Canada - Hydrogen and Fuel Cell Demonstration Programs Leading to Commercialization

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Canadian Hydrogen and Fuel Cell Association

Importance of Hydrogen and Fuel Cells to Canada

- Hydrogen and fuel cells are a growing part of an integrated clean energy system. They **minimize the carbon impact** of fossil fuels and **optimize** renewable energy sources.
- Continued innovation in this sector advances national objectives of:
  - ✓ Improving energy efficiency
  - ✓ Economic development and job creation
  - ✓ Greenhouse gas emission reduction
  - ✓ Enhancing Canada's science and technology capacity
  - ✓ Reducing the environmental impact of our fossil fuels

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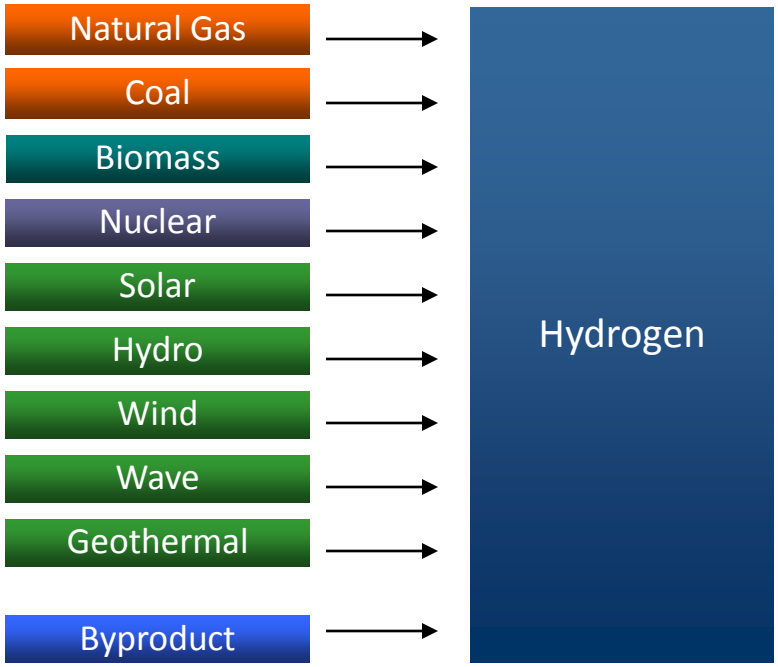
Canada Produces 3 Million Tonnes of Hydrogen per Year
The U.S. Produces 9 Million Tonnes Annually



- Canada's hydrogen is used to refine Alberta's oil sands, to produce ammonia for fertilizer, and to produce gasoline.
- The hydrogen sector in Canada has an excellent safety record.

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What is a fuel cell?

A fuel cell is essentially a battery with the chemicals necessary to create the electricity stored outside rather than inside. It efficiently converts fuels such as hydrogen or natural gas into electricity without combustion.

Benefits:

- High energy efficiency
- Quiet
- Can use multiple fuels: hydrogen, methanol, natural gas, bio-gas, paint fumes
- Zero to near-zero emissions
- Scalable - produce milliwatts or megawatts of electricity
- Low maintenance costs

50 mW	cell phone
15 kW	electric forklift
30 kW	back-up power
100 kW	electric bus/car
1 MW	stationary power plant

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Demonstration Programs in Vancouver and Toronto

Objective of the Canadian Demonstration Programs

- Allow government to understand the technology and the results of their public investment using tax payer dollars.
- Public outreach: raise public awareness and deepen understanding of the technology
- Give investors an opportunity to see the technology, understand it and evaluate progress.
- Provide technology companies an early income stream along with a real-life test bed for evaluating their prototypes and products.
- Educate emergency responder and develop lessons learned for future development.

HydrogenHighway

Demonstrations:

- Network of five H2 filling stations
- Vancouver Fuel Cell Vehicle Program (5 Ford Focus FCV's)
- Waste H2 capture facility
- 9 Hydrogen ICE pick ups
- 2 Ford ICE Shuttle buses
- Stationary fuel cell for heat and power at a car wash
- 4 Hydrogen H-CNG buses
- Fuel cell baggage tug at YVR airport
- Back-up power

2010 Winter Olympics Rings – hydrogen fuel cell power Vancouver Harbour

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Canada's Hydrogen Highway

2010 Olympic H_2i Campaign

www.powering now.ca

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BC - Fuel Cell Electric Bus Fleet

- BC Transit operates the world's largest fleet of fuel cell electric buses (20) - Whistler, B.C.
- 6th generation fuel cell bus technology.
- 80% reduction in GHG emissions compared to diesel buses
- Largest H2 fuelling station in the world (1000 kg/day capacity)

BRITISH COLUMBIA
CANADA

Canadian Project Partners:

Air Liquide Canada
Ballard Power Systems
Dynetek Industries
Hydrogenics
New Flyer
Xebec Technologies
Sacre-Davey

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Hydrogen Fuel Cell Vehicle Development - Canada

- Automotive Fuel Cell Cooperation Inc (AFCC) is the Daimler-Ford JV in Vancouver working on generation III fuel cell vehicles.
- AFCC employs 200 people.
- GM built 100 of its current generation of Equinox fuel cell vehicles in Ontario.

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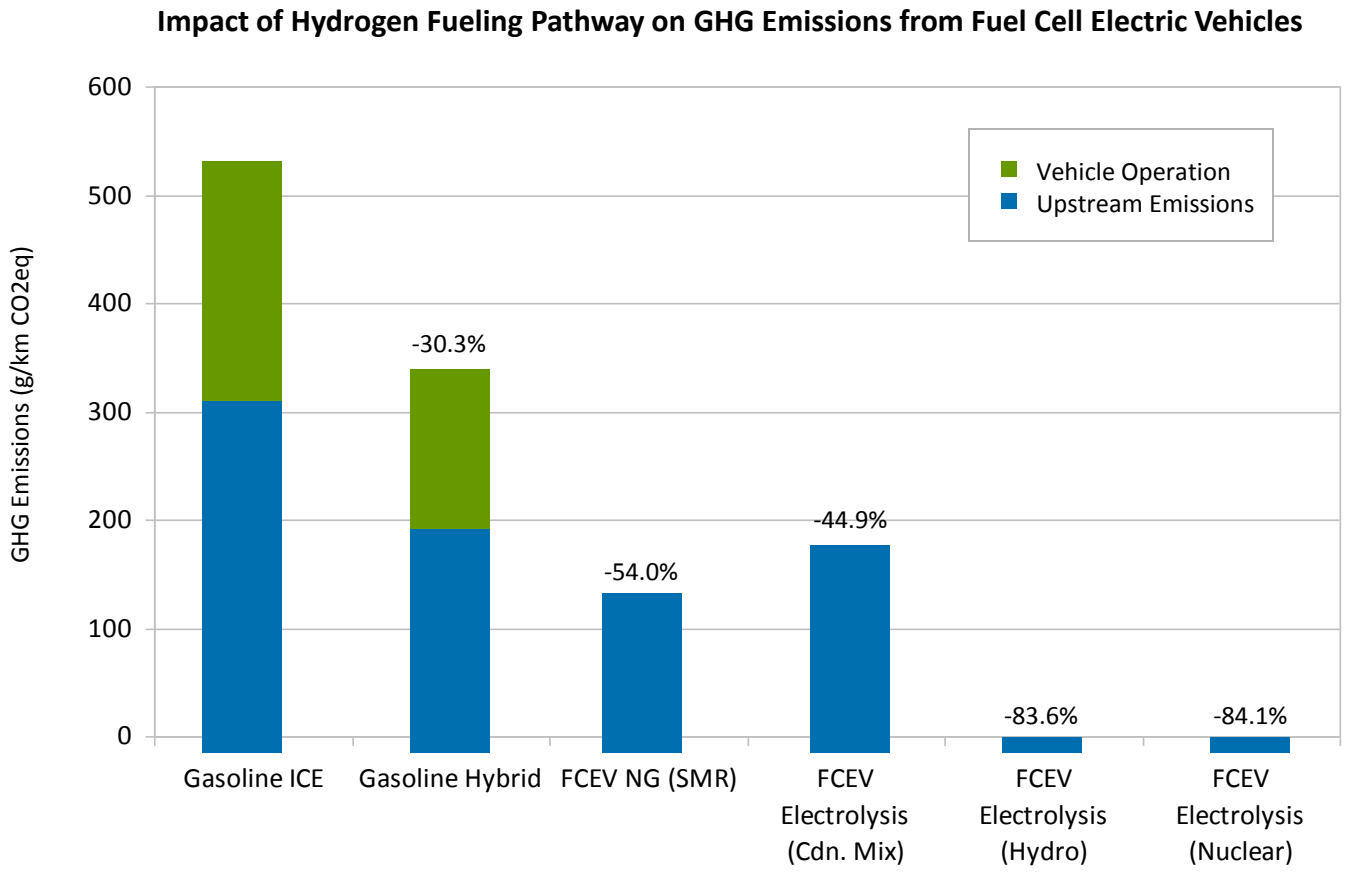
Hydrogen & fuel cells will help Canada meet its greenhouse gas and pollution reduction goals



Modeled by GHGenius (Natural Resources Canada)

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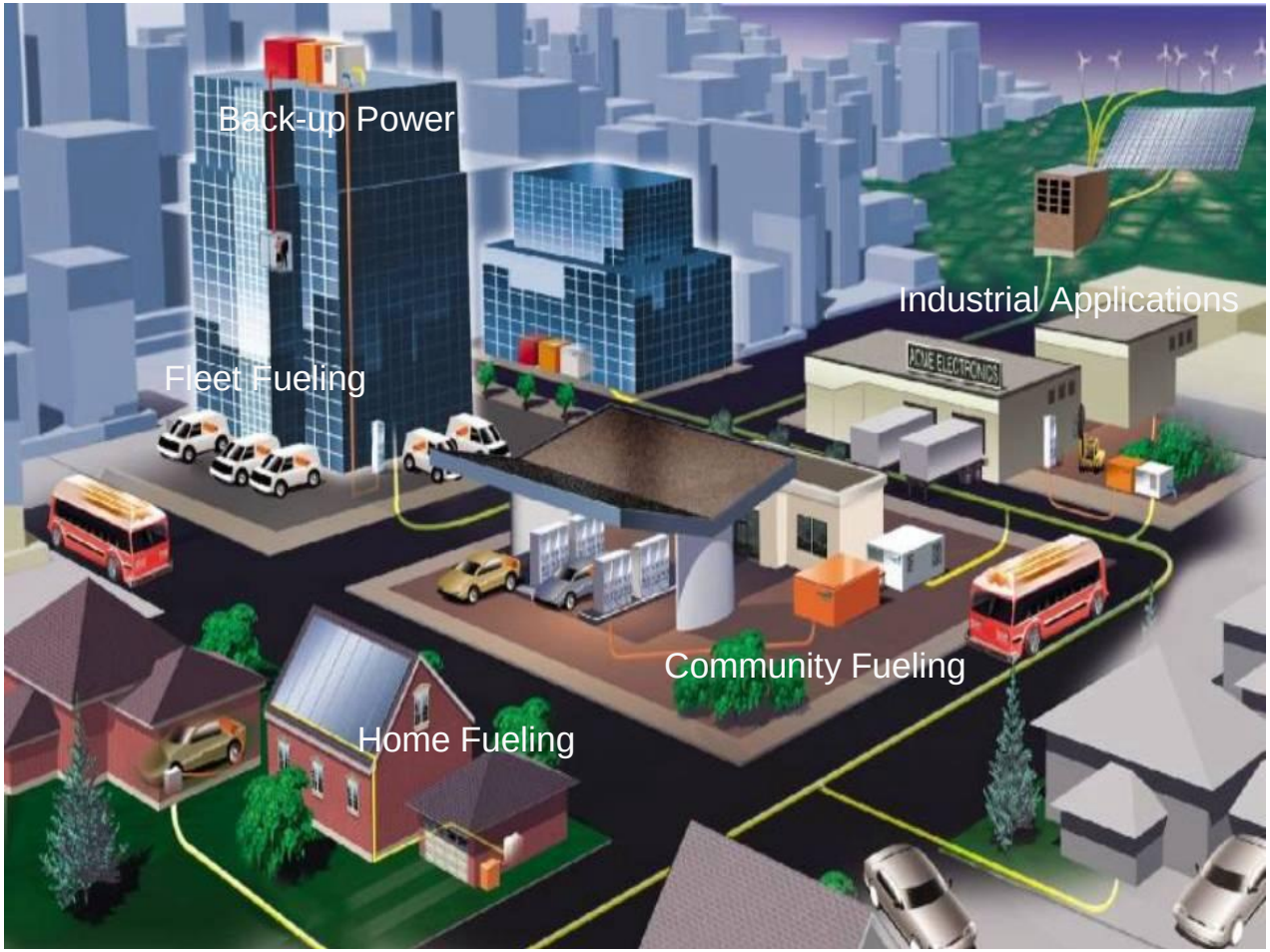
The Hydrogen Village



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Safe, Reliable, Back-up Power

- Back-up power system for a Bell Canada telecommunications switching station.
- DC output: 8kW - HyPM XR fuel cell power module
- 20 kW unit on the 5th floor office of an 80 year old office tower for an internet services company.
- Partners:
  Hydrogenics
  Bell Canada
  Emerson Network Power

Note: Dantherm Power of Denmark is also supplying its fuel cell telecom back-up power products in Toronto.

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Fuel Cell Electric Fork Lifts

- 18 fork lifts working 24 hours per day, 7 days per week at GM Canada.
- 12 kW PEM fuel cell
- Hydrogen generation and refueling inside
- Partners:
  - Hydrogenics
  - GM Canada
  - Natural Resources Canada
  - Sustainable Development Technologies Canada

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Hydrogen from Wind Power

- 65 kg/day electrolyser linked to a wind turbine in central Toronto next to Lake Ontario.
- 60 kgs of Hydrogen storage
- Partners:
  - Hydrogenics
  - John Deere
  - City of Toronto
  - Exhibition Place
  - Natural Resources Canada
  - Giffles

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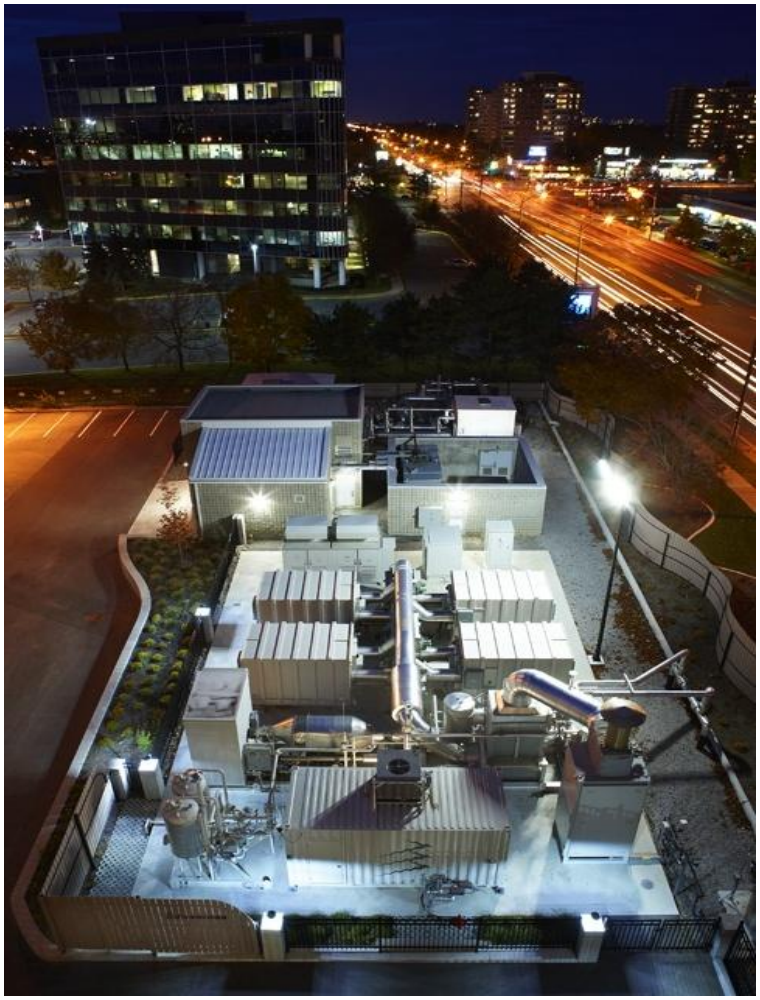
Enbridge Gas – Hybrid Fuel Cell Power Plant (Toronto)



- 2.2 MW of low impact, clean electricity in the city
- Constant power 24/7
- Power for 1,700 homes
- Quiet with low visual profile
- Fits in 22 parking spaces / 500 square metres
- Electrical efficiency > 60%
- Less than 14 cents/ kw

2MW Solar farm near Newcastle, ON occupies 40,000 square metres, is intermittent, and paid 43 cents/ kW

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Paint Solvent to Clean Electricity

- Location: Ford Canada's auto manufacturing plant near Toronto
- 300 kW of green electricity - MCFC fuel cell from FuelCell Energy
- operates on paint fumes (volatile organic compounds) that were previously vented into the atmosphere
- Partners:

  Ford Canada
  FuelCell Energy
  Industry Canada
  Ontario Ministry of Economic Development and Trade

Walmart

February 10, 2010

Why Walmart Canada Is Investing in Hydrogen Fuel Cell Technology

Walmart is building a new distribution centre near Calgary using only fuel cell forklifts trucks as an alternative to using lead acid batteries.

Walmart's new fuel cell forklift fleet will:

- Deliver $2 million in operating cost savings over seven years
- Reduce Greenhouse Gas emissions by 530 tonnnes per year.

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Growing Commercial Uptake by Major End-Users

Production Facilities	Retail / Distribution	Telecommunications
Coca-Cola	Sysco	Sprint Nextel
Nestlé	United Natural Foods	Verizon
Bridgestone-Firestone	Walmart	Motorola
Super Store	Whole Foods Market	Wind Mobile
Kimberly-Clark	Central Grocers Inc.	

** fuel cell forklift trucks, stationary fuel cell back-up power, megawatt power plants*

"With these fuel cell materials handling units, we will be able to maintain productivity, decrease operating costs and lower GHG emissions by 30%."

– Lauren C. Steele, Spokesman, Coca-Cola Consolidated

"Sprint gets it – this alternative source of energy for mobile communications will not only help stimulate the nation's economy and rebuild America, but also help lead to a greener cleaner environment."

– Bob Azzi, Senior Vice President of Network, Sprint

Hydrogen + Fuel Cells 2011

partnerships for global energy solutions

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May 15 – 18, 2011 | www.hfc2011.com

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