

May 18, 2011



**BALLARD**<sup>®</sup>

# Fuel Cell Solutions for Bus Applications

## Scotland

■ A Clean Energy Growth Company | [WWW.BALLARD.COM](http://WWW.BALLARD.COM) | **TSX: BLD** **NASDAQ: BLDP**

# About Ballard



- **Founded in 1989**
- **Listed on NASDAQ (BLDP) and TSX (BLD)**
- **Cash reserves of \$61.7M** (3/31/2011)
- **Market capitalization of ~\$196M** (3/31/2011)
- **~400 employees**

## MARKET FOCUS

- Multi-market growth focus



## POSITION

- Global leader in PEM fuel cell technology & products

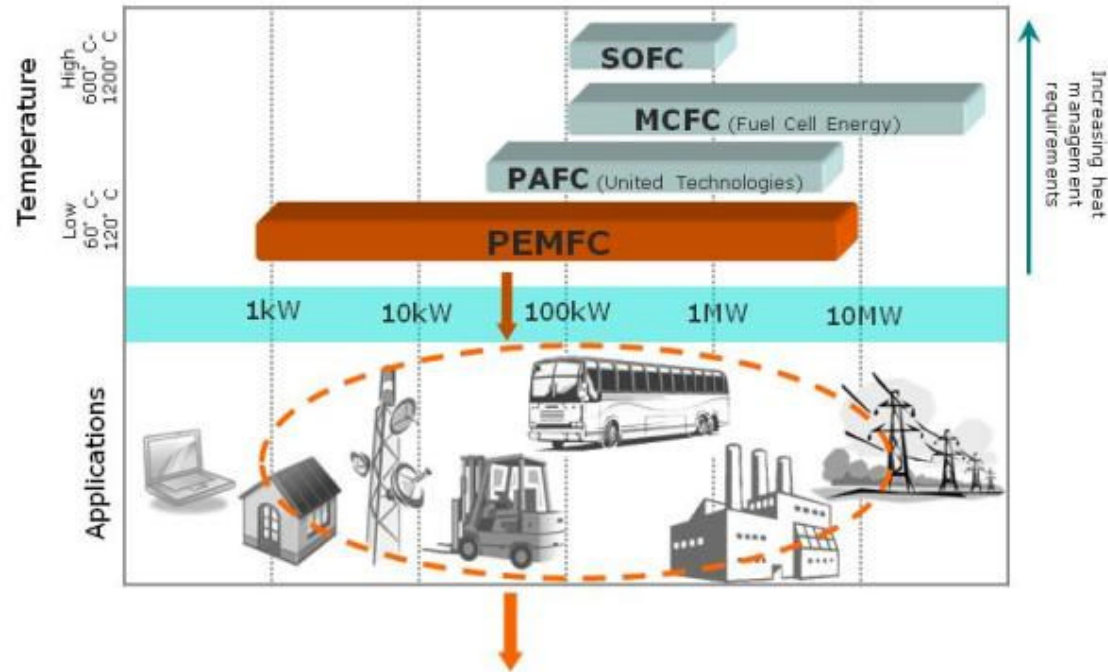


## STRATEGY

- Leverage product leadership and build key channel partnerships to establish first-mover advantage



# PEM Fuel Cells



- **Ballard leverages leadership in PEM across multiple markets...**
  - Compact & scalable
  - Fuel flexibility
  - Efficient, reliable and safe
  - Fast start-up and low temperature
  - Rapid response to changes in power demand
  - Durable across wide variety of duty cycles

# Product Portfolio

<p><b>Fuel Cell Stacks</b></p>	<p><b>FCgen®-1020ACS</b></p>  <ul style="list-style-type: none"> <li>▪ Backup Power</li> <li>▪ Power 500W-2kW</li> <li>▪ Operating life 2,500-4,000 hours</li> </ul>	<p><b>FCgen®-1300</b></p>  <ul style="list-style-type: none"> <li>▪ Distributed Generation</li> <li>▪ Power 2-8kW</li> <li>▪ Operating life 20,000-30,000 hours</li> </ul>	<p><b>FCvelocity®-9SSL</b></p>  <ul style="list-style-type: none"> <li>▪ Material Handling</li> <li>▪ Power 4-20 kW</li> <li>▪ Operating life 8,000-12,000 hours</li> </ul>	<p><b>FCvelocity®-1100</b></p>  <ul style="list-style-type: none"> <li>▪ Power 100 kW</li> <li>▪ Operating life &gt;5,000 hrs</li> <li>▪ Contract manufactured for Daimler AG</li> </ul>
<p><b>Fuel Cell Modules</b></p>	<p><b>FCvelocity®-HD6</b></p>  <ul style="list-style-type: none"> <li>▪ Transit Buses</li> <li>▪ Power 75-150 kW</li> <li>▪ Operating life 12,000 hours</li> </ul>			
<p><b>Complete Fuel Cell Systems</b></p>	<p><b>CLEARgen™</b></p>  <ul style="list-style-type: none"> <li>▪ Distributed Generation</li> <li>▪ Multi-MW power</li> </ul>			

\* As of end 2010; dependent on power level & volume commitment

- **Ballard's product portfolio includes fuel cell stacks, modules as well as complete system solutions**
- **Aggressive cost reductions: average of 45% across products in 2008-10, further 20-25% expected in 2011**

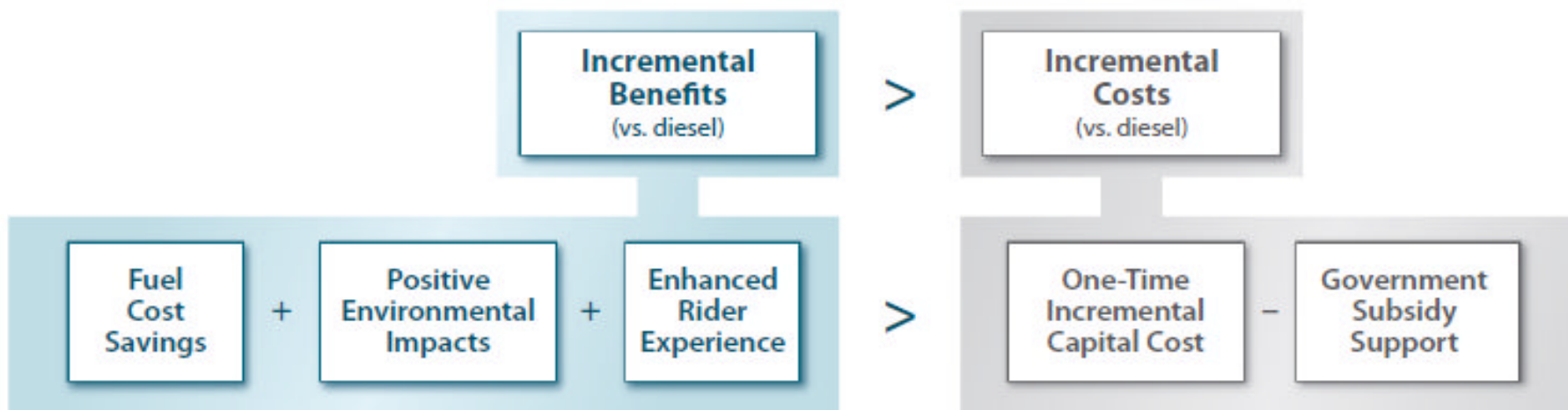
# Ballard: Putting PEM Fuel Cells To Work

- **Ballard leadership in PEM fuel cells is based on -**
  - Portfolio of proven commercial solutions for: Fuel cell stacks, power modules and complete, turn key, systems
- **Strong delivery capabilities**
  - 20 years experience developing, optimising and manufacturing fuel cells for key markets
  - Access to over 2,000 patents and licenses
  - High volume manufacturing facility
  - 100MW+ of fuel cell products shipped
- **Developing a global customer base in each of our markets-**

CHANNELS	Backup Power	Distributed Generation	Material Handling	Bus
System Integrators / OEMs	   			   
Downstream Customers	     	 	     	    

# Why Fuel Cell Buses?

- **Dramatically Reduced Greenhouse Gas Emissions**
  - Demonstrated on a well to wheel basis
- **Completely eliminates tailpipe emissions**
  - Nox, Sox, PM
- **Improved fuel efficiency**
  - 1.5-2.5x improvement over conventional diesel buses on an energy equivalent basis



# Bus Program Evolution

1991 - 1992



Phase 1  
Proof of  
Concept

**Power** 90 kW /  
125 HP

**Location(s)**  
Vancouver

**Lessons Learned**  
Proof of  
concept

1993 - 1995



Phase 2  
Commercial  
Prototype

**Power** 205 kW /  
275 HP

**Location(s)**  
Vancouver

**Lessons Learned**  
Full-size bus  
integration

1996 - 1999



Phase 3 Fleet  
Demonstration  
Alpha Sites

**Power** 205 kW/  
275 HP

**Location(s)**  
Chicago (3)  
Vancouver (3)

**Lessons Learned**  
Field service  
Site  
homologation

1999 - 2002



Phase 4 Fuel  
Cell Engines  
Beta Sites

**Power** 205 kW/  
275 HP

**Location(s)**  
California

**Lessons Learned**  
System  
optimization  
Cost reduction -  
single motor  
concept

2002 - 2009



Phase 5  
Serial  
Production

**Power** 205 kW/  
275 HP

**Location(s)**  
5 Continents  
CUTE (30),  
Perth (3)  
California (3)  
Beijing (3)

**Lessons Learned**  
International  
homologation  
Reliability  
growth  
Real world usage

## HD6 Evolution

- **The Phase 5 bus program was extremely successful with excellent feedback from the operators and riders**
- **The fleet transported more than 7 million passengers over 2.4 million km in a wide variety of environments in 5 continents**
- **Key lessons for HD6:**
  - Improve fuel economy
  - Leverage standard electric and hybrid drive systems
  - Improve stack lifetime and robustness
  - Improve system power density

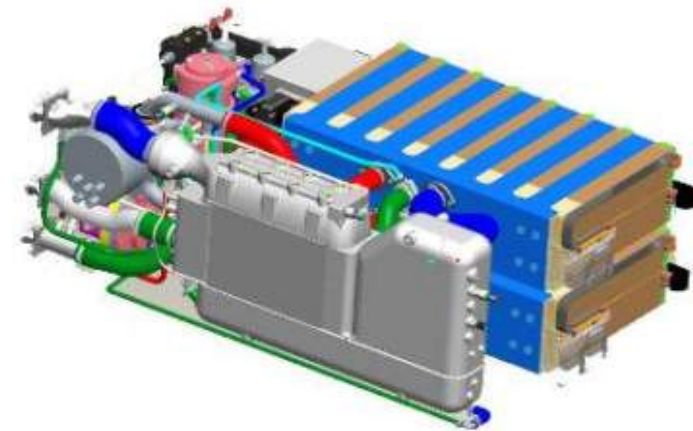


# FCvelocity<sup>®</sup>-HD6

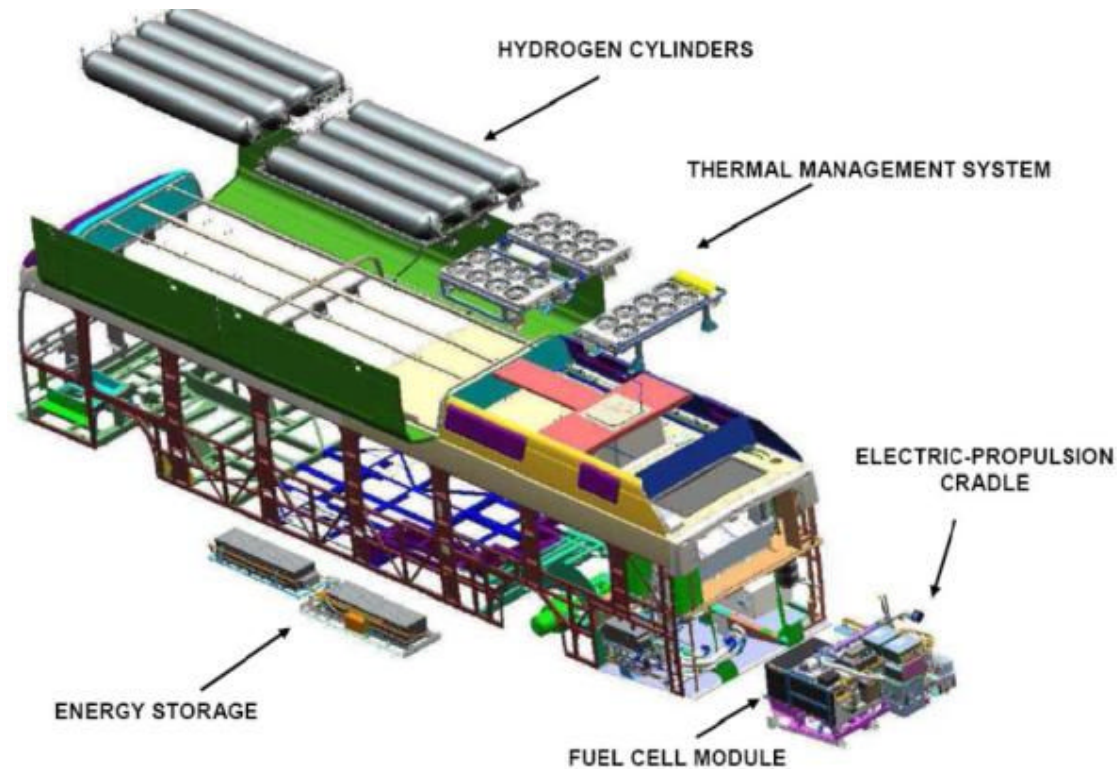
- **FCvelocity<sup>®</sup>-HD6 fuel cell module:**
  - Greater power density and durability while maintaining some of the time tested components of previous design.
  - Featuring state of the art automotive fuel cell stack technology
  - Significantly improved fuel economy
  - Offered with a 12,000 hour, or 5year warranty
- **Includes:**
  - air humidification system
  - hydrogen re-circulation
  - condenser for water management
  - CAN and power supply connections
  - control system
  - 75 or 150kW configurations



HD6 Fuel Cell Module



# Integration into a Hybrid Drive



- The fuel cell module and fuel cell system have excellent power density and are modular in design
- This permits the system to be installed in a variety of existing platforms without modification to the bus chassis



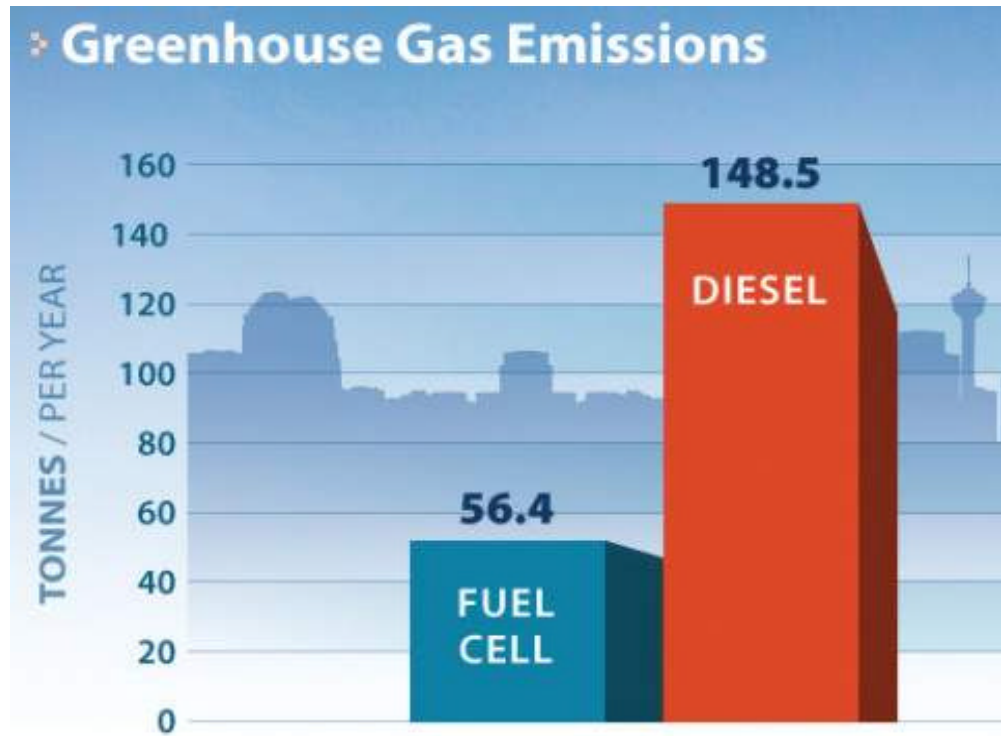
## BC Transit Fuel Cell Bus Fleet

- 20 of the 30 buses in the Whistler fleet are powered by Ballard HD6 fuel cells
- Fuel cell buses are designed to last over 20 years
- To date the fleet has demonstrated:
  - >1,000,000 km's traveled
  - >50,000 hrs of operation



# BC Transit's GHG Profile

- **Calculated on a “well to wheel basis”**
  - BC Transit has calculated\* a reduction in CO<sub>2</sub>e emissions of 62% for the buses to be operated in Whistler
  - Translates to a displacement of more than 1800 tonnes CO<sub>2</sub>e/yr for the fleet



SOURCE: Prototype evaluation data (BC Transit, 2008)

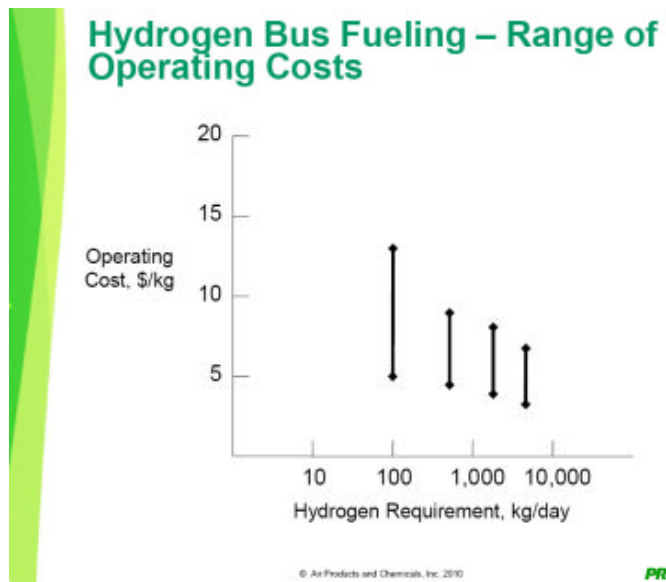
# Other Phase 6 Bus Programs

	London Bus Fleet	UNDP Brazil Fleet	Sun Line	APTS	Oslo Fleet
					
	2010 – 2014	2010 – 2012	2010 – 2014	2010 - 2015	2011 - 2016
Fleet Size	8	3	2	4	5
Transit				 	
FC Power	75 kW	150 kW	150 kW	150 kW	150 kW
Coach Manufacturer					
System Integrator					

**Ballard's HD6 can be adapted to a variety of coaches and systems integrators without any modifications to the chassis making the integration process very easy.**

# Hydrogen Fuel Situation

- **No longer the Achilles heel...**
  - **Abundant hydrogen using existing infrastructure at commercial prices from world class companies such as Air Liquide, Air Products and Praxair**
  - **As demand for hydrogen increases, the cost per kg of hydrogen reduces thereby reducing the overall operating costs**
  - **Capital cost of a fueling station can be amortized on the price of fuel for reasonable quantities**
  - **Turn-key, replicable fueling stations emerging**



## Fuel Cell Bus – Future Prospective

- There is little point in continuing to demonstrate hydrogen buses with small fleets or one offs
- On a per bus basis these small fleets are a huge cost
- Next step for the industry is cost reduction which can be achieved today at relatively low volumes
- Projects involving 75 – 100 buses from a single supplier could reduce the cost of the buses by well over 50%



- Ballard is actively working with partners to encourage deployment of larger bus fleets in the following regions:
  - United Kingdom
  - Europe
  - North America
  - South America

## Recommendations Specifically for Scotland

### Key Recommendations:

- **Avail national, local or EU funding to showcase a Scottish fuel cell bus fleet**
- **Target of a fleet of a least 20 fuel cell hybrid buses for the 2014 Commonwealth Games in Scotland**
- **Use hydrogen from totally renewable sources (such as wind electrolysis, biomass gasification, etc)**
- **Pair fuel cell system with a local coach manufacturer and BAE Systems to help create high tech jobs, in the UK and Scotland**

**BALLARD<sup>®</sup>**



**Thank You**

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