Canadian Hydrogen and Fuel Cell Sector Profile 2010

Canadian Hydrogen and Fuel Cell Association

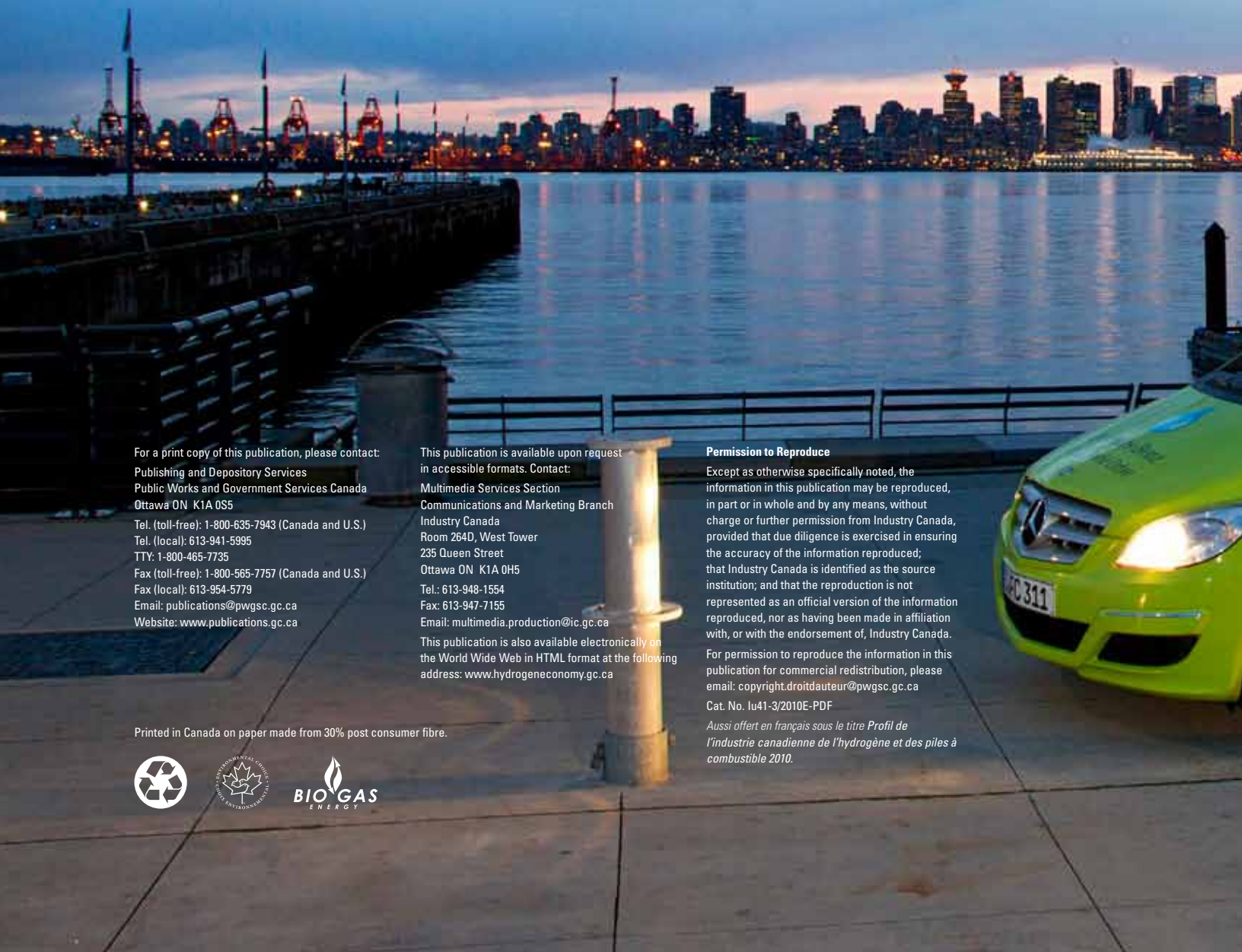
Canada

pwc

Canadian Hydrogen and Fuel Cell Sector Profile 2010

Since 2004, the Government of Canada, the Canadian Hydrogen and Fuel Cell Association and PwC have collaborated to provide an extensive profile of the Canadian hydrogen and fuel cell sector. The 2010 Sector Profile models the previous six editions and provides industry insight on Canada's hydrogen and fuel cell sector for policy makers, investors and other stakeholders. The research adds value to business strategies, investment decisions, and the overall expertise across our country.

The Profile is published annually to monitor trends and recognize growth and achievements for this key influence of the Canadian economy. We would like to thank all the organizations that contributed to the development of the Canadian Hydrogen and Fuel Cell Sector Profile 2010.



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Introduction

The Canadian Hydrogen and Fuel Cell Sector Profile 2010 measures performance indicators and provides industry insight to assess Canada's position within an increasingly competitive global industry. Interest in clean energy research and technologies continues to gain momentum worldwide driven by concerns over the environment, economic development, and energy pricing. Hydrogen and fuel cells have become an increasingly viable commercial resource, and the Canadian sector is well positioned as an established leader in this field. By championing hydrogen and fuel cell technology to help address climate change and sustainable energy issues, we create the opportunity to provide products and solutions for greenhouse gas emissions, air quality, energy security and economic development.

The Industry at a Glance in 2009:

- Revenue was $215 million;
- Product sales generated $111 million of revenue;
- Research, development and demonstration expenditures were $142 million;
- Employment was 1,765;
- There were 86 demonstration projects reported;
- The number of strategic alliances reported was 68;
- There were 350 research partnerships reported.

Mercedes-Benz F-Cell fuel cell electric vehicle

Organization Profile

ORGANIZATION TYPE

Corporate organizations, including public and private companies and subsidiaries, represented 57% of total responses. Government organizations accounted for almost a quarter of respondents (24%), with education organizations, and non-profit organizations including associations representing the remaining 19% of respondents.

HEADQUARTERS

The majority of respondents (92%) reported headquarters of hydrogen and fuel cell activities in Canada. Others were headquartered in the United States and Europe with hydrogen and fuel cell related activities in Canada.

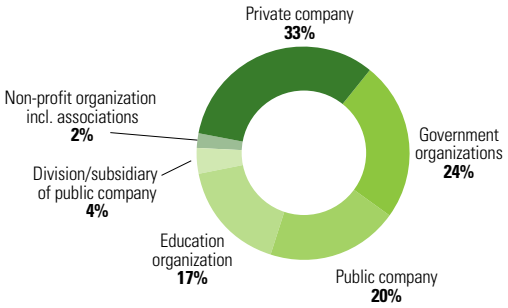
YEARS OF INVOLVEMENT IN HYDROGEN AND FUEL CELL ACTIVITIES

Approximately half of respondents (48%) reported involvement in hydrogen and fuel cell activities for ten years or less.

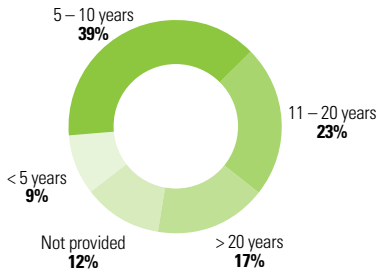
AREAS OF EXPERTISE

The main area of expertise was research organizations (17%). Hydrogen production, along with policy development and program administration each represented 13%, followed by fuel cell developer or manufacturer (9%). Commercialization support and education, safety and training each represented 8% of industry expertise. Supplier to developer or manufacturer, systems integrator, and professional services provider each occupied 6% of industry expertise. Each of the remaining areas of industry expertise accounted for less than 6% of overall responses. The 'other' area of expertise category (5%) included hydrogen fueling infrastructure and testing.

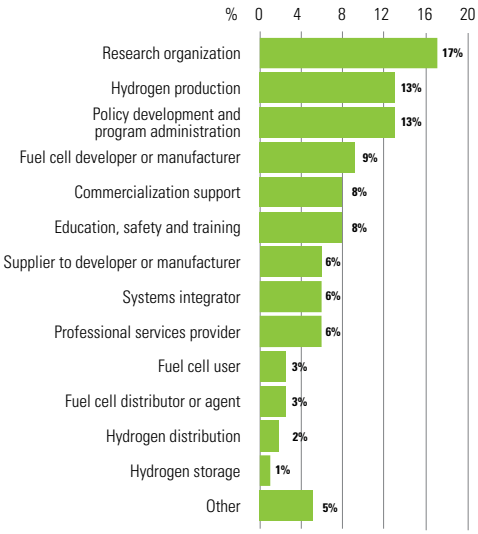
Organization Type



Years of Involvement in Hydrogen and Fuel Cell Activities



Areas of Expertise



MARKET FOCUS

Market focus was split almost evenly between three broad categories. Hydrogen production and fueling infrastructure represented the largest area of market focus at 36%. Stationary applications, including both small (50 kilowatts or less) and large (greater than 50 kilowatts) subcategories, represented 32% of the market focus. The combined mobile applications, including primary power and drivetrain, portable, and auxiliary power represented 32% of the market focus. The results broadly align with those of the prior year survey.

TECHNOLOGY FOCUS

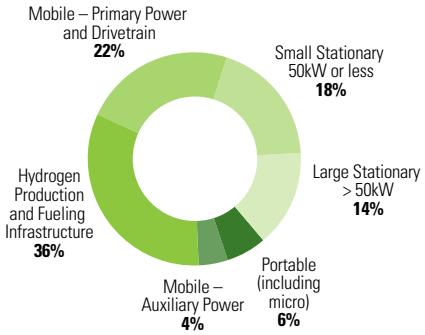
The technology focus for 42% of organizations was on Proton Exchange Membrane (PEM) fuel cells followed by hydrogen production at 25%. Solid oxide and hydrogen storage each represented 8% of technology focus, followed closely by hydrogen distribution at 7%. The 'other' area of technology focus (5%) included hydrogen safety codes and standards, hydrogen internal combustion and fueling infrastructure.

HYDROGEN AND FUEL CELL FACILITIES BY REGION

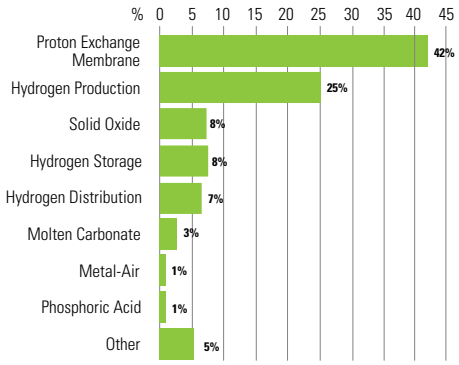
Survey participants reported 102 locations for hydrogen and fuel cell facilities and activities in 2009. In total, 74% of facilities were located in Canada, 10% in Europe, and 8% in the United States. The remaining 8% were overseas in Japan, China, South Korea, and Russia.

Within Canada most provinces were engaged in hydrogen and fuel cell activities. The majority of facilities and activities resided in British Columbia, followed by Ontario, Quebec, Alberta, Saskatchewan, Manitoba, Prince Edward Island, New Brunswick, Newfoundland and Labrador, and Nova Scotia.

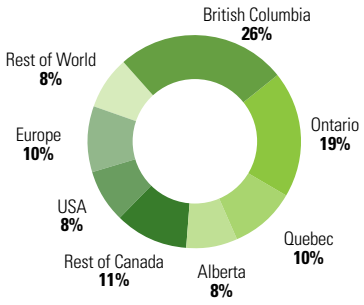
Market Focus



Technology Focus



Hydrogen and Fuel Cell Facilities by Region



Revenue

In 2009, more than half (53%) of respondents participated in revenue generating activities. Survey participants reported revenue from hydrogen and fuel cell activities of $215 million.

Half of organizations surveyed reported less than $1 million in revenue in 2009. In addition, 33% had more than $5 million of revenue and 17% of respondents reported revenue between $1 and $5 million.

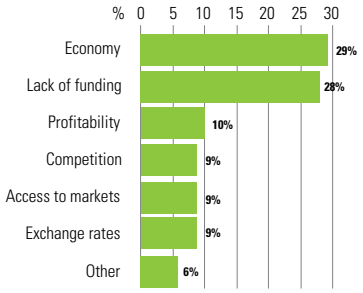
A breakdown was provided for $179 million of the $215 million of revenue reported. In 2009, the two categories that generated the most revenue were product sales with revenue of $111 million and provision of services producing revenue of $47 million.

Foreign government funding and Canadian government support were recognized as revenue and together represented 7% of overall revenue in 2009. Additional details for government funding are provided in the research, development and demonstration and funding sections of this study.

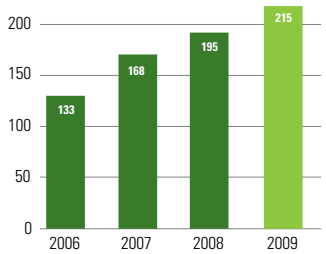
A breakdown by region was provided for $178 million of the $215 million of revenue reported. The two countries with the most hydrogen and fuel cells related sales were Canada at 59% and the USA at 22%. Most of the Canadian revenue was generated in the province of British Columbia.

Survey participants were asked to identify challenges faced by their organization in 2009. Organizations faced economic challenges (29%), followed closely by lack of funding (28%). Profitability (10%) as well as competition, access to markets and exchange rates (9% each) were also challenges in 2009. Participants noted that cost reduction, overcoming barriers to commercialization through codes and standards, customer performance and supply chain were also challenges in 2009.

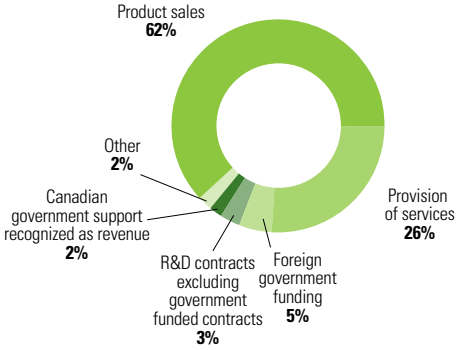
Challenges Faced in 2009



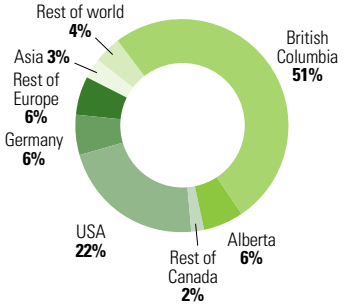
Total Revenue ($ millions)



Revenue by Category



Revenue by Region



Research, Development and Demonstration (RD&D)

In 2009, 64% of respondents participated in RD&D activities, reporting total RD&D expenditure of approximately $142 million. Total research and development (R&D) expenditure amounted to $97.3 million or 69% of total RD&D spending. Demonstration expenditure for 2009 was $44.2 million.

2009 Total RD&D Expenditure ($ millions)	R&D	Demonstration	Total
Corporate	$85.2	$39.6	$124.8
Government	$2.8	$3.0	$5.8
Academic and non-profit	$9.3	$1.6	$10.9
Total RD&D	**$97.3**	**$44.2**	**$141.5**

SOURCES OF FUNDING FOR RD&D EXPENDITURE

The table below provides a breakdown of funding for R&D and demonstration expenditure by source. For R&D expenditure, sources of funding were only provided for $81 million of the $97 million reported by respondents as expenditure in 2009. Parent, affiliated or subsidiary sources funded 39% of overall R&D expenditure, followed closely by corporate operations at 33%. Canadian government (49%) and corporate operations (46%) funded most of the overall demonstration expenditure.

2009 Sources of Funding for RD&D Expenditure	R&D		Demonstration		Total	
	$ millions	%	$ millions	%	$ millions	%
Corporate operations	$ 26.2	33%	$ 20.4	46%	$ 46.6	38%
Canadian government (all levels)	$ 12.8	16%	$ 21.6	49%	$ 34.4	28%
Parent, affiliated or subsidiary organization	$ 31.3	39%	$ 1.9	4%	$ 33.2	27%
Foreign government	$ 6.8	8%	$ 0.1	0.5%	$ 6.9	6%
University or academic institute	$ 2.7	3%	–	–	$ 2.7	–
Other	$ 0.8	1%	$ 0.1	0.5%	$ 0.9	1%
Total	**$ 80.6**	**100%**	**$ 44.1**	**100%**	**$ 124.7**	**100%**

Research and Development

R&D BY REGION

Geographic data was provided for $73 million of R&D expenditure. British Columbia led all regions with 57% of R&D expenditure. Ontario and Quebec contributed 13% and 10% respectively with the rest of Canada making up a further 9%. Regions included in the 'other' category (2%) were France, Belgium and China.

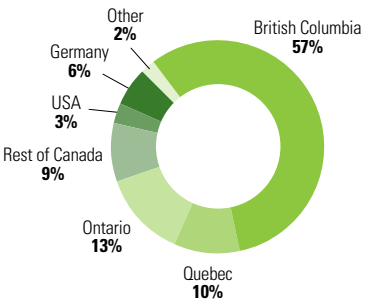
PEOPLE INVOLVED IN RESEARCH

Academic organizations reported that a total of 539 people were involved in hydrogen and fuel cell related research activity in 2009. The majority, 42% were academic/research staff, 25% were Canadian graduate and postgraduate students, and 20% were undergraduate students.

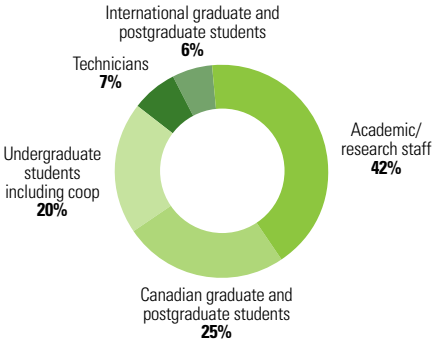
SOURCES OF FUNDING FOR R&D EXPENDITURE

The bar chart below represents sources of funding for R&D expenditure by type of organization. Corporate respondents received most of their funding from parent, affiliated or subsidiary sources (46%). Government organizations received most of their funding from Canadian government sources (100%). Academia and non-profit organizations also received most of their funding from Canadian government sources (59%).

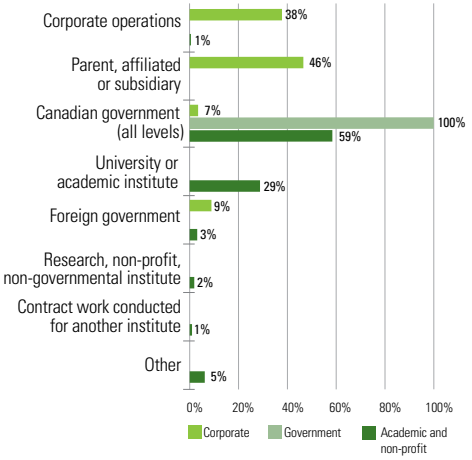
R&D by Region



People Involved in Research



Sources of Funding for R&D Expenditure by Organization



Demonstration Projects

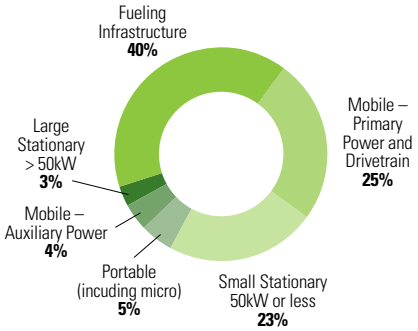
In 2009, survey participants reported participation in 86 demonstration projects around the world. Corporate organizations reported involvement in 56 projects. Academia took part in 17 demonstrations, followed closely by government involvement in 13 demonstration projects.

SOURCES OF FUNDING FOR DEMONSTRATION

In 2009, Canadian governments funded 49% of the reported $44 million demonstration expenditures and corporate operations funded 46%.

Fueling infrastructure was the main focus of overall demonstration projects at 40%. Some 56% of government projects focused on fueling infrastructure. Corporate organizations focused most (36%) of their attention on small stationary projects and fueling infrastructure (33%). Academia demonstration projects focused on fueling infrastructure (44%) followed by mobile primary power and drivetrain projects at (39%).

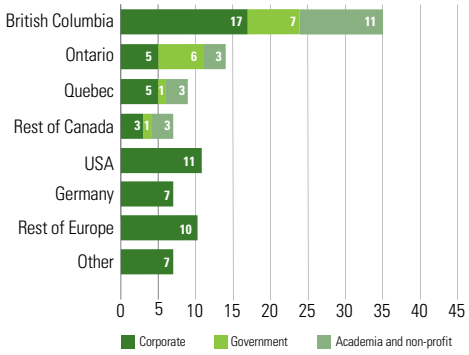
Focus of Demonstration Projects



DEMONSTRATION BY REGION

In total, Canadian provinces hosted a combined 65% of overall demonstrations in British Columbia (35%), Ontario (14%), Quebec (9%) and the rest of Canada (7%). Germany and the rest of Europe hosted 17% of demonstration projects, followed by the United States at 11%. Other locations, including France, Japan, India, Italy, China and the Netherlands hosted the remaining 7% of demonstrations.

Demonstration Projects by Region (Involvement in Projects)

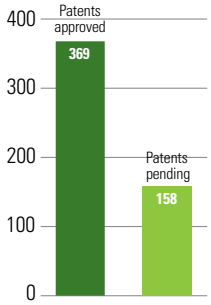


HTEC waste hydrogen capture facility in North Vancouver, BC

Patents

In 2009, corporate respondents reported 369 newly approved patents and 158 patents awaiting approval.

Patents



Employment

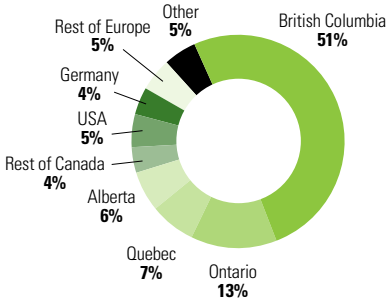
Survey participants reported a total of 1,765 employees involved in hydrogen and fuel cell activities in 2009. A breakdown by region was reported for 1,614 of the 1,765 employees.

In 2009, the largest proportion (81%) of industry employees were located in Canada, 5% in the United States, and the remaining 14% overseas in Belgium, China, Russia and Germany. In Canada, most employees were located in British Columbia (823), followed by Ontario (210), Quebec (113) and Alberta (97).

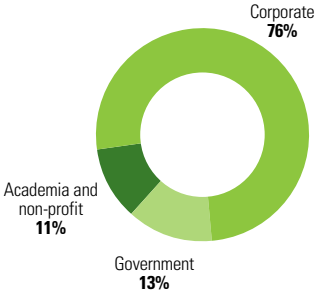
52% of organizations surveyed employed fewer than 10 people, 21% employed between10 and 25, 11% employed between 25 and 50, and 16% employed more than 50 people.

Based on the data provided for number of employees and total salaries, the average annual salary paid to employees was $74,732. Extrapolating the average salary for 2009 to the 1,430 employees in Canada, the sector contributed $107 million in salaries to the national economy.

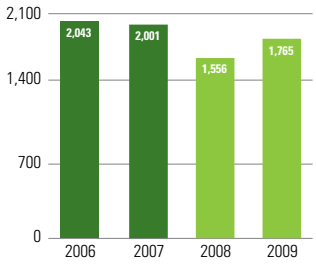
Employment by Region



Employment by Organization



Employment



Funding Requirements

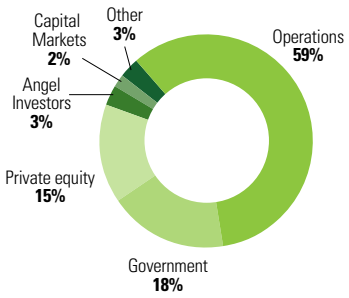
Continued education of governments and capital markets on the benefits of investing in the hydrogen and fuel cell industry is an important part of the industry's efforts to secure funding. Given the industry's long development period and demanding RD&D requirements, adequate financing is necessary to bring commercial products to market.

For government, academia and non-profit organizations funding was allocated primarily for academic research (43%), and demonstration and pilot projects (21%). British Columbia received 73% of the funding allocation, 19% went to Ontario, and the remaining 8% to Quebec, Alberta, Prince Edward Island, and Saskatchewan.

CORPORATE

Corporate participants report the top three sources of funding for 2009 from operations (59%), government (18%) and private equity (15%). The financial requirements for the next five years are estimated to be $300 million with funding expected to come from private equity (48%), operations (35%), and government (14%).

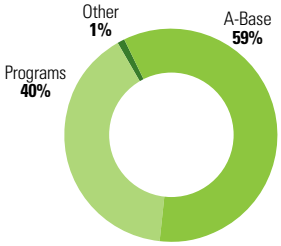
Sources of Funding – Corporate



GOVERNMENT

The total budget for hydrogen and fuel cell related activities reported for 2009 for which government was directly responsible, (including employee salaries and benefits) was $30 million. A-base operations contributed 59% of funding requirements and programs contributed 40%. Details for the 'other' category were not provided.

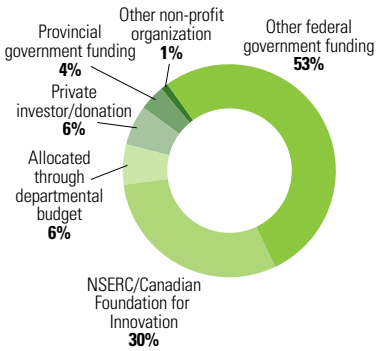
Sources of Funding – Government



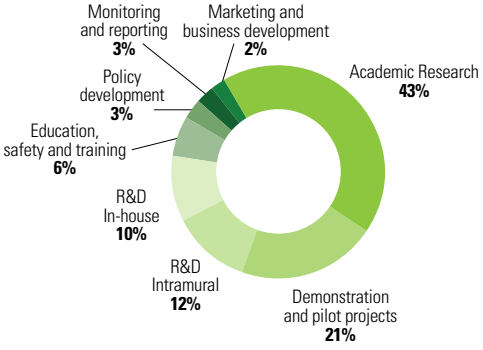
ACADEMIA AND NON-PROFIT

The total budget for hydrogen and fuel cell related activities reported for 2009, for which academia and non-profit was directly responsible, (including employee salaries and benefits) was $37 million. The sources of funding for 2009 were from the Other federal government funding (53%), Natural Science and Engineering Research Council of Canada (NSERC)/Canadian Foundation for Innovation (30%), departmental budget allocation, private investor (6% each), provincial government funding (4%), and other non-profit organization (1%).

Sources of Funding – Academia and Non-Profit



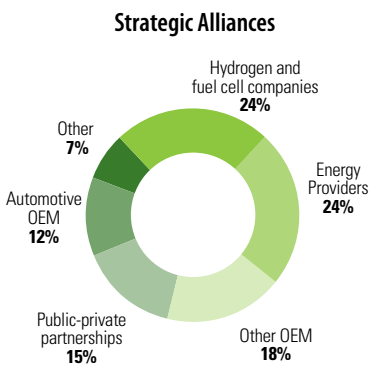
Funding Allocation by Area – Government & Academia & Non-profit



Strategic Alliances

In 2009, respondents reported 68 strategic partnerships and alliances, demonstrating the value and importance of relationships and partnerships to the industry.

Energy providers and hydrogen and fuel cell companies each made up 24% of partnerships. Other original equipment manufacturers (OEM) accounted for 18%, public/private partnerships represented 15% and the category of automotive OEM made up 12% of strategic partnerships and alliances.



Research Partnerships

Research partnerships promote closer collaboration between the university research community and other sectors, including government and Canadian industry. There were 350 research partnerships reported in 2009. Partnerships with industry in Canada represented nearly half (44%) of all research partnerships. Partnerships with Canadian academia/non-profit/associations represented 17%, and the Canadian government represented 15% of total research partnerships.

The number of research partnerships signifies the necessity of pre-commercial collaboration in order to address common technical challenges.

The chart below illustrates the many varied types of partnerships and collaboration in the hydrogen and fuel cell sector within Canada and outside the country.

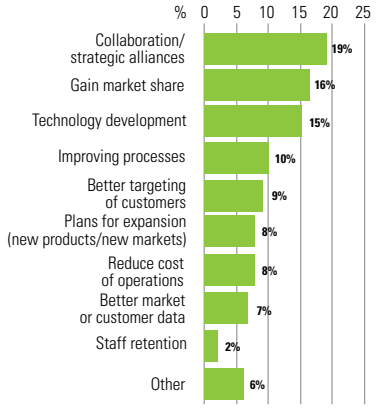
Number of Research Partnerships	Total
In partnership with industry in Canada	155
In partnership with Canadian academia/ non-profit/associations in Canada	58
In partnership with Canadian governments (federal, provincial/territorial and municipal)	54
In partnership with industry outside of Canada	50
In partnership with foreign governments	27
Other	6
Total	**350**

Outlook

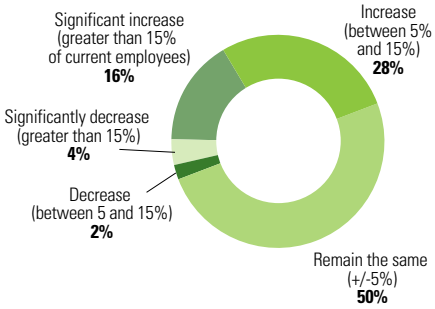
Looking ahead to 2011, participants were asked to identify the top three priorities to enhance competitive performance. Responses varied with collaboration and strategic alliances identified as the top priority at 19%, followed by gaining market share at 16%, and technology development at 15%. Improving processes, better targeting of customers, plans for new products and markets were identified as priorities for 10% or less of respondents.

44% of organizations surveyed indicate plans to increase employment within the next 18 months. Only 6% of companies plan to reduce employment, while half anticipate that employment will remain the same.

Priorities to Enhance Competitive Performance in 2011



Plans to change employment in the next 18 months



Ballard ClearGen 1 MW stationary fuel cell unit

Methodology and Response Rates

The 2010 Sector Profile is the seventh annual publication of information on the Canadian Hydrogen and Fuel Cell Industry. As in previous years, members of Canadian Hydrogen and Fuel Cell Association, non-members, academic institutions, and government stakeholders involved in current hydrogen and fuel cell demonstration activities were asked to voluntarily complete a survey questionnaire.

The survey questionnaire has remained substantially consistent year-over-year. For the 2010 survey, in the sections relating to RD&D and funding, specific questions were asked for three types of stakeholders:

- Corporate (public and private organizations);
- Government (government and government agencies); and
- Academia and non-profit (educational organizations, non-profit, and non-governmental organizations (NGO).

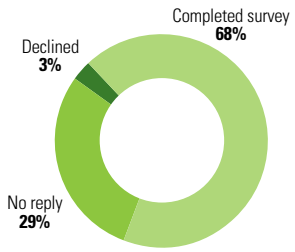
Three new questions were added to the 2010 profile survey. One of the questions addressed challenges faced by organizations in 2009. The remaining two questions addressed organization and employment priorities for the year to 18 months ahead.

All monetary results are presented in Canadian dollars.

A total of 98 organizations associated with hydrogen and fuel cells in Canada were invited to participate in the development of this sector profile. 67 completed surveys were received, representing an overall response rate of 68%. A participant list is included at the end of this report.

Not all respondents provided information for every category requested. No investigation was conducted as to the completeness of the data provided by respondents or reasons for non-provision.

Profile participation rate



PRESENTATION OF DATA

Figures presented for 2009 were collected by an online questionnaire in 2010. Figures presented for 2008 are as reported in the 2009 Sector Profile and, therefore, may not be fully comparable due to differing respondents and/or basis of individual responses.

Hydrogenics MidiBus deployed in Dusseldorf, Germany

Conclusion

In 2009, the Canadian hydrogen and fuel cell sector reported:

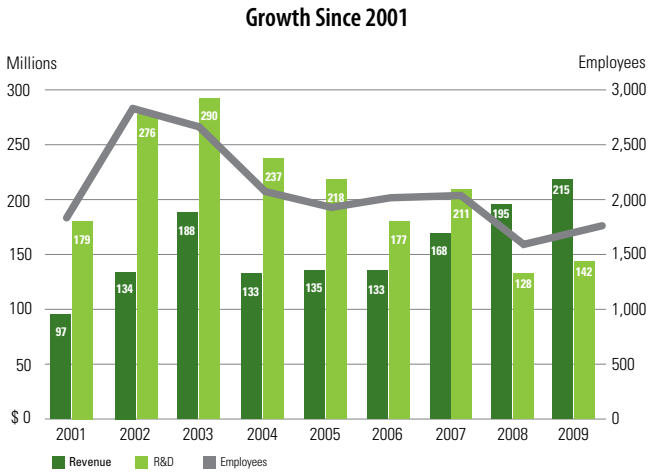
- revenue of $215 million in 2009 with British Columbia representing the largest revenue region;
- continued commitment to RD&D with $142 million in expenditures;
- employment at 1,765;
- continued involvement in demonstration projects (86) and substantial expenditure in demonstration projects of $44 million;
- a slight decline in strategic alliances (68) and a significant rise in research partnerships (350) compared to prior years; and
- hydrogen and fuel cell related facilities and activity, RD&D expenditure and employment were largely concentrated in British Columbia.

The Government of Canada, the Canadian Hydrogen and Fuel Cell Association and PwC would like to thank the organizations that took part in this survey. By participating, stakeholders from private industry, government and academia showed their support for improving publicly available industry intelligence. This information will be used to support policy and funding decisions, influence alliance partnerships, and strengthen the overall competitive position of the Canadian hydrogen and fuel cell industry.

GROWTH SINCE 2001

An initial sector profile, The Economic Impact of Industrial Hydrogen Activity in Canada, conducted by Sypher Mueller and Natural Resources Canada in 2001, provided the first glimpse into the sector's early days. Subsequent Government of Canada, Canadian Hydrogen and Fuel Cell Association and PwC Sector Profiles have updated the original industry benchmark study to demonstrate an active hydrogen and fuel cell sector within Canada. Although some data may not be fully comparable due to differing methodology, we can see significant revenue growth in the industry over the nine-year period:

- Revenue has grown 122% from $97 million in 2001 to $215 million in 2009
- R&D expenditures have decreased by 46% from $179 million in 2001 to $97 million in 2009. Adding demonstration expenditure brings the RD&D total to $142 million.
- Employment in the industry has decreased slightly from 1,772 in 2001 to 1,765 in 2009.



Forklifts a significant market for hydrogen and fuel cell technology

CANADIAN HYDROGEN AND FUEL CELL ASSOCIATION (CHFCA)

The Canadian Hydrogen and Fuel Cell Association (CHFCA) is the national association accelerating Canada's world-recognized hydrogen and fuel cell sector. As the sector's collective voice, the CHFCA works to raise awareness of the economic, environmental and social benefits of hydrogen and fuel cells. We are a national, non-profit association providing services and support to Canadian corporations, governments and educational institutions promoting, developing, demonstrating and deploying hydrogen and fuel cell products and services in Canada. Our members cover most types of hydrogen and fuel cell technologies, components, systems supply and integration, fuelling systems, fuel storage, and engineering and financial services.

The CHFCA was formed in January of 2009 as a result of a merger between the Canadian Hydrogen Association (CHA) and Hydrogen & Fuel Cells Canada (H2FCC). The merger unites the members of the former associations to create a vibrant, influential association that represents the majority of the stakeholders in Canada's hydrogen and fuel cell sector.

INDUSTRY CANADA

Industry Canada's goal is to enhance the competitiveness of Canadian industry. The organization is responsible for maintaining channels of communication with key sectors to facilitate informed advocacy of industry interests in government decision-making and to convey the government perspective back to industry; analyzing the challenges and opportunitites that face key sectors in the economy; developing policy options for possible government response to extraordinary challenges and opportunities; and delivering the subsequent programs and services.

PwC

PwC understands and supports the fuel cell industry in Canada and around the world. Our Alternative Energy network of professional staff drawn from over 154,000 people in over 153 countries has a firm grasp of the issues facing companies in the industry as it evolves towards commercialization. We are continually expanding our knowledge and client base with the goal of being the pre-eminent advisor to the industry in local, national and global markets.

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2010 Participants

A.V. Tchouvelev & Associates

Air Liquide Canada

Air Products and Chemicals Inc

Angstrom Power Inc

Atlantic Hydrogen Inc

Automotive Fuel Cell Cooperation

Automotive Partnerships Canada

Ballard Power Systems Inc

BC Transit

Canadian Hydrogen and Fuel Cells Association

CCS Global Group Inc

Cellestial Fuels Inc

Dana Canada Corporation

Department of National Defence

dPoint Technologies Inc

Dynetek Industries Ltd

L'École Polytechnique de Montréal

Enbridge Gas Distribution Inc

Environment Canada

Government of BC, Ministry of Energy, Mines and Petroleum Resources

Government of Manitoba

Greenlight Innovation

Heliocentris Energy Systems Inc

HRH Consulting Services Inc

HTC Purenergy Inc

HTEC Hydrogen Technology & Energy Corp

Hummingbird Hydrogen Corporation

Hydrogen Research Institute (Université du Québec à Trois-Rivières)

Hydrogenics Corporation

Hyteon Inc

IMW Industries Ltd

Industry Canada

Institute for Integrated Energy Systems at the University of Victoria

Ku Group

Lambton College

Membrane Reactor Technologies Ltd

Mitsubishi Canada

National Research Council

Natural Resources Canada, CANMET

Natural Sciences and Engineering Research Council of Canada

New Flyer Industries Inc

NORAM Engineering and Constructors Ltd

Ontario Ministry of Research and Innovation

Palcan Energy Corporation

Plug Power Inc

Powertech Labs Inc

Praxair Canada Inc

Profile Composites Inc

Quadrogen Power Systems Inc

Queen's – RMC Fuel Cell Research Centre

Sacré-Davey Engineering

Saskatchewan Research Council

Simon Fraser University

Sustainable Development Technology Canada

Sustainable Energy Technologies Ltd

Tekion Inc

TISEC Inc

Transport Canada

University of Calgary

University of Ontario Institute of Technology

University of Toronto, Mississauga

University of Waterloo, Department of Mechanical & Mechatronics Engineering

Versa Power Systems

Western Economic Diversification Canada

Xebec Adsorption Inc

BC Transit 20 fuel cell electric bus deployment in Whistler, BC

Canadian Hydrogen
and Fuel Cell Association

Canada

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