

BALLARD®

power to change the world

Driving Productivity In Material Handling Using Fuel Cells

*Fuel Cell Seminar
November, 2009*



BALLARD POWER SYSTEMS

BUILDING A CLEAN ENERGY GROWTH COMPANY

WWW.BALLARD.COM

NOVEMBER 2009



CLEAN ENERGY FUEL CELL PRODUCTS...

▶ OUR COMPANY

- Approximately 335 employees
- World-leading R&D & manufacturing facilities
- Locations in Vancouver, Canada (HQ) & Lowell, MA

▶ OUR BUSINESS

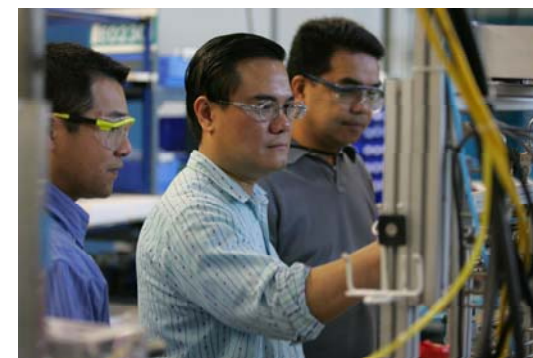
- Design, manufacture, sale & service of hydrogen fuel cell products

▶ OUR CUSTOMERS

- System integrators and OEM's addressing end-user needs: materials handling, telecom backup power, residential cogeneration, and transit buses

▶ OUR FOUNDATION

- *Technology Leadership* – 350+ Patents and patent applications
- *Production Expertise* – Shipped over 100MW fuel Cell Products
- *Expanding Go-to-Market Capabilities* – Powered over 1,000 stationary installations and over 200 heavy and light duty vehicles



The Company

- Design, manufacture, sale & service of hydrogen fuel cell products
- Acknowledged leader in zero emission **PEM fuel cells**

Our Focus




- Power **lift trucks** (~\$1.5 billion addressable market)
- Provide **backup/supplemental power** (~\$2 billion addressable market)
- Power other emerging applications

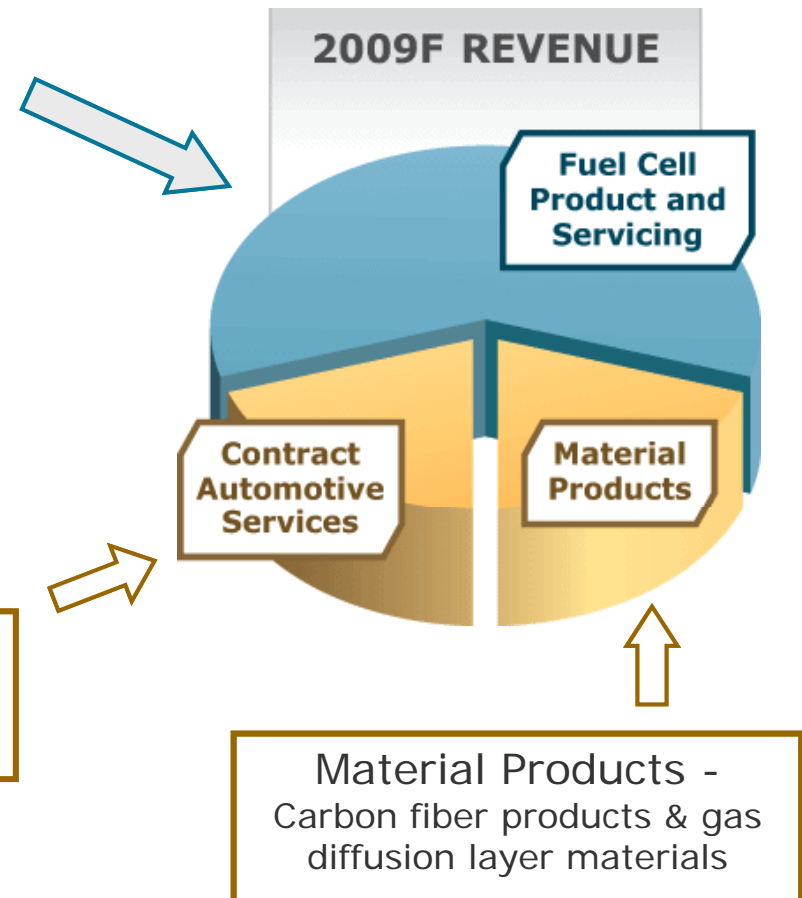
Our Customers







- **System integrators, OEM's, utilities** including:
 - Plug Power
 - Dantherm
 - Motorola
 - ACME Tele Power
 - IdaTech
 - BC Transit
 - Raymond Corp.
 - Exide Technologies

The Opportunity

- To become a **profitable clean energy growth company**
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Clean Energy Fuel Cell Products	
Stationary Power	Motive Power
	 



Fuel Cell Growth Markets	
Stationary Power	Motive Power
<p>Backup Power</p>  <p>Distributed Power Generation</p>  	<p>Material Handling</p>  <p>Heavy Duty</p>  

Leading Fuel Cell Products Portfolio



PRODUCTS	Power Level (gross)	Life	Product Positioning
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Stationary Power

FCgen™-1020ACS	0.3 – 3.4kW	4,000 hrs	Telecom backup power
FCgen™-1300	2.3 – 11kW	10,000 hrs	Telecom backup power

Motive Power

FCvelocity™-9SSL	4.4kW – 19.3kW	10,000 hrs	Material handling applications
FCvelocity™-HD6	75kW & 150kW	6,000 hrs	Bus & other heavy-duty applications



Fuel Cells in Material Handling

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- **Increased lift truck uptime**
 - Eliminate need to change batteries
 - Quick refuelling vs. long battery charging
 - Extended runtime
- **Consistent power**
 - Better truck performance at end of shift
- **More productive warehouse floor space**
 - Eliminate need for battery room
- **Environmental benefits**
 - Zero emissions
 - Reduced GHG emissions
 - Eliminate need to handle, store, and dispose of lead & acid



Value Proposition Explained

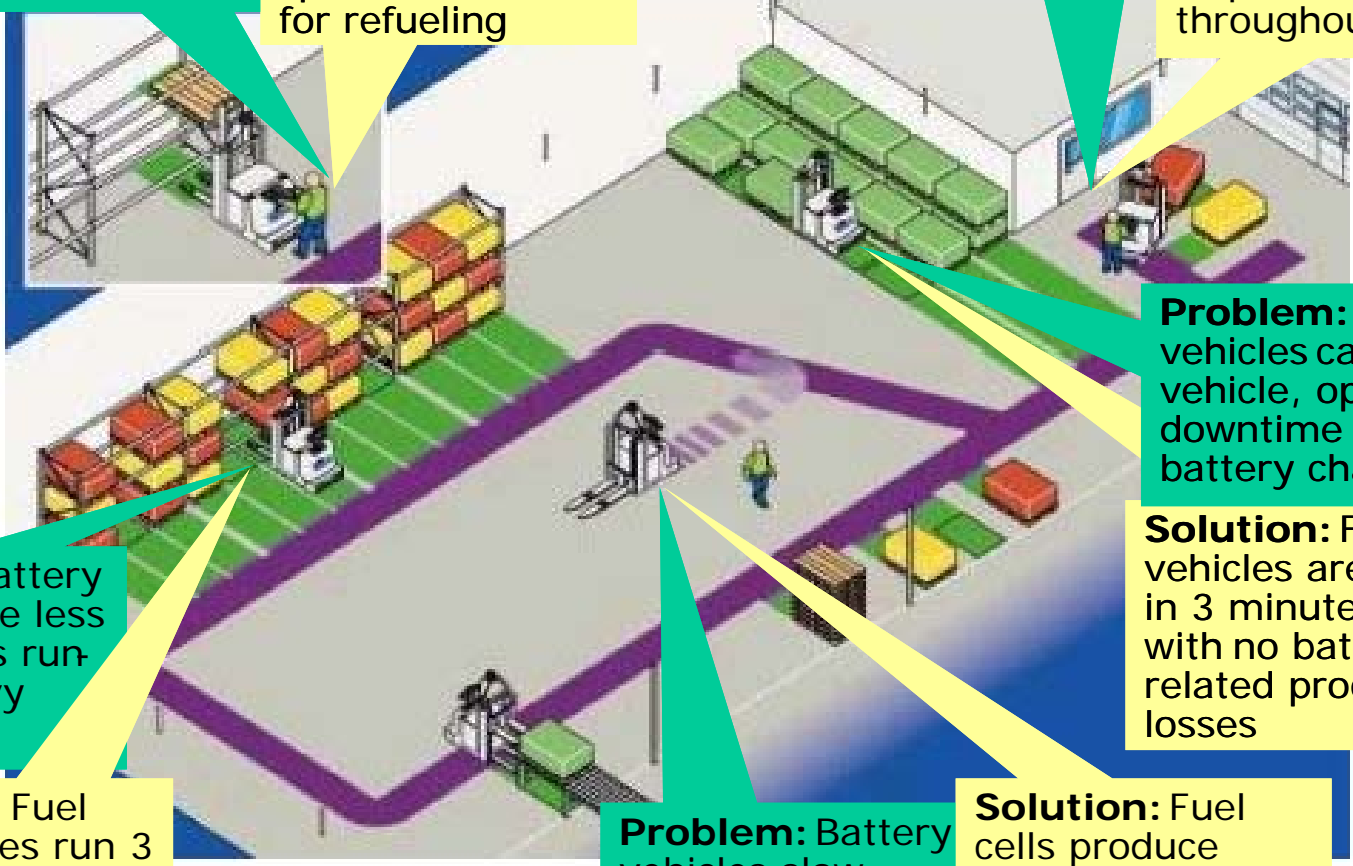


Problem: Battery vehicles require specialized labor for changing and maintenance

Solution: Fuel cell vehicles do not require specialized labor for refueling

Problem: Battery rooms take up valuable floor space & vehicles are tied to them

Solution: No battery room required & fuel dispensers located throughout facility



Problem: Battery vehicles cause vehicle, operator downtime for battery changing

Solution: Fuel cell vehicles are refueled in 3 minutes or less, with no battery related productivity losses

Problem: Battery vehicles have less than 6 hours run-time in heavy applications

Solution: Fuel cell vehicles run 3 times as long

Problem: Battery vehicles slow down and incur motor damage as they discharge

Solution: Fuel cells produce constant voltage, so vehicles never slow down



■ Fuel Cell Battery Emulator (FCBE)

- Replacement for lead-acid battery
- **Benefit:** Removal of battery charging infrastructure, fast-fill, extended run-time, increased productivity



■ Fuel Cell Hybrid Battery (FCHB)

- Small fuel cell trickle charges lead-acid battery
- **Benefit:** Removal of battery charging infrastructure, fast-fill, improved productivity



■ Integrated Forklift Truck (IFC)

- Forklift truck contains built-in fuel cell engine
- **Benefit:** Removes constraints of truck designed around battery





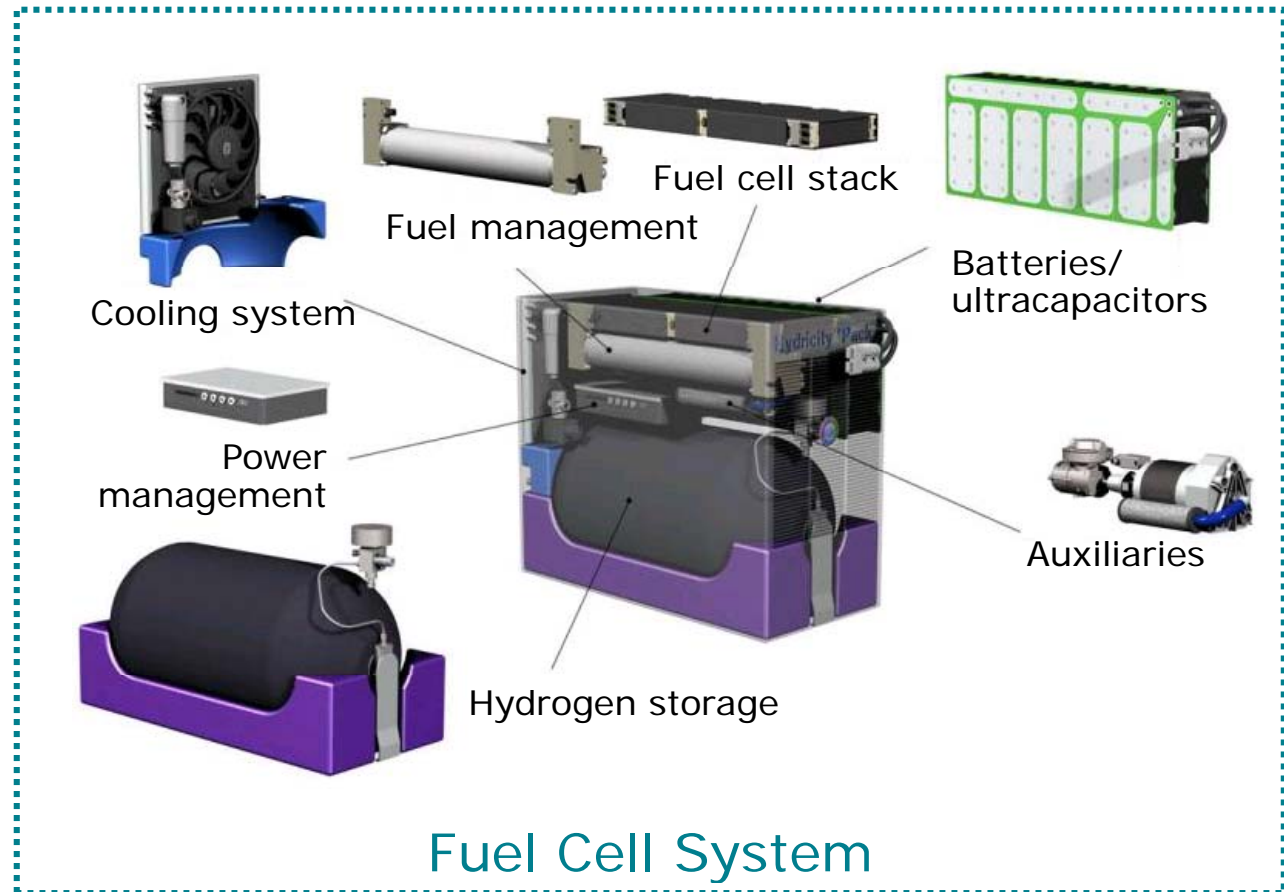
Fuel Cell Stack



FCvelocity™-9SSL

- Simplified, modular stack
- Easily integrated into a system
- Proven durability (10,000 hrs)

Fuel Cell Battery Emulator



Commercially Available Products



Class 3



Class 1



Class 2

Images courtesy of Plug Power Inc.



Commercial End Users – Walmart

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plug power

- 2006 - successful trials completed
- 2007 – commercial order for Plug Power GenDrive™ units.
- Plug Power GenDrive™ currently in operation at Walmart DC – Washington Court House, Ohio

“We’ve seen how fuel cells can improve efficiency in our distribution centers while enabling us to be more responsible global citizens.”

Johnnie Dobbs, EVP – Logistics and Supply Chain, Wal-Mart Stores



Commercial End Users - Central Grocers

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plug power

- 290,000 sq. ft “greenfield” distribution center located in Joliet, IL – opened March 2009.
- Full facility operating on hydrogen fuel cells for increased productivity and environmental benefits
- 220 units
- Hydrogen provided by Air Products
- Expect a total savings of \$1.5M over ten year product life





- 32 Plug Power GenDrive™ units installed at Nestle Waters North America plant in Dallas, TX
- Full conversion of sit-down counterbalance forklift truck fleet from internal combustion engines (LPG) to hydrogen fuel cells
- Zero emission solution offsets increasing cost of carbon emissions - less expensive than installing battery infrastructure
- Hydrogen provided by Air Products





- 2008 – Aiken County, South Carolina Bridgestone Firestone Plant converted 22 forklift trucks to Plug Power GenDrive™
- Expect to convert the remainder of fleet as equipment is retired

“The fuel cells... last longer than batteries, take less time to change or refuel and only emit water vapor. This is certainly a step in the right direction as we work continually to minimize our impact on our environment.”

Mike Rose

Aiken County Plant Manager,
Bridgestone Firestone
North American Tire



Commercial End Users - DOE Announcement

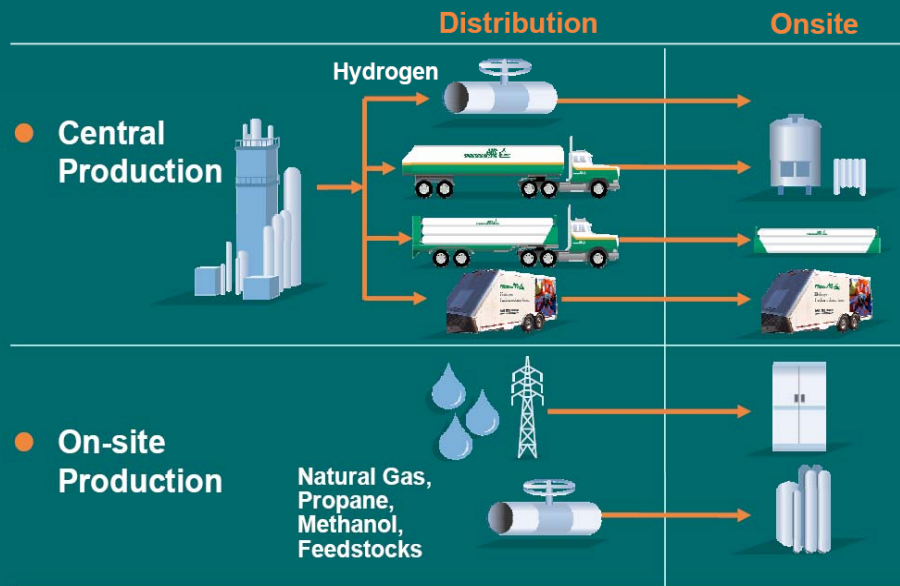


- **Sysco** - \$1.2M to deploy 90 Plug Power GenDrive™ units in Houston, TX distribution center, planned to open August 2009 (Sysco operates 169 DC's across North America)
- **GenCo** - \$6.1M to deploy 156 Plug Power GenDrive™ units at 6 distribution centers (Genco operates 109 DC's across North America)
- **FedEx** - \$1.3M to deploy 35 Plug Power GenDrive™ units at Springfield, MO service center (Fed Ex operates a network of 470 service centers)
- **Anheuser-Busch** - \$1.1M to deploy 23 Plug Power GenDrive™ units at Fort Collins, CO facility (Anheuser-Busch operates 11 US facilities)



Hydrogen Supply

Industrial Applications: H₂ Sourcing Options



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Fueling Systems



Standalone Fueling System



Wall Mounted Fueling System

Operator Refilling



Options based on:

- Warehouse size
- Daily usage
- Local availability

Advantages:

- On-site refuelling
- No Battery Rooms / Chargers
- No Battery Swaps

Images courtesy of Air Products Inc.

Hydrogen Installations



Images courtesy of Linde BOC



Indoor Hydrogen Dispensing

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Images courtesy of Linde BOC



- Target end users for early adoption
 - ▶ High throughput distribution centers or large manufacturers
 - ▶ Operate large fleets (>30 trucks)
 - ▶ Run multi-shift operation (2-3 shifts/day)
 - ▶ National accounts / corporate decisions
- Key factors affecting ROI & payback time
 - ▶ Hydrogen consumption ▶ hydrogen price/kg
 - ▶ Battery changing characteristics
 - ▶ Labour rates
- A payback time of 2-3 years is achievable today for target customers



Return on Investment Model

Batteries vs Fuel Cells



► Key assumptions for the battery option are:

Cost per battery:	\$2,600 Class 3 \$4,900 Class 2 \$5,500 Class 1
Number of batteries:	2 per truck
Cost of battery chargers:	\$2,300 per truck
Electricity price:	\$0.08 per kWh
Annual battery room G&A:	\$1,000 per truck
Average battery life:	5 years
Lost productivity per battery change:	20 minutes
Labor rate of the lift-truck driver:	\$25 per hour

► Key assumptions for the fuel cell system option are:

Cost per fuel cell system:	\$20,000 Class 3 \$40,000 Classes 1 & 2
Number of fuel cell systems:	1 per truck
Fuel cell tax credit rebate:	30%, up to \$3,000 per kW
Hydrogen price (including delivery & storage):	\$8 per kg
Annual fuel cell system maintenance:	\$200 per truck
Average fuel cell system life:	10 years
Annual fuel cell stack life:	10,000 hours
Lost productivity per hydrogen refill:	3 minutes
Labor rate of the lift-truck driver:	\$25 per hour

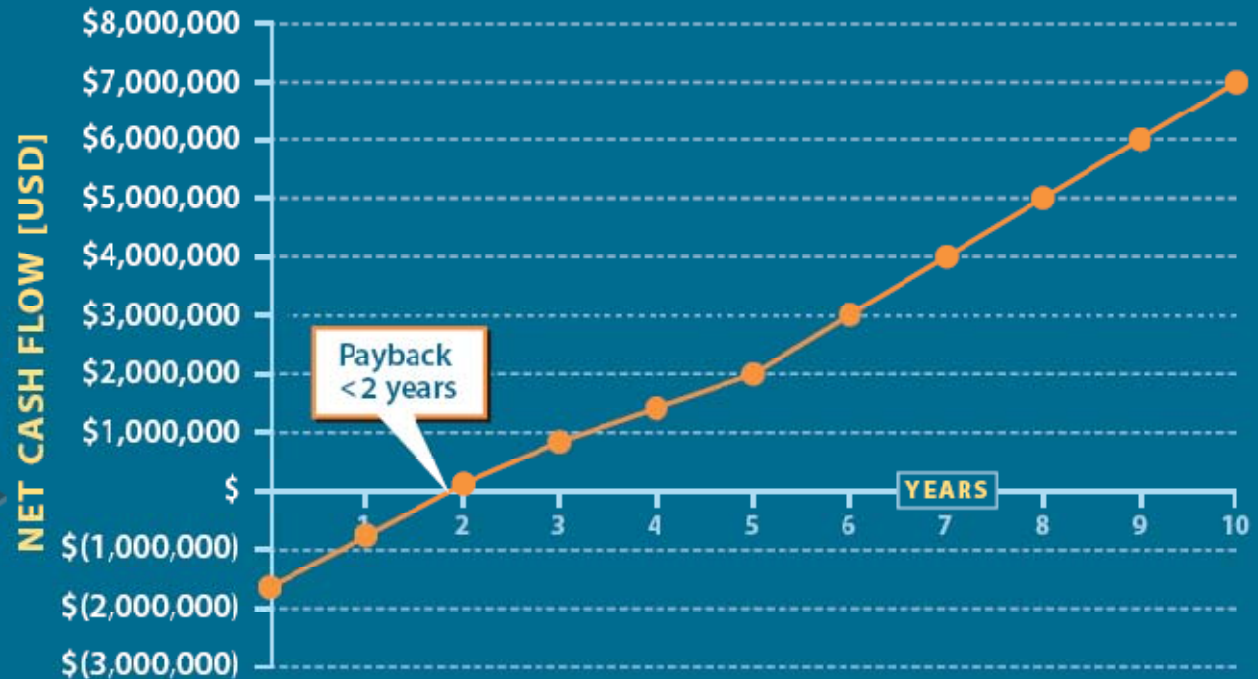


ECONOMIC RESULTS

As results of this scenario illustrate, this warehouse operation will realize a full payback in less than two years, even with an initial higher capital investment for 230 forklift trucks. Over ten years, the operation will realize a 34% savings in total lifetime ownership cost. The associated reduction in lost productivity means that over 50,000 hours of work time is recovered per year.



Net Cash Flow: Fuel Cells vs. Batteries



In this scenario, the fuel cell option yields an NPV of \$3.6 million

Compelling Value Proposition Today

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