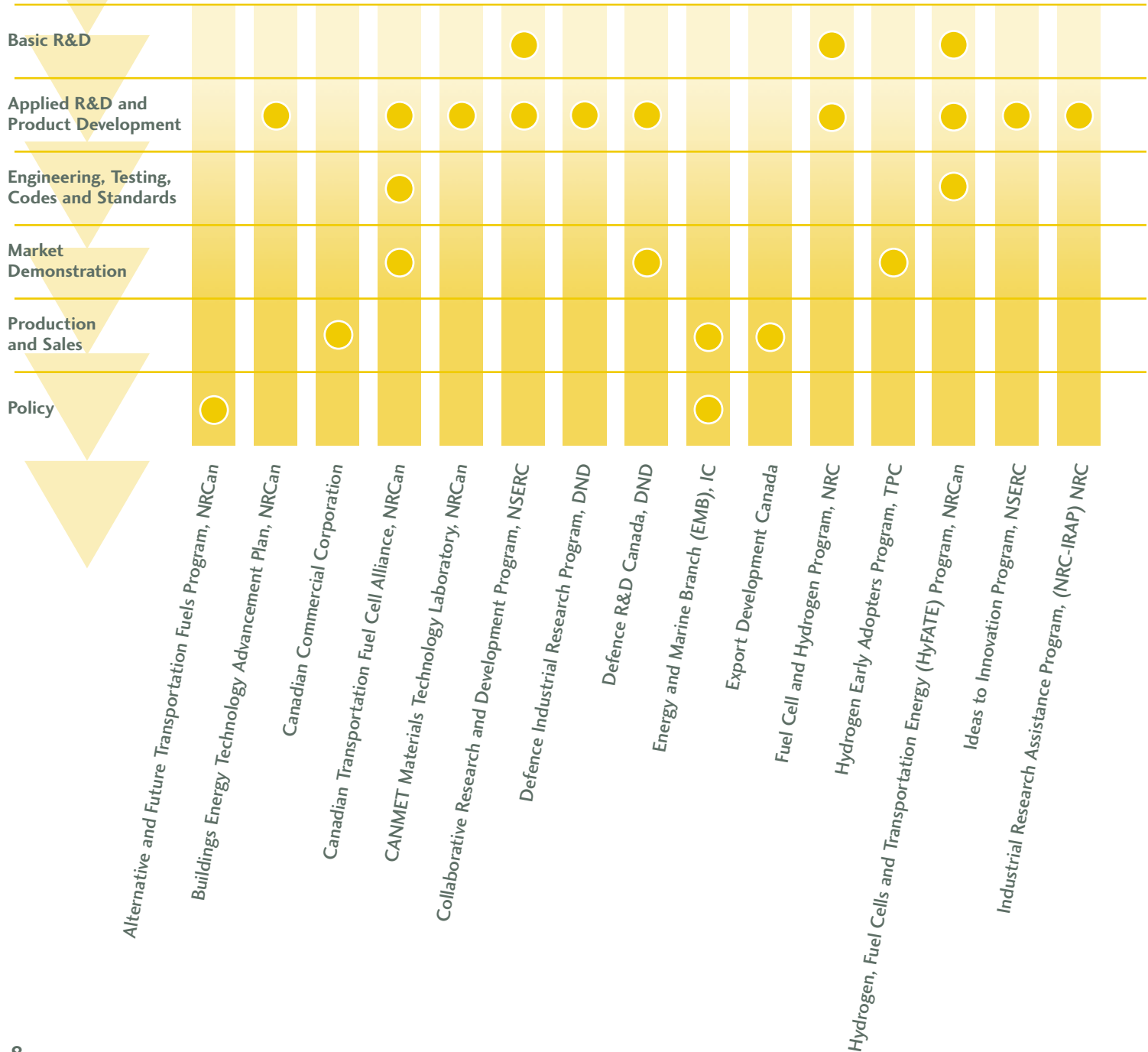
2003 Technology Partnerships Canada invests in an R&D initiative by QuestAir Technologies to develop best-of-breed hydrogen purification products for fuel cell developers.



A PROGRAM ROADMAP

A range of strategic federal programs and activities are helping Canada’s hydrogen and fuel cell industry overcome technical challenges and develop infrastructure that will accelerate the commercialization of hydrogen and fuel cell technologies. These programs span the innovation spectrum, from basic research and development through to the policy development needed for mass commercialization of hydrogen and related technologies.

See Appendix A for program details and contact information.



**Alternative and Future Transportation
Fuels Program, NRCan***Policy*

Supports the use, development and production of alternative transportation fuels such as ethanol, natural gas and hydrogen fuel cells. Provides public education, economic and market analyses, research of standards and harmonization of policies.

Contact: <http://www.oee.nrcan.gc.ca>

**Buildings Energy Technology
Advancement (BETA) Plan, NRCan***Applied R&D and Product Development*

Integrated program dedicated to the advancement and commercialization of energy-efficient and innovative technologies including fuel cells for residential and commercial buildings. Provides funding for basic research by organizations, assists with the commercialization of emerging and market-ready technologies through product standards development, field trials, monitoring and technology transfer and provides technical information and advice for the adoption of proven technologies by industry. Technologies must concern energy efficiency and demonstrate improved indoor air quality and comfort as well as workmanship and durability. Environmentally friendly equipment and user-friendly energy management systems are also important considerations. BETA programs are funded via cost-shared agreements with industry, universities and other organizations.

Contact: <http://www.buildingsgroup.nrcan.gc.ca>

Canadian Commercial Corporation (CCC)*Production and Sales*

Brings buyers and Canadian exporters together through contracts built on the best possible terms and conditions. For Canadian exporters, CCC wraps the Canadian flag around their proposal, providing a government-backed guarantee of contract performance.

Contact: <http://www.ccc.ca>

**Canadian Transportation Fuel Cell
Alliance (CTFCA), NRCan***Applied R&D and Product Development
Engineering, Testing, Codes and Standards
Market Demonstration*

Supports hydrogen refuelling demonstration projects. The CTFCA is designed to encourage advancements in hydrogen and fuel cell technologies and GHG emissions reduction by developing a hydrogen-fuelling

infrastructure for fuel cell vehicles. The program will provide approximately 30 to 50% of total project costs with the remainder of support coming from partners.

Contact: <http://www.ctfca.nrcan.gc.ca>

**CANMET Materials Technology
Laboratory, NRCan***Applied R&D and Product Development*

Develops and deploys technologies that improve the production and use of value-added products from metals and other materials.

Contact: http://www.nrcan.gc.ca/mms/canmet-mtb/mtl/default_e.htm

**Collaborative Research and Development
(CRD) Program, NSERC***Basic R&D**Applied R&D and Product Development*

CRD grants support collaborative university/private-sector research projects. Projects may range from six months to five years. Most awards are for two or three years. Provincial or federal government departments and agencies can also co-sponsor/support a CRD project, but only the industrial contributions are taken into account when NSERC determines its funding level. The industrial supporting organizations will normally contribute towards at least half of the costs (in cash and in-kind) with NSERC contributing the remainder.

Contact: http://www.nserc.ca/professors_e.asp?nav=profnav&lbi=b3

**Defence Industrial Research Program,
DND***Applied R&D and Product Development*

Strengthens and supports the Canadian Defence Industrial Base through the provision of financial and scientific support for eligible industry-initiated research projects relevant to the defence of Canada and/or its allies. The objective is to stimulate research and innovation to enhance Canada's ability to share in the development of technologies to meet Canadian, NATO and other allied defence requirements. The Program supports eligible R&D projects at a maximum 50% funding level. The scope of the projects supported is from the laboratory to the experimental model or proof-of-concept stage. The intellectual property developed by the company during the project resides with the company, but may be used by National Defence according to conditions set forth in formal contracts.

Contact: http://www.drdc-rddc.dnd.ca/business/dirp/dirp_e.asp

Defence R&D Canada, DND

*Applied R&D and Product Development
Market Demonstration*

Issues R&D contracts for tender.

Contact: <http://www.drdc-rddc.dnd.ca>

Energy and Marine Branch (EMB), IC

*Production and Sales
Policy*

Industry Canada's Energy and Marine Branch is presently engaged in a number of activities related to the development and commercialization of hydrogen and fuel cell technologies. These activities include: increasing access to investment capital and promoting international strategic partnerships; addressing technical barriers to distributed generation; and, facilitating commercialization roadmaps. The Energy and Marine Branch is developing policies and programs to enhance the economic climate for the growth of the Canadian hydrogen and fuel cell industry and linking opportunities with already established Industries.

Contact: <http://strategis.gc.ca/hydrogen>

Export Development Canada (EDC)

Production and Sales

EDC is a Canadian financial institution devoted exclusively to providing trade finance services to support Canadian exporters and investors in some 200 markets, 130 of which are in developing markets. Catering primarily to small businesses, their services include: credit insurance, bonding and guarantees, political risk insurance, and direct loans to buyers and lines of credit in other countries to encourage buyers to "buy Canadian." EDC also provides limited recourse financing arrangements and joint ventures for projects involving long-term leasing arrangements and equity participation.

Contact: <http://www.edc.ca>

Fuel Cell and Hydrogen Program, NRC

*Basic R&D
Applied R&D and Product Development*

Targeting manufacturing companies and end users who need technical solutions for commercialization of products and services, NRC's Fuel Cell and Hydrogen Program facilitates R&D at a national level, and draws from NRC's 4,000 staff and specialized facilities. The program provides a broad, extensive and multi-disciplinary network of expertise for platform R&D, testing and evaluation, and technology demonstration in fuel cell and hydrogen technologies. Principal NRC institutes contributing to the program are the Institute for Fuel Cell Innovation (Vancouver), Institute for Chemical Process and Environmental Technology (Ottawa), Steacie Institute for Molecular Science

(Ottawa), Integrated Manufacturing Technologies Institute (London), and Industrial Materials Institute (Boucherville). The research program focuses on three strategic areas: Polymer Electrolyte Membrane Fuel Cell; Solid Oxide Fuel Cells; and Hydrogen Generation and Infrastructure. Each participating Institute works closely with regional R&D providers, universities, government agencies and local industry to support the development of regional fuel cell clusters.

Contact: http://www.ifci-iipc.nrc-cnrc.gc.ca/about_nrcfcprogram.html

Hydrogen, Fuel Cells and Transportation Energy (HyFATE) Program, NRCan

*Basic R&D
Applied R&D and Product Development
Engineering, Testing, Codes and Standards*

Partners with industry and other federal and provincial agencies to develop and deploy new hydrogen and fuel cell technologies for stationary and mobile applications. The program assists with the development, demonstration and evaluation of fuel cells, hydrogen fuelling systems and hydrogen storage technologies. The program is involved in the development of codes and standards, and training and certification. The program supports R&D through cost-shared agreements, standards development and technology transfer, both domestically and internationally.

Contact: <http://www.cetc.nrcan.gc.ca>

Hydrogen Early Adopters (h₂EA) program, TPC

Market Demonstration

Supports projects that demonstrate integrated hydrogen and hydrogen-compatible technologies in real-world settings. These working pilot-scale versions of a hydrogen economy will enable firms to test and showcase technologies and help increase investor and consumer awareness of Canadian capabilities and of the many benefits and uses of hydrogen-powered applications. Initially, the h₂EA program will provide support for approximately five projects across Canada. Projects include concepts such as "hydrogen highways" and "hydrogen villages" now in development by industry and governments in several parts of the country. Projects must involve groups of two or more private- and/or public-sector partners. Funding support will be up to 50% of eligible costs for approved projects. In exceptional circumstances, the sharing ratio may reach, but not exceed, 75% of eligible costs. A maximum of \$40 million per project and \$20 million per eligible recipient will be awarded.

Contact: <http://www.tpc-ptc.ic.gc.ca/h2/en/>

Ideas to Innovation (I2I) Program, NSERC

Applied R&D and Product Development

Provides funding to university researchers for R&D leading to technology transfer to a new or established Canadian company. The program involves two distinct time-limited phases characterized by the maturity of the technology or the involvement of an early-stage investment entity or an industrial partner. In the first phase, the direct costs of research will be entirely supported by NSERC; in the second phase, they will be shared with a private partner. The technology development may begin with a Phase I (Proof-of-Concept) project followed by a Phase II (Technology Enhancement) project, or, if the development is at a later stage, can start directly with a Phase II project. In any case, a maximum of three years' funding will be available for any given project.

Contact: http://www.nserc.ca/professors_e.asp?nav=profnav&lbi=b4

Industrial Research Assistance Program (NRC-IRAP), NRC

Applied R&D and Product Development

Canada's premier innovation assistance program for SMEs, NRC-IRAP provides Canadian SMEs with value-added technological and business advice, financial assistance and a range of other innovation assistance. NRC-IRAP provides non-repayable contributions to Canadian SMEs on a cost-shared basis for research and pre-competitive development technical projects, upon assessment of a project and firm by a team of Industrial Technology Advisors (ITAs). NRC-IRAP partner organizations also receive contributions to provide technical and research assistance to Canadian SMEs.

Contact: <http://www.irap-pari.nrc-cnrc.gc.ca>

Industrial Research Assistance Program (IRAP-TPC), NRC

Applied R&D and Product Development

Through the IRAP-TPC Program, IRAP ITAs offer financial assistance to firms to support improved technological competitiveness. ITAs also help clients access information, expertise and other resources to undertake and develop their innovation activity. The IRAP-TPC Program is available to SMEs, defined as companies with 500 or fewer employees. Total eligible project costs under IRAP-TPC Program may not exceed \$3,000,000. Contributions will not normally exceed 33% of total eligible project costs. Contribution decisions are made in the region. The ITA responsible remains the main point of contact for questions and assistance for the duration of the project.

Contact: http://www.irap-pari.nrc-cnrc.gc.ca/iraptpc_e.html

Industrial Research Chairs (IRC), NSERC

Basic R&D

Applied R&D and Product Development

Assists universities in building science and engineering strengths to achieve critical mass for a major research endeavour of interest to industry; and/or assists in the development of Canadian university research efforts needed by industry. IRC grants provide funding for infrastructure, equipment, and general expenses, and the salary of a distinguished researcher as the Chairholder. IRCs are funded jointly by NSERC and industry. Sponsors normally contribute half the cost in cash, with NSERC contributing the remainder. NSERC may assume a larger share of the direct costs when a company makes a significant in-kind contribution in addition to its cash support. Provincial or federal government departments and agencies can also co-sponsor/support an IRC, but only the industrial contributions are taken into account when NSERC determines its funding level

Contact: http://www.nserc.ca/professors_e.asp?nav=profnav&lbi=c1

Industry Energy Research and Development (IERD), NRCan

Applied R&D and Product Development

Supports the development and use of new energy-efficient processes, products, systems and equipment proposed by industry. Projects contribute to a cleaner environment and help Canadian companies increase their market competitiveness. The cost of technology development is shared with industry and other project participants. Funding is dependent on technical risk, potential energy savings and the degree to which the technology can improve Canada's economic competitiveness. The average level of an IERD repayable contribution is 35% of total project costs. Applicants must have appropriate scientific and technical personnel, access to suitable research facilities; and adequate financial resources to carry out the project and exploit the results. Projects must be based on a sound technical basis and a reasonable chance of success; a significant amount of development work; general applicability of the technology to one or more industrial sectors; and, sufficient potential energy savings.

Contact: http://www.nrcan.gc.ca/es/etb/cetc/cetc01/htmldocs/cetc_o_programs_e.html

The Initiative on the New Economy (INE), SSHRC

Basic R&D

Applied R&D and Product Development

Market Demonstration and First Purchase

This five-year research initiative explores the nature, problems and opportunities of the new economy. Specific programs that fall under this initiative are: the Canada Project Research Initiative, Education Research Initiative

(CESC-SSHRC), and the Skills Research Initiative.

Contact: http://www.sshrc.ca/web/apply/program_index_e.asp#4

International Trade Canada Regional Offices (ITCan)

Production and Sales

Regional offices work within the Team Canada Inc (TCI) partnership to substantially increase the number of Canadian exporters, to expand and diversify exports and to support the investment initiatives of Canadian SMEs.

Contact: <http://www.infoexport.gc.ca/regions/menu-en.html>

NRC Institute for Fuel Cell Innovation, NRC

Basic R&D

Applied R&D and Product Development

Engineering, Testing, Codes and Standards

Market Demonstration

The NRC Institute for Fuel Cell Innovation (NRC-IFCI) works in partnership with industry, university and government stakeholders to build fuel cell technology clusters across Canada and to support the innovation needs of Canadian fuel cell companies. The Institute provides access to specialized equipment to industry and academic partners focused on fuel cell and energy systems development, energy systems integration, testing and evaluation. The Institute includes fuel cell test stations and hydrogen-safe labs as well as a hydrogen-ready environmental chamber that is controlled for humidity, temperature and altitude. NRC-IFCI also offers expertise, training and partnership opportunities. The research program focuses on three strategic areas: Polymer Electrolyte Membrane Fuel Cell; Solid Oxide Fuel Cells; and Hydrogen Generation and Infrastructure. Technical support and facilities are also available for demonstration projects and company incubation /acceleration. NRC-IFCI is located on the campus of the University of British Columbia (UBC), allowing the Institute to position itself within the B.C. cluster, strengthen partnerships with academia, and emphasize federal support for Canada's hydrogen and fuel cell sector.

Contact: <http://www.ifci-iipac.nrc-cnrc.gc.ca>

Process and Environmental Catalyst Program, NRCan

Basic R&D

Applied R&D and Product Development

Works with domestic and foreign partners developing catalytic systems for NO_x removal from engine emissions, and expanding market opportunities for natural gas through its conversion to liquid fuels, fuel components, petrochemicals and synthesis gas. Also involved in developing transportation fuels from biomass-derived

oils. R&D projects are task- or cost-shared with clients and usually can be customized to meet client needs.

Contact: http://www.nrcan.gc.ca/es/etb/cetc/cetc01/htmldocs/research_programs_pec_e.html

Research and Development Program, TPC

Applied R&D and Product Development

TPC invests strategically in research, development and innovation in order to encourage private-sector investment and technology commercialization. Over the past several years, TPC has provided approximately \$60 million of financial support to Canadian fuel cell and hydrogen businesses to develop innovative products and processes. The TPC program funds 33% of project costs relating to industrial research (to develop or improve products, processes or services); pre-competitive development (translation of industrial research findings into pre-production activities); and studies pertaining to industrial research or pre-competitive development projects.

Contact: <http://www.tpc.ic.gc.ca>

Research Partnership Program, DND/NSERC

Basic R&D

Applied R&D and Product Development

DND and NSERC have established a jointly managed and funded program that aims to capitalize on the complementary R&D capacity existing in universities, industry and DND in order to generate new knowledge and support the development of dual-use technologies in selected areas of interest to both DND and NSERC. The program will provide funding for university-based research, research training and research-related activities carried out in collaboration with DND and Canadian-based companies. The program may contribute up to two dollars for every dollar invested by industry. Projects may last up to five years.

Contact: <http://www.nserc.gc.ca>, www.drdd-rddc.dnd.ca

Science Research and Experimental Development (SR&ED) Program, CRA

Production and Sales

Federal tax incentive program to encourage Canadian businesses to conduct R&D in Canada that will lead to new, improved or technologically advanced products or processes. SR&ED investment tax credits may apply to qualified expenditures such as wages, materials, machinery, applied and basic research, equipment and more. Canadian-controlled private corporations with less than \$200,000 in taxable income can receive a refundable investment tax credit of 35% of qualifying SR&ED expenditures, to a maximum of \$2 million of expenditures. Most other Canadian corporations, proprietorships, partnerships and trusts can receive an

investment tax credit of 20% of qualifying SR&ED expenditures.

Contact: <http://www.cra.gc.ca/taxcredit/sred/menu-e.html>

Strategic Project Grants, NSERC

Basic R&D

Applied R&D and Product Development

Provides one to three year grants for early stage, high risk research projects involving academic and non-academic researchers including non-governmental organizations, industries and government agencies/departments. Projects must show potential for exploitation or research results to benefit Canada. Projects that contribute to the training of highly qualified personnel and knowledge exchange are encouraged. A cash contribution from non-academic participant(s) is not required; however, they should be actively involved in all stages of the research project.

Contact: http://www.nserc.ca/professors_e.asp?nav=profnav&lbi=b1

Sustainable Development Technology Canada (SDTC)

Applied R&D and Product Development

Engineering, Testing, Codes and Standards

Market Demonstration

Funding organization that fosters the rapid development, demonstration and pre-commercialization of technological solutions that address climate change and improve air quality. Funding is dependant on the formation of sound partnerships involving the key elements of the innovation chain—including private sector, academia, government and not-for-profit organizations. SDTC will fund up to 33% of total eligible project costs.

Contact: <http://www.sdtc.ca>

Team Canada Inc

Production and Sales

Team Canada Inc is a network of more than 20 federal departments and agencies working with the provinces, territories and other partners to help Canadian businesses prepare for the global marketplace.

Contact: <http://www.exportsource.gc.ca>

Technology Demonstration Program (TPD), DND

Applied R&D and Product Development

TPD is an evolutionary refinement of the DND R&D Program. Designed to meet the challenges of defence capability development in the face of rapidly changing missions, the TPD's objective is to demonstrate technologies fostered by Defence R&D Canada and

Canadian industry within the context of real and potential future Canadian Forces capabilities, concepts, doctrine, operations and equipment.

Contact: http://www.drdc-rddc.dnd.ca/business/tdp/tdp_e.asp

Technology Early Action Measures (TEAM), NRCan, IC, EC

Market Demonstration

TEAM is uniquely positioned to build on long-term Government of Canada investments in technology research and development by establishing partnerships that offer both expertise and funding for innovative technology demonstration projects that reduce greenhouse gases. This produces both workable environmental solutions, and major economic and export opportunities.

Contact: <http://www.team.gc.ca>

Western Diversification Program (WDP)

Market Demonstration

The WDP supports activities that develop and diversify the western Canadian economy and activities where economic benefits and job creation occur primarily within Western Canada. Funding is focused on activities that support innovation, promote a competitive and expanded business sector in Western Canada, and develop sustainable communities that improve the competitiveness and quality of life in the West.

Contact: http://www.wd.gc.ca/programs/pgms_e.asp

Western Economic Partnership Agreements (WEPAs)

WEPAs are joint federal/provincial initiatives aimed at fostering increased economic activity and improving the quality of life in communities across Western Canada. New WEPAs were signed with each of the four western provinces in late 2003. They build on a previous set of agreements which allocated a total of \$160 million over five years towards federal-provincial economic priorities. Cost-shared on a 50:50 basis, the new WEPAs will invest a total of \$200 million in the western Canadian economy over the next four years. Funding is directed to initiatives that support WD's three ongoing priorities: innovation, entrepreneurship and sustainable communities. Specific priorities in some regions include tourism revitalization, development and promotion of environmental technologies, and ground-breaking health technology research and development.

Contact: <http://www.wd.gc.ca/ced/wepa>

Agriculture and Agri-Food Canada provides information, research and technology, and policies and programs to achieve security of the food system, health of the environment and innovation for growth.

Contact: <http://www.agr.gc.ca>

Canada Economic Development for Quebec Regions promotes the long-term economic development of the regions of Quebec, paying attention to those with slow economic growth and inadequate employment. Canada Economic Development fulfils its mandate with a view to the enhancement of prosperity and employment in the long term, by focusing on two main areas of activity: enterprise development and improved support environment for development of the regions.

Contact: <http://www.dec-ced.gc.ca>

Defence R&D Canada (DRDC) is involved in the International Energy Agency ANNEX VIII PEM Fuel Cells through the Royal Military College of Canada (RMC), the Panel on Energy Research and Development (PERD) and has fuel cell development contracts with Canadian firms in this arena.

Contact: <http://www.rddc-drdc.gc.ca>

Department of Finance plans and prepares the federal government's budget, analyses and designs tax policies, and develops rules and regulations for Canada's banks and other financial institutions. The department is also responsible for: administering the transfer of federal funds to the provinces and territories, developing policies on international finance and helping design our country's tariff policies, monitoring economic and financial developments in Canada and providing policy advice on a wide range of economic issues.

Contact: <http://www.fin.gc.ca>

Department of National Defence (DND) – through its science and technology arm, DND has long supported the development of Canadian hydrogen and fuel cell technologies and is identified as one of the early adopters of this technology for military purposes in the Canadian government.

Contact: <http://www.dnd.ca>

Environment Canada (EC)—through its environmental Technology Advancement Directorate—

brokers projects that promote the development and demonstration of fuel cells and hydrogen infrastructure. Environment Canada's Environmental Technology Centre (ETC) evaluates various technologies related to fuel cells; its Emissions Research and Measurement Division is involved in the emissions testing of fuel cell vehicles. Environment Canada's objective is to ensure hydrogen is produced in a cleaner and environmentally sustainable manner.

Contact: <http://www.ec.gc.ca>

Export Development Canada (EDC) is a Canadian financial institution devoted exclusively to providing trade finance services to support Canadian exporters and investors in some 200 markets, 130 of which are in developing markets. Catering primarily to small businesses, their services include: credit insurance, bonding and guarantees, political risk insurance, and direct loans to buyers and lines of credit in other countries to encourage buyers to 'buy Canadian.' EDC also provides limited recourse financing arrangements and joint ventures for projects involving long-term leasing arrangements and equity participation.

Contact: <http://www.edc.ca>

Foreign Affairs Canada (FAC) represents Canada around the world through our network of embassies and trade and diplomatic offices, and by participating in multilateral institutions and international treaties and arrangements. We work to promote prosperity, ensure Canadians' security within a global framework and promote Canadian values and culture on the international stage. We also offer travel assistance and passport services to Canadians, at home and abroad.

The strategic direction given to the Department's mandate and role comes from the three key objectives of Canada's foreign policy set out in the Government's statement, *Canada in the World*: the promotion of prosperity and employment, the protection of our security within a stable global framework, the projection of Canadian values and culture in the world.

Contact: <http://www.fac-aec.gc.ca>

Health Canada is the federal department responsible for helping the people of Canada maintain and improve their health. Health Canada is committed to improving the lives of all of Canada's people and to making this country's population among the healthiest in the world

as measured by longevity, lifestyle and effective use of the public health-care system. In partnership with provincial and territorial governments, Health Canada provides national leadership to develop health policy, enforce health regulations, promote disease prevention and enhance healthy living for all Canadians. Health Canada ensures that health services are available and accessible to First Nations and Inuit communities. It also works closely with other federal departments, agencies and health stakeholders to reduce health and safety risks to Canadians.

Contact: <http://www.hc-sc.gc.ca>

Indian and Northern Affairs Canada (INAC) has primary, but not exclusive, responsibility for meeting the federal government's constitutional, treaty, political and legal responsibilities to First Nations, Inuit and Northerners. To fulfil this mandate, INAC must work collaboratively with First Nations, Inuit and Northerners, as well as with other federal departments and agencies, provinces and territories. Increasingly, INAC's role has become one of facilitating change and bringing together the partners and interests needed to implement Gathering Strength—Canada's Aboriginal Action Plan.

Contact: <http://www.ainc-inac.gc.ca>

Industry Canada (IC) supports the development of new energy technologies including fuel cells and hydrogen. Its activities include demonstrating pilot and large-scale technology projects; increasing access to investment capital for emerging companies; and addressing technical barriers to distributed generation. IC facilitated the industry-led Fuel Cell Commercialization Roadmap—a report that outlined the sector's key commercialization challenges and presented recommendations to help Canadian industry capitalize on its leadership position. IC's Energy and Marine Branch is developing policies and programs to enhance the industry's economic growth potential.

Contact: <http://www.strategis.gc.ca/hydrogen>

International Trade Canada (ITCan) works to position Canada as a business leader for the 21st century. ITCan helps large and small Canadian companies expand and succeed internationally, promotes Canada as a dynamic place to do business, and negotiates and administers trade agreements. Through Investment Partnerships Canada, ITCan provides foreign investors with the assistance they need in investing in Canada. ITCan's services are offered through three broad business lines: services for Canadian businesses; services for non-Canadian businesses; and information on Canada's trade and economic policy. The Trade Commissioner Service is a network of more than 500

trade professionals working in Canadian embassies, high commissions and consulates located in 140 cities around the world and 12 regional offices in Canada. The Trade Commissioner Service has a primary role of providing in-market assistance to Canadian companies in the development of their international business. The Trade Commissioner Service also helps foreign buyers find Canadian products and services.

Contact: <http://www.itcan-cican.gc.ca>

National Research Council (NRC) is the Government of Canada's premier research and development organization, operating world-class research facilities and innovation support networks from coast to coast. In partnership with industry, universities and government, NRC has established the NRC Fuel Cell Program, a national initiative to foster the emergence of a viable, knowledge-based and sustainable fuel cell industry in Canada. This initiative is part of the Government of Canada's commitment to strengthen research and development in this critical sector. The Program mobilizes fuel cell expertise and research strength from a network of NRC research institutes across Canada. Participating Institutes works closely with regional R&D providers, universities, government agencies and local industry to support the development of regional fuel cell clusters. By linking these Institutes through a coordinated national program, the NRC will help to build a strong Canadian fuel cell industry.

Contact: [http://www.nrc-cnrc.gc.ca/
randd/areas/fuelcells_e.html](http://www.nrc-cnrc.gc.ca/randd/areas/fuelcells_e.html)

Natural Resources Canada's CANMET Energy Technology Centre (CETC) is Canada's leading federal S&T organization that is developing and deploying energy efficient, alternative energy and renewable energy technologies. CETC's Hydrogen, Fuel Cells and Transportation Energy (HyFATE) program partners with industry and other federal and provincial agencies to develop and deploy new transportation technologies, including hydrogen and fuel cells, alternative fuels and advanced propulsion systems; energy storage systems; emissions control technologies; vehicle transportation system efficiency; and hydrogen fuelling infrastructure technologies. The program supports R&D through cost-shared agreements, standards development and technology transfer, both domestically and internationally. NRCan is also involved in hydrogen separation technologies and utilization of hydrogen fuel cells in underground mines as well as stationary applications for fuel cells. NRCan also is responsible for Canada's energy policy.

Contact: <http://www.cetc.nrcan.gc.ca>

Natural Sciences and Engineering Research Council Canada (NSERC) invests in people, discovery and innovation by supporting basic university research through discovery grants and project research through partnerships among universities, governments and the private sector, and also by helping provide for the advanced training of highly qualified people.

Contact: <http://www.nserc.ca>

Public Works and Government Services Canada (PWGSC) plays a leadership role in a Federal House-in-Order initiative to improve the energy efficiency and reduce greenhouse gas emissions of government operations and activities. The department is working with industry to explore alternative energy sources, including electricity production from fuel cells. PWGSC is also helping Indian and Northern Affairs evaluate fuel cell applications for remote Northern communities.

Contact: <http://www.pwgsc.gc.ca>

Social Sciences and Humanities Research Council of Canada (SSHRC) is Canada's foremost granting agency for research and training in the social sciences and humanities. SSHRC does not conduct research itself. It distributes funds to Canadian researchers, scholars and universities through highly competitive granting programs.

Contact: <http://www.sshrc.ca>

Sustainable Development Technology Canada (SDTC) is a not-for-profit foundation that finances and supports the development and demonstration of clean technologies which provide solutions to issues of climate change, clean air, water quality and soil, and which deliver economic, environmental and health benefits to Canadians.

Contact: <http://www.sdtc.ca>

Technology Early Action Measures (TEAM) has provided \$16 million towards 13 hydrogen economy related projects with a total value of \$113 million since 1998. These technology demonstration commitments have helped pave the way for future commercial investments in hydrogen and fuel cell projects. TEAM operates interdepartmentally and continues to offer technology demonstration funding through federal departments and agencies in support of GHG reduction, including fuel cell and hydrogen production technologies.

Contact: <http://www.team.gc.ca>

Technology Partnerships Canada (TPC) is a special operating agency of Industry Canada. Its mandate is to provide funding support for strategic research and development, and demonstration projects that will

produce economic, social and environmental benefits to Canadians. TPC offers two main programs: the TPC R&D program, geared to pre-competitive projects, and the Hydrogen Early Adopters program. Since 1996, TPC's activity has been rooted in helping Canadian companies perform R&D that takes new technologies closer to the marketplace by supporting pre-competitive projects across a wide spectrum of technological development, including environmental technologies, life sciences, information and communications technologies and advanced manufacturing.

Contact: <http://www.tpc.ic.gc.ca>

Transport Canada (TC) supports research into future fuels including hydrogen, and as an active member of the Canadian Transportation Fuel Cell Alliance is also interested in fuel cell vehicles. Part of TC's Freight Efficiency and Technology Initiative, which is designed to reduce the growth of greenhouse gas (GHG) emissions from freight transportation, is its commitment to demonstrating and encouraging the uptake of innovative technologies.

Contact: <http://www.tc.gc.ca>

Western Economic Diversification Canada (WD) is the federal government's lead department for developing the economy of Western Canada. The department is mandated to promote the development and diversification of the economy of Western Canada and to advance the interests of Western Canada in national economic policy, program and project development and implementation. To do this, WD organizes its programs and services to achieve the following strategic outcomes:

1. Sustainable Communities: Creating economically viable communities, which provide western Canadians with a high quality of life.
2. Innovation: Strengthening the western Canadian innovation network.
3. Entrepreneurship: Fostering a competitive and expanded business sector in the West.

WD's strategic investments in these areas will help to fulfill WD's vision of a stronger West in a stronger Canada.

Contact: <http://www.wd.gc.ca>



