



# 2005 Fuel Cell Industry Survey

A Survey of 2004 Financial Results of Public Fuel Cell Companies\*

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PRICEWATERHOUSECOOPERS 

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### Focus Areas

**Alkaline Fuel Cells (AFC)** have been used in the US space program since the 1960s.

**Direct Liquid Fuel Cells (DLFC)** are primarily battery replacements for portable electronic devices.

**Direct Methanol Fuel Cells (DMFC)** are being developed for portable and micro applications such as laptop computers and mobile phones.

**Infrastructure** refers to developing components of the hydrogen supply chain, including the creation, storage and distribution of hydrogen.

**Molten Carbonate Fuel Cells (MCFC)** are best suited for larger stationary applications.

**Proton Exchange Membrane Fuel Cells (PEMFC)** are the leading fuel cell technology for use in transportation applications.

**Solid Oxide Fuel Cells (SOFC)** may be used in both utility and small-scale stationary power systems.

### Scope

The financial data and discussion presented in this survey are based on information published in the annual reports of the publicly traded fuel cell companies listed below (the PwC Fuel Cell List) for the fiscal year ending in 2004. All figures are expressed in US dollars. Companies were included in the survey if: (a) their primary goal is fuel cell production and/or system integration and/or related fueling infrastructure; and (b) they were a stand-alone public company as at December 31, 2004.

#### 2005 PwC Fuel Cell List

Company	Country	Focus Area
Alternate Energy Corp.	US	Infrastructure
Astris Energi Inc.	Canada	AFC
Ballard Power Systems Inc.	Canada	PEMFC
Ceramic Fuel Cells Ltd.	Australia	SOFC
Ceres Power Holdings Plc	UK	SOFC
Distributed Energy Systems Corp.	US	Infrastructure
Dynetek Industries Ltd.	Canada	Infrastructure
Fuel Cell Technologies Corp.	Canada	SOFC
FuelCell Energy Inc.	US	SOFC/MCFC
Hydrogenics Corp.	Canada	PEMFC/Infrastructure
ITM Power Plc	UK	PEMFC
Manhattan Scientifics Inc.	US	DMFC
Medis Technologies Ltd.	US	DLFC
Millennium Cell Inc.	US	Infrastructure
Pacific Fuel Cell Corp.	US	PEMFC/DMFC
Palcan Power Systems	Canada	PEMFC/Infrastructure
Plug Power Inc.	US	PEMFC
Quantum Fuel Systems Technologies Worldwide Inc.	US	Infrastructure
QuestAir Technologies Inc.	Canada	Infrastructure
Stuart Energy Systems Corp.	Canada	Infrastructure

It is estimated that public companies represent less than one third of the industry. Readers should note that considerable activity in this sector is conducted by private companies and operating divisions or subsidiaries of larger, diversified organizations, including MTI Micro Fuel Cells, Rolls Royce Fuel Cells and UTC Fuel Cells.

1. Financial data have been converted to US dollars using year end and year end average rates of exchange, where applicable. All companies have December 31 year ends except those listed below:

Ceramic Fuel Cells Ltd. – June 30 2004  
Ceres Fuel Cells Ltd. – June 30 2004  
FuelCell Energy Inc. – October 31 2004  
ITM Power Plc. – April 30 2004  
Quantum Fuel Systems Technologies Worldwide Inc. – April 30 2004  
QuestAir Technologies Inc. – September 30 2004  
Stuart Energy Systems Corp. – March 31 2004



## INTRODUCTION

Welcome to the PricewaterhouseCoopers 2005 Fuel Cell Industry Survey. Published annually, this survey provides the industry and the public with a perspective on the financial performance and activities of publicly traded companies in the sector as they develop.

The PwC Fuel Cell List for 2005 contains 20 companies and includes, for the first time, public companies from outside North America. Four new companies joined the list this year: Ceres Power Holdings Plc (UK), ITM Power Plc (UK), Ceramic Fuel Cells Limited (Australia) and QuestAir Technologies Inc. (Canada). Two companies from the 2004 list were removed: Energy Visions Inc., which is now refocusing on oil and gas exploration (changing its name to Lions Petroleum Inc.) and Snow Leopard Resources Inc., which was suspended from trading after failing to meet ongoing listing requirements.

For the key industry metrics reported by this survey, aggregate 2004 results show only slight changes from 2003:

- A 4% decrease in revenues to \$234 million;
- A 2% increase in research and development (R&D) expenditures to \$221 million;
- A 2% decrease in employees to 2,789; and
- An 11% decrease in market capitalization to \$3.2 billion.

However, the dynamic nature of the industry is more adequately reflected by the year-on-year changes in financial and employment figures among the individual companies surveyed. 2004 saw revenues rise sharply for some and fall dramatically for others. Changes in R&D spending also varied widely with some companies maintaining 2003 spending levels and others increasing or decreasing spending in 2004.

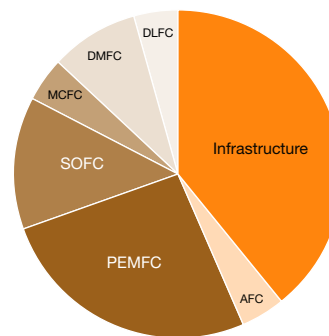
All companies surveyed continued to operate at a loss as they sought to commercialize. Yet in 2004, industry consolidation continued, technical milestones were met and sales were being made in early markets.

## INDUSTRY OVERVIEW

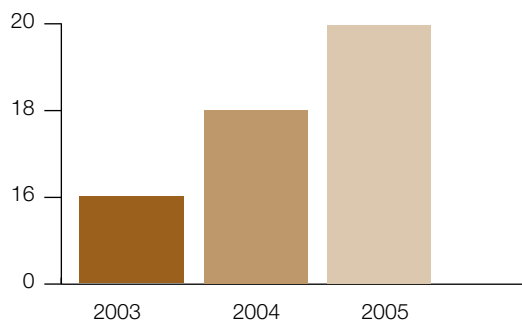
With the inclusion of two new public companies from Europe and one from Australia it would appear that public equity markets are becoming more attractive to fuel cell organizations outside North America. However, the increasing number of public fuel cell and hydrogen companies may simply be indicative of overall industry growth.

Geographically, 17 of the 20 companies included in the survey were from North America, split almost evenly between Canada and the US.

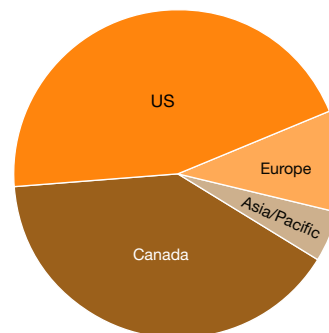
Of the four new companies included in the survey this year, two (Ceramic Fuel Cells and Ceres Power Holdings) are focused on developing solid oxide fuel cells for stationary market applications, and two (ITM Power and QuestAir Technology) are concerned with hydrogen infrastructure.



Focus Areas of the PwC Fuel Cell List



Number of Companies in the PwC Fuel Cell List



Geographic Location of the PwC Fuel Cell List

### Company Financial Information (\$ thousands)

		Gross Revenues <sup>2</sup>		R&D Expenditures <sup>3</sup>		Total Assets		Net Loss		Market Capitalization <sup>4</sup>		Net Cash Flow	
		2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003
Ballard Power Systems	Canada	\$ 81,373	\$119,566	\$ 91,737	\$103,863	\$ 659,171	\$ 834,835	\$(175,407)	\$(125,092)	\$ 805,321	\$1,398,163	\$(89,351)	\$ 40,866
FuelCell Energy	USA	31,386	33,790	26,677	8,509	236,510	223,363	(86,443)	(67,414)	593,476	602,385	4,759	(61,495)
Quantum Fuel Systems	USA	28,119	23,639	15,657	15,062	103,477	51,274	(8,934)	(18,197)	186,492	45,095	4,190	11,361
Distributed Energy Systems	USA	22,460	4,194	6,253	7,716	124,571	144,031	(22,437)	(16,768)	89,024	101,121	1,714	(12,140)
Dynetek Industries	Canada	20,337	14,556	2,744	3,408	38,023	35,136	(952)	(3,489)	37,214	24,132	(4,338)	(7,506)
Hydrogenics	Canada	16,656	26,660	9,069	7,038	117,861	91,438	(33,539)	(22,091)	312,795	327,149	1,245	1,019
Plug Power	USA	16,141	12,502	35,203	40,070	117,997	160,589	(46,739)	(53,039)	448,174	528,168	(69,708)	61,428
Stuart Energy Systems	Canada	13,203	4,208	4,913	7,696	84,491	85,266	(27,756)	(22,063)	79,937	54,648	1,134	1,822
QuestAir Technologies	Canada	2,266	1,262	3,546	4,748	9,940	15,101	(7,182)	(10,992)	N/A	N/A	3,163	(7,511)
Fuel Cell Technologies	Canada	715	1,823	1,795	2,367	5,463	7,531	(3,007)	(2,157)	19,516	22,921	(2,582)	1,175
Ceramic Fuel Cells	Australia	254	916	7,261	8,299	18,420	11,224	(11,111)	(10,781)	N/A	N/A	9,123	(10,559)
Millennium Cell	USA	198	467	475	1,020	13,306	10,985	(10,805)	(16,103)	50,066	81,618	2,214	(1,983)
Manhattan Scientifics	USA	150	300	125	286	1,303	1,225	(1,517)	(2,569)	10,701	10,321	60	(12)
Pacific Fuel Cell	USA	114	0	57	71	952	23	(142)	(103)	20,608	25,376	633	(89)
Palcan Power Systems	Canada	114	57	642	554	355	375	(1,476)	(1,327)	2,920	4,838	32	(180)
Astris Energi	Canada	68	48	1,033	877	423	337	(2,661)	(1,575)	9,401	9,970	(130)	67
Medis Technologies	USA	0	131	9,799	4,804	79,773	68,451	(15,662)	(9,837)	495,759	262,559	9,138	584
Alternate Energy	USA	0	0	31	0	3,822	5,542	(5,348)	(3,699)	38,782	93,053	7	412
Ceres Power Holdings	UK	0	N/A	2,531	N/A	10,911	N/A	(2,891)	N/A	N/A	N/A	54	N/A
ITM Power	UK	0	N/A	992	N/A	827	N/A	(1,019)	N/A	N/A	N/A	(147)	N/A
<b>Total</b>		<b>\$233,554</b>	<b>\$244,119</b>	<b>\$220,540</b>	<b>\$216,388</b>	<b>\$1,627,596</b>	<b>\$1,746,726</b>	<b>\$(465,028)</b>	<b>\$(387,296)</b>	<b>\$3,200,186</b>	<b>\$3,571,517</b>	<b>\$(128,790)</b>	<b>\$ 17,259</b>

2. Revenues reported are total revenue as stated in the companies' financial statements and do not include investment or other income.

3. R&D expenditures are net and exclude costs of R&D contracts.

4. Based on common shares outstanding and share prices at company's year end.

# REVENUE AND INCOME

## REVENUE GENERATION

In 2004, gross revenues for public fuel cell companies decreased by 4% to \$234 million from \$244 million in 2003. This is the first revenue decline since we began gathering data on this sector.

### Losses

Overall, eight of the 20 companies surveyed reported reduced revenues.

The industry's two largest players, Ballard Power Systems and FuelCell Energy, which together accounted for 48% of total 2004 revenues, both reported reduced revenues in 2004. Despite a 32% decrease in revenue, Ballard still dominated the industry with revenues exceeding \$81 million—35% of the industry total. Ballard's decline in revenue was attributed to a \$12 million decrease in product revenue and a \$26 million decrease in engineering and other revenue.

With 2004 revenues of \$31 million, FuelCell Energy remained the second largest revenue producer, down 10% from \$34 million in 2003.

Hydrogenics' 37% decrease in revenue, from \$27 million in 2003 to \$17 million in 2004, was largely attributed to declines in its testing business.

Gross Revenues (\$ thousands)		2004	2003
Ballard Power Systems	Canada	\$ 81,373	\$ 119,566
FuelCell Energy	USA	31,386	33,790
Quantum Fuel Systems	USA	28,119	23,639
Distributed Energy Systems	USA	22,460	4,194
Dynetek Industries	Canada	20,337	14,556
Hydrogenics	Canada	16,656	26,660
Plug Power	USA	16,141	12,502
Stuart Energy Systems	Canada	13,203	4,208
QuestAir Technologies	Canada	2,266	1,262
Fuel Cell Technologies	Canada	715	1,823
Ceramic Fuel Cells	Australia	254	916
Millennium Cell	USA	198	467
Manhattan Scientifics	USA	150	300
Pacific Fuel Cell	USA	114	0
Palcan Power Systems	Canada	114	57
Astris Energi	Canada	68	48
Medis Technologies	USA	0	131
Alternate Energy	USA	0	0
Ceres Power Holdings	UK	0	N/A
ITM Power	UK	0	N/A
<b>Total</b>		<b>\$ 233,554</b>	<b>\$ 244,119</b>

## Gains

With Ballard's revenue figures excluded, the industry as a whole showed a 22% increase in revenue with several companies reporting major increases.

Quantum Fuel Systems remained the third largest revenue producer, reporting an overall increase in revenue to \$28 million or 19%, from \$24 million in 2003. The increase is mainly attributable to the company's fuel cell system segment, growing by 64%, despite being partially offset by a 13% decrease in year-on-year alternative fuel revenue.

Distributed Energy Systems, the parent company of Proton Energy and Northern Power Systems, reported the largest revenue increase of 450%, from a combined \$4 million in 2003 to \$22 million in 2004. These revenues include an 80% increase in Proton revenue, to \$5 million, and a total of \$15 million in revenue from Northern.

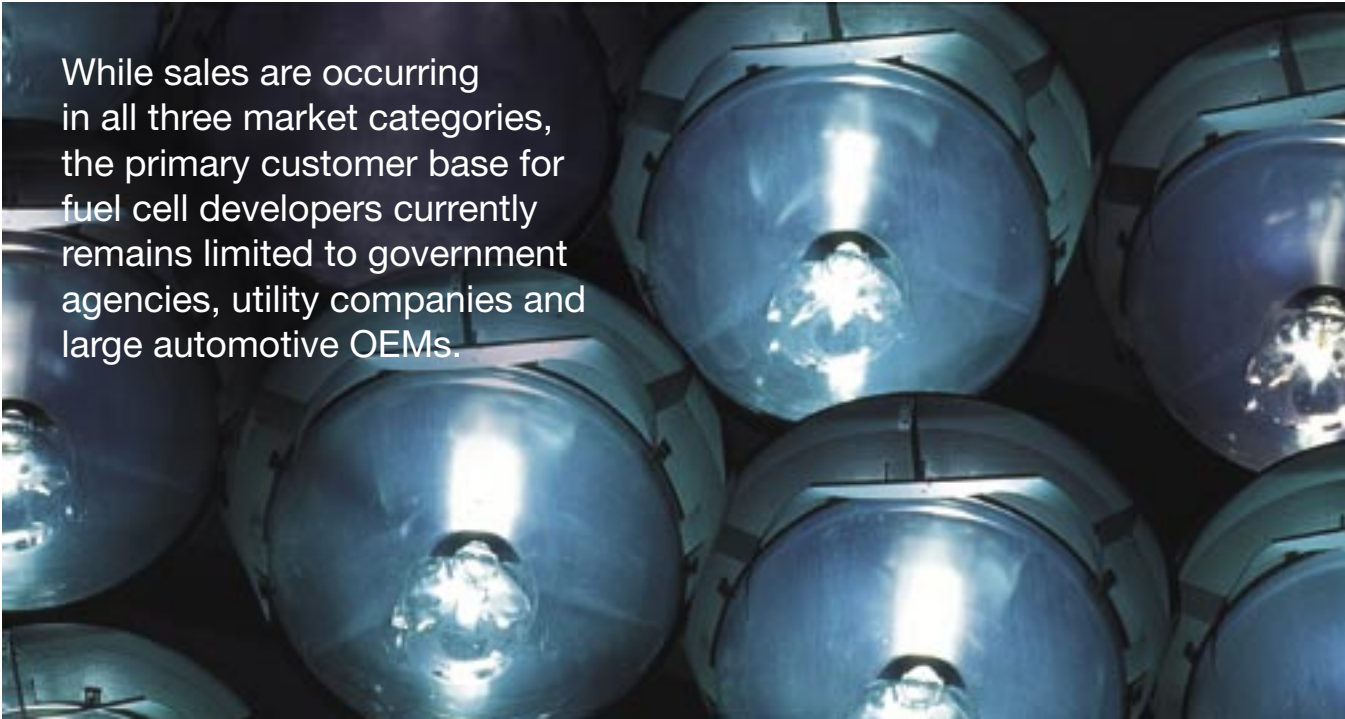
Stuart Energy's revenue increased 225% from \$4 million in 2003 to \$13 million in 2004. The company attributes half of this increase to organic growth and the other half to the acquisition of Vandenborre Technologies.

Increased sales in compressed natural gas (CNG) markets led to a 33% increase in revenue for Dynetek Industries from \$15 million in 2003 to \$20 million in 2004.

Plug Power and QuestAir Technologies also reported increased revenues to \$16 million and \$2.3 million, respectively.

## No revenue

Much of the industry remains in the R&D stage. Seven companies surveyed reported revenues under \$1 million and four reported no revenue at all.



While sales are occurring in all three market categories, the primary customer base for fuel cell developers currently remains limited to government agencies, utility companies and large automotive OEMs.

## MARKETS AND CUSTOMERS

The fuel cell technologies being developed and commercialized by the public companies surveyed reflect the diverse power and infrastructure requirements of three broad market categories: Portable, Stationary and Mobile. Portable power requirements range from a single watt required for small consumer electronics to over a kilowatt for large battery chargers. The power requirements of stationary markets range considerably, from a single kilowatt for residential applications to several megawatts for large distributed power generation. Mobile market applications require a narrower range of power, from one kilowatt for scooters and light industrial vehicles to over one hundred kilowatts for cars and buses. The infrastructure companies included in this survey are aligning their technologies to meet the hydrogen generation, transportation and storage needs of these diverse markets.

While sales are occurring in all three market categories, the primary customer base for fuel cell developers currently remains limited to government agencies, utility companies and large automotive OEMs supporting pre-commercial technology development and demonstration. Hydrogen infrastructure companies are pursuing opportunities in both fuel cell demonstration markets and complementary industrial and alternate energy markets. A selection of market facing activities follows.

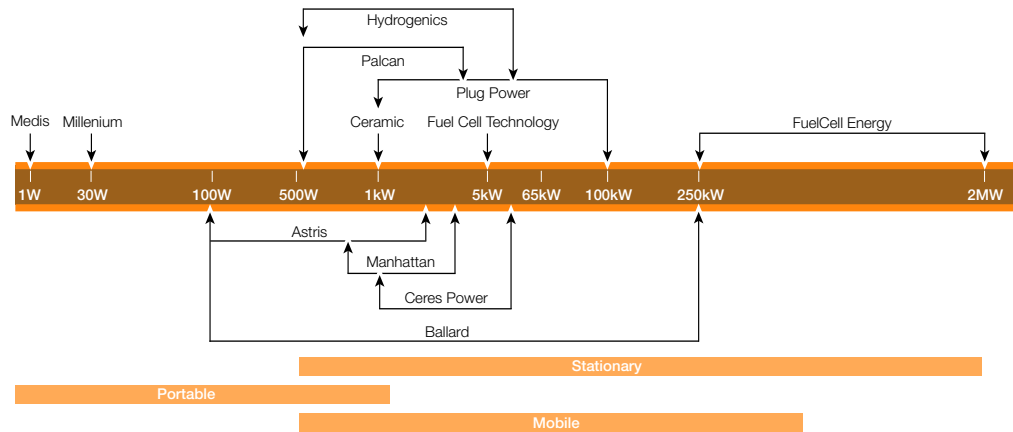
### Portable

The US military is seen as a major pre-commercial market for portable power applications in North America. In 2004, Manhattan Scientifics delivered its 700 watt prototype fuel cell system to the US Army for testing. Globally, much of the power generation needs of consumer electronics markets are being met by large Japanese OEMs that are actively developing fuel cell technologies to meet specific performance requirements. However, US-based Medis Technologies is developing a disposable Power Pack battery charger to operate and charge cell phones, digital cameras, PDAs and other devices.

### Stationary

The residential cogeneration market in Japan is recognized as one of the most promising near-term commercialization opportunities in stationary power. Ballard Power Systems is one of several companies pursuing opportunities in this market, and is also working with Sanmina-SCI Corporation to commercialize and sell fuel cell based backup power systems for the telecommunication industry. In North America, Plug Power delivered 150 fuel cell systems to telecom, utilities, government entities and distribution partners. FuelCell Energy sold a 250 kilowatt power plant to the US Postal Service in San Francisco. A 5 kilowatt Solid Oxide fuel cell from Fuel Cell Technologies will be used to power a Ground Source Heat Pump to provide climate control for the new National Research Council's Institute for Fuel Cell Innovation in Vancouver, Canada.

**Approximate Fuel Cell Power Ranges**  
(Scale descriptive)



**Mobile**

The financial risks and rewards related to a limited customer base are especially relevant for the mobile market. For Quantum and other companies closely aligned with the automotive industry, revenues are largely dependent on consumer acceptance of emerging automotive technologies and the related production schedules of their automotive OEM customers.

Hydrogenics Corporation was contracted to develop and deploy a fuel cell hybrid delivery van and an on-site hydrogen refuelling system as part of Purolator Courier's "Greening the Fleet" initiative. Hydrogenics also sold a power module to Quantum in support of Quantum's contract with the US Army to develop a fuel cell powered military vehicle.

Small industrial vehicles, such as forklifts and golf carts, offer near-term applications for fuel cells. Companies including Astris Energi are pursuing opportunities in these markets.

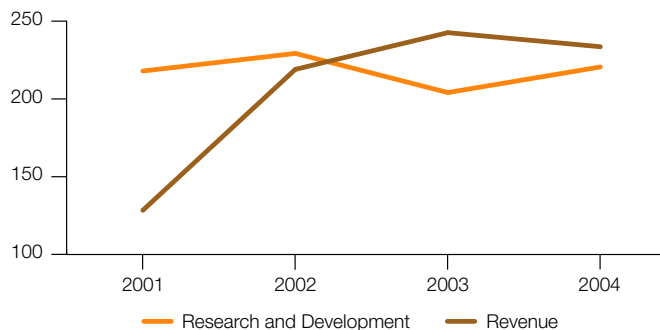
**Infrastructure**

In 2004, Stuart Energy attributed its significant increase in revenue from transportation and power markets to investment in hydrogen fuelling infrastructure in Europe and the US. Companies including Dynetek and Distributed Energy are generating revenue from immediate, complementary compressed natural gas (CNG) and energy integration markets. Proton Energy (a subsidiary of Distributed Energy Systems) was selected as a member of the Air Products hydrogen infrastructure project team to participate in the government-funded Hydrogen Research Initiative.

**PROFITABILITY**

In 2004 none of the companies surveyed were profitable, a trend consistent since this survey began three years ago. Moreover, the total net loss increased from \$387 million in 2003 to \$465 million in 2004, a movement of 20% year-on-year.

**Revenues versus Research and Development Expenditures<sup>5</sup>**  
(\$ millions)



5. 2001 data from: 2003 Fuel Cell Industry Survey: PricewaterhouseCoopers  
2002 data from: 2004 Fuel Cell Industry Survey: PricewaterhouseCoopers

Net Loss		2004	2003
		(\$ thousands)	
Ballard Power Systems	Canada	\$(175,407)	\$(125,092)
FuelCell Energy	USA	(86,443)	(67,414)
Quantum Fuel Systems	USA	(8,934)	(18,197)
Distributed Energy Systems	USA	(22,437)	(16,768)
Dynetek Industries	Canada	(952)	(3,489)
Hydrogenics	Canada	(33,539)	(22,091)
Plug Power	USA	(46,739)	(53,039)
Stuart Energy Systems	Canada	(27,756)	(22,063)
QuestAir Technologies	Canada	(7,182)	(10,992)
Fuel Cell Technologies	Canada	(3,007)	(2,157)
Ceramic Fuel Cells	Australia	(11,111)	(10,781)
Millennium Cell	USA	(10,805)	(16,103)
Manhattan Scientifics	USA	(1,517)	(2,569)
Pacific Fuel Cell	USA	(142)	(103)
Palcan Power Systems	Canada	(1,476)	(1,327)
Astris Energi	Canada	(2,661)	(1,575)
Medis Technologies	USA	(15,662)	(9,837)
Alternate Energy	USA	(5,348)	(3,699)
Ceres Power Holdings	UK	(2,891)	N/A
ITM Power	UK	(1,019)	N/A
<b>Total</b>		<b>\$(465,028)</b>	<b>\$(387,296)</b>

## STRATEGY

The financial performance of the fuel cell and hydrogen companies surveyed reflects the costs of implementing strategies to refine pre-commercial technology, develop production capacity and secure market access. The strategies developed to meet and balance these challenges vary widely across the industry.

With its purchase of Greenlight Power in 2003 and its announced (and subsequently completed) purchase of Stuart Energy in 2004, Hydrogenics appears to be pursuing a strategy of diversification to limit risk associated with individual markets or products.

Infrastructure companies are looking beyond the industry to generate revenue. Dynetek has been penetrating automotive OEMs, heavy truck and bus manufacturers throughout the US and Europe to generate revenue from the sale of CNG storage products. In 2004, Dynetek delivered an on-board hydrogen fuel storage system to Mazda for use in its RX-8 Hydrogen test vehicle as well as on-board CNG fuel storage systems to Toyota Motor Corporation.

Other companies are narrowing the focus of their research and development efforts to more specific technologies or markets. Ballard Power Systems announced it will focus on stack development and leave power generation and balance of plant to customers and partners. Palcan is changing its strategy to focus on a power module for small portable and UPS (uninterruptible power supply) markets, and explore hydrogen storage using rare earth metal hydrides.

Some companies, including Astris Energi, will remain focused on technology research; while others, including Ceramic Fuel Cells and Medis, report they are preparing for product manufacturing and distribution.

## Collaboration

While strategic alliances have been an important characteristic of the industry in the past, most of the companies surveyed are now looking to form alliances with companies that will directly use their product or third parties that will provide vertical or regional market access. A selection of strategic alliances announced in 2004 includes:

- Fuel Cell Technologies and Siemens Westinghouse Power Corporation signed a Memorandum of Understanding to establish strategic regional marketing relationships that will allow for further expansion of introductory markets.
- Dynetek entered into a Letter of Collaboration with Veecon – IPA Gastechnik Ltd. to promote Dynetek's Storage Cylinders throughout India and Bangladesh.
- Proton (Distributed Energy Systems) signed a distribution agreement with GE Supply that appoints GE as a non-exclusive distributor of Proton's products.

- FuelCell Energy and its distribution partner in Japan, Marubeni Corp., signed an agreement with POSCO to enter into a strategic alliance to distribute and package its product in Korea.
- Astris Energi received a purchase order from Alternate Energy Corporation for the first portable power generator covered by the value added reseller agreement the two companies signed in May 2004.
- Ballard Power Systems announced partnerships with Energy Outfitters, Solar Depot, Akeena Solar, DC Power Systems and MBL & Sons to enhance sales channels for its power converter product for photovoltaic applications.

## M&A Activity

The trend towards consolidation in the industry first noted in 2003 continues. Examples in 2004 include:

- FuelCell Energy sold its Canadian solid oxide fuel cell operations to Versa Power Systems. In exchange FuelCell received stock in Versa, increasing its ownership position from 16% to 42%.
- Astris Energi acquired 100% ownership of Astris s.r.o., its affiliate company in the Czech Republic.
- Hydrogenics purchased all of the outstanding common shares of Stuart Energy. The acquisition was finalized in January 2005.
- Proton Energy Systems and Distributed Energy Systems completed the acquisition of Northern Power Systems.
- Ballard announced a non binding Memorandum of Understanding with Alliance partners, DaimlerChrysler and Ford under which it was proposed that DaimlerChrysler and Ford would acquire 50.1% interest in Ballard Power Systems AG.



# INNOVATION

## RESEARCH AND DEVELOPMENT

Continuing the trend first set in 2003, revenues exceeded R&D expenditures—this year by \$13 million. With R&D expenditures exceeding \$92 million, Ballard was by far the industry’s largest spender. Plug Power and FuelCell Energy were next with expenditures of \$35 million and \$27 million, respectively.

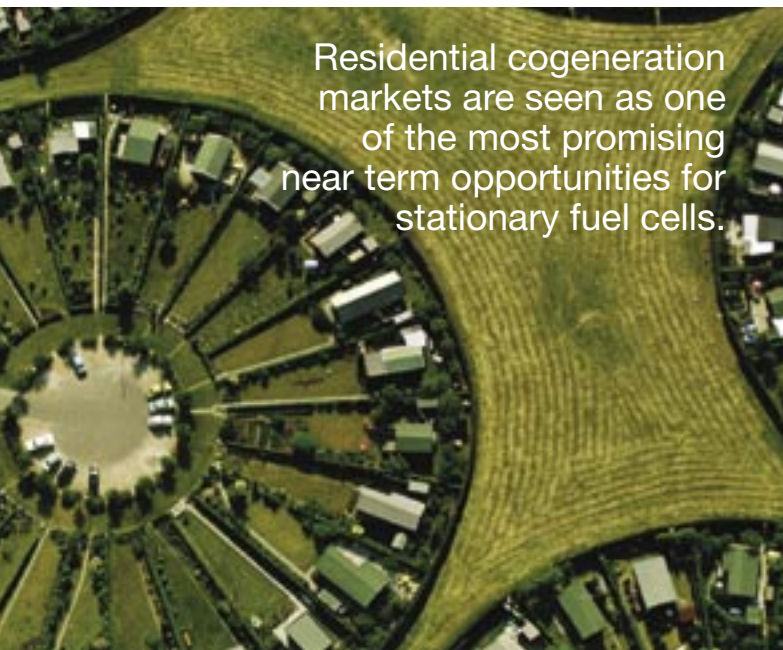
In 2004, overall R&D expenditures for the companies surveyed increased slightly to \$221 million from \$216 million in 2003. A selection of companies that increased R&D spending is listed below.

- FuelCell Energy increased its R&D spending by over 214% or \$18 million. The company has started assembly of the 500 kW power plant for marine applications.
- Medis Technologies almost doubled its R&D spending to \$10 million in 2004, seeking to increase the performance and decrease the size of its direct methanol fuel cell.
- Hydrogenics’ 29% increase in R&D expenses to \$9 million, was related to its emerging power products business including a 10 kW power module and its hydrogen generation business.

Most companies, however, decreased their R&D expenditures in 2004. Most significantly, Ballard reduced its R&D spending by \$12 million or 12% from 2003. This decrease was attributed to the completion of its light-duty and heavy-duty fuel cell engine development programs, cost reduction initiatives and restructuring activities.

The focus of research and development efforts varies across the industry:

- Fuel Cell Technology is developing a reformer to collect, concentrate and breakdown airborne paint solvents into hydrogen rich gas to fuel its 5 kW SOFC as part of Ford’s *Fumes-to-Fuel* program.
- Palcan Fuel Cells has reduced R&D spending by limiting its focus to a 500 watt power module and, through a joint venture with Jiazing Zheda-Palcan Hydrogen Storage Technology Co. Ltd., a rare earth metal hydride storage system.
- Pacific Fuel Cell is developing its carbon nanotube technology for use in low-cost fuel cells for small electronic device applications.
- Alternate Energy has been working on improving the purity of hydrogen produced by its technology and is working with Feel Good Cars Inc. to produce a prototype hydrogen powered vehicle.
- Astris is completing work on its second-generation fuel cell powered golf cart.
- Millennium Cell is working on a fuel cell concept vehicle with European automaker PSA Peugeot Citroen and in 2004, demonstrated a prototype hydrogen fuel cell system powering a notebook computer.
- In 2004, Ballard announced its “hat trick”, demonstrating low temperature starts, increased durability and a reduced platinum coating of its automotive fuel cell.
- QuestAir Technologies’ hydrogen purifier has been installed at the Oume Hydrogen Station (Tokyo), the world’s first mobile hydrogen fueling station that produces hydrogen from natural gas.
- Honda R&D Americas and Plug Power began successful operation of the second-generation Home Energy Station.



R&D Expenditure		2004	2003
(\$ thousands)			
Ballard Power Systems	Canada	\$ 91,737	\$ 103,863
FuelCell Energy	USA	26,677	8,509
Quantum Fuel Systems	USA	15,657	15,062
Distributed Energy Systems	USA	6,253	7,716
Dynetek Industries	Canada	2,744	3,408
Hydrogenics	Canada	9,069	7,038
Plug Power	USA	35,203	40,070
Stuart Energy Systems	Canada	4,913	7,696
QuestAir Technologies	Canada	3,546	4,748
Fuel Cell Technologies	Canada	1,795	2,367
Ceramic Fuel Cells	Australia	7,261	8,299
Millennium Cell	USA	475	1,020
Manhattan Scientifics	USA	125	286
Pacific Fuel Cell	USA	57	71
Palcan Power Systems	Canada	642	554
Astris Energi	Canada	1,033	877
Medis Technologies	USA	9,799	4,804
Alternate Energy	USA	31	0
Ceres Power Holdings	UK	2,531	N/A
ITM Power	UK	992	N/A
<b>Total</b>		<b>\$ 220,540</b>	<b>\$ 216,388</b>



For some fuel cell companies revenues are largely dependent on the consumer acceptance of emerging automotive technologies.

## DEMONSTRATION PROJECTS

Many of the companies surveyed participated in government sponsored fuel cell and hydrogen demonstration projects. Generally, these are larger collaborative projects that bring together several companies from across the value chain to test infrastructure and technology performance and raise public awareness.

In British Columbia a fleet of five Ford Focus vehicles powered by Ballard fuel cells began operations. QuestAir Technologies announced that it will supply hydrogen purification technology to the Hydrogen Highway project. Proton Energy Systems announced that it intends to provide hydrogen generation and fueling technologies for a similar Hydrogen Highway program in California.

In Ontario, Hydrogenics unveiled the first of four projects to be part of Toronto's Hydrogen Village. Under the same program, Fuel Cell Technologies installed four fuel cells at the University of Toronto.

Three Mercedes-Benz Citaro buses powered with Ballard fuel cell engines were launched in Perth, Australia as part of that city's STEP (Sustainable Transport Energy for Perth) program.

These specific projects represent only a fraction of the demonstration activities in which public fuel cell companies participated in 2004.

Increasingly, demonstration projects are also showcasing the compatibility of fuel cell and hydrogen technologies with existing or renewable power sources.

## EMPLOYMENT

This year's employment numbers show an overall decrease in employment in those companies that were surveyed. In 2004, a total decrease of 66 employees, or 2% reduction from 2003, was seen across the surveyed companies.

Despite an 11% reduction in staff, Ballard remained the largest employer in the industry, accounting for 35% (976 people). FuelCell Energy was again the second largest employer with 346 employees in 2004, down from 372 employees in 2003. Plug Power was a close third with 330 employees in 2004, down from 343 employees in 2003.

Of the companies surveyed, 35% had over 100 employees as at their financial year-ends.

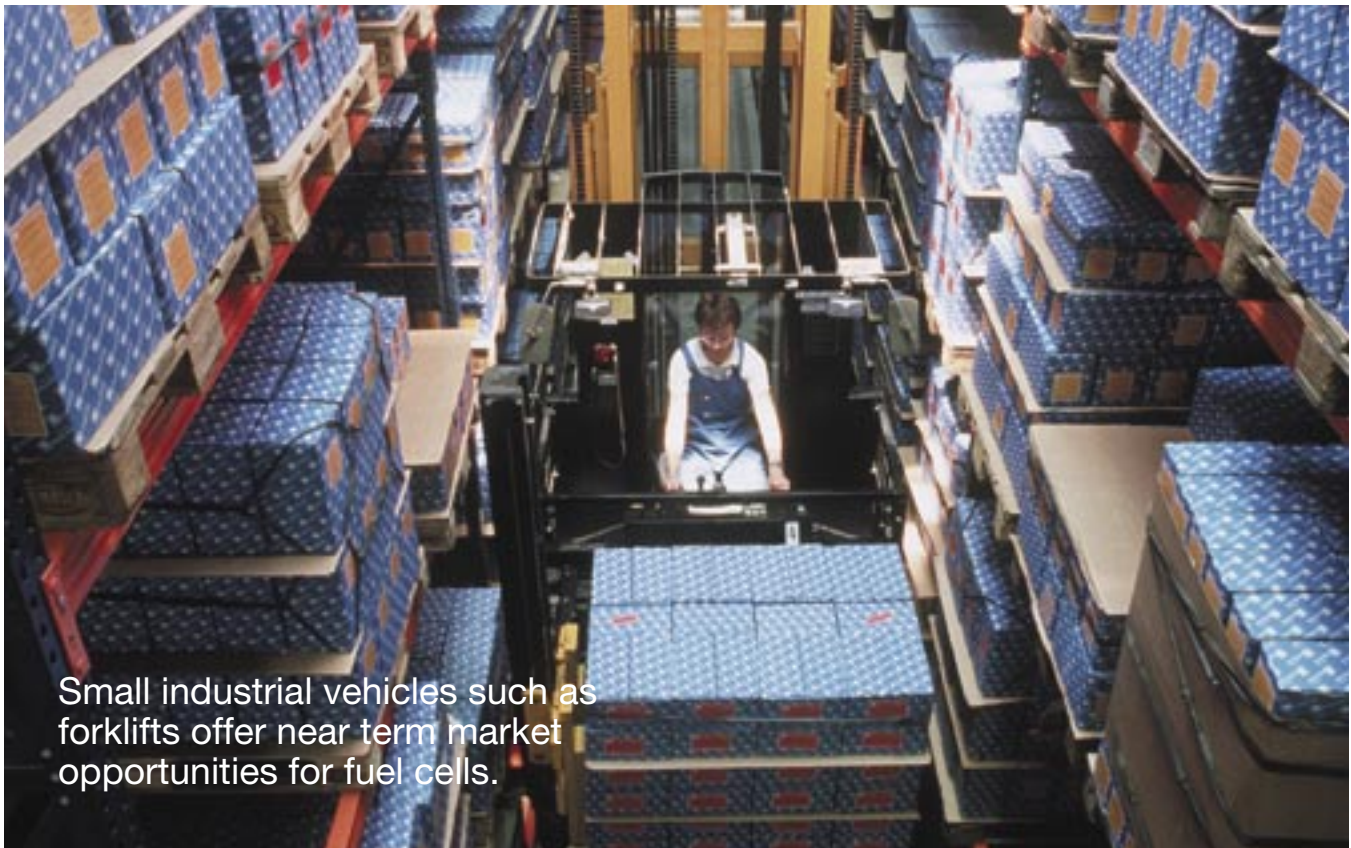
Distributed Energy Systems and Medis Technologies made the largest staff increases, each with the addition of 14 new employees during 2004. The number of employees at Distributed Energy Systems grew by 6%, whereas Medis number of employees grew by 24%.

Ballard and Hydrogenics reported the largest decreases in employment figures. Ballard showed a decrease of 123 employees, down from 1,099 employees in 2003, and Hydrogenics showed a decrease of 35 employees, down from 250 last year. This resulted in an 11% and 14% reduction in the number of employees at each company respectively.

### Employment

	2004	2003
Ballard Power Systems	976	1,099
FuelCell Energy	346	372
Quantum Fuel Systems Technologies Worldwide	138	134
Distributed Energy Systems	241	227
Hydrogenics	215	250
Plug Power	330	343
Stuart Energy Systems	165	186
QuestAir Technologies	74	N/A
Fuel Cell Technologies	26	26
Ceramic Fuel Cells	91	84
Millennium Cell	32	31
Manhattan Scientifics	2	2
Pacific Fuel Cell	3	3
Palcan Power Systems*	15	20
Astris Energi	25	12
Medis Technologies	72	58
Alternate Energy	8	8
Ceres Power Holdings	21	N/A
ITM Power	9	N/A
<b>Total</b>	<b>2,789</b>	<b>2,855</b>

\* Estimated 2004



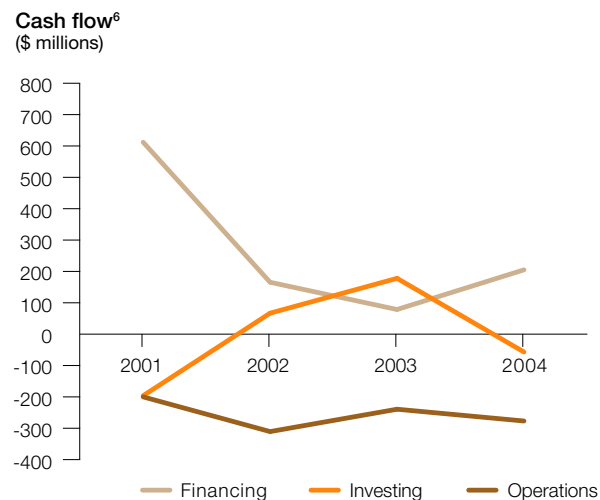
## SHAREHOLDER VALUE

### CASH FLOW

Total cash flow for the companies surveyed was negative \$129 million in 2004 compared to \$17 million positive in 2003.

Cash flow from operations was again negative for 2004 at \$277 million, a decline from negative \$239 million in 2003. Cash flow from investing decreased in 2004, following increases in this figure from 2001 to 2003; this year, this decrease amounted to \$235 million. Cash flow from financing made a significant increase to \$205 million from \$79 million in 2003, a 159% increase. This increase counters the decreasing trend that was seen from 2001 to 2003.

Cash Flow (\$ thousands)		
	2004	2003
Cash Flow from Operations	\$ (276,905)	\$(239,336)
Cash Flow from Investing	\$ (56,895)	\$178,008
Cash Flow from Financing	\$ 205,010	\$ 78,589
<b>Total Cash Flow</b>	<b>\$ (128,790)</b>	<b>\$17,259</b>



6. 2001 data from: 2003 Fuel Cell Industry Survey: PricewaterhouseCoopers  
2002 data from: 2003 Fuel Cell Industry Survey: PricewaterhouseCoopers

## MARKET CAPITALIZATION

Unlike the show of investor confidence in 2003, market capitalization of the companies surveyed in 2004 showed an overall 11% decrease from \$3.6 billion in 2003 to \$3.2 billion in 2004. This decrease is, however, inconsistent with an overall increase seen in other indices—S&P/TSX Composite Index up 13%, Dow Jones Industrial Average up 3%, and the S&P 500 up 9%. Some notable movements included:

- Quantum Fuel Systems – increase in market capitalization by 313%, to \$186 million from \$45 million
- Alternate Energy Corp – decrease in market capitalization by 58%, to \$39 million from \$93 million
- Ballard Power Systems – decrease in market capitalization by 43%, to \$805 million from \$1.4 billion

Market Capitalization <sup>7</sup> (\$ thousands)			
		2004	2003
Ballard Power Systems	Canada	\$ 805,321	\$ 1,398,163
FuelCell Energy	USA	593,476	602,385
Quantum Fuel Systems	USA	186,492	45,095
Distributed Energy Systems	USA	89,024	101,121
Dynetek Industries	Canada	37,214	24,132
Hydrogenics	Canada	312,795	327,149
Plug Power	USA	448,174	528,168
Stuart Energy Systems	Canada	79,937	54,648
QuestAir Technologies	Canada	N/A	N/A
Fuel Cell Technologies	Canada	19,516	22,921
Ceramic Fuel Cells	Australia	N/A	N/A
Millennium Cell	USA	50,066	81,618
Manhattan Scientifics	USA	10,701	10,321
Pacific Fuel Cell	USA	20,608	25,376
Palcan Power Systems	Canada	2,920	4,838
Astris Energi	Canada	9,401	9,970
Medis Technologies	USA	495,759	262,559
Alternate Energy	USA	38,782	93,053
Ceres Power Holdings	UK	N/A	N/A
ITM Power	UK	N/A	N/A
<b>Total</b>		<b>\$ 3,200,186</b>	<b>\$ 3,571,517</b>

7. Calculated at company's fiscal year end.

### Ratio of Market Capitalization at Year End to Revenue for the Year

		2004	2003
Ballard Power Systems	Canada	10	12
FuelCell Energy	USA	19	18
Quantum Fuel Systems	USA	7	2
Distributed Energy Systems	USA	4	24
Dynetek Industries	Canada	2	2
Hydrogenics	Canada	19	12
Plug Power	USA	28	42
Stuart Energy Systems	Canada	6	13
QuestAir Technologies	Canada	N/A	N/A
Fuel Cell Technologies	Canada	27	13
Ceramic Fuel Cells	Australia	N/A	N/A
Millennium Cell	USA	252	175
Manhattan Scientifics	USA	71	34
Pacific Fuel Cell	USA	181	0
Palcan Power Systems	Canada	26	83
Astris Energi	Canada	138	206
Medis Technologies	USA	0	2,004
Alternate Energy	USA	0	0
Ceres Power Holdings	UK	N/A	N/A
ITM Power	UK	N/A	N/A



## Perspective

This year marks the third issue of PwC's annual Fuel Cell Industry Survey, and our fourth year of data collection. As ever the numbers that we report produce interesting reading and reflect the challenges faced by the fuel cell sector. As we reported last year, however, there is as much going on "off-screen" as there is "on-screen" and we will try and add some insight both to what our research shows and what else is going on.

Let's reflect on the numbers first. There are more companies in our survey this year than in prior years. Two dropped off the list and four joined. Of the four new companies, three became public as a result of a listing on the Alternative Investment Market in London, which demonstrated an investor readiness for fuel cells and hydrogen technologies. All the new companies are relatively small and two of them are pre-revenue. All except one is from outside North America.

When we look at financial performance alone we see a pretty bleak picture. For the first time, the companies surveyed showed a decline in revenues. Research and development expenditures increased marginally and we saw declines in total assets with significant increases in net losses. Some of these trends, we are certain, contributed to a decline in market capitalization. So what should we take from these numbers and what can we see happening outside the public

companies surveyed that can assist us in gaining a better understanding of the sector?

The numbers do reflect some realities that public companies, indeed all companies in the sector, have begun to realize; that the commercialization of a new technology takes a great deal of time and money; that incumbent technologies with customers, facilities and supply chains continue to be competitive on both performance and price; that capital markets are reluctant to finance companies whose success depends on the future rather than the past or present.

Notwithstanding these realities, the drivers for fuel cells and the transition to a hydrogen economy are stronger and more plentiful than ever. Energy supply and security are critical issues facing two of the largest economies in the world, the United States and China. Fuel cells, along with other

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technologies are critical – not only in the conservation of conventional energy resources but also in the transition to a sustainable hydrogen economy. Air quality is a real driver and will become an important political, as well as economic issue, as growing numbers of people around the world begin to demand access to clean air. Climate change is a global issue for which the move to fuel cells and a hydrogen economy represents part of the solution.

Some may argue that other “renewables” such as solar or wind may be better suited to providing solutions to these issues or that attempts at conservation, efficiency and new discoveries, combined with beneficial “cleansing” technologies will extend the life of hydrocarbons and will delay the introduction of fuel cells and hydrogen technologies.

However, the future may be less clear cut than many people believe and we are increasingly seeing fuel cells being incorporated into the wider energy landscape and working in conjunction with both incumbent and evolving technology.

For example, we know fuel cells are being developed for use with many smaller electronic devices where batteries cannot effectively provide the power to use the full potential of these devices without frequent recharging. But, fuel cells are also acting in concert with batteries in systems whereby a fuel cell provides the power for a battery charger (especially in remote and military applications) and conventional batteries are still used to power the end application.

One of the more interesting developments in this area is the recognition that renewable technologies and fuel cells can be complementary. For example, one of the issues hampering wind power is that wind does not blow all the time. Wind power companies are now exploring the use of electrolyzers to generate hydrogen to effectively capture energy which

otherwise may be wasted. One can see that the resultant “system” of using the wind to power an electrolyzer to produce hydrogen from water and using that hydrogen to power a fuel cell to produce electricity and water brings a new dimension to the integration of the energy landscape. Similar strategies can be used with small hydro-electric, wave and solar power technologies.

Despite the growing number of fuel cell installations, increasing examples of integration with other technologies and improvements in power delivery and cost reduction, some people believe that the lack of existing hydrogen infrastructure will severely hamper the development of a hydrogen economy.

However, while there may not be a hydrogen outlet on every street corner, neither was there a gas station on every corner when the automotive industry began. In the early twentieth century it was the demand for cars that drove the development of infrastructure, and so it will be with hydrogen.

We are already seeing companies, some of which are included in this survey, focusing on developing components of hydrogen and fuel cell infrastructure. This will continue to evolve and the development of Hydrogen Highways in Canada, US, Germany and other countries will spur this on in the short term.

While the exact path of development of many aspects of this industry may not be clear as yet, there is one thing for certain – with conventional energy becoming more expensive, with supplies diminishing and the impacts of current technologies being felt ever more acutely through local air pollution or through climate change, the need for continued development of fuel cells and the creation of a hydrogen economy has never been greater.



