

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.

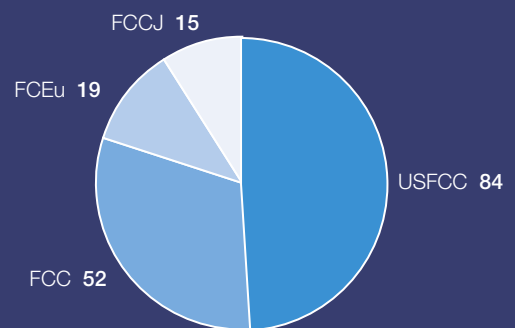
Response rates

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

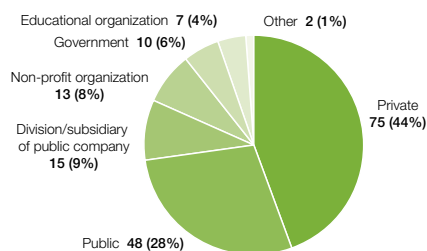
Close to half (44%) of the respondents to this survey are private companies. Over one third (37%) are either public or a division or subsidiary of a public company.

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

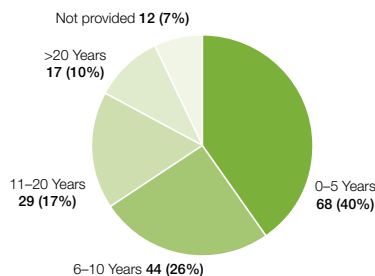
Fuel cell developers and manufacturers and/or suppliers to fuel cell manufacturers made up almost half the respondents (46%). Research and professional services firms also featured prominently at 15% each. The category of fuel cell distributor or agent was not selected by any respondents.

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.

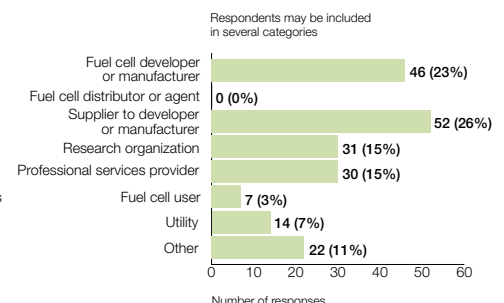
Organization type



Number of years involved in fuel cell activities



Area of expertise



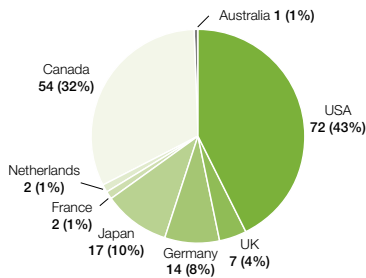


The USA, Canada, Japan and Germany feature prominently as locations for fuel cell related manufacturing and/or R&D activities.

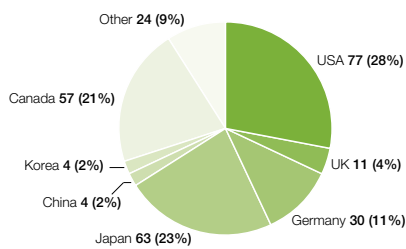
Stationary markets were a focus of almost half the respondents (42%), while just over a quarter (26%) of respondents reported a market focus on mobile applications: vehicle drive and auxiliary power units for vehicles.

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%.

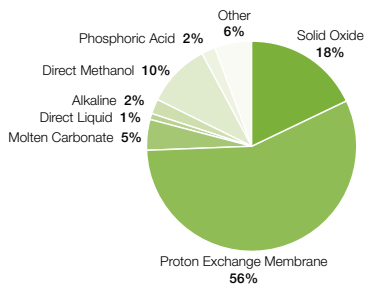
Headquarters of fuel cell activities



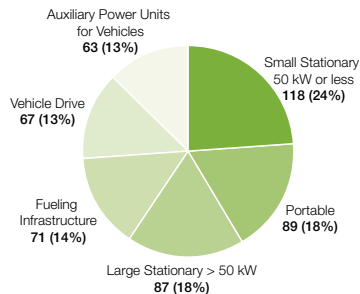
Location of fuel cell manufacturing and R&D activities



Technology focus



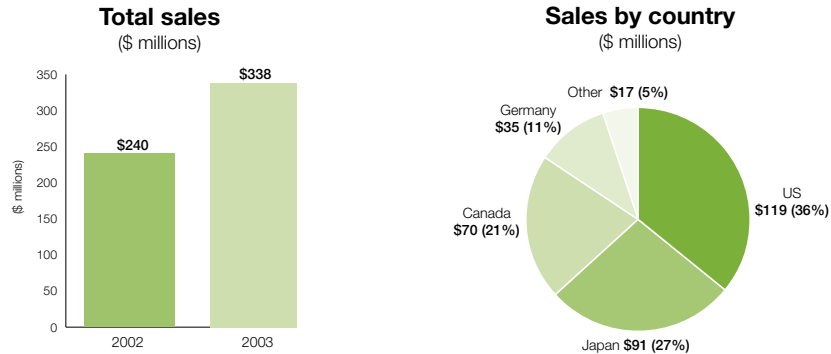
Market focus



Key Industry Indicators

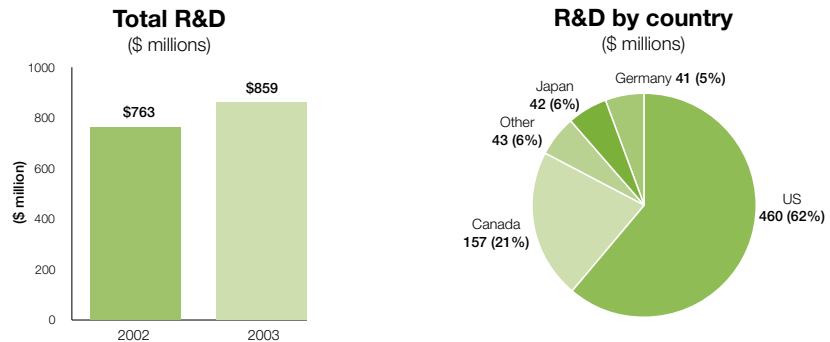
Sales

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.



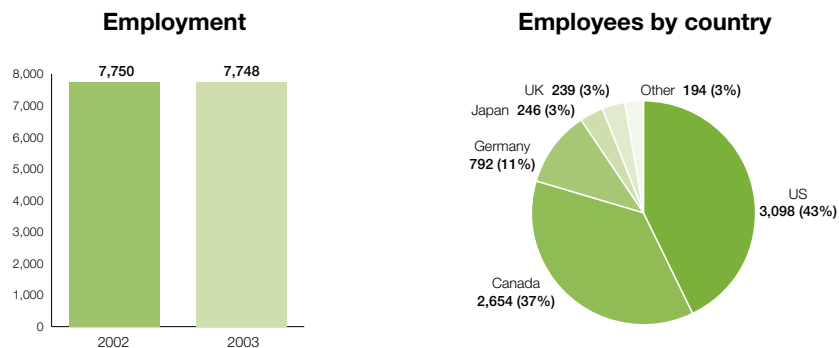
Research and Development

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