

2004 Worldwide Fuel Cell Industry Survey

Methodology

Members of the US Fuel Cell Council (USFCC), Fuel Cell Europe (FCEu) and the Fuel Cell Commercialization Conference of Japan (FCCJ) were asked to voluntarily supply information on their fuel cell activities in the areas of Corporate Profile, Sales, Research & Development (R&D) Expenditure and Employees to PricewaterhouseCoopers. This data was combined with similar information previously supplied by members of Fuel Cells Canada (FCC) and reported in the 2004 Canadian Hydrogen and Fuel Cell Sector Profile. The 2004 Worldwide Fuel Cell Industry Survey presents aggregate results from these sources.

Aggregation of results

In order to protect the confidentiality of respondents, all results are reported in aggregate and a “50% rule” has been applied. Under this rule, results are not reported where a single respondent provided 50% or more of the data for any specific category of Sales, R&D Expenditure or Employees. While totals were not affected, a number of countries have been excluded from the geographic analysis due to breaches of this rule.

Financial data is expressed in US dollars. Responses were not challenged, tested or audited.

Provision of data

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

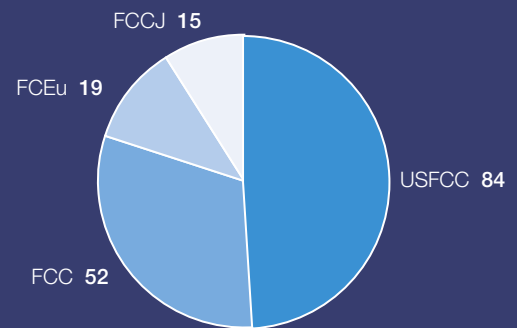
Response rates

A total of 395 organizations—the combined membership of USFCC, FCC, FCEu and FCCJ—were invited to participate in this survey. A complete distribution list is included on the back cover of this report.

170 completed responses were received—representing a response rate of 43%.

Response profile by association*

(Number of respondents)



* Where respondents are members of more than one association they have been included within the association corresponding geographically to their response.



2004 Worldwide Fuel Cell Industry Survey

Companies involved in the rapidly expanding fuel cell industry face similar goals and similar challenges, regardless of geographic location and nationality. The 2004 Worldwide Fuel Cell Industry Survey is a collaborative effort by the four leading fuel cell industry associations in North America, Europe and Asia to address one such challenge: the need for increased information about the industry.

The survey provides a profile of the organizations involved in the industry and reports on three key indicators of industry performance: Sales, R&D Expenditure and Employment.

This information will provide industry stakeholders with the most comprehensive picture of the global industry to date, and assist in future benchmarking and trend analysis as the sector matures.

PricewaterhouseCoopers was retained as the independent survey administrator in order to maintain the confidentiality of respondents' data.

Summary results

The 2004 Worldwide Fuel Cell Industry Survey shows a growing sector between 2002 and 2003.

- **Sales** increased 41% from \$240 million in 2002 to \$338 million in 2003.
- **R&D Expenditure** increased 13% from \$764 million in 2002 to \$859 million in 2003.
- **Employees** remained relatively constant at 7,750 in 2002 and 7,748 in 2003.



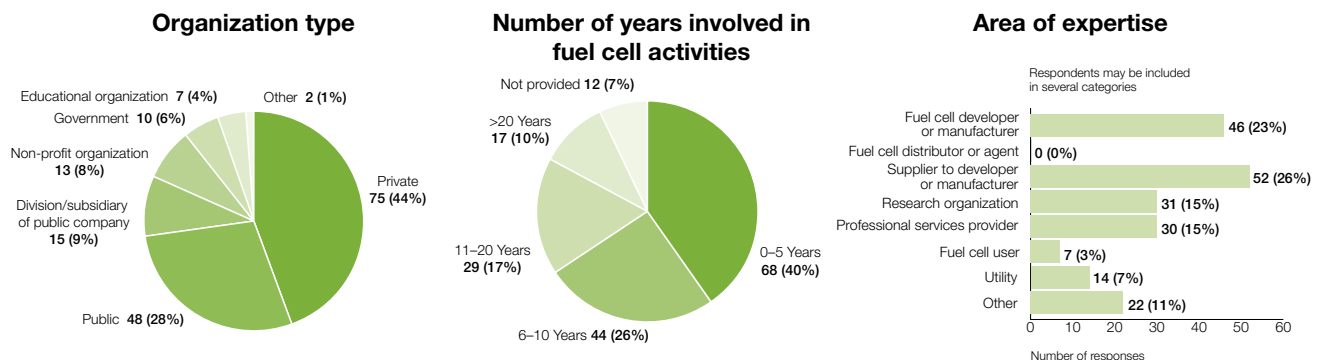
Corporate Profile

Close to half (44%) of the respondents to this survey are private companies. Over one third (37%) are either public or a division or subsidiary of a public company.

Two thirds (66%) of the respondents have been involved in fuel cell related activities for ten years or less.

Fuel cell developers and manufacturers and/or suppliers to fuel cell manufacturers made up almost half the respondents (49%). Research and professional services firms also featured prominently at 15% each. The category of fuel cell distributor or agent was not selected by any respondents.

Seventy-five percent of the respondents reported headquarters of fuel cell activities in North America. Outside of the USA and Canada, Japan, Germany, UK, France, The Netherlands and Australia were cited as bases for fuel cell activities.



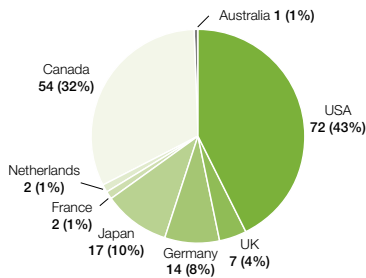


The USA, Canada, Japan and Germany feature prominently as locations for fuel cell related manufacturing and/or R&D activities.

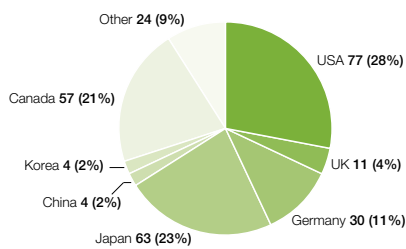
Stationary markets were a focus of almost half the respondents (42%), while just over a quarter (26%) of respondents reported a market focus on mobile applications: vehicle drive and auxiliary power units for vehicles.

Proton exchange membrane technology dominated the industry with 56% of respondents reporting this technology as a key focus. Solid oxide technology was next at 18% and then direct methanol at 10%.

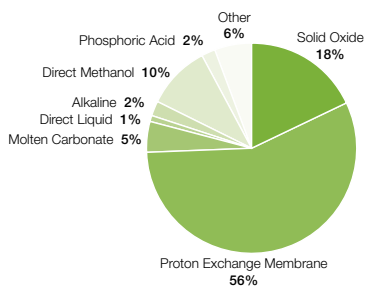
Headquarters of fuel cell activities



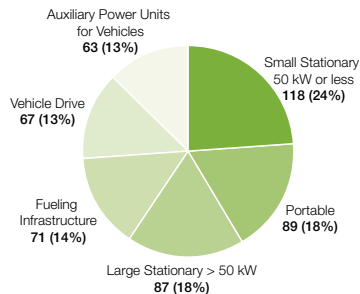
Location of fuel cell manufacturing and R&D activities



Technology focus



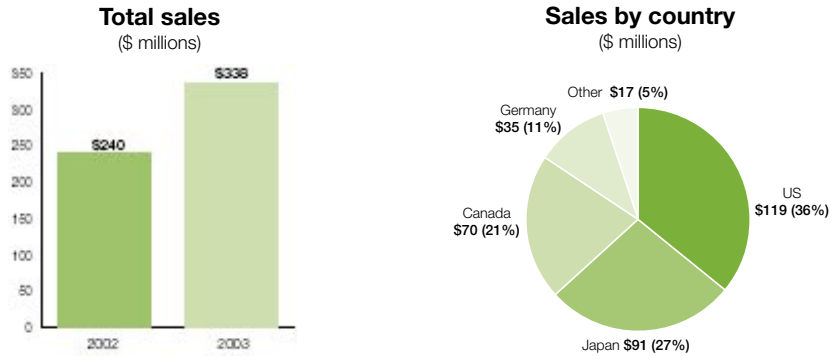
Market focus



Key Industry Indicators

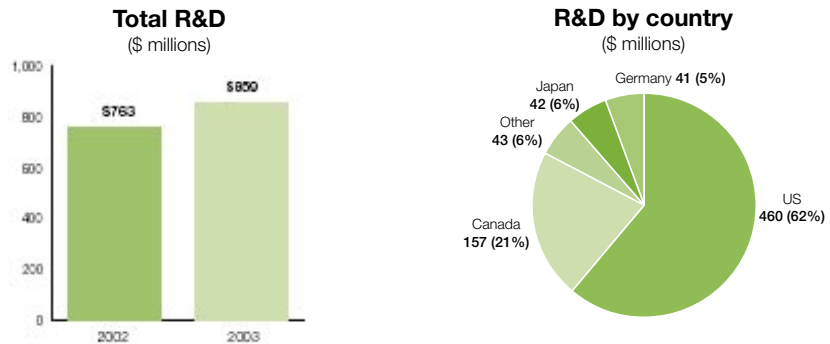
Sales

A total of 134 participants, or 79% of respondents, provided sales data. Reported fuel cell related sales from these participants increased 41% from \$240 million in 2002 to \$338 million in 2003. Of the total sales reported in 2003, geographic data was provided for \$332 million—98% coverage.



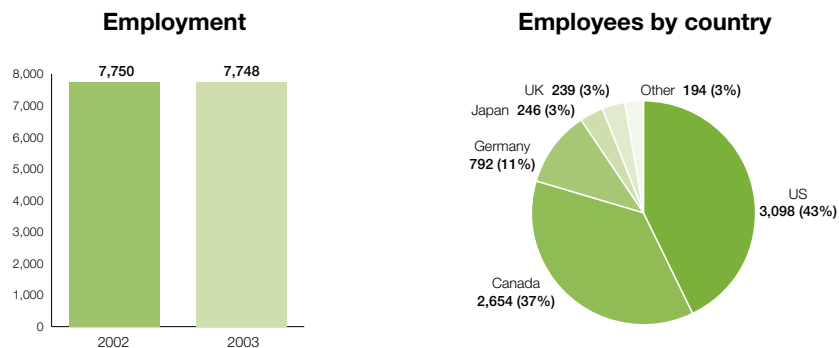
Research and Development

A total of 131 participants, or 77% of respondents, provided R&D expenditure data. Total related R&D expenditure reported by these participants was \$763 million and \$859 million for 2002 and 2003 respectively—representing a 13% increase year on year. Of the total R&D expenditure reported for 2003, geographic data was provided for \$743 million—87% coverage.



Employees

The number of employees engaged in fuel cell activities remained almost constant as figures reported by respondents were 7,750 and 7,748 for 2002 and 2003 respectively. A total of 152 participants, or 89% of respondents, provided data on employees. Of the 7,748 reported employees in 2003, geographic data was provided for 7,223—93% coverage.





Conclusion

The 2004 Worldwide Fuel Cell Industry Survey provides valuable benchmark data for a growing industry. While some organizations were unwilling to provide specific data due to concerns over confidentiality, the summarized results describe a dynamic industry sector. Between 2002 and 2003:

- Sales increased 41% to \$338 million
- R&D expenditure increased 13% to \$859 million
- Employment remained constant at 7,748

The world's leading fuel cell industry associations, the USFCC, FCC, FCEu and FCCJ, view collaboration as integral to the successful commercialization of fuel cell technology. The organizers thank the organizations that took part in this survey and look forward to increased participation in future editions.

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PricewaterhouseCoopers LLP
Alastair Nimmons
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alastair.nimmons@ca.pwc.com

Invited to participate

3M	Daido Steel	Gastec Technology BV	Japan Eco-Service Stations Association	National Federation Petroleum Commercial Associations	Riken Corp.	The Kansai Electric Power
Adam Opel AG GAPC	Daihatsu Motor	Gaz de France	Japan Electrical Safety and Environment Technology Laboratories	National Fuel Cell Research Center	Rinnai Corp.	The Tokyo Electric Power
Advanced Measurements Air Products and Chemicals	DaimlerChrysler	General Electric Hybrid Power Generation Systems	Japan LP-Gas Association	National Joint Apprenticeship & Training Committee	Rochester Institute of Technology	Tiax
Alberta Research Council	Dainippon Ink and Chemicals	General Hydrogen Corporation	Japan Metals & Chemicals	National Research Council, Canada	RWE Power International	Timcal
Alphea Hydrogen Centre of Expertise	Dana Corporation	General Motors	Japan Petroleum Exploration	Neah Power Systems, NedStack FC Technology	Sacré-Davey Engineering	TNO-MEP
Alternate Energy Corporation	De Nora North America, Delft Un. of Technology, Fac. Chem. Techn. & Materials Science	GKSS Res. Centre Geesthacht	JFE Container	NedStack FC Technology	SANYO Electric	TOHO ACETYLENE
American Electric Power	Deloitte & Touche	Gore Fuel Cell Technologies	Johnson Matthey Fuel Cells	Neutron Technologies	Schunk	Toho Gas
Angstrom Power	Delphi Corporation	Gowling Lafleur Henderson	Kamei Corp.	NexTech Materials	Kohlenstofftechnik	Tohoku Electric Power
Ansaldo Fuel Cells	Denaro	Graftech	Kanagawa Electric	NextEnergy Corporation	Sekisui Chemical	Tokai Carbon
Argonne National Laboratory	Denyo	GrowthWorks	Kandenko	Nichias Corp.	SENTECH	Tokyo Boeki
Asahi Glass	Deutsches Zentrum für Luft- und Raumfahrt	GS Yuasa Corporation	KANEKA CORPORATION	Nippon Carbon	Seventeen	Tokyo Gas
Asahikasei Corp	Donaldson Company	Greater Vancouver Regional District	Keen Engineering	Nippon Oil Corp.	SGL TECHNIC	Tonen General Sekiyu K.K.
Asbury Graphite Mills	Dong Natargas Syd AS	H.C. Starck	Keio Univ.	Nippon Pillar Packing	Shell Hydrogen BV	Toray Industries
Astris Energi	Dornier	Habco	Keiyo Gas	Nippon Sanso Corp.	Shikoku Electric power	Toshiba International Fuel Cells Corp.
ATMI	Forschung & Technologie	Hamburg Un	KEMSA	Nippon Steel Chemical	Shizuoka Gas	Toyo Radiator
Atofina Chemicals	Dow Corning Corp.	HB Travel Corporation	Kettering University	Nippon Steel Corp.	Showa Denko K.K.	Toyota Motor Europe & Manufacturing Europe
Azure Dynamics Corporation	DT Industries, Assembly Techn. & Test	Heliocentris Energy Systems	Khushu Electric Power Kinectrics	Nishikawa Keisoku	Showa Shell Sekiyu K. K.	Toyota Tsusho Corporation
Ballard Power Systems	DuPont Fuel Cells	Helion	Kockums AB, R&D	Nissan Diesel Motor	Siemens Westinghouse	Tractebel Engineering
BC Hydro	Dynetek Industries	HERA, Hydrogen Storage Systems	Koninklijke Bibliotheek	Nissan Motor	SiM Technologies	TU Graz, Christian Doppler Lab. for FC Systems
BCC	Ebara Corp.	Hexion b.v.	Koyo Seiko	Nissan Technical Center N.A.	SINANEN	U.S. Army CERL
BEWAG AG, A Vattenfall	ElectroChem	Hino Motors	KPMG	NORAM Engineering and Constructors	SINANEN	U.S. Department of Energy
BG Engineering	ENbridge Gas Distribution	Hiroshima Gas	Kurita Water Industries	Noritake	SOCAL	UEKI CORPORATION
BIC Corporation	ENECA Casaccia	Hitachi Zosen Corp.	Kuwait Petroleum Research & Technology	Novem/Senter	SOFCo-EFS Holdings	UltraCell.
BOC Gases	Energi E2 A/S	Hitachi	Kyocera Corporation	Nuvera Fuel Cells	Son of Son Agency	Umicore Autocat USA,
Bonneville Power Administration	Engerizer Battery Manufacturing	Hoku Scientific	Kyushu Oil	Office of Navy Research	South Coast Air Quality Management District	Underwriters Laboratories
BP Hydrogen Global Business Centre	Energy QBD	Honda Motor	LBST	Ogura Industrial Corp.	Stuart Energy Systems Corporation	University of Leuven
Breakthrough Technolgies Institute	Enertech Solutions	Honda R&D Europe	Lueckel Consulting	Ohio Department of Development - Technology Division	Sud-Chemie	University of Milan
Bulk Molding Compounds	Engelhard	Houston Advanced Research Center	Marsh Canada	Ontario Power Generation	Sulzer Hexis AG, Mark. & Sales Dept.	University Twente, Lab. Inorg. Materials Science
Business Development Bank of Canada	Engineering Advancement Association of Japan	HSBC Bank Canada	Marubeni Corp.	Organization for the Promotion of Low Emission Vehicles	Sumitomo Air Water	University College of the Fraser Valley
Cabot Superior Micro Powders	Entegris	H-tec Hydrogen Systems	Matsushita Electric Industrial	Noritake	Sumitomo Chemical	University of Birmingham
California Air Resources Board	EscoVale Consultancy Services	Hydrogenics Corporation	Mazda Motor Corp.	Novem/Senter	Sumitomo Corp.	University of South Carolina
Caterpillar Electric Power Group	Essent Energy South bv	HyRadix	McCarthy Tétrault	Nuvera Fuel Cells	Sumitomo Electric Industries	University of Victoria, Institute for Integrated Energy Systems
CEA/Grenoble I 894	Eugeneo	Hyundai Motor Japan R&D Center	Meidensha	Office of Navy Research	Super Grafion PVT Company	University of Twente, Lab. Inorg. Materials Science
Cellex Power Products	EUR Centre for Sustainable Development	IdaTech	Membrane Reactor Technologies	Ogura Industrial Corp.	Suzuki Motor Corp.	University of Victoria, Institute for Integrated Energy Systems
Centre for Automotive Materials & Manufacturing	Exergy	Idemityu Kosan	MesoFuel	Ohio Department of Development - Technology Division	Suzuyo Shoji	University of South Carolina
Ceramic Fuel Cells	FC & FC Appl. Specialist	Illinois Institute of Technology	Methanex Corporation	Ontario Power Generation	Syntrolore Corporation	University of Victoria, Institute for Integrated Energy Systems
Ceres Power	Florida Department of Environmental Protection	Imperial College Dept. of Materials Science	Methanol Institute	Organization for the Promotion of Low Emission Vehicles	Taiyo Oil	University of Victoria, Institute for Integrated Energy Systems
Chevron Texaco Technology Ventures	FMC-KC Marin	Inco Special Products	Microtherm	Osaka Gas	Tatsuno Corp.	University of Victoria, Institute for Integrated Energy Systems
Chrysalix Energy Management	Foamex	Indigo Holding	Millennium Cell	Osaka Science and Technology Center	TD Securities.	University of Victoria, Institute for Integrated Energy Systems
Chubu Electric Power	Ford Motor Company	Inst. of Physics Publ., FC Review	Mitsubishi Cell	Osaka Science and Technology Center	Teikoku Electric Mfg.	University of Victoria, Institute for Integrated Energy Systems
CIDETEC	Forschungszentrum Jülich PBZ	Instituto C.N.R./I.T.A.E	Mitsubishi Gas Chemical	Osaka Science and Technology Center	Teikoku Oil	University of Victoria, Institute for Integrated Energy Systems
Clean Energy Canada	Franklin Fuel Cells Inc.	Ion Power	Mitsubishi Heavy Industries	Osaka Science and Technology Center	Tekion Solutions	University of Victoria, Institute for Integrated Energy Systems
Columbian Chemicals Company	Fraunhofer Institute Solar Energy Systems ISE	Ishikawajima Shibaura Machinery	Mitsubishi Kakoki kaisha	Osaka Science and Technology Center	Teledyne Energy Systems	University of Victoria, Institute for Integrated Energy Systems
Concurrent Technologies Corporation	Freudenberg FCCT oHG	Isuzu Advanced Engineering Center	Mitsubishi Motors Corp.	Osaka Science and Technology Center	Teleflex Canada	University of Victoria, Institute for Integrated Energy Systems
Conduit Ventures Limited	Freudenberg-NOK	Itochu Corp.	Mitsubishi Rayon	Osaka Science and Technology Center	Tenneco Automotive	University of Victoria, Institute for Integrated Energy Systems
Connecticut Clean Energy Fund	General Partnership	Itochu Enex	Mitsui	Osaka Science and Technology Center	Tenneco Automotive/Heinrich Gillet	University of Victoria, Institute for Integrated Energy Systems
ConocoPhillips Company	FTI International	Iwatani International Corp.	Mitsui Oil and Gas	Osaka Science and Technology Center	The Chugoku Electric Power	University of Victoria, Institute for Integrated Energy Systems
Cooperative Research Network (NRECA)	Fuel Cell Development Inf. Centre	Izumi Propane Corp.	Morgan Fuel Cell	Osaka Science and Technology Center	The European Commission	University of Victoria, Institute for Integrated Energy Systems
Core Technology Ventures	Fuel Cell Markets	James Hoggan & Associates	Motorola Labs	Osaka Science and Technology Center	The Federation of Electric Power Companies	University of Victoria, Institute for Integrated Energy Systems
Corona Corp.	Fuel Cell Technologies	Japan Energy Corp.	Mott Corporation	Osaka Science and Technology Center	The Freedonia Group	University of Victoria, Institute for Integrated Energy Systems
Cosmo Oil	FuelCell Energy	Japan Air Gases	MTI Micro Fuel Cells	Osaka Science and Technology Center	The Furukawa Electric	University of Victoria, Institute for Integrated Energy Systems
Créébel	Fuji Die	Japan Auto Parts Industries Association	MTU CFC Solutions	Osaka Science and Technology Center	The Gillette Company	University of Victoria, Institute for Integrated Energy Systems
CSA International	Fuji Electric Advanced Technology	Japan Automobile Manufacturers Association	N.E. Chemcat Corp.	Osaka Science and Technology Center	The Hydrogen Park Venice	University of Victoria, Institute for Integrated Energy Systems
	Fuji Heavy Industries	Japan Automobile Research Institute	N.V. Chemcat Corp.	Osaka Science and Technology Center	The Institute of Applied Energy	University of Victoria, Institute for Integrated Energy Systems
	Gas Technology Institute		N.V. Nederlandse Gasunie	Osaka Science and Technology Center	The Institute of Energy Economics, Japan	University of Victoria, Institute for Integrated Energy Systems
			N.V. NUON	Osaka Science and Technology Center	The Japan Electrical Manufacturers Association	University of Victoria, Institute for Integrated Energy Systems
			NAPS Systems Oy	Osaka Science and Technology Center	The Japan Gas Association	University of Victoria, Institute for Integrated Energy Systems
			National Bank Financial	Osaka Science and Technology Center	The Japan Steel Works	University of Victoria, Institute for Integrated Energy Systems