New technologies, economic potential and environmental issues – from a Canadian perspective

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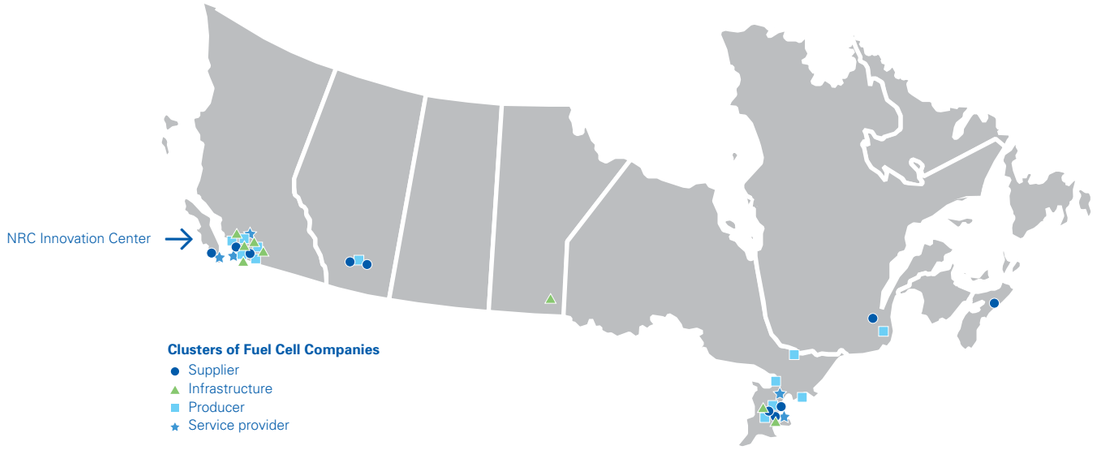
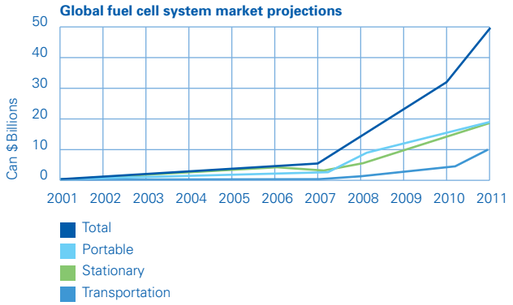
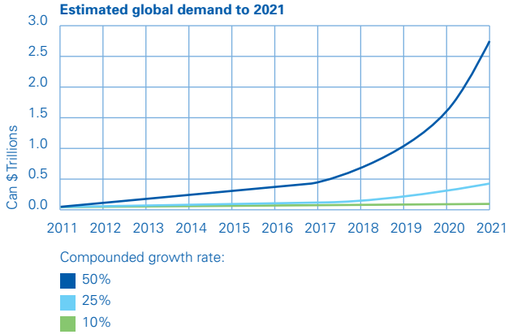
Canada is a leading country in the use of renewable energy due largely to its abundant natural resources, which include biomass and large- and small-scale hydro. The Government of Canada has also long supported private-sector development of efficient, alternative energy technologies. With worldwide desire for secure and sustainable sources of energy increasing, Canada is now benefiting from its past R&D (research and development) investments in new energy technologies, particularly hydrogen fuel cells.



All graphics are from the report: Fuel Cells: The Opportunity for Canada, June 2002. It was produced by Pricewaterhouse Coopers for Fuel Cells Canada.





Canada's interest in energy is rooted in both availability of natural resources and large domestic demand. In 2000, Canadians consumed 600 net terawatt hours of electricity produced 62 % from hydropower, 19 % coal, 12 % nuclear and 7 % oil, gas and other sources.

Canada has devoted considerable effort to the production of renewable energy. Today, approximately 17 % of Canada's primary energy supply is from renewable sources. By comparison, in 1995 the average use of renewables by International Energy Agency member countries was about 6.1 %. Canada's persuit of low- to zero-emissions technologies is part of Canada's strategy to meet its GHG (Greenhouse Gas) emissions targets while securing its energy needs.

New technologies and market opportunities

Among the most promising sustainable energy technologies in which Canada has developed particular expertise are hydrogen fuel cell systems. Today, after nearly 20 years of research and development, fuel cell and hydrogen technologies are now on the cusp of commercialization. A Pricewaterhouse Coopers report released by industry association Fuel Cells Canada estimated that the global market value for fuel cell products will reach $ 46 billion USD by 2011. Canada has implemented strategies to ensure that its industry translates technology expertise into economic success.

Fuel cell development – history and strategy

Canada's interest in fuel cell and hydrogen technologies is not new. Public R&D in this area began in 1978, however the Government's interest piqued about 20 years ago when Dr. Geoffery Ballard and his team working in a private laboratory opened the door to commercial potential of hydrogen fuel cell technologies.

A number of federal organizations have since provided varying forms of support to Canadian fuel cell developers. Through its Hydrogen and Fuel Cell R&D Program, managed by the CANMET Energy Technology Centre (CETC), Natural Resources Canada (NRCan) has been supporting fuel cell and hydrogen R&D for more than two decades. NRCan is responsible for directing Canada's energy S&T (science & technology), policy and programs.

Canada's National Research Council (NRC) – the nation's premier science and technology research organization – has also joined the effort. NRC brings the S&T strength of its 17 institutes across Canada and its collaborative R&D capacity that links other government organizations, industry and academics and international stakeholders worldwide. Today NRCan and NRC are among the

top Government organizations leading the support of Canada's growing hydrogen and fuel cell sector.

Ushering in the hydrogen economy

To realize their full environmental and economic potential, fuel cells must become competitive with internal combustion engines, traditional batteries and other power products. Canadian efforts are now focused on enhancing the technology's reliability and power output while lowering costs of materials and production.

In August 1999 the Government of Canada intensified its commitment with a $30-million five-year partnership initiative, a key component of which is the NRC Fuel Cell Program. Since 1999, that Program has funded 12 industry-driven research projects uniting experts at six NRC institutes across Canada, 10 Canadian universities, and other organizations. The NRC Fuel Cell Program has so far touched more than 20 Canadian companies.

In June 2001 the Government launched the Canadian Transportation Fuel Cell Alliance (CTFCA), a $23-million NRCan-led effort focused on developing a fuelling infrastructure for fuel cell vehicles, including safety, standards and training.

This year, NRC received another $20-million, establishing a dedicated institute in Vancouver, British Columbia, now home of the NRC Fuel Cell Program.

Global fuel cell systems estimated demand

Market Segment	2001	2003	2005	2007	2009	2011	CAAG* 2003 to 2011	CAAG 2007 to 2011
Stationary (in MW)	75	225	675	2,025	7,088	15,947	70 %	67 %
portable ('000 units)	0	50	2,000	50,000	290,000	470,000	214 %	75 %
transportation ('000 units)	10	3,523	7,608	31,680	275,520	1,610,080	115 %	167 %

Sources: Allied Business Intelligence, Frost & Sullivan, The Freedonia Group, PwC analyis, industry analysts
* Cumulative average anual growth

Global fuel cell systems estimated demand
($ millions)

Market Segment	2001	2003	2005	2007	2009	2011	CAAG 2003 to 2011	CAAG 2007 to 2011
Stationary	$397	$886	$1,747	$2,734	$7,974	$17,940	46 %	60 %
Portable	0	3	94	1,875	10,875	17,625	193 %	75 %
Transportation	1	79	123	311	1,746	10,257	84 %	140 %
Total Market	$398	$968	$1,963	$4,920	$20,595	$45,822	62 %	75 %

Sources: Allied Business Intelligence, Frost & Sullivan, The Freedonia Group, PwC analyis, industry analysts

Canada's partnership strategy

The Fuel Cells Canada report noted Canada is among the world's fuel cell technology leaders, a short list that also includes Germany, the U.S. and Japan. Despite its reputation for developing world-class technology, compared to some other countries, Canada's financial investment has and continues to be modest.

To accelerate technology development, NRCan and NRC are now leveraging Canadian expertise through international collaborative S&T partnerships. NRC, for example, is already working with Hydrogen Economy stakeholders in Brazil, China, Thailand, the United Kingdom and elsewhere. In the fall of 2002, significant industrial and government organizations in Japan and in Korea expressed strong interest in working with NRC. The National Research Council is now exploring R&D partnerships in Germany. NRCan is an active member of the International Energy Agency's Hydrogen and Fuel Cell Implementing Agreements.

Pursuing this strategy, Canada and its partners are pooling resources and expertise to accelerate the movement of fuel cell technology from prototype status to the marketplace.