

## Hydrogen as an alternative to fossil fuels: dream or reality?

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Air Liquide Canada Inc.

### Air Liquide In Brief

- 9,4 billion euros in turn over
  - ✓ 80% outside France
- > 1 million clients
- > 8,700 patents
- 36,000 employees
- 350,000 shareholders



**Solutions integrated into our customer processes:  
gas, equipment  
and services bringing added value**

**Technical leadership and innovation**

## Production



SMR: Steam Methane Reformer



PSA: Pressure Swing Adsorption

- 3 billion m<sup>3</sup> annually
- 30 Large plants
- 1,200 km of pipelines
- 400 M€ of H<sub>2</sub> turn over



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## Hydrogen: Tomorrow's Energy?



### Tomorrow's dream!

- H<sub>2</sub> Energy
- zero emissions
  - greater efficiency
  - H<sub>2</sub>: abundance



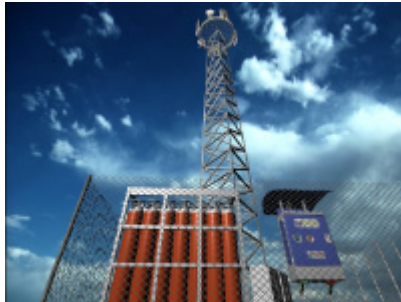
### Today's reality:

- 2004: 800 million vehicles
- 2030: 1.4 to 1.6 billion vehicles
- 1,2kg of H<sub>2</sub> to travel 100 km
- For 10 million vehicles: 22 billion m<sup>3</sup>/year
- World production of H<sub>2</sub>: 40 billion m<sup>3</sup>/year
- Today: 135 000 gas stations in Europe / 180 000 in the U.S.
- Conversion cost of 10% to H<sub>2</sub>: 10 Billion €

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## Today's Reality



Stationary Generators

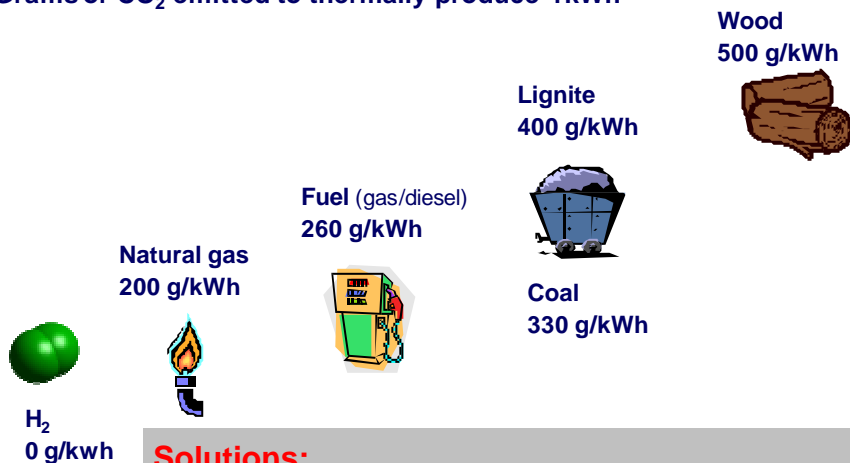


Portable Generators



## Challenge # 1: Hydrogen without carbon

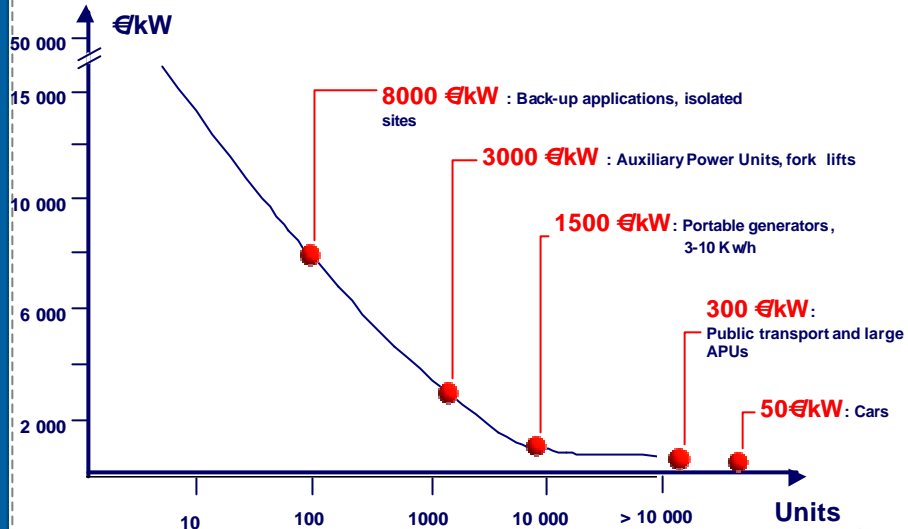
Grams of CO<sub>2</sub> emitted to thermally produce 1kWh



### Solutions:

H<sub>2</sub> from H<sub>2</sub>O – from wind, nuclear or other  
 H<sub>2</sub> from hydrocarbons with CO<sub>2</sub> sequestration

## Challenge # 2: Cost of fuel cells



**Solution:** Mass production



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## Challenge #3: Distribution



- Large existing network:
  - ✓ 180,000 Gas stations in U.S.
  - ✓ 135,000 Gas stations in Europe
  - ✓ Liquid Fuel
- Gaseous fuel
  - ✓ Storage size
  - ✓ Filling speed
- On-board storage
  - ✓ Gas at 700 bars – Safety and Technological challenges



**Solution:** Technical effort & very large investments

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**Hydrogen, an alternative to fossil fuels:  
dream or reality?**

Air Liquide needs to take leadership in large Canadian projects to act as an enabler of this new H<sub>2</sub> economy.

**Significant Projects**

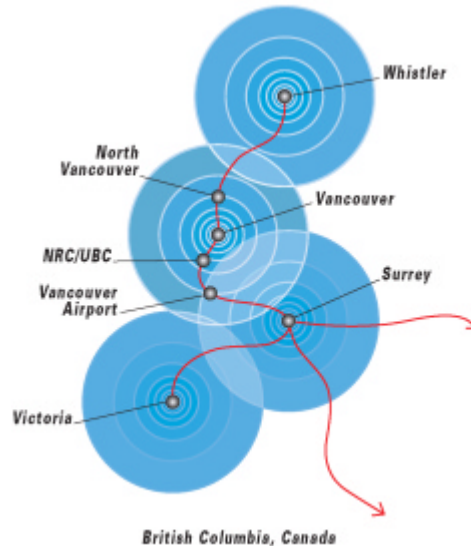
1. H<sub>2</sub> Highway – British Columbia
2. Vancouver Fuel Cell Vehicle Program
3. H<sub>2</sub> Village – Greater Toronto Area
4. H<sub>2</sub> Port – Montreal Airport



## 1. Hydrogen Highway



- West Coast: BC
- Integrated supply chain with 7 nodes
- Full implementation by 2010 Olympic Winter Games
- Variety of applications, including stationary, portable and mobile
- Participants must contribute to a specific project
- Project coordinator & seed funds provided by NRCan – CTFCA
- Formalized April 2004



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## 2. Vancouver Fuel Cell Vehicle Program



- Vancouver, BC
- First fleet demonstration of fuel cell vehicles in Canada
- Announced April 2004
- 5 third generation fuel cell vehicles from Ford
- \$5.8 MM from:
  - ✓ FCC, Ford, Government of Canada, TEAM Program, Government of BC
- Active in filling station compression design



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### 3. Hydrogen Village



- Greater Toronto area
- Less formally integrated approach
- 39 members from three stakeholder groups
- Open membership
- Emphasis on pre-commercial viability and public awareness
- Oversight Committee elected
- Started July 2003
- Project coordinator in place, supported by NRCan & CTFCA
- Approved projects include:
  - ✓ U of T at Mississauga
  - ✓ H<sub>2</sub> Production and 400 bar filling station(s)

### 4. Hydrogen Airport – H<sub>2</sub> Port

- Montreal, Quebec
- Selected partners only
- Integrated approach
- Applications:
  - ✓ Internal combustion engines
  - ✓ Axane fuel cells
- Value analysis important to identify niche areas with longevity
- Closer to commercial approach than others
- Very high visibility potential
- Project in proposal stage

