



*Transnational and Diaspora
Network for Development, Canada*
TDND Canada - International Development Organization

Fuel Cell: Today's Technology for Alternative Energies

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Fuel Cell: Today's Technology for Alternative Energies

**Ontario Society of Professional Engineers - OSPE
International Conference on Change for Climate
Toronto, Ontario, Canada
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Ontario, Canada

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2.	Fuel Cell Market and Economy
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4.	Fuel Cells Commercialization
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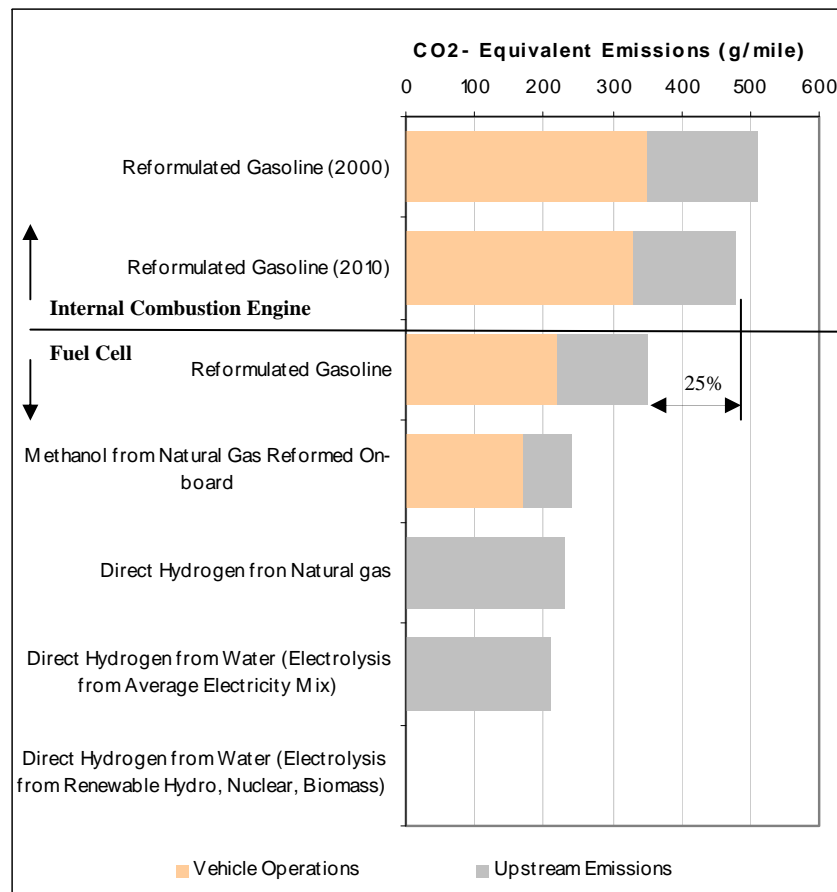
Introduction

- Hydrogen and Fuel Cell Technology
- Green House Gas Emission
- Hydrogen and Fuel Cell Development
- Elements of Hydrogen Energy

Hydrogen and Fuel Cell Technology

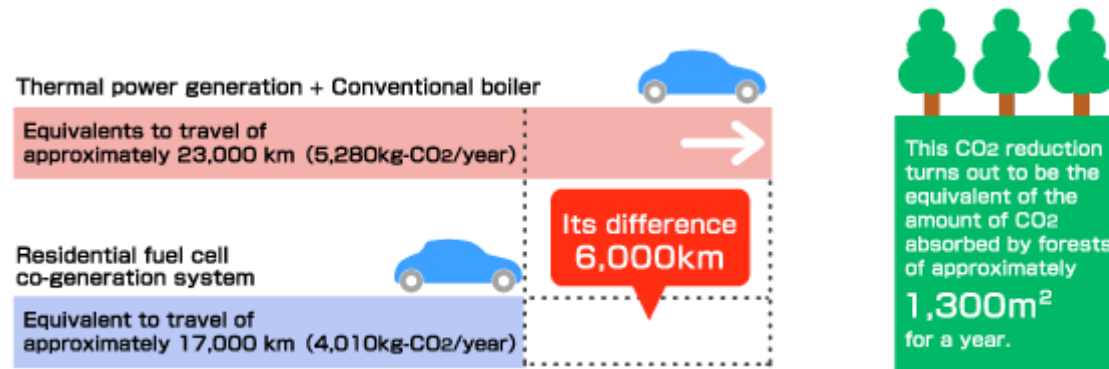
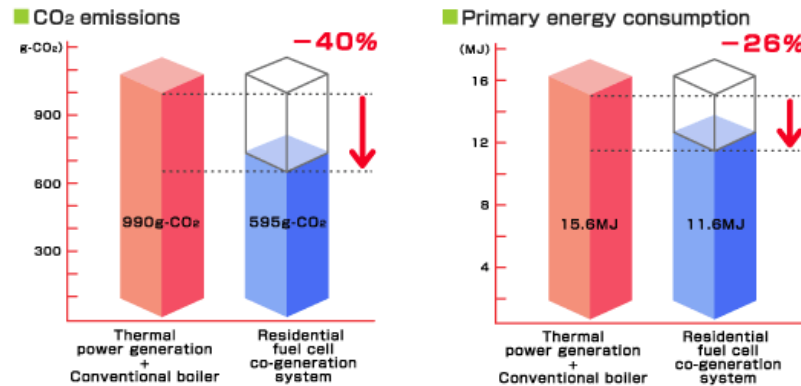
- Energy security
- International competitiveness
- Environmental quality
- Climate change

Green House Gas Emission – Various Fuel Technologies



Source: Reference 5 – NRCan June 2001

Green House Gas Emission – Residential Fuel Cell Co-generation



Source: Reference 8 – Tokyo Gas

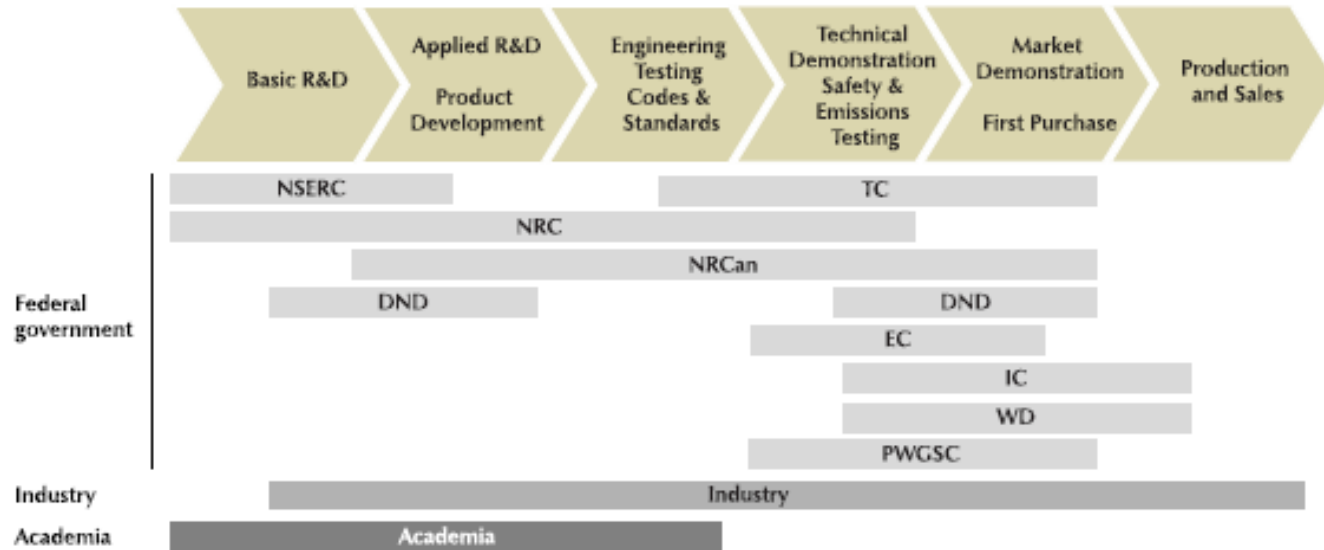
Hydrogen and Fuel Cell Development - USA

“With a new national commitment, our scientists and engineers will overcome obstacles so that the first car driven by a child born today could be powered by hydrogen, and pollution-free.”

Former President, George W. Bush
State of the Union Address

January 28, 2008

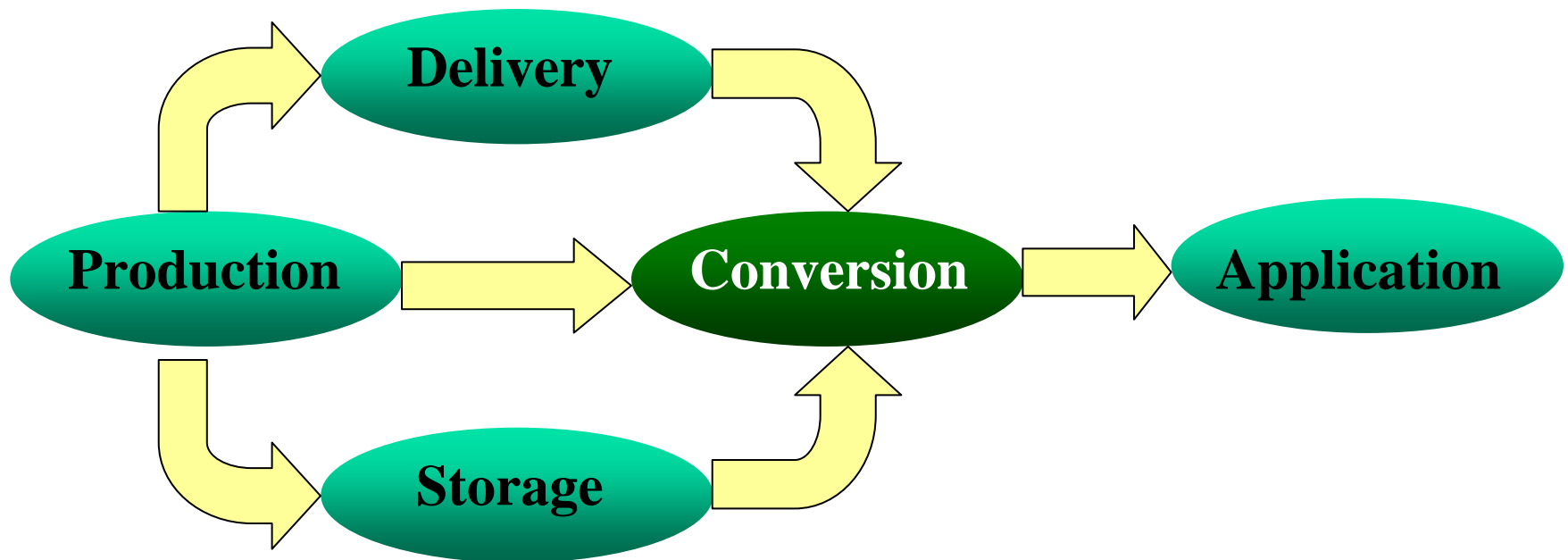
Hydrogen and Fuel Cell Development - Canada



Source: Reference 5 – Industry Canada

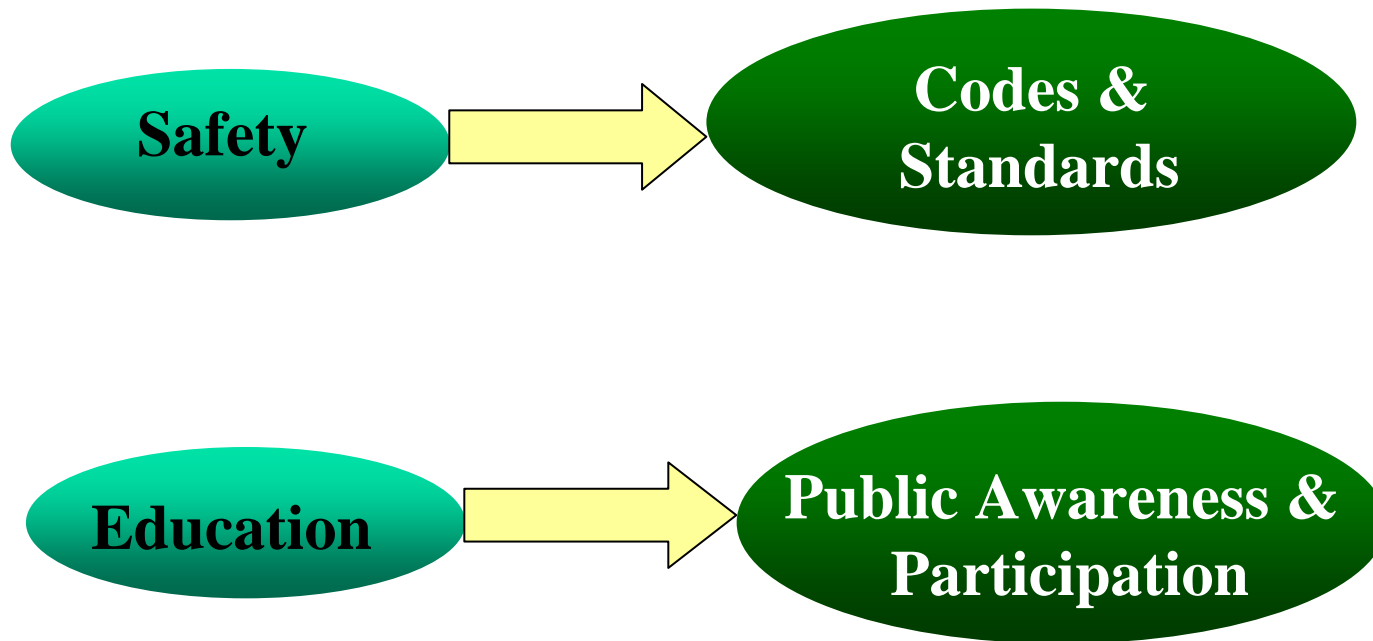
- NSERC – Natural Sciences and Engineering Research Council of Canada
- NRC – National Research Council
- NRCan – Natural Resources Canada
- DND – Department of National Defence
- EC – Environment Canada
- IC – Industry Canada
- TC – Transport Canada
- WD – Western Economic Diversification Canada
- PWGSC – Public Works and Government Services of Canada

Elements of Hydrogen Energy - Technology



Source: Reference 7 – US DOE

Elements of Hydrogen Energy - Policy



Source: Reference 7 – US DOE

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Fuel Cell Market and Economy

The main commercial applications:

- Transportation - Automotive
- Electric Power - Stationary & Portable

Energy Business Reports:

- Global demand by 2013 - \$18.5 billion
- If automotive prospected - \$35 billion

Global Fuel Cell Demand

Market Segment	Annual Demand for Years 2001 - 2011						CAAG	
	2001	2003	2005	2007	2009	2011	2003 to 2011	2007 to 2011
Stationary (in MW)	75	225	675	2,025	7,068	15,047	69%	65%
Portable ('000 Units)	0	50	2,000	50,000	200,000	470,000	214%	75%
Transportation (Units)	10	3,523	7,608	31,680	275,520	1,610,080	115%	167%

CAAG - Cumulative Annual Average Growth

Source: Reference 5

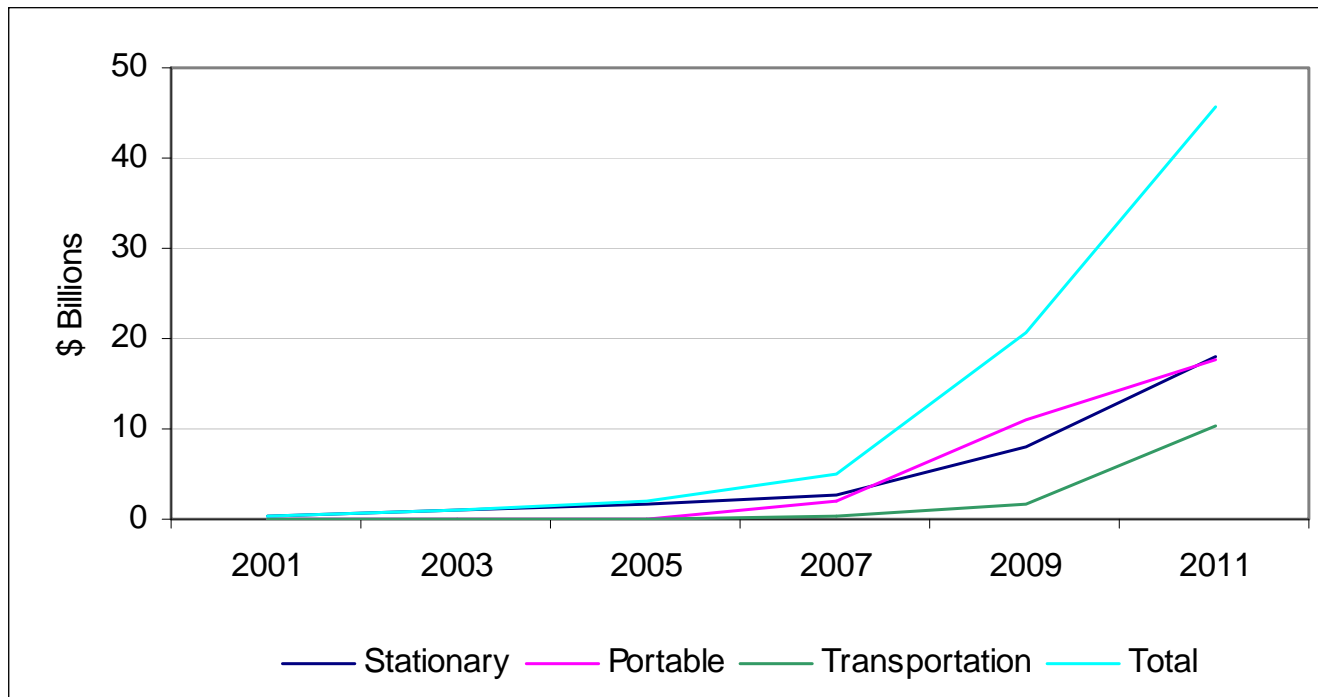
Global Market Projections – Fuel Cell Products

Market Segment	Annual Market Projections in \$Million						CAAG	
	2001	2003	2005	2007	2009	2011	2003 to 2011	2007 to 2011
Stationary	\$397	\$886	\$1,747	\$2,734	\$7,974	\$17,940	46%	60%
Portable	0	3	94	1,875	10,875	17,625	196%	75%
Transportation	1	79	123	311	1,746	10,257	84%	140%
Total	\$398	\$968	\$1,964	\$4,920	\$20,595	\$45,822	62%	75%

CAAG - Cumulative Annual Average Growth

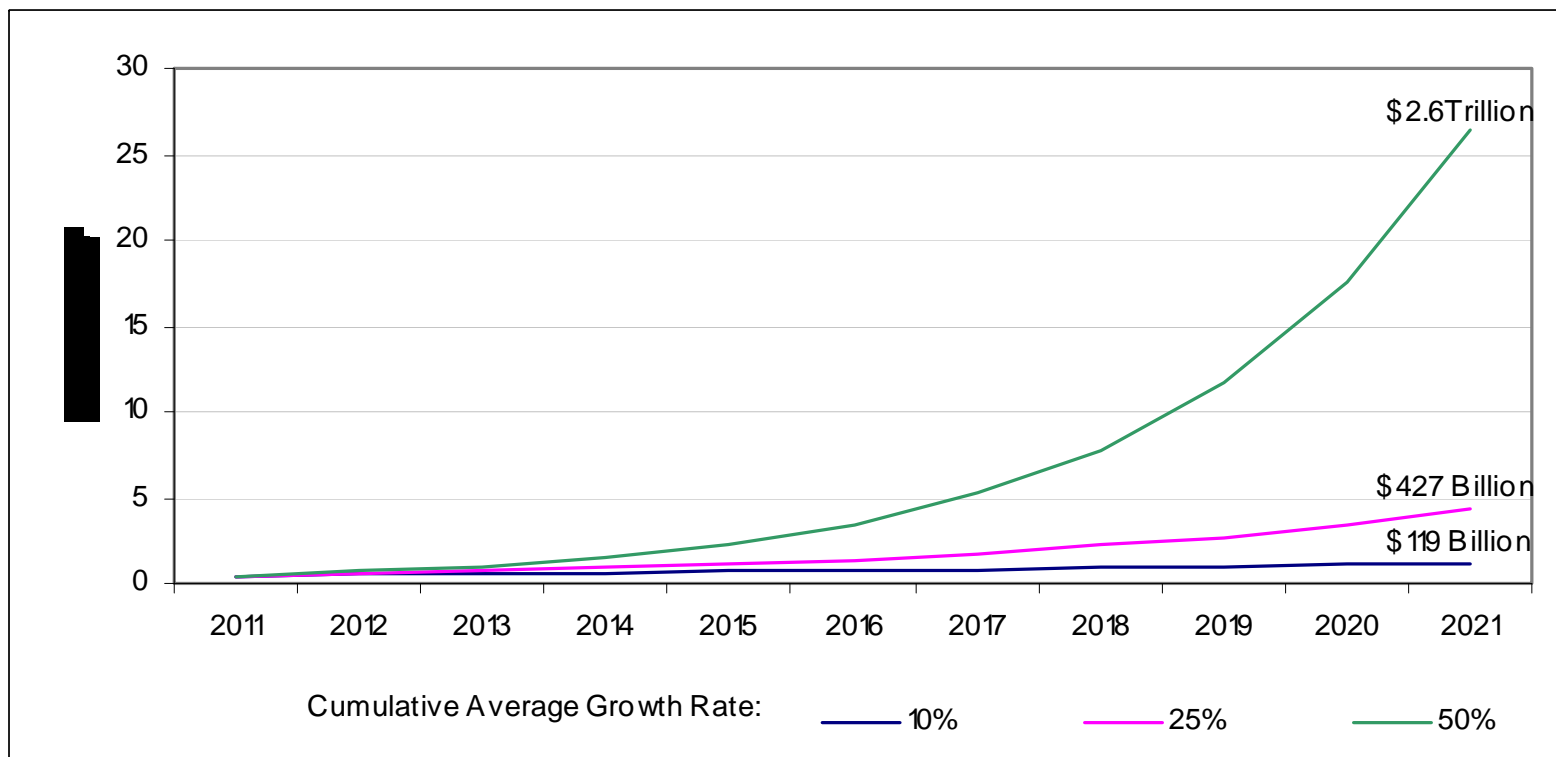
Source: Reference 5

Global Market Projections – Fuel Cell Products



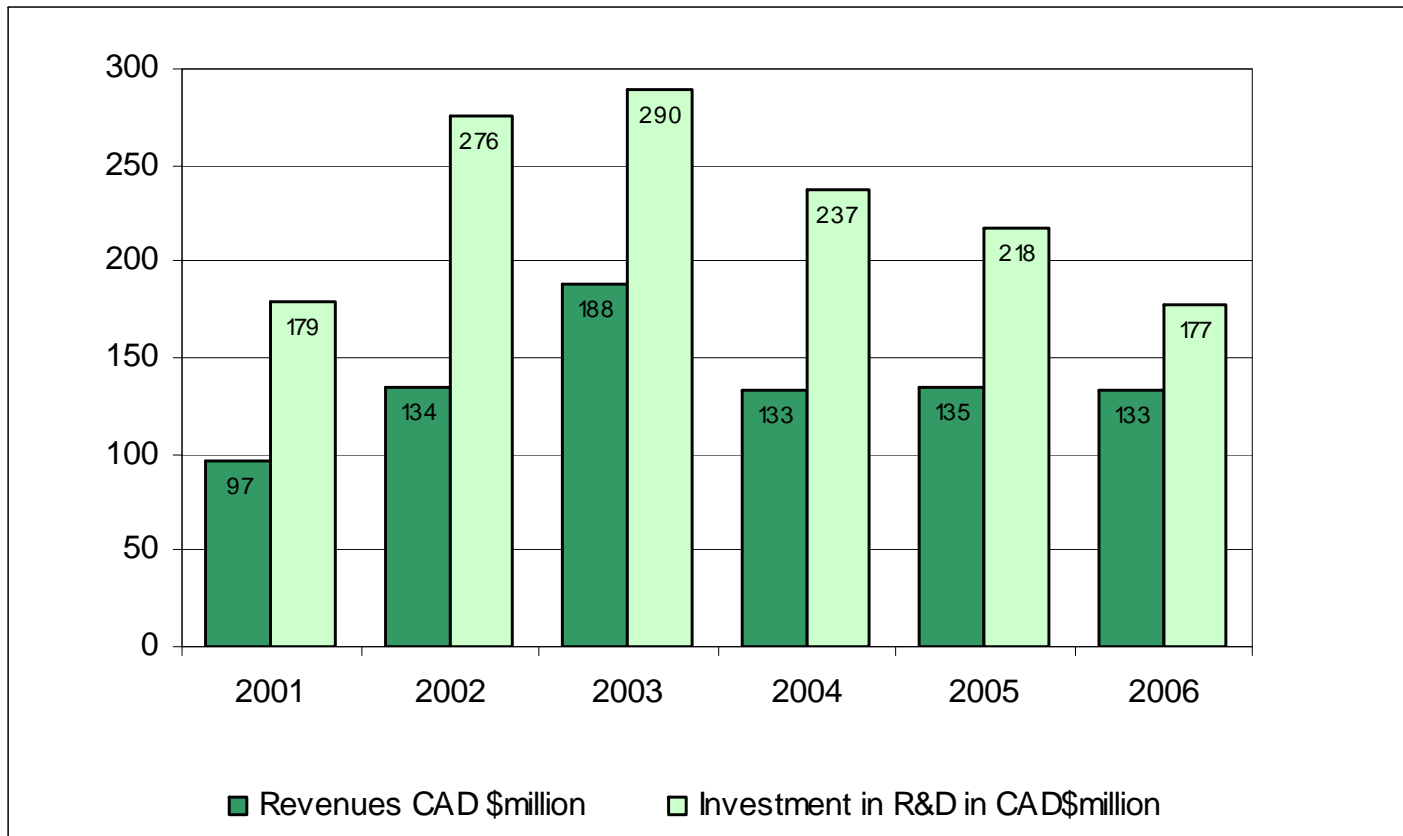
Source: Reference 5

Global Fuel Cell Demand and Market Projections



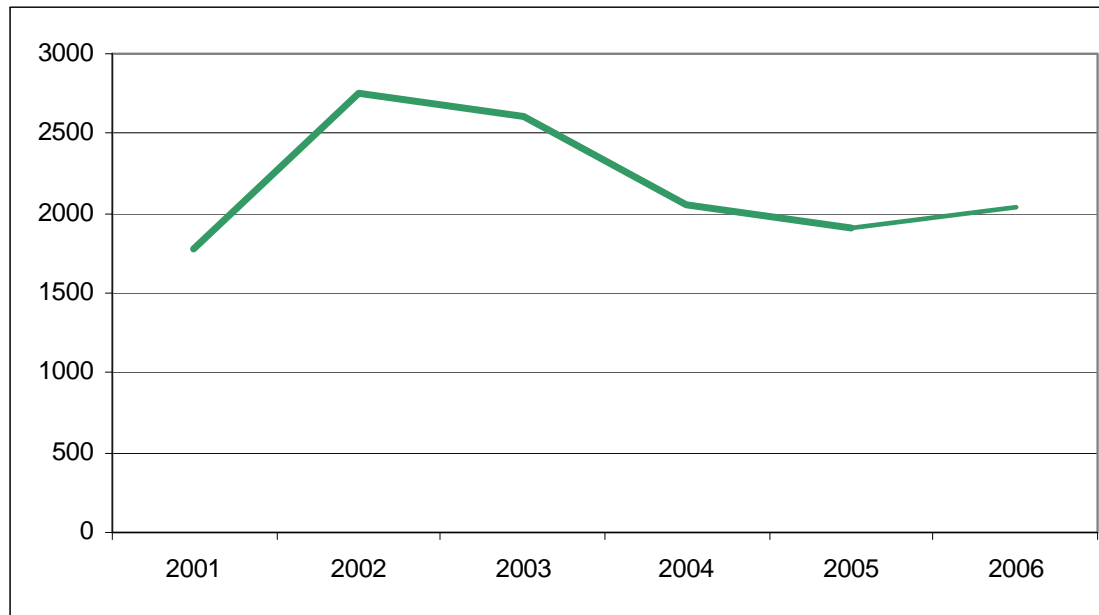
Source: Reference 5

Canadian Fuel Cell Economy



Source: Reference 3

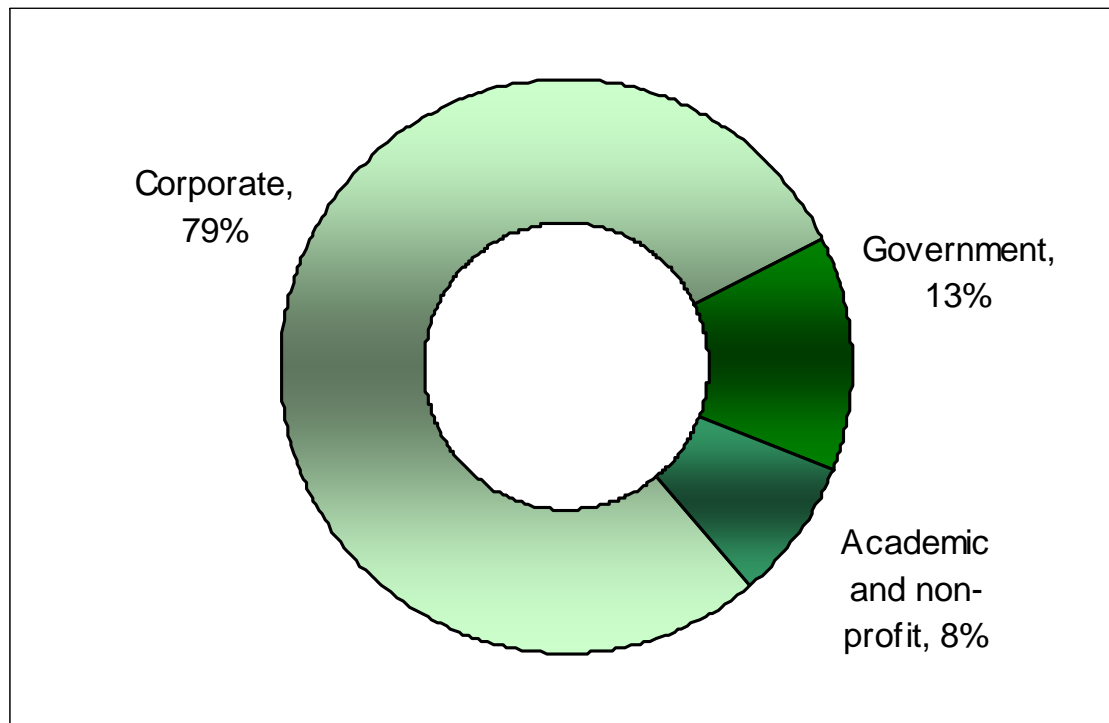
Canadian Fuel Cell Employment



- Average Salary \$55,262 in 2005
\$63,256 in 2006
- 14% increase from 2005 to 2006

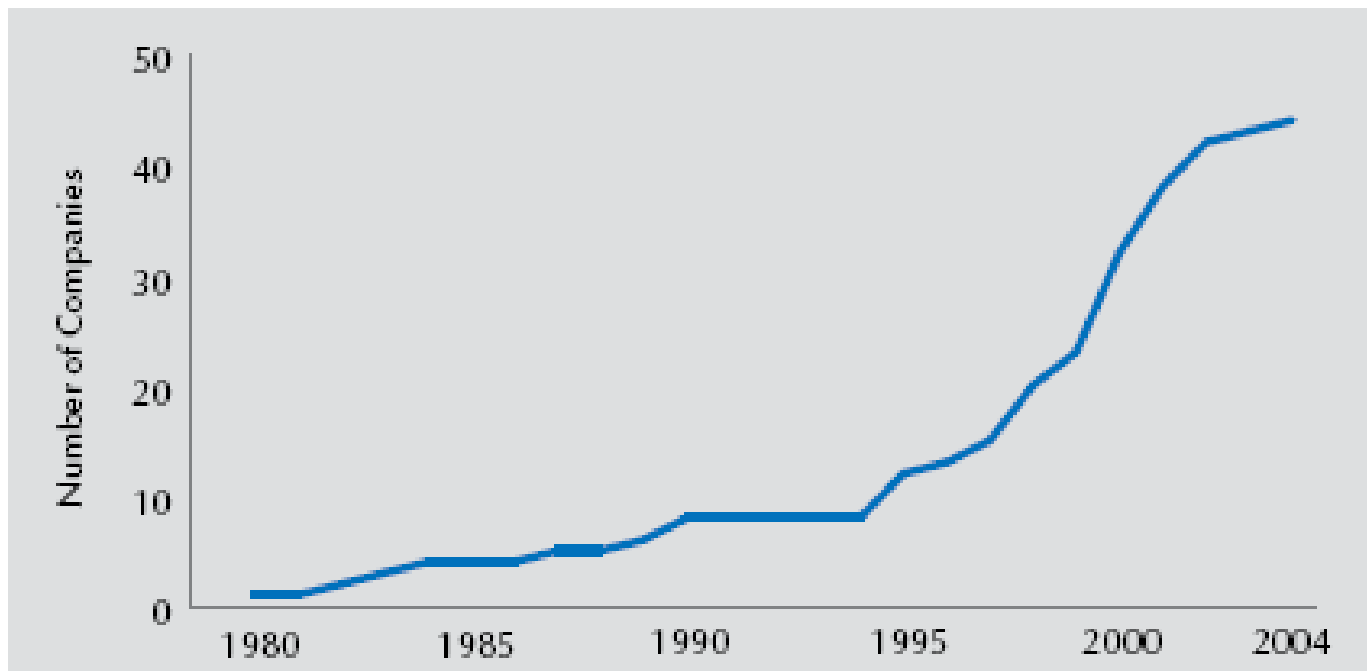
Source: References 3

Canadian Hydrogen and Fuel Cell Sector Employment Distribution



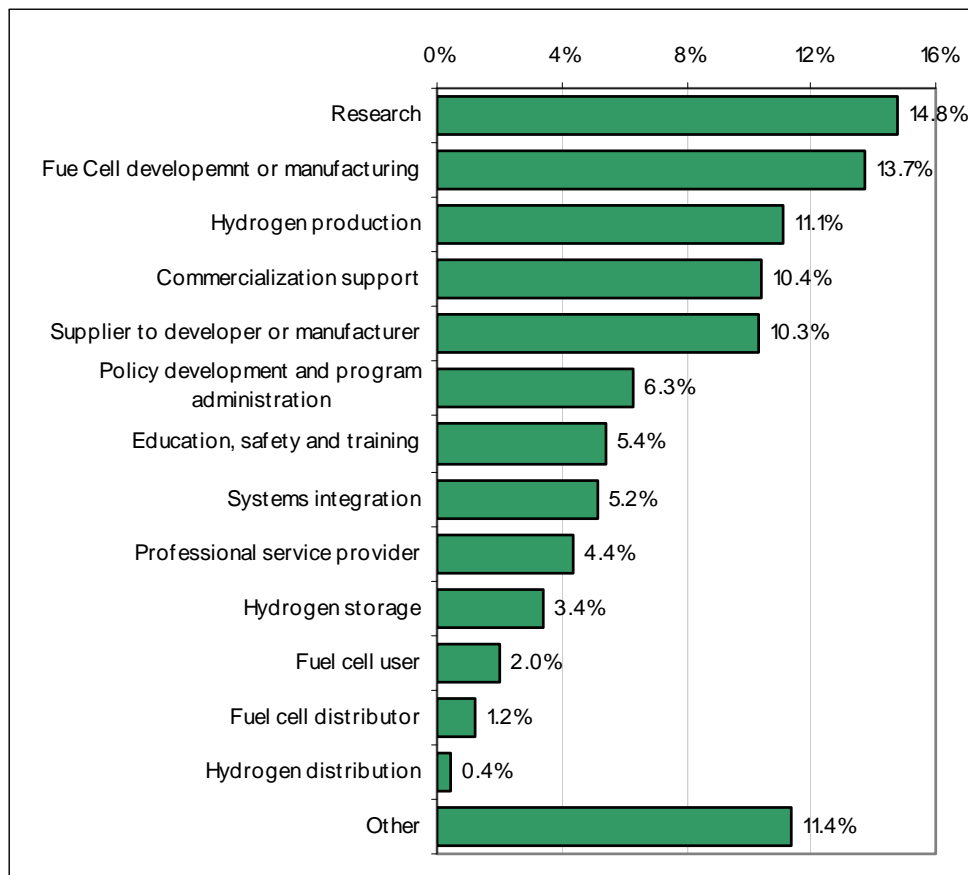
Source: References 3

Canadian Hydrogen and Fuel Cell Sector 1980-2004



Source: References 5

Canadian Hydrogen and Fuel Cell Sector Expertise Distribution



Source: References 3

Survey report in 2006

- 124 Strategic Alliances
- 221 Research partnerships

Note:

135 and 88 Organizations and Institutions invited to participate in a survey in 2006 and 2007 respectively

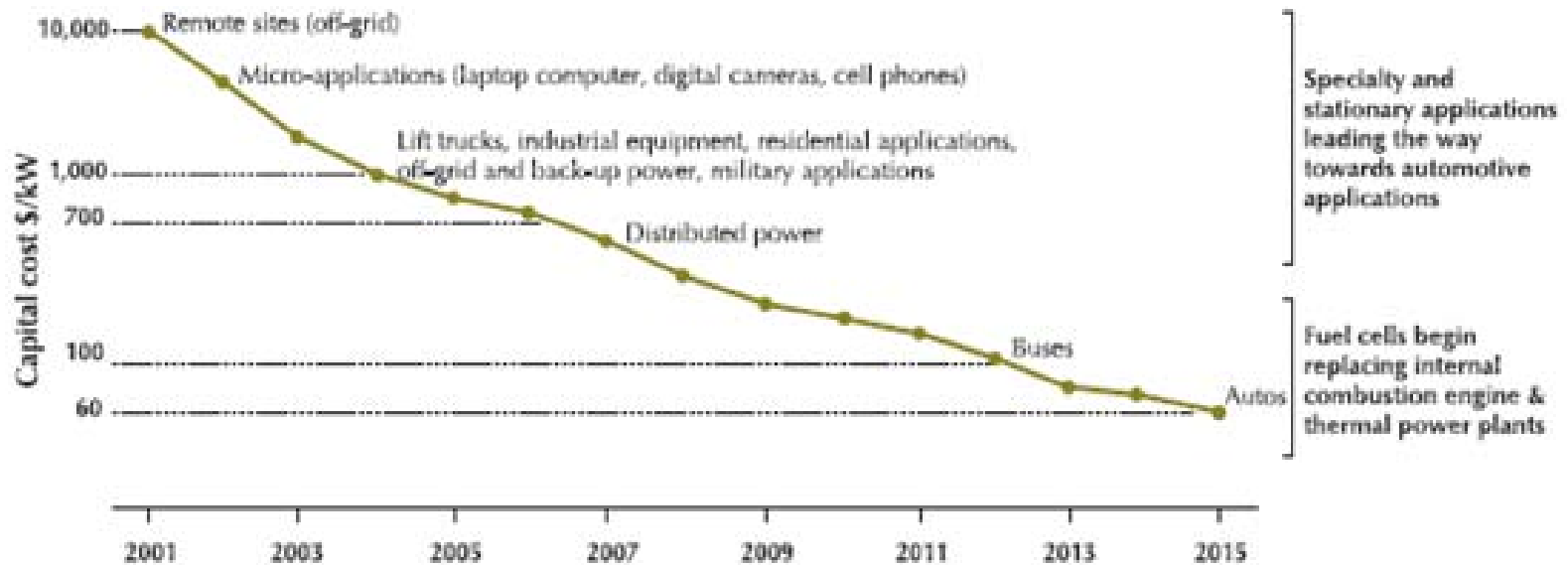
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Challenges of Fuel Cell Technology

- Infrastructure building
- Emission level reports
- Cost reduction
- Codes and standards
- Public education

Past and Future of Fuel Cell



Fuel Cell Cost Based Market Forecast

Source: References 5

Fuel Cell Distributed Generation

Size	1-100kW	100kW-1MW	1MW-10MW
2003	5,285	6,231	7,250
2005	3,819	3,920	3,983
2010	1,624	1,777	1,813
2015	1,079	1,230	1,249
2020	901	1,041	1,087

Fig: 1 Estimated Fuel Cell Cost for installed capacity in \$/kWe

Source: Reference 11

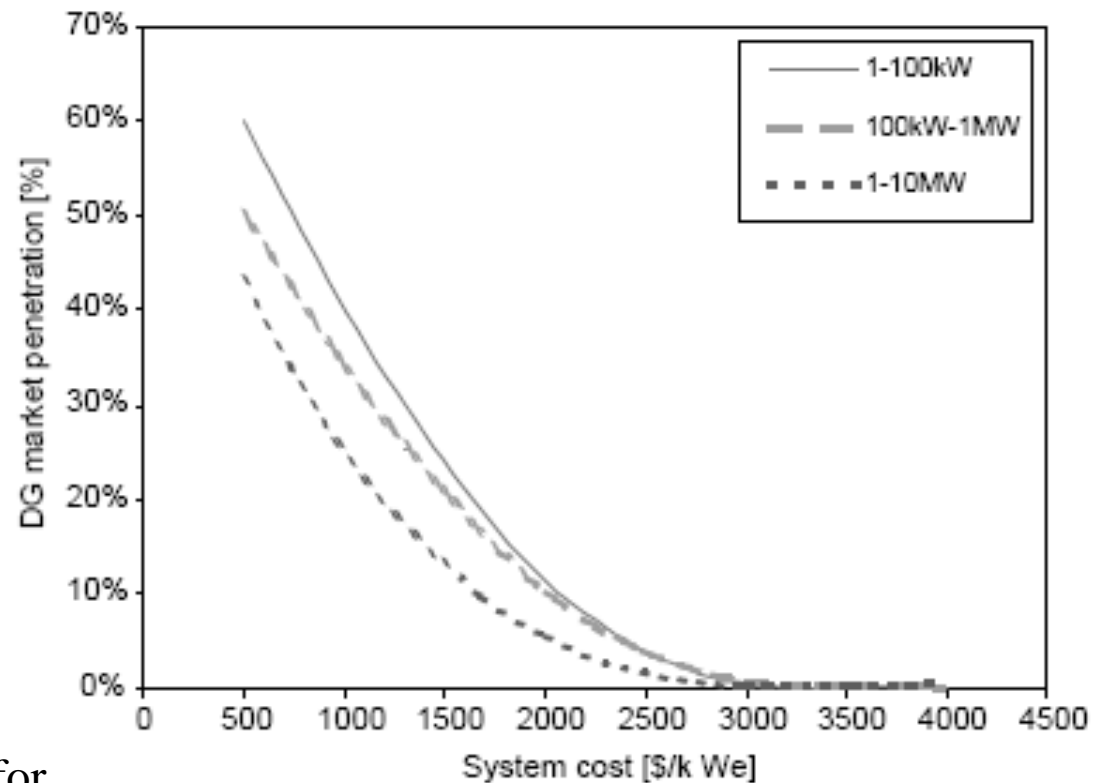


Fig: 2 Estimated Fuel Cell Demand

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Fuel Cells Commercialization

Ballard Power Systems

- Residential Co-generation
- Bus Fleet Deployment
- Backup power
- Automotive
- Material Handling

Fuel Cells Commercialization

Hydrogenics

- Mobility Application – Urban Transit Buses
- Mobility Application - Material handling
- Stationary Backup Power
- Hydrogen onsite generation

Fuel Cells Commercialization

Enbridge

- Distributed Generation

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Recommendations

Future study and development on

- Cost/Benefit analysis of Fuel Cell projects
- Pilot and Prototype performance reports
- Fuel Reformers and Emission Levels
- Electrical Modeling of Fuel Cells
- Implementation in both developed and developing countries

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Conclusions

- Polluting technology, a liability in the future
- Fuel Cell, an investment for the future
- Fuel Cell technology, prospective and sustainable globally

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Thank you