Hydrogen Village Overview

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IPHE Steering Committee Meeting

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Fuel Cells Canada™

Natural Resources Canada

Ontario

What *is* Hydrogen Village?

An **end user-driven** market development program.

Goal:

To ***accelerate sustainable commercialization*** of hydrogen and fuel cell technologies.

Objectives:

Awareness, education, and ***promotion*** of early deployments throughout the **GTA**.

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What *is* Hydrogen Village?

- Collaborative public-private partnership of more than 40 companies.
- Broad cross-section of industry.
- Administered through Fuel Cells Canada.
- Program funded by NRCan's CTFCA program and the Ontario MRI's OFCIP.

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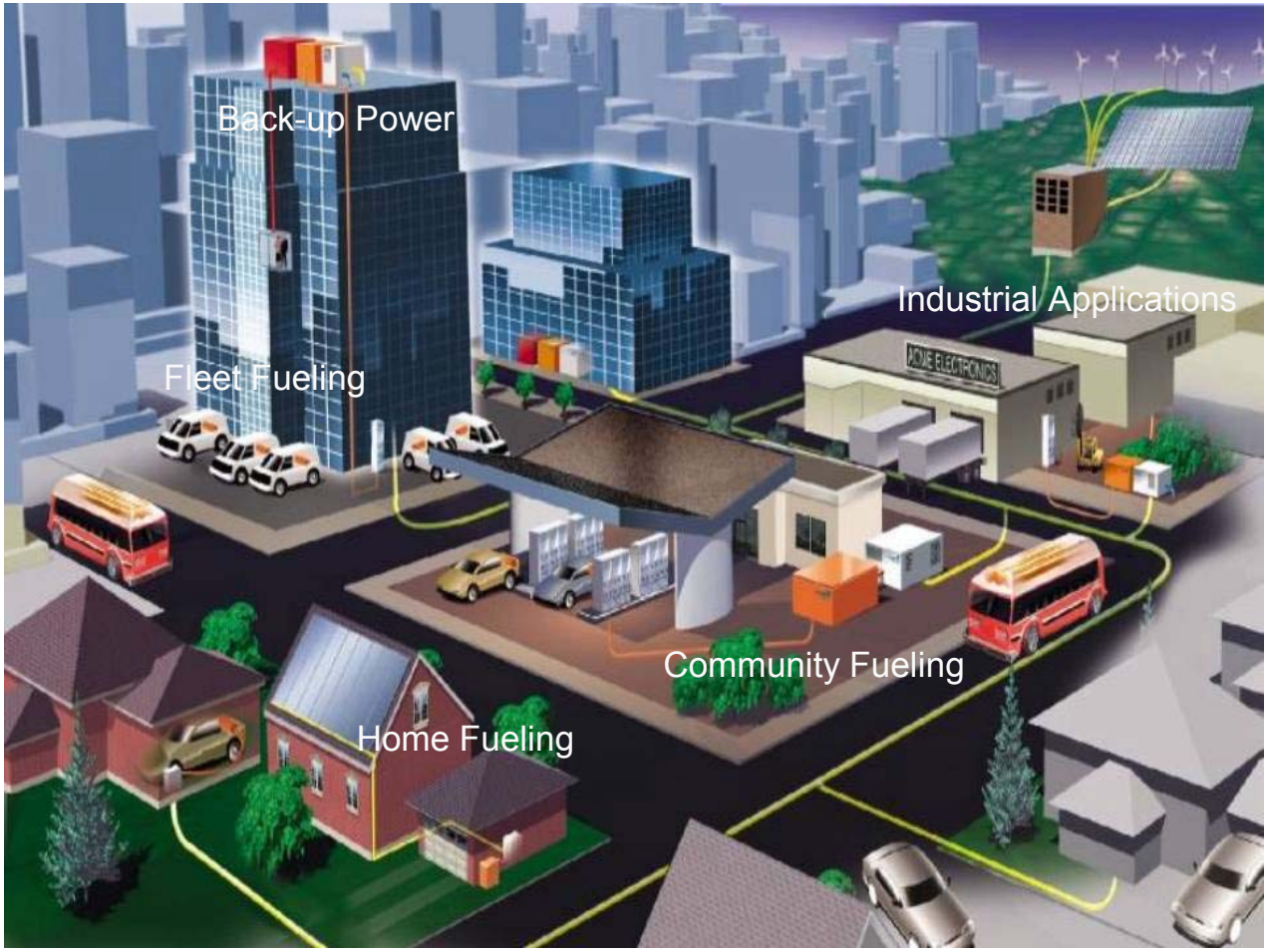
The Hydrogen Village



Hydrogen Village Goals

1. To deploy technology.
   - Ensure technology deployments (stationary, mobile and transportation) fit within the context of existing community infrastructure and activity
2. To develop a coordinated, integrated hydrogen delivery infrastructure.
   - Support the principles of conservation and sustainability
3. To create awareness in three key areas:
   - Public and Corporate policy
   - Codes/ Standards/ Regulations: Opportunity for real world implementation and feedback on developing codes and standards
   - General public awareness through educational institutions and the media

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Hydrogen Village Goals

4. To create market development infrastructure.
   - Supply chain, service capability, and knowledge base needed to support a sustainable market
5. To contribute to the complementary growth of other centers across Southern Ontario.
   - The Hydrogen Business Corridor

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Hydrogen Village Program Areas

1. Fuel
   i. Production
   ii. Storage and delivery
   iii. Handling and dispensing

2. End use technology
   i. Energy conversion
   ii. Applications

3. Education and Awareness
   i. Codes, Standards and Safety
   ii. Education, Outreach and Public Policy
   iii. Renewables and Conservation

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Communications Program

- A comprehensive Communications Strategic Plan is in place. Tactics currently being pursued include:
  - Website
  - Media plan development
  - Conferences
  - School programs
  - Surveys
  - Development of printed materials

Projects

- Funding for several projects has been announced through several Canadian funding initiatives(h2EA, CTFCA, SDTC).
- Five projects have been approved and built.
- Two projects are currently under construction.
  - Residential heating and power generation using four solid oxide fuel cells for twelve student residences at the University of Toronto at Mississauga
  - Fuel cell based back-up power system at an ISP located in downtown Toronto
- Twelve projects are currently under development.

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Refueling Infrastructure

Hydrogen refueling infrastructure projects are located to facilitate strategic development of the refueling infrastructure

GM

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Projects Under Development

Transportation Applications:
Small fleets operating in downtown core
Mini bus
Utility and Works vehicle applications

Portable and Stationary Applications:
Backup Power (FC and ICE):
- Office
- Critical Ops equipment

Microgrid supply (FC):
- Telecommunications systems
- Communities

Battery replacement:
- Bicycles
- Appliances

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Hydrogen Village Membership

Air Liquide
Angstrom Power
Astris Energi
Bell Canada
BET Services
Bruce Power
CAMM
Canadian H2 Energy
City of Mississauga
City of Toronto
CRESTech
Technologies
Decoma International
Dynetek
Enbridge
Energy QBD
Fuel Cell Technologies
FTI International
General Hydrogen
Giffels Engineering
Hydrogenics
John Deere
Kinectrics
KPMG
National Research Council
Price Waterhouse Coopers
Purolator Courier
Questair
Rogers Cable Communications
Sarnia/Lambton Economic Development
Toronto Electric
U of T Mississauga
University of Waterloo

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Hydrogenics Projects in Progress

Hydrogen Production and Refueling at Exhibition Place

- Facility opened August 24, 2004
- 65 kg/day electrolyser linked to wind power from urban wind turbine
- 60 kg storage
- CaFCP Protocol compatible dispenser
- Partners: Hydrogenics, City of Toronto, Exhibition Place, h2EA, CTFCA

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Hydrogenics Projects in Progress
Hydrogen FC Powered Utility Vehicles

- Two vehicles in regular active service at Exhibition Place since April, 2005
- 12 kW PEM FC/ Ultracapacitor Hybrid.
- Units provide both on and off board power
- Partners: Hydrogenics, John Deere, h2EA, Exhibition Place

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Hydrogenics Projects Completed
Fuel Cell Fork Lifts at FedEx and GM

- Two fork lifts deployed in 24/7 high-demand operations
- 12 kW PEM FC/Ultracapacitor hybrid power train
- Indoor hydrogen generating and refueling facility installed at GM
- Transportable hydrogen refueling facility at FedEx facility at Pearson International Airport
- Partners:SDTC, CTFCA, Hydrogenics, GM, Fedex, Nacco

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Hydrogenics Projects in Progress
Fuel cell back-up power system

- Back-up Power system for a Bell telecommunications switching station in Burlington.
- In operation as of February 16, 2006
- DC output, 8kW HyPM XR fuel cell power module
- Partners:Hydrogenics, Bell, Emerson Network Power, h2EA

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Purolator Project in Progress
Hydrogen FC Delivery Vehicles and Refueling

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Where business is going.

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Initial Project Background

- Purolator owns, operates and maintains 3000 Class 4, P&D type vehicles within Canada
- Vehicles are gasoline powered and spend their operational life in urban traffic conditions
- "Greening the Fleet" initiative will enhance Purolator's Corporate Environmental Policy

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Purolator Program Objectives

- Reduce carbon based fuel consumption and GHG emission levels by a target level of 100%, and reduce maintenance costs by 20%
- Meet and exceed federal GHG commitments
- Creates an opportunity to redesign and improve the courier P&D vehicle
- Become a leader in public awareness of hydrogen fuel cell technology
- Contribute in the development of Codes and Standards

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Phase 1

- FC-HEV (Workhorse chassis, Utilimaster body, drive train by Hydrogenics)
- Proton Exchange Membrane (PEM)
- 65 kW fuel cell with standard lead acid battery pack, which includes regen braking, zero emission emitting only water & heat
- Enova designed electronics
- Partners involved: Purolator, Hydrogenics, NRCan (CTFCA), h2EA
- Onsite Hydrogen Electrolyser, hydrogen storage and refueler located at Purolator's West Toronto facility
- Truck will be utilized in the courier environment for a period of 6 months for testing and validation – Testing will resume Spring 2006

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Phase 1 Objective: In-Service Validation

- Reliability / durability (10 – 15 courier stops per hour)
- Courier / driver & customer acceptance (Well received, currently delay in Fuel Cell start up)
- Restricted access to undergrounds
- Undergone safety and awareness training
- Cost effective operation
- Utilize our Fleet Maintenance System to record data

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Next Steps

- Potential build of (4) next generation FC-HEV class 4 curbside vehicles
  - Improved power storage technology
  - Addition of a cold weather package
  - Improved / quicker Fuel Cell power up
- Extend and expand test areas
- Technician training & tooling
- Further input to Codes and Standards
- Development and access to additional hydrogen refueling infrastructure

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Challenges to FC-HEVs

- Pioneers must bear the load:
  - High cost of purchase borne by early-adopters
  - Operational risks in early stages (reliability, liability)
- Mitigating strategies
  - Cost assistance for the incremental costs is required to promote and expand the technology
  - Commitment from additional partners and fleets willing to test and purchase
    - Government and industry could develop investment opportunities to help identify and pursue additional partners
    - User groups join forces to create RFP's which create standardization and interest from manufacturers and Fuel Cell Industry leaders.

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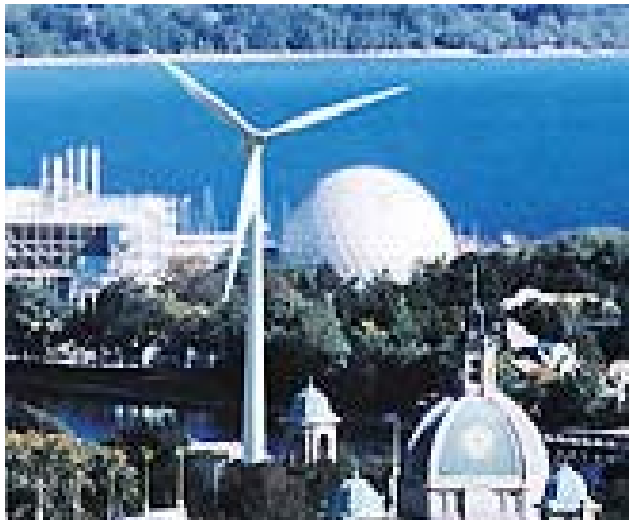
Hydrogen Village Impact on CO_2

- Current planned and implemented projects should result in a reduction of approximately 300 tonnes of CO_2 annually
- Hydrogen Village initiatives aim for a significant multiplier effect as the market moves to broader adoption of hydrogen and fuel cell technologies.



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