

# BALLARD

NASDAQ:BLDP • TSX:BLD

### **Fuel Cell Systems for Telecom Backup Power**

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# **Ballard - Who We Are**



- Ballard is the global leader in clean energy PEM fuel cell products ... design, manufacturing & deployment
  - 2,500 → Telecom Backup Power systems ... 9MW's of power
  - 4,000 → Material Handling stacks ... 10M hours of runtime
  - 180 → Bus power modules ... *more than 4M miles of revenue service*

#### • 355 employees

- o HQ in Vancouver, Canada
- Product Engineering in Vancouver, Bend, Oregon & Denmark
- Manufacturing in Vancouver & Mexico



Ballard HQ facility – Vancouver, B.C., Canada

# **Ballard Competitive Advantage**

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- Leadership position in technology & product development
- Long history with automotive industry
  - 4 major automotive development programs
  - Supplier to more than 10 small automotive fleets and demonstrations
- Extensive R&D work over past 15 years
  - $\circ$  \$1B+ investment in development
  - Significant contribution from Ford & Daimler
- Extensive patent portfolio and licensing rights







# **Stationary Product Portfolio**





# Ballard's industry-leading PEM fuel cell systems for stationary applications range in power output from ~2kW to multi-megawatts

### Trends Supporting Fuel Cell Backup Power for Telecom





### **Telecom Backup Power** *Approaching 2,500 Systems Shipped Globally*





### **Telecom Backup Power** *Value Proposition*







#### High Reliability

- •Commercially proven
- Industry leading technology

#### **Autonomous Solution**

- Extended duration runtime
- Remote monitoring
- Flexible fueling

#### **Reduced Operating Costs**

- Minimal maintenance
- Longer lifecycle less frequent replacement
- Not subject to pilferage issues
- Up to 20% more efficient than alternatives

#### **Environmentally Friendly**

- 20-50% reduction in CO<sub>2</sub>
- > 95% reduction in CO, NOx and SOx
- Zero particulate matter

#### **Flexible Siting**

- Light weight, small footprint
- Quiet no vibrations
- Low emissions

### Fuel Cell Solution for Distributed Generation





Power	Scalable in 500kW increments	
Packaging	Custom ISO container	
Fuel efficiency	40%, based on HHV	
Output voltage	380 - 480 V AC	
Output heat load	>950 kWt/MW	
Available water temp	60-65°C	
Siting	Self-contained systems, simple integration with plant	



- Zero-emission power production
- Compact & scalable
- Efficient, reliable and safe
- Sources of hydrogen suitable for ClearGen<sup>™</sup> system:
  - By-product hydrogen
  - Electrolysis from renewable energy



- Fast start-up and low temperature
- Rapid response to changes in power demand
- Durable across wide variety of duty cycles
- Steam-reformation of biogas
- Gasification of biomass

# **Methanol Fuel is Growth Driver**

- Methanol-fuelled systems are a key driver of growth in the telecom backup power industry
  - Liquid methanol fuel is a readily available and abundant feedstock
  - Meets demand for extended duration operation in regions with unreliable grid or natural disasters
  - o Demand requires record high production levels at Ballard's Tijuana facility



Ballard ElectraGen<sup>™</sup>-ME systems provide backup power for new telecom network in East Timor



Ballard fuel cell systems prove 100% reliable, providing backup power during Hurricane Sandy

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### **Green Advantages of Fuel Cells**





#### **Telecom Backup Power Technology Comparison**

Fuel Cell Systems vs. Diesel Generator

	ElectraGen ME System	Diesel Generator
	Fuel Cell system with	
Exhaust Emissions <sup>1,2</sup>		
Nitrogen Oxides (NOx)	0.007 g/kWh	7.5 g/kWh
Carbon Monoxide (CO)	0.17 g/kWh	8.0 g/kWh
Sulfur Oxides (Sox)	0 g/kWh	12.0 g/kWh
Particulate Matter	0 g/kWh	0.8 g/kWh
Carbon Dioxide (CO2)	783 g/kWh	1,500 g/kWh
Noise Emissions <sup>3</sup>		
Decibel rating	Quiet: 52 dB at 1 m	<b>Loud</b> : 68 dB at <b>7</b> m
	47 db at <b>7</b> m	
System Efficiency		
System Efficiency (%)	33%	10-25%
<b>Operational Costs</b>		
Maintenance (visits per year)	1	2-4
Theft Costs (fuel, parts)	None	Fuel & Parts
Reliability	Few moving parts	Many moving parts

Note 1: ElectraGen<sup>™</sup> ME System emissions data from IdaTech

Note 2: Diesel generator emissions data from EPA standards for 2007 and newer generators, EPA Standards of Performance for Stationary Compression Ignition Internal Combustion Engines; Final Rule July 11, 2006

Note 3: ElectraGen systems operated at 75% power output during noise test

# **Regional Case Studies**









#### **Hutchison Telecom**

- >250 ElectraGen<sup>™</sup> systems deployed in Indonesia
- Backup power required frequently due to unreliable grid
- Fueled with direct hydrogen

#### Bahamas Telecom Company

- 21 ElectraGen<sup>™</sup> systems provide backup power to telecom network
- During Hurricane Sandy, systems proved 100% reliable
- Fueled with HydroPlus™ methanol-water mix

#### **Toyota Motor Sales**

- 1.1 MW ClearGen<sup>™</sup>, largest PEM system in the world
- Offsets peak power rates at California campus
- Sited along hydrogen pipeline
- Avoid 10,000 tons of CO2 emissions annually





- Ballard is a global leader in clean energy fuel cell technology and power solutions
  - Active in leading markets for fuel cell commercialization, including North America, Europe, Asia, Caribbean & Latin America and South Africa
  - Offering a comprehensive portfolio of fuel cell power generation products to meet a range of stationary power needs

#### • Focused on near-term commercial applications for fuel cell products

 Positive revenue trajectory combined with solid order book underpin aggressive 2014 outlook



# **Appendix: Regional Case Studies**

### Case Study – Unreliable Grid: Backup Power Systems for Hutchison Telecom

#### **Customer:**

- PT Hutchison CP Telecom
- Location: Sumatra and Java, Indonesia
- Industry: Telecommunications

#### **Challenge:**

- Poor grid quality (several hrs/week)
- Outdoor BTS (no air conditioner for batteries)
- Diesel and battery theft issues
- Local community issues (generator noise)

#### Solution: / ElectraGen-H2

- +250 fuel cell systems being deployed
- Load (average): 1-3kW @48Vdc
- Product: 2.5 kW Fuel cell system
- Fuel: Hydrogen gas

#### Advantages:

- Site autonomy: 6 cylinders (42hrs)
- Improved site availability
- Zero emission, low noise
- Low maintenance









### Case Study – Crisis Situation: Backup Power Systems During Hurricane Sandy

#### **Customer:**

- Bahamas Telecommunications Company
- Location: Bahamas
- Industry: Telecommunications

#### **Challenge:**

- Remote locations
- Unreliable grid
- Susceptible to tropical storms and hurricanes

#### Solution / Electra Gen-ME

- 21 systems installed, additional 16 systems currently being deployed
- Configuration: 5kW, 48 Vdc
- Fuel: HydroPlus<sup>™</sup> (Methanol-Water liquid fuel)

#### Advantages:

- High reliability
- Extended duration runtime
- Minimal maintenance

#### **Result:**

- ElectraGen<sup>™</sup>- ME systems proved 100% reliable during Hurricane Sandy
- Each system operated as needed to maintain consistent power
- Provided 700 hours of backup power over a concentrated 7 day period
- Produced more than 1,200 kilowatt-hours of electricity
- Prevented a potential 50% loss of cell service









### Case Study – Peaking Power: Distributed Generation System for Toyota

#### **Customer:**

- Toyota Motor Sales
- Location: California, USA
- Industry: Automaker

#### Challenge:

 Offset peak power rates at Toyota's 5,000 employee campus

Solution: Clear Gen

- 1.1 MW ClearGen<sup>™</sup> system, the largest PEM fuel cell system in North America
- Fuel: Hydrogen

#### Advantages:

- Demand side management for Southern California Edison
- Reliable power for critical applications
- Heat will provide hot water & space heating at employee activity centre
- Avoid 10,000 tons of CO2 emissions annually



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