IPHE Policy Forum

International Partnership for the Hydrogen Economy

John Loughhead

Implementation and Liaison Committee co-Chair

Tuesday, 14 October 2008

Presentation Outline

- IPHE Overview
  - Purpose, History, Partners, Structure, Priorities
- IPHE Accomplishments
- Becoming an IPHE member
- IPHE Strategic Directions
- Overview of Hydrogen and Fuel Cells

IPHE Purpose

"Serve as a mechanism to organize and implement effective, efficient, and focused international research, development, demonstration and commercial utilization activities that advance the transition to a global hydrogen economy and to provide a forum for advancing policies, and common codes and standards."

IPHE History

- Established in November 2003 for 10 years
- Two committee structure (ILC and SC) supported by a Secretariat
- Chaired by United States for initial 4 years including Secretariat function
- Presently Chaired by Canada for 2 years including Secretariat function
- 17 partners with growing interest *(e.g. Israel, Mexico, South Africa)*

IPHE Partners

Russian Federation | USA | Canada | Iceland

IPHE Partners' Economy:

- Over $35 Trillion in GDP, 85% of world GDP
- Nearly 3.5 billion people
- Over 75% of electricity used worldwide;
- > 2/3 of CO_2 emissions and energy consumption

Japan

Republic of Korea

China

India

United Kingdom

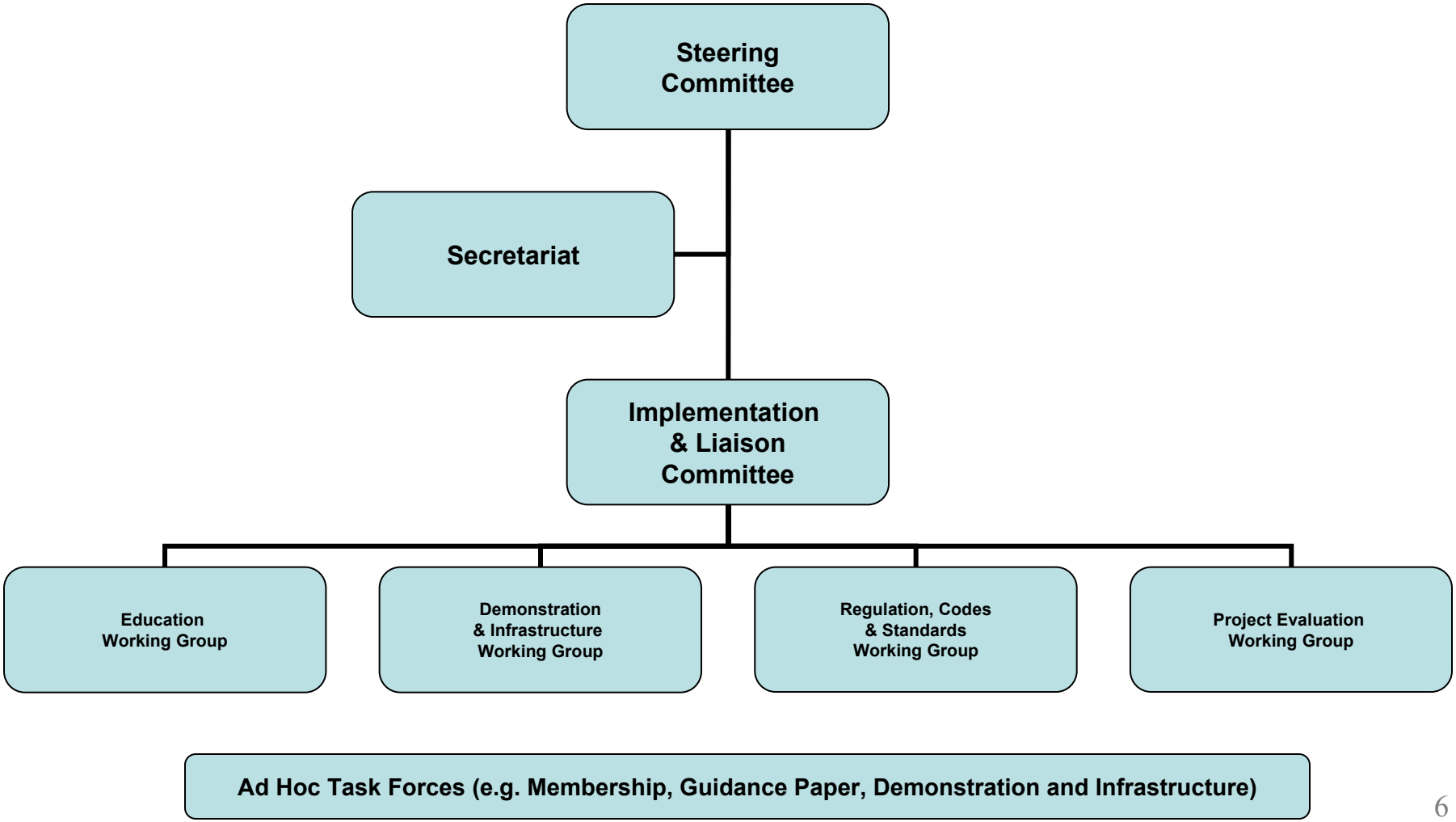
France

Germany

Italy

Australia | Brazil | Norway | European Commission | New Zealand

IPHE Structure



IPHE Functions

- Identifies/promotes potential areas of bilateral &multilateral collaboration;
- Analyzes & recommends priorities for RD&D/commercial/utilization
- Analyzes & develops policy recommendations on technical guidance
- Fosters implementation of public-private cooperation
- Coordinates & leverages resources to advance bilateral/multilateral cooperation
- Addresses emerging technical, financial, legal, market, socioeconomic, environmental, policy issues & opportunities not currently being addressed elsewhere

IPHE Committee Roles

Steering Committee

- Governs the overall framework, policies and procedures of the IPHE
- Periodically reviews program of collaborative activities and organizational structure if necessary
- Provides direction to the Secretariat

Implementation and Liaison Committee

- Reviews progress of collaborative projects
- Identifies promising directions for RD&D and commercial use
- Provides technical assessments for policy decisions, pursues international codes and standards and safety protocols, and makes recommendations to the Steering Committee on needed actions
- ILC groups serve as the mechanism for IPHE Members to advance and manage strategic collaboration.

IPHE Priorities

1. Accelerating the market penetration and early adoption of hydrogen and fuel cell technologies and its supporting infrastructure.

2. Raising profile with policy-makers and public - Continuing Education (ILC) and Outreach (SC) Efforts.

3. Monitor Hydrogen, Fuel Cell and Complementary Technology Developments.

4. Policy and regulatory actions to support widespread deployment.

IPHE Accomplishments

- Unique forum joining together leading countries working to advance hydrogen technologies
  - IPHE-IEA MOU
- Organized and implemented effective collaborative activities and projects
  - 30 collaborative R&D Projects approved
  - Dozens of IPHE sponsored Workshops
- Identifying common international priorities for advancing hydrogen in the economy
  - Engaging governments and aligning objectives

Becoming an IPHE member

- Currently, the IPHE has 17 country members
- New national government entities may be invited to become Partners of the IPHE if the Steering Committee determines the applicant has demonstrated:

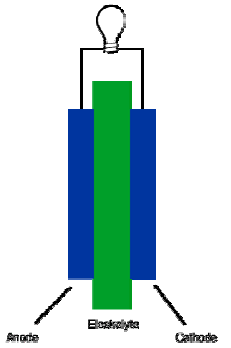
  1) a substantial, long-term resource commitment to hydrogen and fuel cell technology research and development activities;

  2) a well-defined vision and national strategy to advance technology deployment and infrastructure development; and

  3) a commitment reflected in policies and strategies that effectively advance private sector development of a hydrogen economy.

Hydrogen and Fuel Cells: Backgrounder

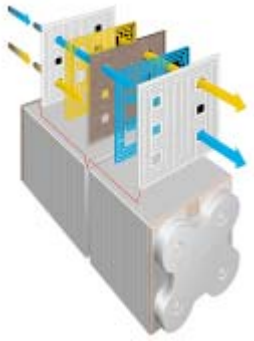
- Hydrogen
  - Most abundant element on earth
  - Contains no carbon, is odourless and non-toxic
  - Is widely available
  - Is an energy carrier produced from primary sources, that can be distributed and stored



- Fuel cell
  - Electrochemical device combining hydrogen with oxygen to produce electricity, heat and water
  - Twice as efficient in energy conversion through chemical process than through combustion.
  - Non polluting and reliable.
  - Able to replace or enhance operation of internal combustion engines and batteries.
  - Used in cars, buses, material handling equipment and industrial vehicles (forklifts, delivery trucks), back-up and premium power applications, electricity generating stations, cellphones, laptops, handheld radios.

A fuel cell "stack" is a series of cells stacked together.

Depending on the number and size of cells, a stack can produce from watts to megawatts of power.



Hydrogen and Fuel Cells (H2FC): Key Drivers

- IPHE formed in recognition of need for international collaboration in order to advance the transition to a global hydrogen economy
- H2FC technologies are recognized internationally as offering effective solutions to:
  - ***Energy Security and reliability***: H2FC technologies reduces demand on scarce resources and supports deployment of renewable energy technologies
  - ***Environmental protection***: H2FC technologies hold a longer term potential to 'decarbonize' energy systems
  - ***Economic development***: H2FC technologies have huge growth potential across a range of sectors.

-Anticipated GHG savings from the introduction of 7000 transit buses, from 2015 to 2025, over the projected life of the buses (20 years) is 18 600 000 tonnes.

- Results in significant reductions in air pollution emissions and improvements in local air quality.

- H2FC technologies have potential to address these issues across sectors such as transport, banking, telecommunications and energy
- Early commercialization in near term markets includes: residential co-gen, back-up power, materials handling, portable electronics
- Research efforts focus on mass markets (Passenger vehicles)

Public Investment in the Sector

- The potential benefits have led the world to develop H2FC technologies and needed corresponding infrastructure
- Governments have played a key role in developing h2 and fuel cell technologies through investing $1 B US in 2007*

  North America - $400M US

  Europe – $214M US

  Asia - $262 M US

- Funding supports projects and programs across the innovation continuum
- Seven IPHE countries account for 80% of investments: US, Japan, Germany, South Korea, China, Canada, UK
- Significant investments have been made by the EC
- Funding has resulted in leveraging of significant private sector investment
- Many countries are home to industrial leaders across the value chain

*Fuel Cell Today: Fuel Cells: Commercialization Industry Review 2008

IPHE Member Activities in Deployment

IPHE members are focused on a range of early commercial applications

- UPS for ICT, Residential Back-up Power, Buses, Materials Handling

H2 Fuel Cell Buses across Europe, in China, Australia, UK, US, and Canada – 20 fuel cell buses in Whistler, BC

CUTE

BC Transit

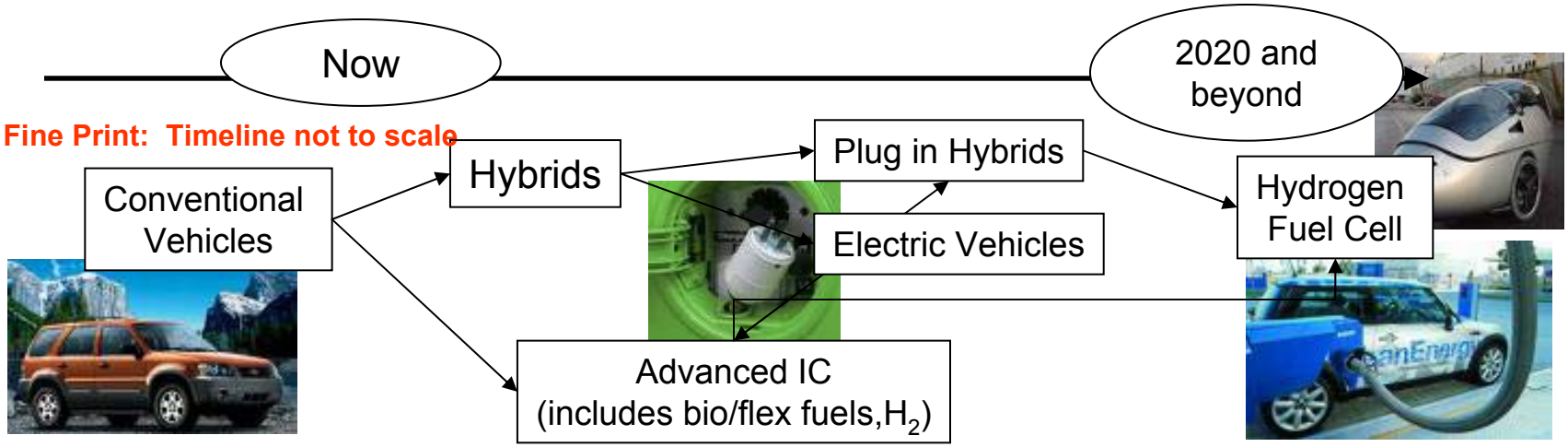
Canada and US: Fuel Cell Forklifts at GM and Walmart Distribution Centres

Japan: Large-Scale Demo Project for Stationary PEFC system –over 2000 units installed

US: Uninterrupted power supply (UPS) to keep critical data centers and telecommunication towers up and running

H2FC Vehicle Development

- The international community sees H_2 as a major component to a future clean energy and clean transportation mix
- H2FC vehicles are part of a long term solution
  - OEMs moving to electrification
  - PHEV, EV and hybrid IC are also part of the mix
- IPHE members have partnerships with major automotive OEMs
- Over 100 vehicles have been demonstrated, with significant programs in US, Japan and Germany

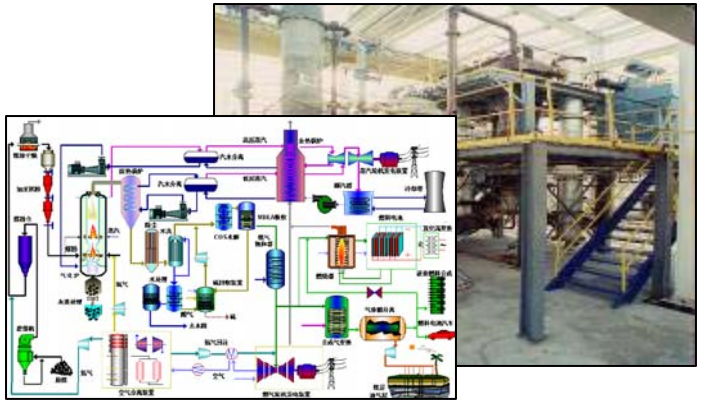


IPHE Member Activities in H2 Infrastructure

- H2 production/distribution from a variety of hydro carbon and renewable hydrogen sources

New Zealand: Wind-/HyLink-/AFC H2 Distributed energy project a first for rural communities

Germany: H2 for transit buses



Italy, China: Green Coal-Based Power Generation

Canada: World First 700 Bar H2 Refueling Station

Japan: JHFC Yokohama-Tsurumi Hydrogen Station

US: Hydrogen & gasoline station Washington, DC

Current Industry Snapshot

Global industry focus on commercialization

According to Fuel Cell Today ramp-up of activity in 2007*

- Over past three years, annual growth rate of 59%

- From 2006
  - Revenues increased 59% to $416M
  - R&D consistent at $213M
  - Employment increased by 10% to 3,434
  - Market capitalization increased 20% to $3.8B
  - Increasingly developing strategic relationships with OEMs and energy providers

  - Supply chains needed for volume production and focus on generating near term revenues
  - No company is profitable – firms share net losses of $644M
- Cost reductions averaging 10% to 20% per annum

*Fuel Cell Today: Fuel Cells: Commercialization Industry Review 2008

Closing Remarks

- In spite of commercial advances in near term markets, H2FC technologies for the mass markets are a long term solution
- Key obstacles remain:
  - Costs to manufacture, store and transport H2 compared to conventional fuels
  - Infrastructure development
- Much R&D is still required
- Complementary technologies such as EVs, PHEVs will help to stimulate uptake of H2FC technologies in mass markets
- A short/medium term policy view may hinder H2FC development in certain sectors
- Successful H2FC uptake will require strong public private partnerships with a long term view to ensure sufficient technology and R&D support

…/cont'd

Closing Remarks

- Enhancing/establishing collaboration with the EU will help:
  - •Develop international policies and programs to better tackle the remaining obstacles to successful commercialisation
  - •Promote the benefits of H2 and FCs through ongoing education and demonstration activities
  - •Act as broker between the EU and IPHE members sharing information on best practices, lessons learned and international activities
  - •Build common messaging on the relevance of international priorities and activities
- Working together will certainly facilitate overall progress, provide positive solutions and avoid duplicating efforts

Thank you.

www.iphe.net