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BC's Hydrogen Highway – Partnerships in Action

Fuel Cells Canada
March 29th, 2006

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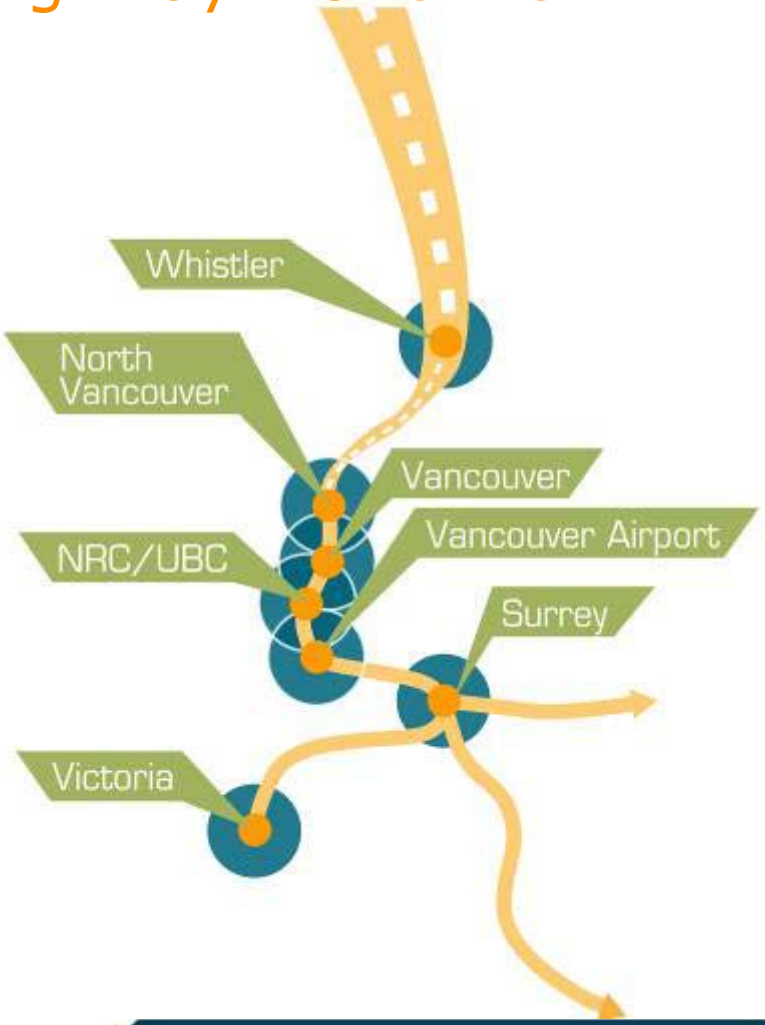
British Columbia Hydrogen Highway - Overview

- One of the world's most integrated and advanced hydrogen and fuel cell technology demonstration and deployment programs
- Route to the Future
- Showcases Canadian technology in real-world applications
- Engages 'early adopters'
- Organizations who may be early customers



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Partnerships

- Project of Natural Resources Canada's Canadian Transportation Fuel Cell Alliance (CTFCA)
- Partnering with additional funding programs allows:
  - Value for investment dollars for all parties
  - Diversity of goals and objectives
  - Opportunity for future projects
- Hydrogen Highway creates a critical mass of projects:
  - Brings greater focus and attention to the hydrogen and fuel cell sector

Progress / Status

April 2004 – concept launched

April 2006 - implementation

- 3 operational fuelling stations (Pacific Spirit Station, Surrey, Victoria)
- +2 stations in design (North Vancouver)
- +1 station in planning (YVR)
- +1 mobile 350 and 700-bar station (Powertech)
- Micro hydrogen fuel cells in hospital, airport, universities, Urban Search and Rescue (Angstrom)
- Industrial vehicle demonstration (To be announced)
- Stationary fuel cell development (NRC-IFCI)

Several active committees:

- Project Managers' Committee
- Marketing & Communications
- Hydrogen Safety Users Group (with FCC)

Rolling out Hydrogen Highway brand identity

Upcoming Milestones:

- Expand fuelling network
- North Vancouver project (IWHUP)
- Decision on proposal for fuel cell bus deployment

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Experiences

The Hydrogen Highway:

- Provides a venue and framework for other projects
- Offers resources that will be needed by the majority of projects
- Encourages information sharing
- Creates a critical mass of projects so that any one project can be a part of something 'bigger'

Main benefits include:

- Shared resources
- Marketing power of larger 'brand'
- Networking and engagement with end-users

Showcasing a range of products and services creates a 'one-stop-shop' for those with an interest in hydrogen and fuel cell technology

Having fuel cell vehicles critical for getting stations 'deployed'

Best Practices

Recognize value of marketing, communications and networking

Communicate, communicate, communicate

Dedicate a program manager as the 'go-to' person

Establish program-related goals and objectives

Provide secure source of funding

Timeliness of funding for projects

Be authentic in reporting on progress, such as to the media

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The Integrated Waste Hydrogen Utilization Project

Sacré-Davey Engineering

March 29th, 2006

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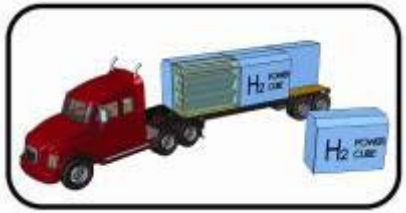
The Integrated Waste Hydrogen Utilization Project

SP 1 - Capture & Purification

QuestAir NEWALTA HTEC Sacré-Davey

SP2 - Transportation with PowerCubes



Dynetek Powertech

SP3 – Mobile Hydrogen Fuelling System

Sacré-Davey Powertech

SP4 - HCNG Fuelling Station

Clean Energy

SP5 - 8 100% H2-ICE Pickup Trucks

Powertech

SP6 - 4 HCNG Transit Buses

Westport TRANS LINK

SP7 - Combined Heat & Power 150 kW PEMFC

Sacré-Davey easywash NUVERA

And…Education & Outreach

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IWHUP Demonstration Project Site Locations

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Partners, Supporters & Funders

Project Partners & Supporters

- Sacré-Davey Innovations (Lead)
- Sacré-Davey Engineering
- Westport Innovations
  - Clean Energy Fuels
  - Dynetek Industries
  - Easywash
  - HTEC H2 Energy & Technology Corp.
  - Newalta
  - Nuvera Fuel Cells
  - Powertech Labs & BC Hydro
  - QuestAir Technologies
  - Translink

Funders

- SDTC
- h2EA
- CTFCA

Milestones / Progress

Completed:

- SOI submitted to SDTC - Fall 2002
- H2EA and SDTC indicated intent to fund - June 2004
- Contribution Agreements finalized with SDTC, CTFCA, H2EA- Spring 2005…..Soft Start to Project
- "Official" Project Launch: October, 2005
- H2 Plant Complete – April/May, 2006
- Fuelling infrastructure in place, Summer 2006
- Trucks/Buses & Fuel Cell in service, Summer 2006
- Demonstration scheduled to complete, Spring 2008

Next steps:

- Add more load to IWHUP project with additional/continued demonstrations

Experiences & Opportunities

Showcases harnessing of otherwise wasted resource

Fully integrated project: "a model H_2 Economy"

Showcases real-world applications

Increase awareness and advancement of Codes and Standards

- Get Transport Canada approval of 450 Bar storage for hydrogen distribution
- Get public and Authorities familiar with H_2

Private/public partnership in development and launch of H2 Technologies to:

- Build Canadian expertise
- Technological evolution
- Raise partner profiles and showcase Canadian technology

By-product hydrogen in North Vancouver for over 20,000 fuel cell vehicles, enough in Canada for 200,000

Looking for partners interested in a Vancouver demonstration, or for adoption of some of the IWHUP technologies

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General Hydrogen

General Hydrogen
March 29th, 2006

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General Hydrogen

GH Presentation to be delivered in separate file

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Pacific Spirit Station

BOC Gases
March 29th, 2006

Michael McGowan – email: Michael.McGowan@boc.com

Pacific Spirit Station Overview

Funded by CTFCA, BOC, and NRC Requirements:

- Meet the immediate need to fuel four Ford Focus vehicles from the Vancouver Fuel Cell Vehicle Program
- Utilize existing General Hydrogen dispenser and high pressure storage bank
- Utilize existing Stuart electrolyzer
- A modular and re-locatable package

BOC Specifications Supported by Partners

- Provide expansion and 700 bar fuelling capabilities
- Provide capability for tube trailer back-up supply
- Remote monitoring capabilities via software and cameras
- Fuel Quality Assurance Program

Partnerships

Project Management:

- BOC led the risk mitigation, system integration and fuel quality assurance programs
- Cost Shared with CFTCA funding, and in-kind support from NRC-IFCI
- Excellent cooperation and support between BOC and General Hydrogen on integration of the BOC designed compression skid and the existing General Hydrogen equipment

Safety:

- Comprehensive safety review included representatives from funding partners, General Hydrogen, Powertech Labs, and add local public safety authorities, and third party safety expert

Progress & Status

Milestones:

- Pacific Spirit Station Fully Operational
- Excellent safety record
- Over 100 fills on three VFCVP cars since March 2005

In Progress:

- Relocation of Station with new National Research Council building (also on UBC campus)
- Operations & Maintenance contract
- Considering modern electrolyzer
- Provide fueling for additional programs at UBC

Technical Innovation at Pacific Spirit Station

Multiple Compressor design:

- Compression of generated hydrogen
- High capacity compressor to manage bank storage for fast fueling to large vehicles.

Dynetek Composite vessels:

- Used for ground storage
- Are being monitored as a code case for ISO, CGA, CSA and ASME standards development activities

Hydrogen Fuel Quality:

- Protocols for are being developed at PSS and knowledge shared with DOE, ASTM, CTFCA and SAE C&S working groups

Data collection at the Pump:

- Supplying hydrogen to a diverse Fleet requires a pay at the pump level of commercialism

Testimonials on Experiences

Open and cooperative relationships

Designed with contingencies in mind:

- the need to relocate
- 700 Bar pressure
- tube trailer supply
- remote monitoring

Industrial approach to components "behind the wall"

- safer access
- easier maintenance
- modular design

700 Bar network of stations envisioned

Rational balance between traditional industrial gas solutions and novel storage/dispensing offerings

Best Practices

Project Management:

- Get everyone on same page on roles, responsibilities, performance expectations, technical and aesthetic approach, and liabilities at the **proposal** stage
- Choose partners with mutual respect and trust and who understand each others' goals and limits
- Invite outsiders to participate in design and safety reviews

Demonstration Projects:

- Capture lessons learned
- Know there will be challenges - if everything goes perfectly, there probably wasn't very much learning
- Avoid 'science projects' - unless you're in a lab

Demonstrate Promise not Prophecy