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PRICEWATERHOUSECOOPERS 

# Canadian Hydrogen and Fuel Cell Sector Profile

# 2005



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Aussi offert en français sous le titre *Profil de l'industrie canadienne de l'hydrogène et des piles à combustible de 2005*.

## This profile of the Canadian hydrogen and fuel cell sector provides an objective assessment of Canada's position within the increasingly competitive global industry.

In 2004, the Government of Canada, Fuel Cells Canada and PricewaterhouseCoopers partnered to develop a comprehensive profile of the Canadian hydrogen and fuel cell sector. Following on the success of its inaugural edition, the Canadian Hydrogen and Fuel Cell Sector Profile has been updated for 2005. The 2005 Sector Profile responds to the needs of stakeholders—companies, governments, academia and investors—to obtain the current economic and corporate information required to assess and benchmark the progress of the industry. The profile describes the sector in terms of revenue, research and development activity and employment. These statistics are needed to keep policy makers, investors and other stakeholders informed and assess Canada's competitive position within the international hydrogen and fuel cell community.

The Profile will be published annually to ensure that this important sector of the Canadian economy is consistently measured, its trends tracked and its achievements and growth recognized. We thank all the companies and organizations that contributed to the development of the Canadian Hydrogen and Fuel Cell Sector Profile 2005.





# Canadian Hydrogen and Fuel Cell Sector Profile

# 2005

## Introduction

The Canadian Hydrogen and Fuel Cell Sector Profile 2005 measures several key performance indicators and provides an objective assessment of Canada's position within the increasingly competitive global industry. The Canadian industry continues to evolve and build technological capability as the new energy paradigm emerges.

The hydrogen and fuel cell industry underwent significant refocusing of activities in 2004 and the results of this sector profile reflect this shift in direction. Between 2003 and 2004, revenue decreased 29% from \$188 million to \$133 million. Research & development expenditures decreased 18% from \$290 million in 2003 to \$237 million in 2004; employment numbers decreased 23% from 2,685 in 2003 to 2,056 in 2004; and the number of demonstration projects declined 18%, from 262 in 2003 to 215 in 2004.

Respondents reported a 5% increase in strategic alliances between 2003 and 2004, from 256 to 270. These collaborative relationships among private companies and between the public and private sectors are critical to helping the industry achieve its commercialization goals.

The Canadian hydrogen and fuel cell industry, like many other Canadian industries, relies on export markets to prosper in the long term. In 2004, external markets accounted for the vast majority of sales revenue. While domestic sources account for much of the industry's funding, foreign sources were also important. The Canadian hydrogen and fuel cell industry must continue to reflect global priorities to ensure the industry's ongoing growth, while maintaining its position as a leader in innovation.

## Methodology and response rates

A total of 125 organizations associated with the hydrogen and fuel cell sector in Canada were invited to participate in the development of this profile. The complete distribution list is included at the end of this report. Invitees included existing and potential members of Fuel Cells Canada, academic institutions, government stakeholders and partners in current hydrogen and fuel cell demonstration activities. A total of 82 organizations responded, representing an overall response rate of 66%.

Figures presented for 2004 were collected by survey questionnaire in 2005. Figures presented for 2003 are as reported in the 2004 Sector Profile and therefore may not be fully comparable due to differing respondents and/or basis of individual responses.

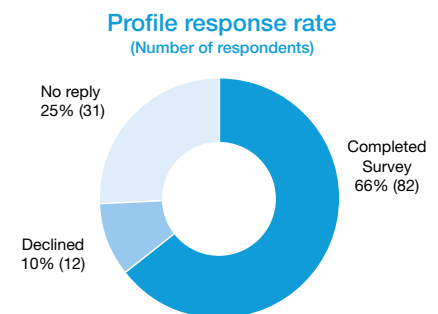
In order to protect the confidentiality of respondents, all results are reported in aggregate. No investigation was conducted as to the completeness of data provided by respondents or reasons for non-provision. All monetary results are presented in Canadian dollars.

## The industry at a glance

- **Revenue** decreased 29% from \$188 million to \$133 million.
- **Research & development expenditures** decreased 18% from \$290 million in 2003 to \$237 million in 2004.
- **Employment** numbers decreased 23% from 2,685 in 2003 to 2,056 in 2004.
- **The number of demonstration projects** declined 18% from 262 in 2003 to 215 in 2004.
- **The number of strategic alliances** reported a modest increase from 256 to 270.

## Growth since 2001

The 2005 Sector Profile provides important updates to the information reported in *Economic Impact of Industrial Hydrogen Activity in Canada*—the initial sector profile conducted by Sypher Mueller and Natural Resources Canada in 2001. Over the four year period from 2001 to 2004, the sector shows growth in all key indicators in spite of a downturn in 2004. For details please see the discussion at the end of this report.



# 52% OF CANADIAN TECHNOLOGY ACTIVITIES FOCUSED ON PROTON EXCHANGE MEMBRANE (PEM)



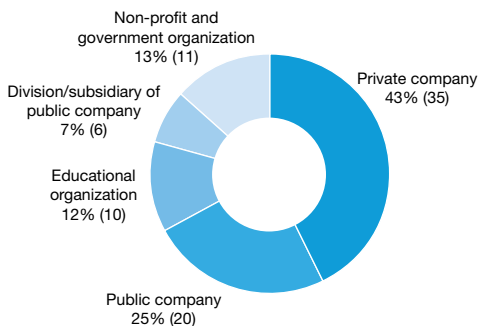
## Corporate profile

Almost half of the respondents included in this profile are private companies (43%) and, as such, are not obliged to provide financial or other data to the market. Their voluntary participation in this year's profile provides a more thorough appreciation of the size and activities of the hydrogen and fuel cell industry in Canada. Just under one third (32%) are public companies or divisions/subsidiaries of public companies, the parent companies of which may or may not be based in Canada.

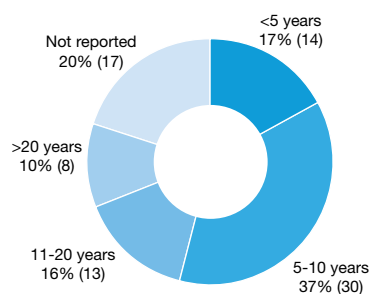
The majority of organizations (54%) reported ten years or less involvement in hydrogen and fuel cell activities, with 37% of respondents reporting between five and ten years of activity. While the industry is still relatively young in Canada, there is a strong foundation on which to build.

Research accounted for the largest area of expertise, followed closely by professional services providers, and suppliers to developers or manufacturers.

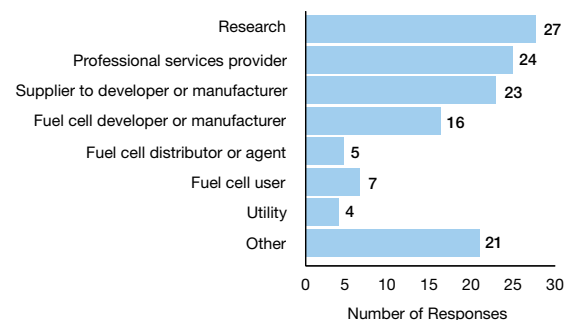
**Organization type**  
(Number of respondents)



**Number of years involved in fuel cell/hydrogen activities**  
(Number of respondents)



**Areas of expertise**  
(Respondents may be included in several categories)



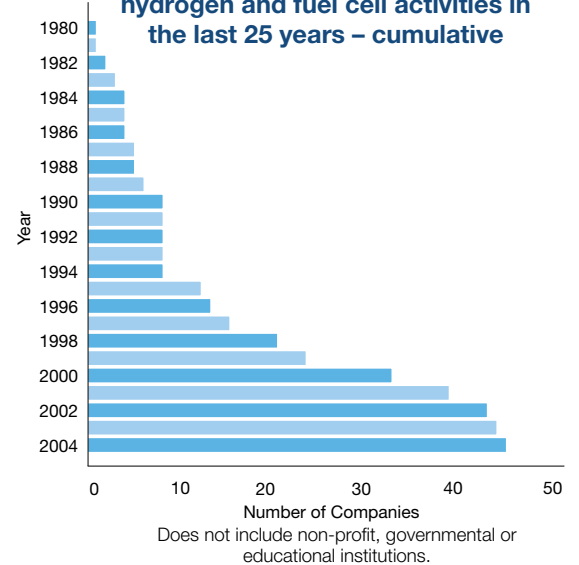


Source:  
Ballard Power Systems, Inc.

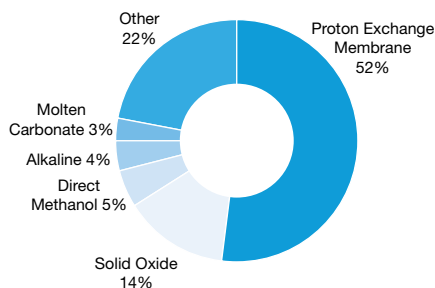
While market focus was split fairly evenly among stationary, portable, mobile and fuelling infrastructure applications, technology activities were largely focused on Proton Exchange Membrane (PEM) (52%). These results are unsurprising as Canada is a recognized leader in the development of PEM technology for mobile, small stationary and portable applications.

In Canada, most fuel cell related activity occurs in Western Canada. Canadian companies also have facilities in the United States, Germany, and Japan, among other countries.

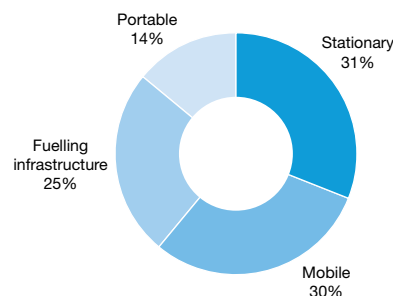
**Number of companies involved in hydrogen and fuel cell activities in the last 25 years – cumulative**



**Technology focus**

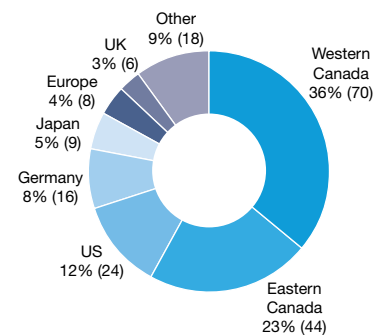


**Market focus**



**Location of fuel cell related facilities**

(Number of respondents)

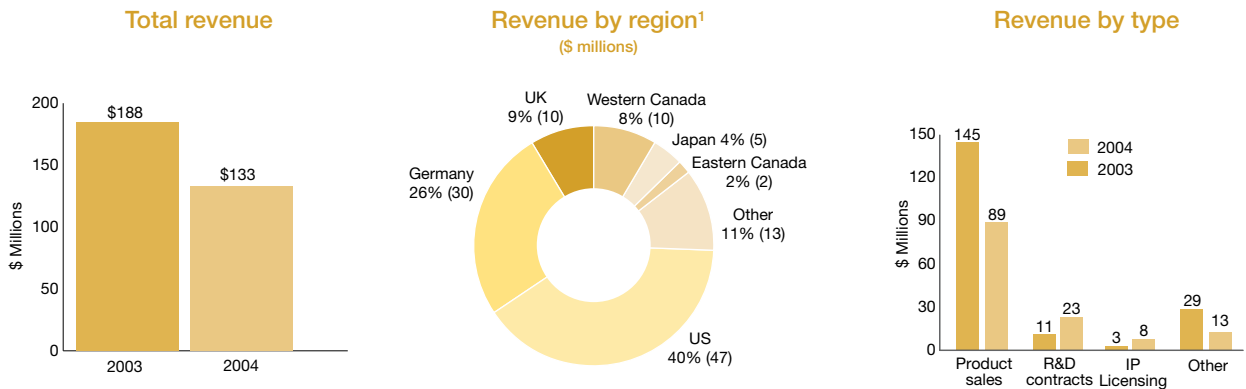




## Revenue

Total revenue from hydrogen and fuel cell activities reported by respondents decreased 29% from \$188 million in 2003 to \$133 million in 2004. Of the total revenue reported in 2004, geographic data was provided for \$117 million. Sales in the United States accounted for 40% of revenue, followed by sales in Germany at 26%. Sales in Canada represented slightly more than 10% of revenue.

Product sales comprised the largest revenue stream for both 2003 and 2004, while there was over 100% growth in R&D contracts and intellectual property licensing.



1. Sector revenue may include sales allocated according to the location of the customer and the location of the operating division credited with the sale.

**CANADIAN TECHNOLOGY IS FEATURED  
IN DEMONSTRATION PROJECTS  
AROUND THE WORLD**

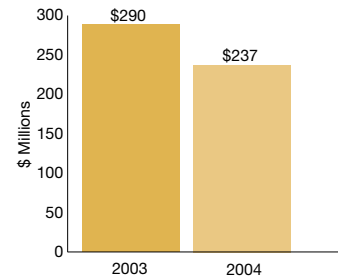
## Research and development

Total research and development (R&D) expenditures on hydrogen and fuel cell activities by respondents decreased 18% from \$290 million in 2003 to \$237 million in 2004. Of the total R&D expenditures reported for 2004, geographic data was provided for \$227 million—96% coverage. Western Canada accounted for the majority of R&D expenditures in 2004. R&D expenditures outside of the United States and Canada represented less than one percent of the total.

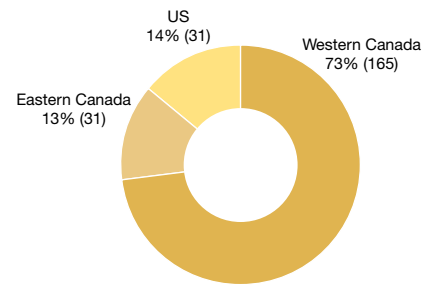
## Demonstration projects

Closely corresponding to the decrease in R&D expenditures, an 18% decrease in demonstration projects was also reported by respondents—from 262 in 2003 to 215 in 2004. Stationary, mobile and fueling infrastructure projects account for the bulk of R&D demonstration projects. Demonstration projects represent a valuable opportunity to increase public and investor knowledge, and must therefore continue to be treated as a priority by the industry. It is anticipated that portable and small stationary applications will experience growth in the near future, and the number of demonstration projects in these areas should rise accordingly.

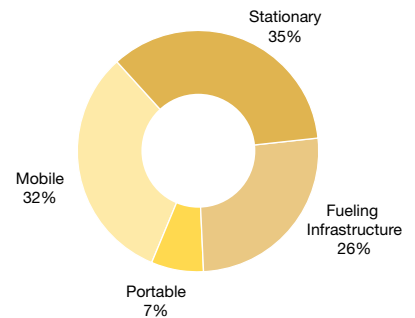
Total research and development



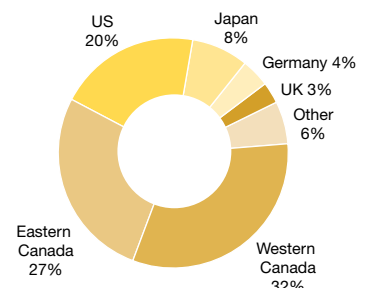
Research and development by region  
(\$ millions)



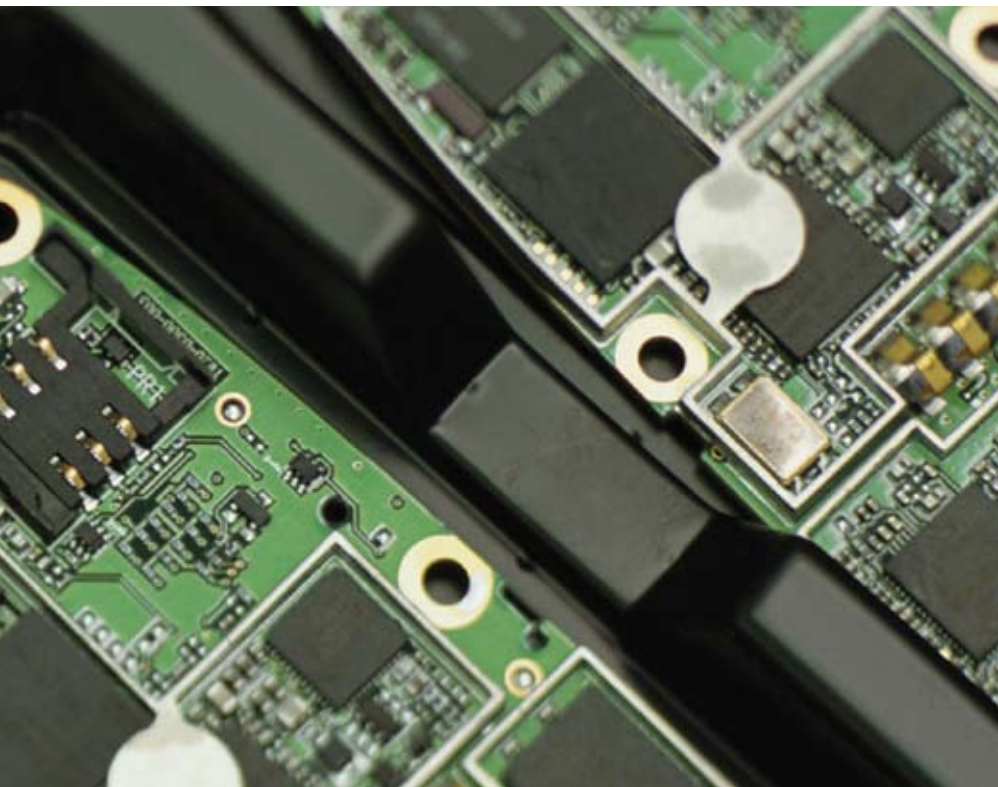
Demonstration focus



Location of demonstration projects



Source:  
PricewaterhouseCoopers

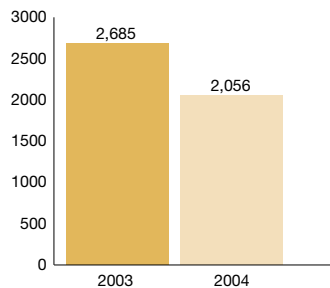


## Employees

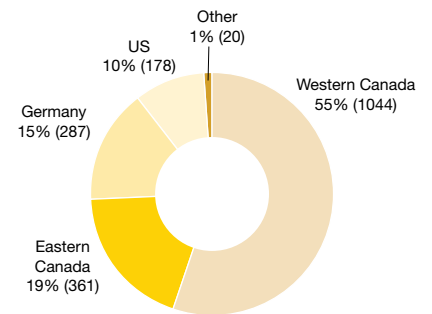
Respondents reported a 23% decrease in the total number of employees focused on hydrogen and fuel cells activities from 2,685 in 2003 to 2,056 in 2004. Of the 2,056 employees reported in 2004, geographic data was provided for 1,890. A total of 1,405, or 74%, were based in Canada. Within Canada, there was a three-to-one split between Western and Eastern Canada. Outside of Canada, Germany and the United States, at 15% and 10% respectively, accounted for the largest employment clusters.

The average annual salary paid to hydrogen and fuel cell employees in Canada decreased from \$69,986 in 2003 to \$66,798 in 2004. Extrapolating the \$66,798 average salary for 2004 to the 1,405 employees in Canada, the industry contributes \$32 million in salaries to the national economy.

Employment



Employees by region



**THE INCREASE IN STRATEGIC ALLIANCES CONFIRMS THE CONTINUED VALUE OF KEY RELATIONSHIPS**





## Funding requirements

Respondents were asked to identify their capital requirements for the period 2006 to 2011, and if possible, to break down their requirements by year and expected funding source. Respondents providing information on funding estimated total capital requirements for this period at \$1.21 billion. Respondents identified domestic and foreign public capital markets as the largest expected sources of funding, with the Canadian and foreign governments providing the next largest sources. In 2003, respondents expected only 16% of funding to come from public markets.

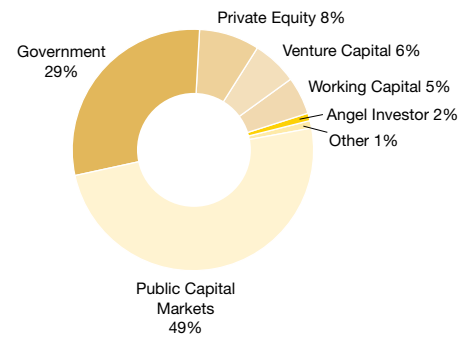
Continued education of governments and public capital markets on the benefits of investing in the hydrogen and fuel cell industry is an important part of the industry's efforts to secure funding. Given the industry's long development period and demanding R&D requirements, adequate financing is necessary if commercialization is to be achieved.

## Strategic alliances

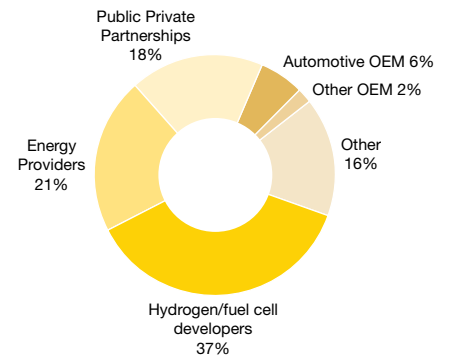
A 5% increase in strategic alliances from 256 in 2003 to 270 in 2004 confirms the continued value and importance of key relationships and partnerships for the industry, in the face of an otherwise difficult year.

Hydrogen and fuel cell developers partnering with each other represented the largest segment in 2004 at 37%, followed by energy providers at 21%. Automotive original equipment manufacturers (OEM), which represented the most significant group of strategic partners in 2003, accounted for only 6% in 2004, illustrating a shift to early commercial applications.

Expected domestic funding by source 2006 to 2011



Strategic alliances





Source:  
Hydrogenics Corporation

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Industry Canada  
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**John Webster**  
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PricewaterhouseCoopers LLP  
1 604 806 7726  
john.webster@ca.pwc.com

## Conclusion

In 2004, the Canadian hydrogen and fuel cell sector faced a challenging year. Key indicators include:

- Revenue decreased 29% from \$188 million to \$133 million.
- Research & development expenditures decreased 18% from \$290 million in 2003 to \$237 million in 2004.
- Employment numbers decreased 23% from 2,685 in 2003 to 2,056 in 2004.
- The number of demonstration projects declined 18% from 262 in 2003 to 215 in 2004.
- The number of strategic alliances reported a modest increase from 256 to 270.

Canada is helping to lead the way in providing energy technology alternatives as the world moves towards a new energy economy, one with cleaner and more sustainable energy systems. With a steady employment base, a solid export framework, and an ongoing commitment to R&D expenditures, Canada's hydrogen and fuel cell industry continues to innovate as a result of its success in securing needed financial support and strong strategic alliances.

The Government of Canada, Fuel Cells Canada and PricewaterhouseCoopers 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 funding decisions, influence alliance partnerships, and strengthen the overall competitive position of the Canadian hydrogen and fuel cell industry.

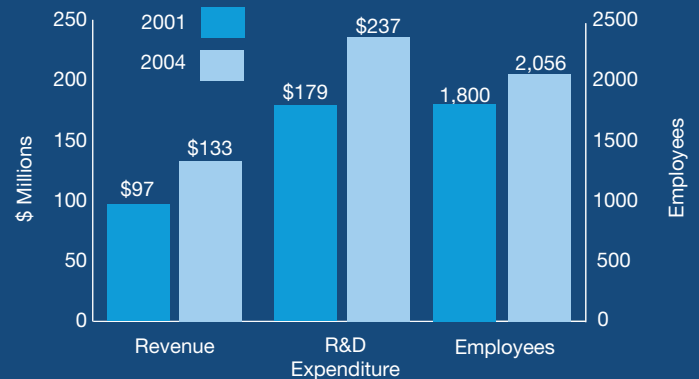


## Growth since 2001

The initial sector profile, *Economic Impact of Industrial Hydrogen Activity in Canada*, conducted by Sypher Mueller and Natural Resources Canada in 2001, offered insight into the industry's early days. The 2005 Sector Profile provides benchmark data to update the original industry study, revealing the existence of a growing hydrogen and fuel cell sector within Canada. While some of the details may not be fully comparable due to differing methodologies, the results of 2005 Sector Profile study suggest that the Canadian hydrogen and fuel cell sector has grown significantly over the past four year years, in spite of the declines seen in 2004.

- Revenue has grown 37%—from \$97 million in 2001 to \$133 million in 2004.
- R&D expenditures have increased 32% to \$237 million per year.
- Employment in the industry has seen an increase of 14% and currently stands at over 2,000.

## Comparative Sector Statistics: 2001 vs 2004



Sources: 2001 - Sypher Mueller and Natural Resources Canada  
2004 - Government of Canada, Fuel Cells Canada and PricewaterhouseCoopers

## Invited to participate

Advanced Measurements Inc.  
Agile Systems Inc.  
Air Liquide Canada  
Alberta Research Council Inc.  
Alchemix Corp.  
Analytic Systems  
Angstrom Power Inc.  
Astris Energi Inc.  
Azure Dynamics Corporation  
Ballard Power Systems Inc.  
BC Hydro  
BC Transit  
BET Services Inc.  
BOC Gases  
Business Development Bank of Canada  
Canadian Hydrogen Association  
Canadian Hydrogen Energy Corporation Ltd.  
Cellex Power Products Inc.  
Chrysalix Energy Management Inc.  
Cimtex Industries Ltd.  
Clean Energy Canada  
Conduit Ventures Limited  
Deere & Co.  
Deloitte & Touche  
Delta Q Technologies Corp.  
Dynetek Industries Ltd.  
E-One Moli Energy (Canada) Ltd.  
Electrovaya  
Enbridge Gas Distribution  
Energix Research Inc.  
Energy and Environmental Industries Branch, Industry Canada

Energy Inet  
EnergyQBD Inc.  
FTI International Inc.  
Fuel Cell Technologies Ltd.  
Fuel Cells Canada  
FuelCon Systems Inc.  
Fueling Technologies Inc.  
FuelMaker Corp.  
General Hydrogen Corporation  
Global Hydrofuel Technologies Inc.  
British Columbia Ministry of Mines, Energy, and Petroleum  
Gowling Lafleur Henderson LLP  
Greater Vancouver Regional District  
GrowthWorks Ltd.  
H2 Concepts Alternative Fuels Consulting  
H3 Energy Ltd.  
Heliocentris Energy Systems  
HERA Hydrogen Storage Systems Inc.  
HSBC  
Hybrid Energy Inc.  
Hydrogen Early Adopters Program  
Hydrogen Research Institute  
Hydrogen Village Partnership  
Hydrogenics Corporation  
Hyteon  
IMW Industries Ltd.  
Inco Special Products  
Natural Sciences and Engineering Research Council  
Institute for Integrated Energy Systems  
James Hoggan and Associates Inc.  
Kinectrics Inc.

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MARCON Management Consultants  
Marsh Canada Limited  
McCarthy Tetrault LLP  
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Membrane Reactor Technologies Ltd.  
Methanex Corporation  
MH2 Canada Inc.  
National Bank Financial  
National Research Council  
Natural Resources Canada  
Neodym Technologies  
NORAM Engineering & Constructors Ltd.  
Ontario Power Generation  
Palcan Power Systems Inc.  
Pathway Design & Manufacturing Inc.  
PEI Ministry of Development and Technology  
PEM Engineers  
PolyFuel Inc.  
PowerDisc Development Corp. Ltd.  
PowerNova Technologies Corp.  
Powertech  
Praxair Inc.  
PrecisionH2 Inc.  
PricewaterhouseCoopers LLP  
Propane Gas Association of Canada Inc.  
Province of Ontario  
Quebec Fuel Cells & Hydrogen Network  
Queens RMC Fuel Cell Research Centre

QuestAir Technologies Inc.  
Royal Military College of Canada  
Sacre-Davey Engineering  
Sarnia-Lambton Economic Partnership  
Saskatchewan Research Council  
SatCon Power Systems Canada Ltd.  
Sea Breeze Power Corp.  
Simon Fraser University  
SMC Pneumatics (Canada) Ltd.  
Stantec Consulting  
START Corp  
Staubli Corp.  
Sustainable Development Technologies Canada  
Sustainable Energy Technologies  
Tekion Inc.  
Teleflex Canada Inc.  
The Armstrong Monitoring Corp.  
Tyco Electronics Canada Ltd.  
Universal Dynamics Ltd.  
University College of the Fraser Valley  
University of Alberta  
University of British Columbia  
University of Calgary  
University of Toronto Mississauga Campus  
University of Windsor  
Ventures West Management Inc.  
Versa Power Systems  
Westport Innovations Inc.  
Xantrex Technology Inc.  
Yaletown Venture Partners  
Zetacon Corp.  
Zongshen PEM Power Systems

