Ultra Efficient Combined Heat, Hydrogen, and Power System

DE-EE0003679

FuelCell Energy, Inc / FCE Torrington Manufacturing

10/1/2010 through 12/31/14

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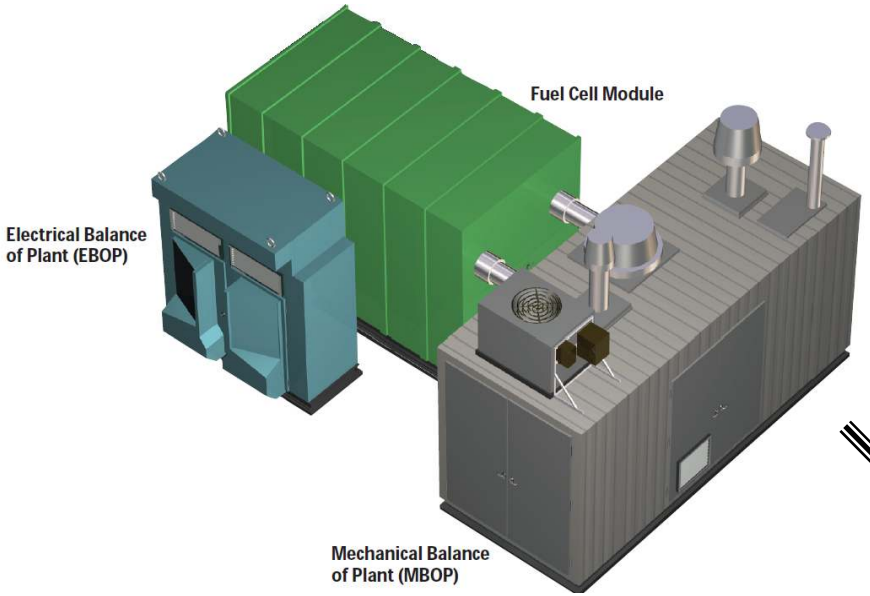
FuelCell Energy, Inc .

U.S. DOE Advanced Manufacturing Office Peer Review Meeting
Washington, D.C.
May 6-7, 2014

Project Objective

- Demonstrate Tri-generation (CHHP) combining heat, hydrogen and power production using a high temperature fuel cell to reduce O&M costs up to 25%.
- Many industrial sites import liquid hydrogen, power and natural gas at high cost. On-site Tri-generation reduces cost and increases efficiency and reliability.
- Requires integration without disturbing commercial operation. New technology being used to provide high efficiency

Project Objective



- DFC® Fuel Cell for clean power
- H2 Extraction from waste H2 in Anode Exhaust
- Heat recovery to reduce fuel costs

Hydrogen + Heat + Power

Technical Approach – Current Practice

- Today purchase liquid (or compressed) H2 and N2 for reducing gas in sintering furnace. **Delivery and storage costs more than cost of gases.**
- Purchase Power from grid
- Purchase Natural Gas and Power for Heat

Copper Furnace

Nickel Furnace

Technical Approach – Innovation

- Low cost reducing gas produced on-site using tri-generation system along with power and heat.
- Waste H2 from high temperature fuel cell recovered to provide reducing gas
- Low pressure H2 purification will provide reducing gas

Expect success because

- Building on commercial DFC® technology.
- Building on existing tri-generation Orange County, Ca. Project.
- Key parts are solid state, no compressors used.

Technical Approach – Market Leadership

Design

Megawatt–class distributed power generation solutions

Manufacture

Global manufacturing footprint

- *North America*
- *Europe*
- *Asia via partner*

Sales

Direct & via Partners

Installations & orders in 9 countries

EPC*

Project Development and Project Finance, Engineering & Construction

Over 300 megawatts installed and in backlog

** Engineering, Procurement & Construction*

Services

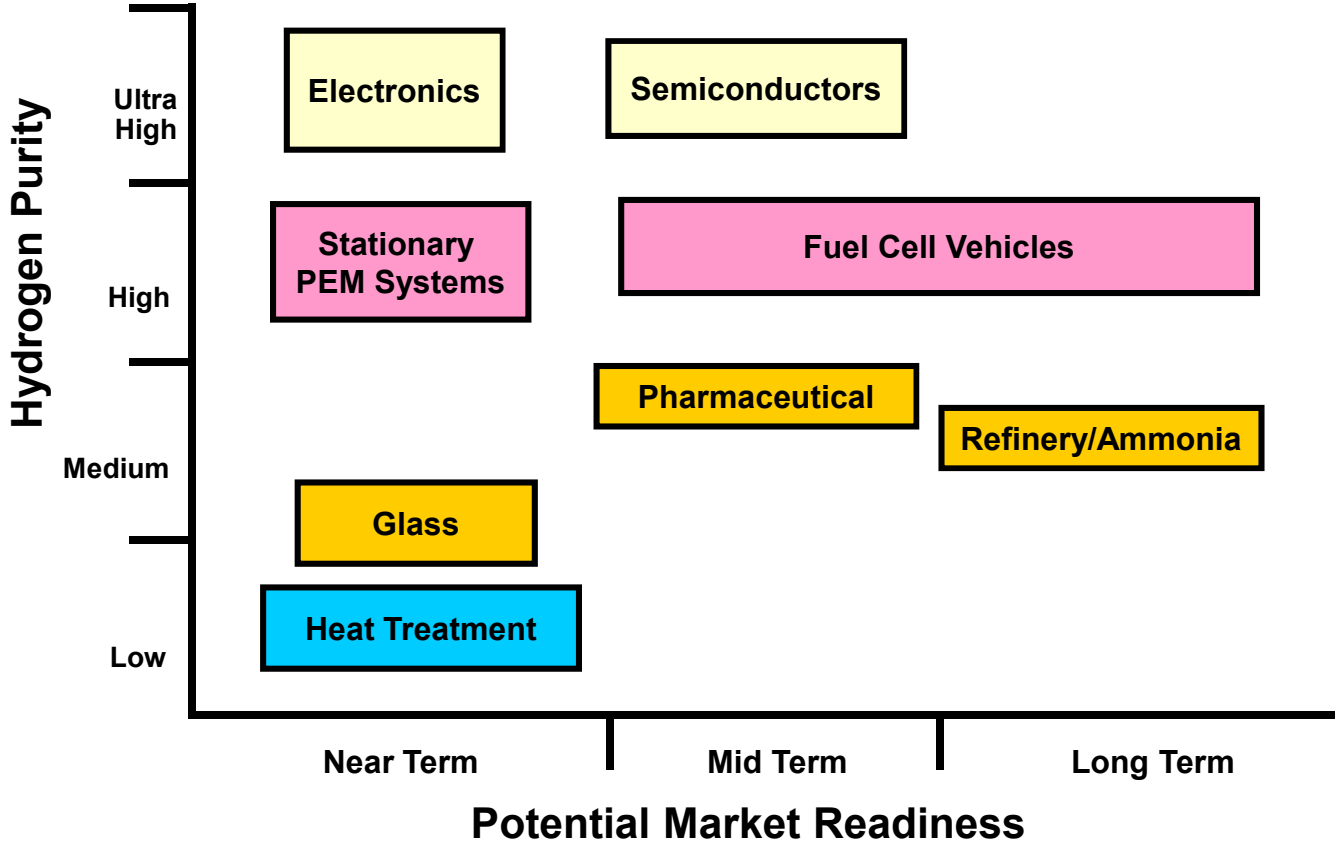
Operate & maintain power plants

- *Over 100 DFC® plants operating at more than 50 sites globally*
- *Two billion kWh ultra-clean power produced*

Providing turn-key distributed power generation solutions that meet both economic and sustainability goals

Transition and Deployment

- Who Cares - For many reducing gas users, delivery costs double or triple reducing gas cost.
- Near Term – existing users converted to on-site supply.
- Long Term – new markets develop based on lower cost.



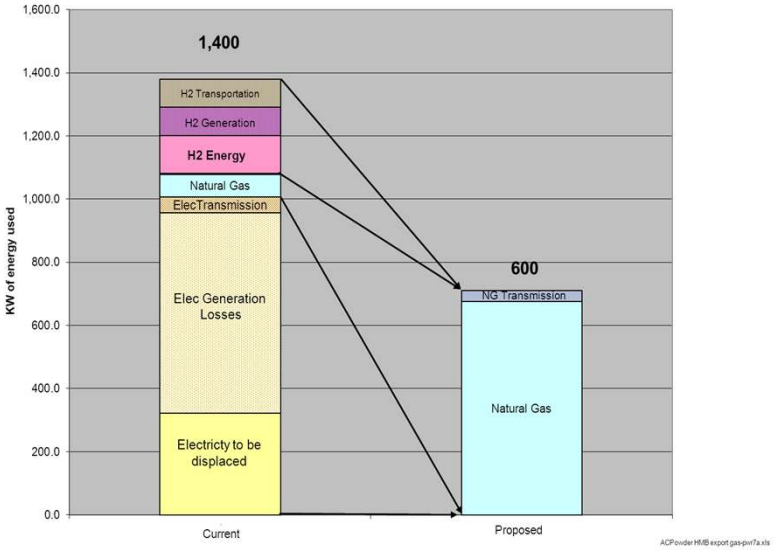
Transition and Deployment

- Identify early adapters to improve manufacturing and energy efficiency
- Near term potential sites - ACuPowder parent company, Steel Company Europe & California, Float Glass California, Heat Treatment Connecticut
- MPA (Metal Processing Association) indicated iron and other metal powder users
- Develop business model for disruptive technology
  - Who owns, Value proposition,
- CHHP technology scale up to megawatt size

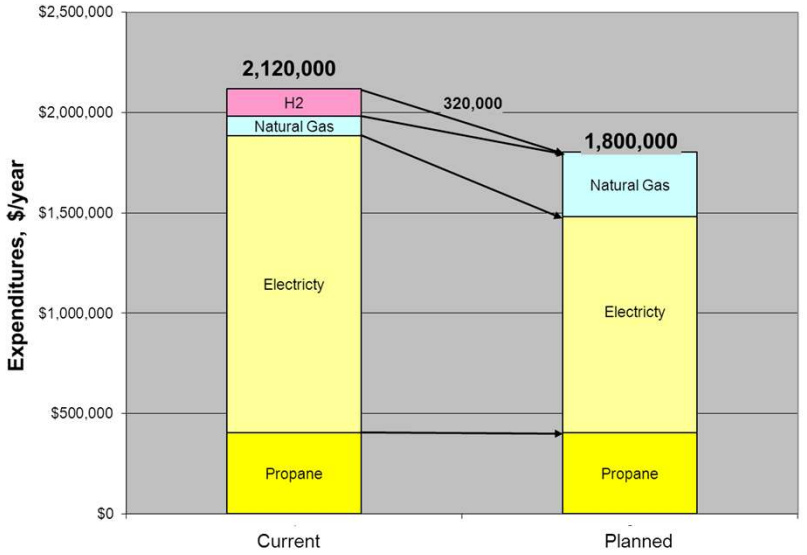
Measure of Success

- Success criteria
  - Maintain product quality (match properties, satisfy customers)
  - Substantially reduce gross utility costs (up to 15-25%)
  - Attain ultra high efficiency (60-75% power+ reducing gas)
  - No new emissions of criteria pollutants

40 to 50% reduction in energy



Gross Utility Savings ~$320,000
15 to 25% of costs



Project Management & Budget

- Project extended due to change in host site. (to 12/31/14)

Mile stone	Description	Completion Date	%	Progress Notes
1	Permitting	8/1/12	100%	Permitting complete.
2	Equipment Purchases	6/1/13	100%	All equipment installed.
3	Unit Construction	9/15/13	100%	Construction complete.
4	Factory Test	2/15/14	100%	Testing in Danbury Complete.
5	Site-Preparation	6/1/14	50%	Slabs in place; Working on Tie-ins
6	Installation	6/15/14	0%	
7	Start-up	7/1/14	0%	
8	Initial Testing	8/1/14	0%	
9	Operation Summary	12/31/14	0%	

Total Project Budget	
DOE Investment	2,780,000
Cost Share	2,880,000
Project Total	**5,660,000**

Results and Accomplishments

- New host site qualified and agreement complete.
- Factory Acceptance Test successful.
- Unit is ready for demonstration testing.

Work to be completed

- Prepare for shipping and ship unit to site
- Install at site and tie-in utilities
- Commissioning and start-up
- Operation and reporting


Planned Site for Unit
Technology Park Dr