Transportation and Stationary Power Integration Workshop (TSPI)

Overview of Options to Integrate Stationary Power Generation from Fuel Cells with Hydrogen Demand for the Transportation Sector

Fred Joseck

U.S. DOE Hydrogen Program

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Why Integration?

- **Move away from conventional thinking…fuel and power generation/supply separate**
- **Make dramatic change, use economies of scale, jump start transition, and take advantage of *integration***
- ***Shift the paradigm***
- ***Use Stationary power generation as the backbone and build out hydrogen supply from the central generation facility for transportation, distributed power and auxiliary applications***

Results of Infrastructure Lessons Learned Project

Alternate Fuel Infrastructure Lessons Learned Project

- Project with NREL
- Workshop held in April 2008

Results of project

- General Lessons Learned
- Availability of refueling infrastructure critical to successful roll-out of vehicles
  - Supply and demand of hydrogen must be coordinated
- Convenient locations and accessibility of fuel increases utilization
- Contracts and permitting can be significant obstacles
- Ensure station investments receive an acceptable rate of return
  - Increasing hydrogen demand to achieve acceptable return on investment will take time
- Large energy companies or fuel providers do not own, operate or design stations as a core business
  - They do not own primary energy resources that these systems draw upon
  - They do not see any advantage in shifting expertise and capital to retail hydrogen stations
  - As a result, need to engage entrepreneurial community

Results of Infrastructure Lessons Learned Project

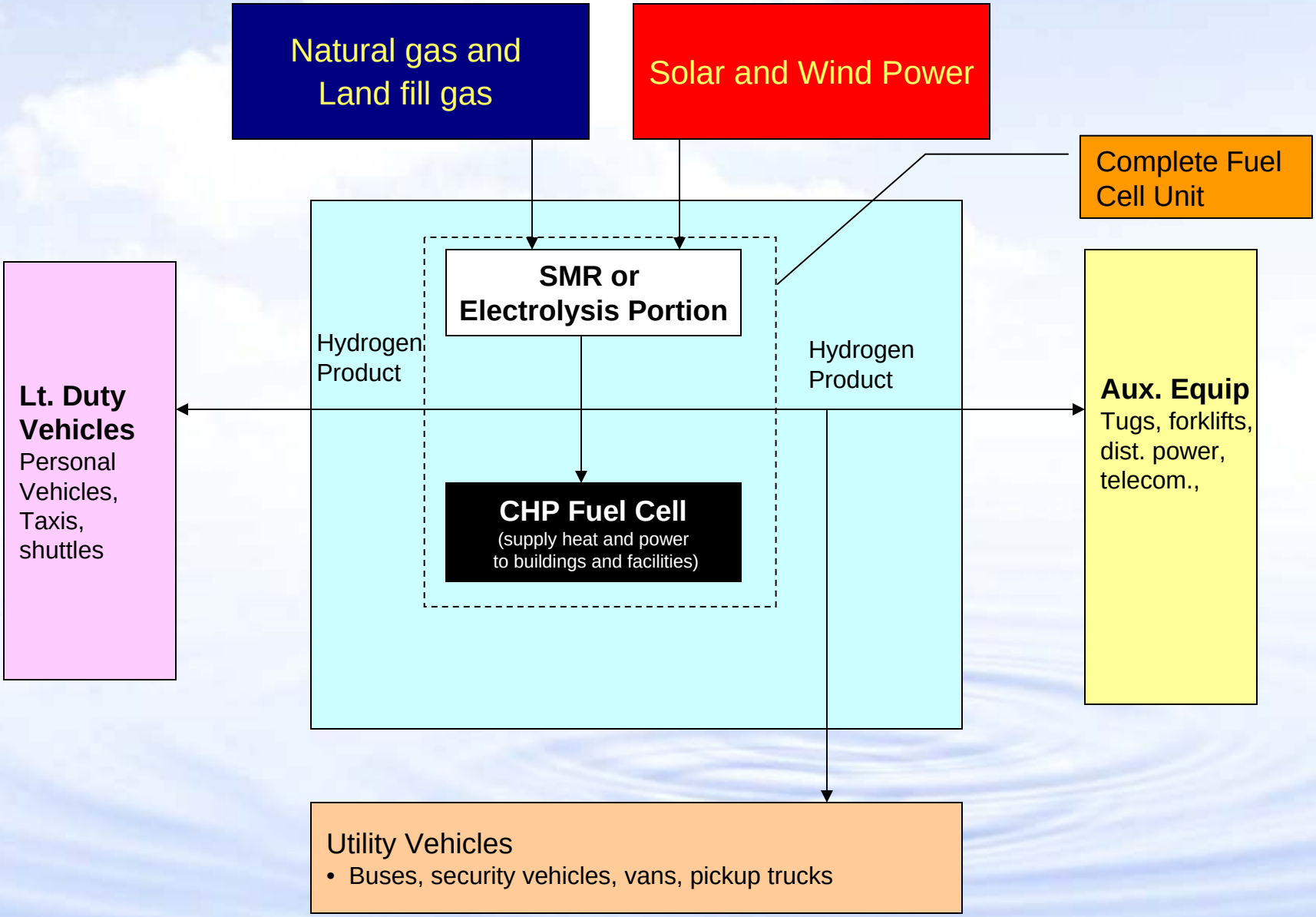
Study and Workshop Results

- Stranded capital is a real concern…do not want to over build stations without demand
- Shorter payback on capital is required if station is underutilized
  - Price of hydrogen needs to be high enough to get acceptable return
- Policy and funding issues stand in way of hydrogen infrastructure development
  - Govt/industry must partner to jump start station refueling infrastructure
  - Policies need to effectively engage the entrepreneurial community

Integration of Stationary Power Generation, Distributed Power, and Hydrogen Fuel Supply…Potential Candidates

	Hydrogen Application					Issues/Barriers Addressed			
	Lt. Duty Transport (taxis, personal)	Buses/ govt vehicles/ security vehicles	Dist. Power	Backup Power	Tele com.	Public Access	Land for prod and dispens. equip	Access to feedstck and utilities	**Econ. Case**
Airport Systems									
Public Hospitals									
Communities									
Shopping centers									
Government facilities									
VA hospitals									
Post Offices									
Fleets									
National Parks									
Military bases									
Municipalities and Local government agencies									
Fire and Rescue facilities									
Policy stations									
Data centers									
Universities									

Hydrogen Integration Scheme



Integration of Stationary Power Generation, Distributed Power, and Hydrogen Fuel Supply - Technologies

Technology	Application	Being used for Large Scale	Reliability
SOFC	Stationary Power- Fuel Cell	Yes	Yes
PEM	Backup Power-Fuel Cell	Yes	Yes
PEM	Distributed Power-Fuel Cell	Moderate	Yes
PEM	Buses- Fuel Cell	Moderate	Moderate
PEM	Light Duty Vehicles-Fuel Cell	Limited	Limited to Moderate
Steam Methane Reformer	Hydrogen generation	Yes	Very
Pipelines	Hydrogen delivery	Yes- Over 1000 miles	Very
Stations	Hydrogen delivery	Limited to Moderate	Limited to Moderate

Early Barrier Resolution for Transition and Early Markets

	Barrier resolution Yes/No	Description
No Infrastructure	Yes	The need for extensive infrastructure is not required to initiate hydrogen fuel supply for transportation. Need for extensive liquid delivery is not required. Use existing pipeline technology.
Insurance	Yes	Use government and large corporations insurance for hydrogen supply and systems.
Business case issue for providing fuel	Yes	Business case is based on integrating central hydrogen supply for CHP, SOFCs and distributed power.
Plea for government intervention	Yes	By using government facilities, fuel supply could be supplied at marginal cost which would be significantly lower than gasoline or other company supplies of hydrogen.
Need for fuel subsidy and policy	Partially	Use existing government subsidies such as loan guarantees and fuel cell incentives. However, these incentives for fuel may have to be expanded. OEMs will still need to drive the price of the vehicles down.
Logistics for fuel supply	Yes	By using post offices, hospitals, airports, universities, police headquarters, big box stores, shopping centers, and military bases, fuel supply can be made available throughout the cities.
Hydrogen storage and fuel cell development	Partially	This scheme would enable the goals and research to continue to gain progress to reducing fuel cell and storage costs.
Hydrogen cost from renewables	Yes	Use renewable sources such as land fill gas, wind and solar to generate hydrogen. Biomass is a potential source.
Land availability	Yes	Government facilities and large facilities have access to land area.
Permits and Rights of Way	Yes	Rights of Way on government or large facilities are not required. Permitting efforts will be minimized since it is focused on facilities properties.

Enablers for Integration

Existing Incentives and Policies

Federal Incentives – Fuel Cells

Business Energy Tax Credit

- (H.R. 1424 Div. B The Energy Improvement and Extension Act of 2008)
- Extends the existing tax credit by 8 years
- Applies to Commercial, Industrial, and Utility Sectors
- 30% of expenditures or $3,000 per kW whichever is smaller
  - Minimum capacity of 0.5 kW
  - Electricity only efficiency of 30% or greater
- Prior to October 3, 2008 the credit was capped at $1,000/kW

Federal Incentives – Fuel Cells

Residential Renewable Energy Tax Credit

- (H.R. 1424 Div. B The Energy Improvement and Extension Act of 2008)
- Extends the existing tax credit by 8 years
- Applies to Residential Sector
  - Home must be the principal residence of the taxpayer
- 30% of expenditures up to $500 per 0.5 kW per person claiming the credit
  - Minimum capacity of 0.5 kW
  - Electricity only efficiency of 30% or greater
  - Maximum of $1,667/ 0.5 kW for all claimants combined

Federal Incentives – Fuel Cells

Renewable Energy Production Incentive

- Federal incentive payments of 1.5c/kWh (1993$ indexed for inflation) during the first 10 years of operation
- Eligible electric production facilities;
  - Not for profit cooperatives, public utilities, state governments, commonwealths, territories, DC, tribal governments, or a political subdivision thereof and Native Corporations
  - Electricity must be generated from renewable sources (including biomass derived hydrogen for fuel cells)
- Subject to availability of appropriations.

Federal Incentives - CHP

- New tax credit for Combined Heat and Power (CHP) systems under HR 1424
  - Applies to Commercial, Industrial, and Utility Sectors
  - Applies to systems up to 50 MW that exceed 60% energy efficiency
    - Efficiency requirement waived for systems that use biomass for at least 90% of the system energy source (but credit may be reduced)
  - Credit equal to 10% of expenditures

Other Federal Incentives

Accelerated depreciation

- 2005 Energy Policy Act (EPAct 2005) specified a 5 year depreciation schedule for fuel cells
- Economic Stimulus Act of 2008:
- 50% bonus depreciation - Owner can deduct 50% of adjusted basis in 2008
  - Fuel must be renewable
  - Fuel cell must be acquired in 2008.
  - Fuel cell must be placed in service in 2008, or in limited cases in 2009
  - 20 year or less depreciation under normal MACRS rules
  - Claimant must be the operator
- **Loan Guarantee Program**

State Programs

- Typically only apply to fuel cells using a renewable energy source
- Grant programs (feasibility studies, design and construction)
- Interconnect standards (distributed generation)
- Renewable Portfolio Standards
- Net metering rules
- Feed-in tariffs (production incentives setting buy/sell prices)
- Rebate programs
- Low interest loans
- Tax exemptions
- R&D grants
- Demonstration projects

Benefits/Summary

- Reduce carbon foot print from improved efficiency from central facility.
- Reduce cost of power generation.
- Reduce natural gas use.
- Reduce carbon from reduced dirty power generation.
- Enable hydrogen to be provided for emerging light duty vehicle.
- Enable incremental hydrogen to be supplied for emerging fleet.
- Enable hydrogen to be provided throughout the cities for access to hydrogen.
- Get over the infrastructure requirements and inefficient liquid hydrogen delivery.
- Overcome the issues for insurance.
- Overcome the hurdles of profitability. By linking with government facilities, government does not need to make profit on fuel sold to the public. Also, hydrogen could be sold at variable cost price.
- Overcome the land issue. Able to link to large land areas of government, university, municipal facilities with large amounts of land.
- Have access to public through various methods.
- Resource accessibility is quite easy.
- Permitting time and right of way issues can be easily resolved.

Incentives and policies in place to help enable stationary power and fuel supply from hydrogen

DOE Integration Team

- National Renewable Energy Laboratory (NREL):
  - GIS for site locations
  - H2A stationary model
  - HyDRA model for resources
- Argonne National Laboratory (ANL):
  - GHG emissions of sites
  - Petroleum use of sites
- Sandia National Laboratory (SNL):
  - Whitney Colella (SNL) dynamic stationary system
- Macro-System Model (MSM) at NREL:
  - Incorporate stationary systems of Sandia and NREL
- Oak Ridge National Laboratory (ORNL) and Brookhaven National Laboratory (BNL):
  - Explore market opportunities and equilibrium for this system vs only transportation system