




BALLARD®

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Smarter Solutions for a Clean Energy Future

A Clean Energy Growth Company | WWW.BALLARD.COM | **TSX:** BLD **NASDAQ:** BLDP

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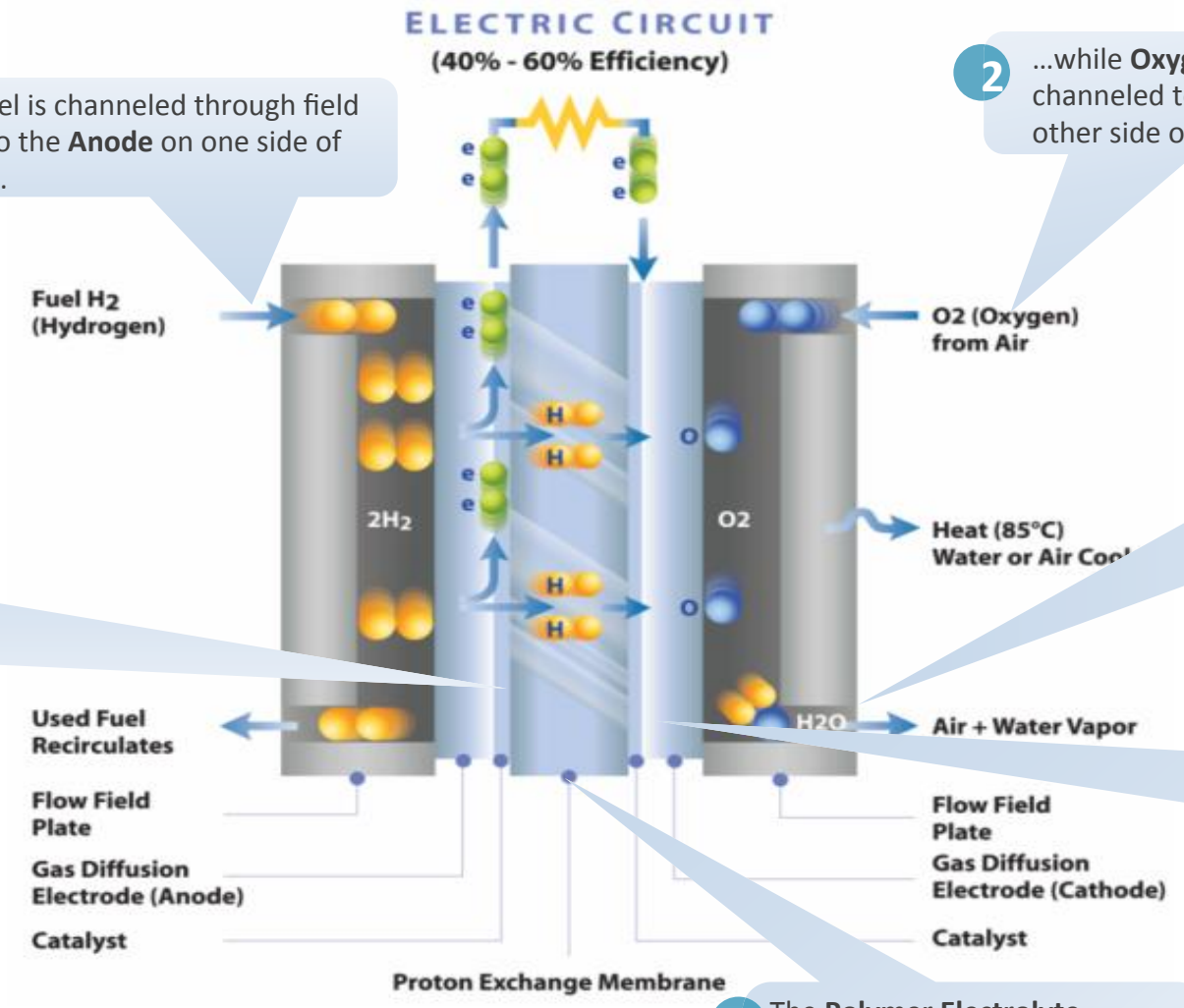
Agenda

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- About Fuel Cell
- Corporate Background
- Market Opportunity
- Availability & Supply Chain of Hydrogen
- Types of PEM Fuel Cells
- Industry Adoption of Fuel Cell Systems
- Summary

How a Fuel Cell Works

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1 **Hydrogen** fuel is channeled through field flow plates to the **Anode** on one side of the fuel cell…

2 …while **Oxygen** from the air is channeled to the cathode on the other side of the cell

3 At the **Anode**, a **platinum** catalyst causes the **Hydrogen** to **split** into positive **Hydrogen ions** (protons) & negatively charged electrons

4 The **Polymer Electrolyte Membrane (PEM)** allows only the positively charged ions to pass through to the cathode...

5 …and the negatively charged electrons are forced to travel along an external circuit to the **Cathode**, creating an electrical current

6 At the **Cathode**, the electrons and positively charged hydrogen ions combine with **Oxygen** to form **Water**, which flows out of the cell

Smarter Solutions for a Clean Energy Future

Corporate Background

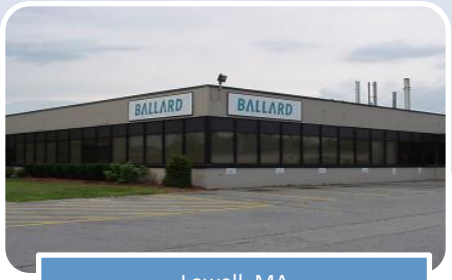
Corporate Background

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- **Ballard Power Systems, Inc. is a recognized global leader in clean energy PEM fuel cells**
  - Design, manufacturing, distribution & support
  - Multi-market focus
  - Own 80% of PEM Fuel Cell Market worldwide including India.
  - Over 2000 patents/applications owned and license rights to >1,000 patents/applications.
- **Headquarters in Burnaby, BC, Canada**
- **Operations:** Canada, Denmark, U.S.A. (Lowell, MA, University of Maryland & Bend, OR)



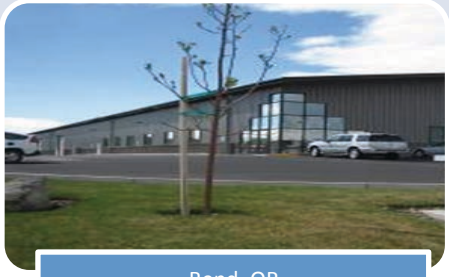
Burnaby HQ facility



Lowell, MA
USA



Maryland
USA



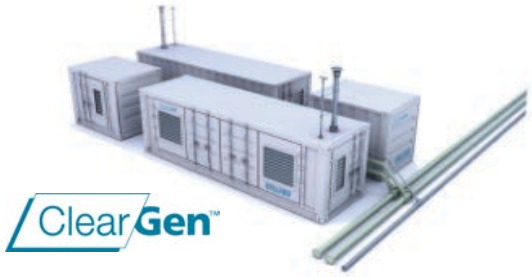
Bend, OR
USA



Hobro
Denmark

Fuel Cell Product Portfolio

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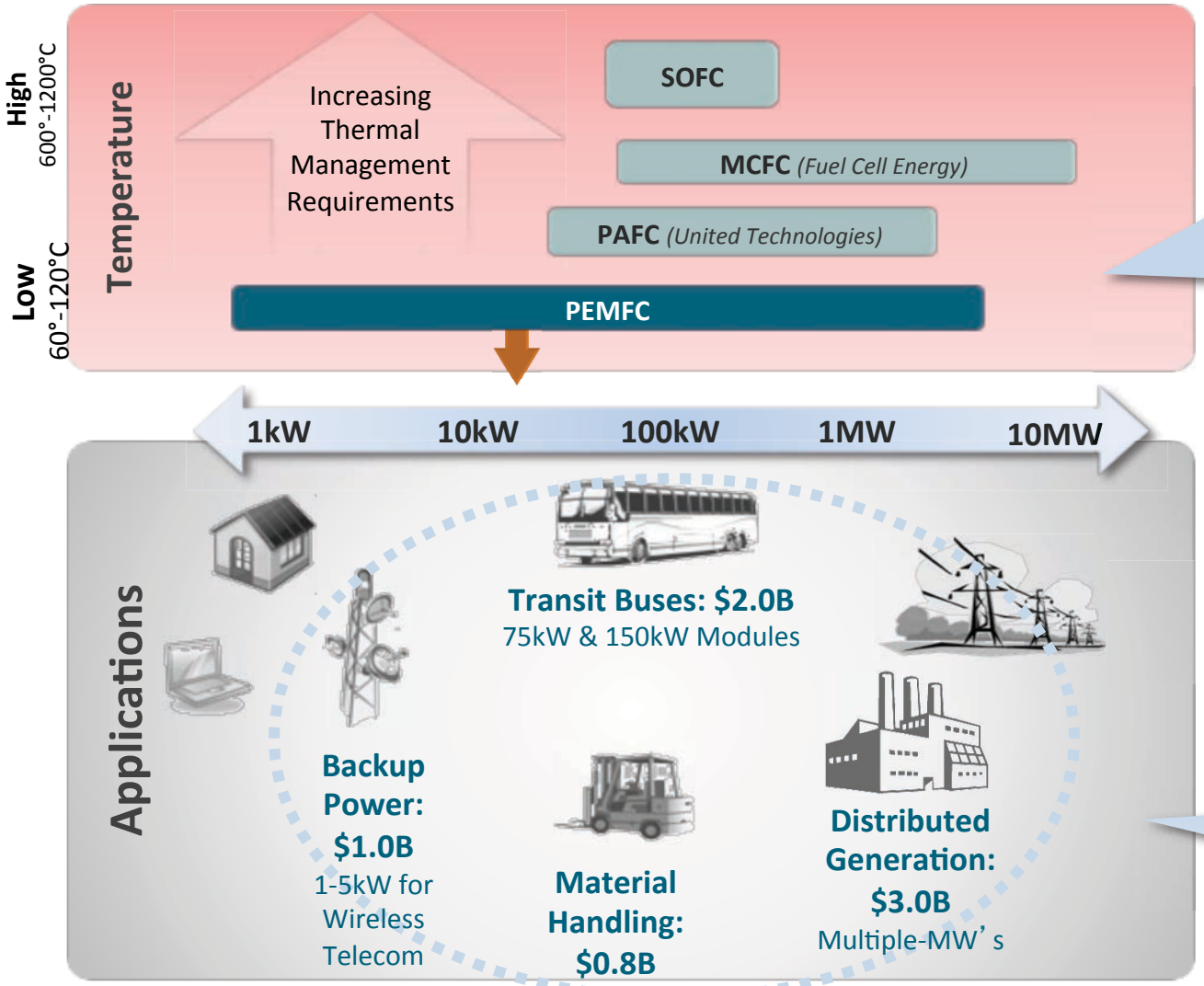
Fuel Cell Stacks	 FCgen®-1020ACS • 500W-2kW	 FCgen®-1300 • 2kW-8kW	 FCvelocity®-9SSL • 4kW-20kW	 FCvelocity®-1100 • 100kW
Fuel Cell Modules	FCvelocity®-HD6		• 75kW-150kW • Up to 12k hours	
Complete Fuel Cell Systems	ElectraGen™-H2  • 1.7 kW, 2.5kW & 5kW • Direct hydrogen • Indoor (rack-mountable) & outdoor 	ElectraGen™-ME  • 2.5kW & 5kW • Methanol fuelled • Outdoor	 ClearGen™ • Multi-MW power	

kW-scale fuel cell systems

Ballard product portfolio includes industry-leading fuel cell stacks, fuel cell modules and complete fuel cell system solutions ... average product cost reduction of 60% in 2009-12 timeframe

Market Opportunity

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Proton Exchange Membrane (PEM) **fuel cell technology accounted for 97% of global fuel cell shipments in 2011 ... and 74% of total megawatts** (MW's)

Source: Fuel Cell Today Industry Review 2011

Ballard's Current Total Addressable Market Opportunity: $6.8B+

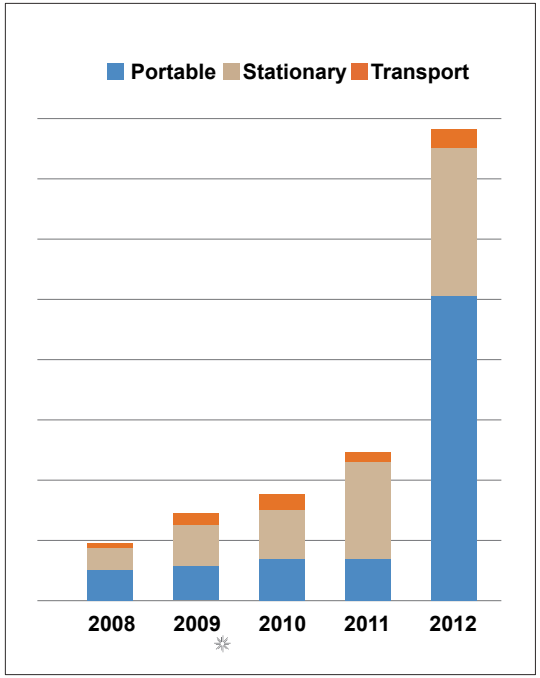
Hydrogen & Fuel Cell potential is real

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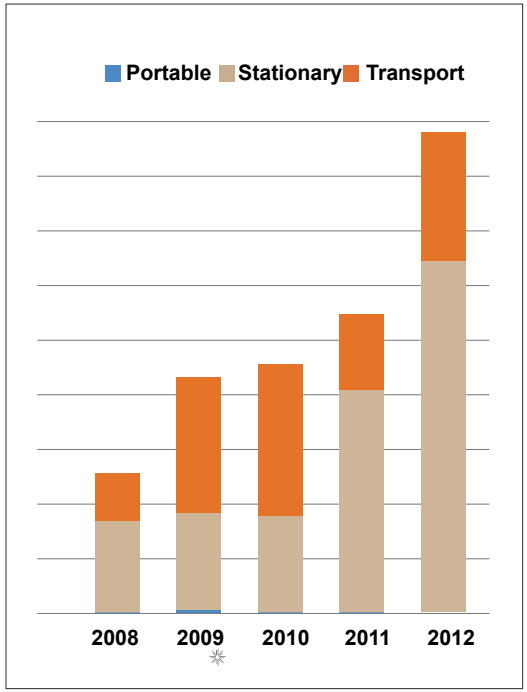
- Continued growth in annual fuel cell system shipments was seen worldwide in 2011, increasing 39% compared to 2010 to reach a new high of 24,600 units.

- In year 2012, our expectations are that fuel cell system shipments to more than triple relative to 2011, reaching 78,200 units.

Shipments by Application 2008– 2012



Megawatts by Application 2008– 2012



Availability of Hydrogen

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Sources of hydrogen for Fuel Cell systems

- **By-product hydrogen – Industrial Waste**

  : Hydrogen created as a by-product of chlor-alkali production, at carbon monoxide plants & other chemical production

- **Steam-reformation of Methanol**

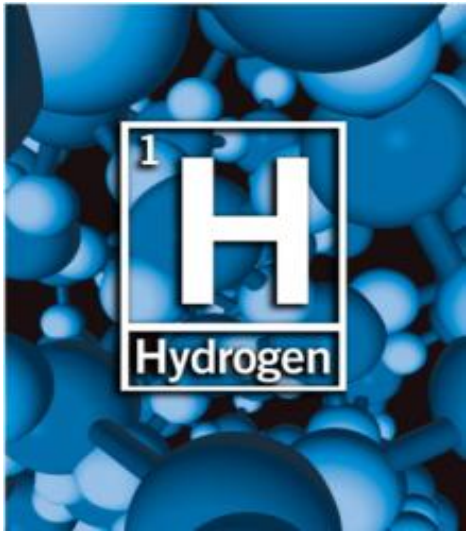
  : Methanol steam reforming is considered as one of the most promising routes to produce high purity hydrogen for mobile fuel cell applications.

- **Gasification of biomass**

  : Converts organic waste to a hydrogen-rich gas stream

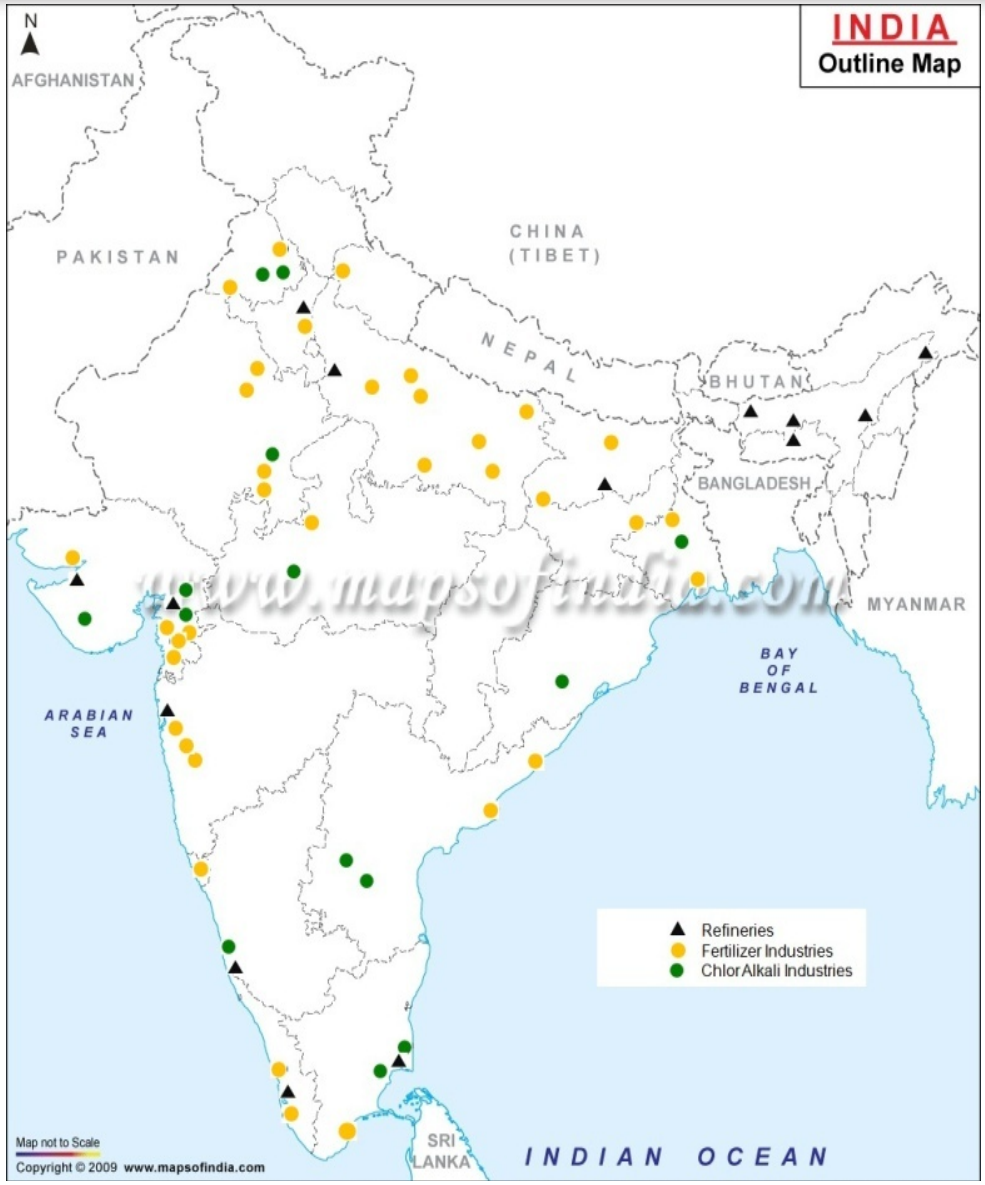
- **Electrolysis from "renewable" energy sources**

  : Large-scale energy storage using hydrogen produced during off-peak times



Source of By-product Hydrogen

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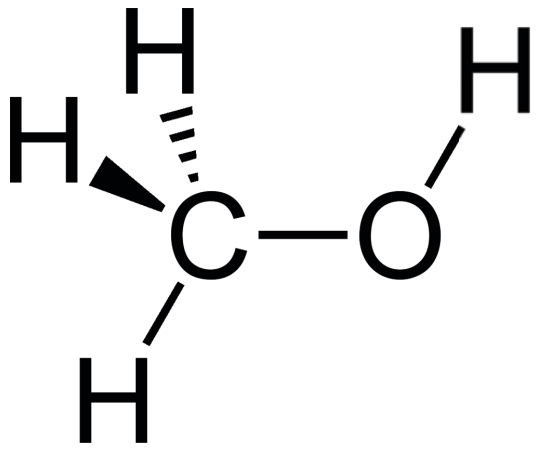
- Hydrogen infrastructure exists while not extensive
- Sources of By-product hydrogen
  - Chlor-alkali plants
  - Refineries
  - Captive plants for fertilizer, soap, glass plants, Sugar Industries
- Industrial waste Hydrogen available form these plants is sufficient to provide green power to more than 50,000 telecom towers in nearby vicinity.

HydroPlus™ (62% Methanol & 38% de-ionized Water)

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- **Methanol is a common liquid**
  - Global production in 2011 – 90 billion liters
  - Methanol, also known as methyl alcohol or wood alcohol, is an ideal hydrogen carrier. With a chemical formula of CH3OH, has more hydrogen atoms in each gallon than any other liquid that is stable in normal conditions.
- **Methanol applications**
  - Windshield washer fluid (up to 50% methanol)
  - Fuel additive – Over 3.5 billion liters in China 2007
  - Solvent
  - Manufacture of plastics and building products
- **Benefits of methanol based fuel**
  - Easily transported liquid fuel
  - Water miscible, biodegradable and sulfur-free
  - Extremely low freezing point < -60°C
  - May be stored for years without degradation
- **Renewable sources of methanol**
  - Produced by crude glycerol in mass production
  - Waste CO_2, wood waste, and others are in development
  - Global production of bio-methanol now greater than 280 million liters annually
- **HydroPlus supply chain**
  - 33 vendors in 18 different countries where Ballard is deploying fuel cells
  - Gujarat Narmada Valley Fertilizers Company Ltd (GNVFC), Deepak Fertilisers, Assam Petrochemicals, Rashtriya Chemicals & Fertilizers Ltd (RCF) and National Fertilizers Ltd are biggest supplier of Methanol in India.





HydroPlus Fuel Vendors established worldwide

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Easy Transportation – HydroPlus Liquid Fuel





55 Gallon/200 Liter Drum
Manual Pump





Refueling Truck – For Large Fleet
Automatic High Speed Pump

Mobile Refueling Unit



½ Ton Commercial Truck



HydroPlus fuel vendors established worldwide

Fuel Transfer to the System

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Hose + Nozzle (100 ft)

Fuel Container

Grounding





HydroPlus fuel vendors established worldwide

Types of PEM Fuel Cells

Types of PEM Fuel Cells for Clean Power

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Direct Hydrogen Fuel Cell (DHFC)	Reformed Methanol Fuel Cell (RMFC)
	

Fuel:	Hydrogen	HydroPlus™ (Methanol-Water)
Power:	2kW, 2.5kW or 5kW	2.5kW or 5kW
Voltage:	48 VDC	24 or 48 VDC
Benefits:	Efficient, reliable, quiet & zero emissions	Efficient, reliable, quiet & zero emissions
Application:	Backup power for telecom – situations requiring short duration runtime with relatively low kW hour requirements	Backup power for telecom (primary power under development) – situations involving longer duration runtime with relatively higher kW hour requirements
Commercial Availability:	Shipping commercially since 2008	Shipping commercially since 2010

ElectraGen™- H2 (Direct Hydrogen Fuel Cell – 5kW)

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Fuel Cell Module

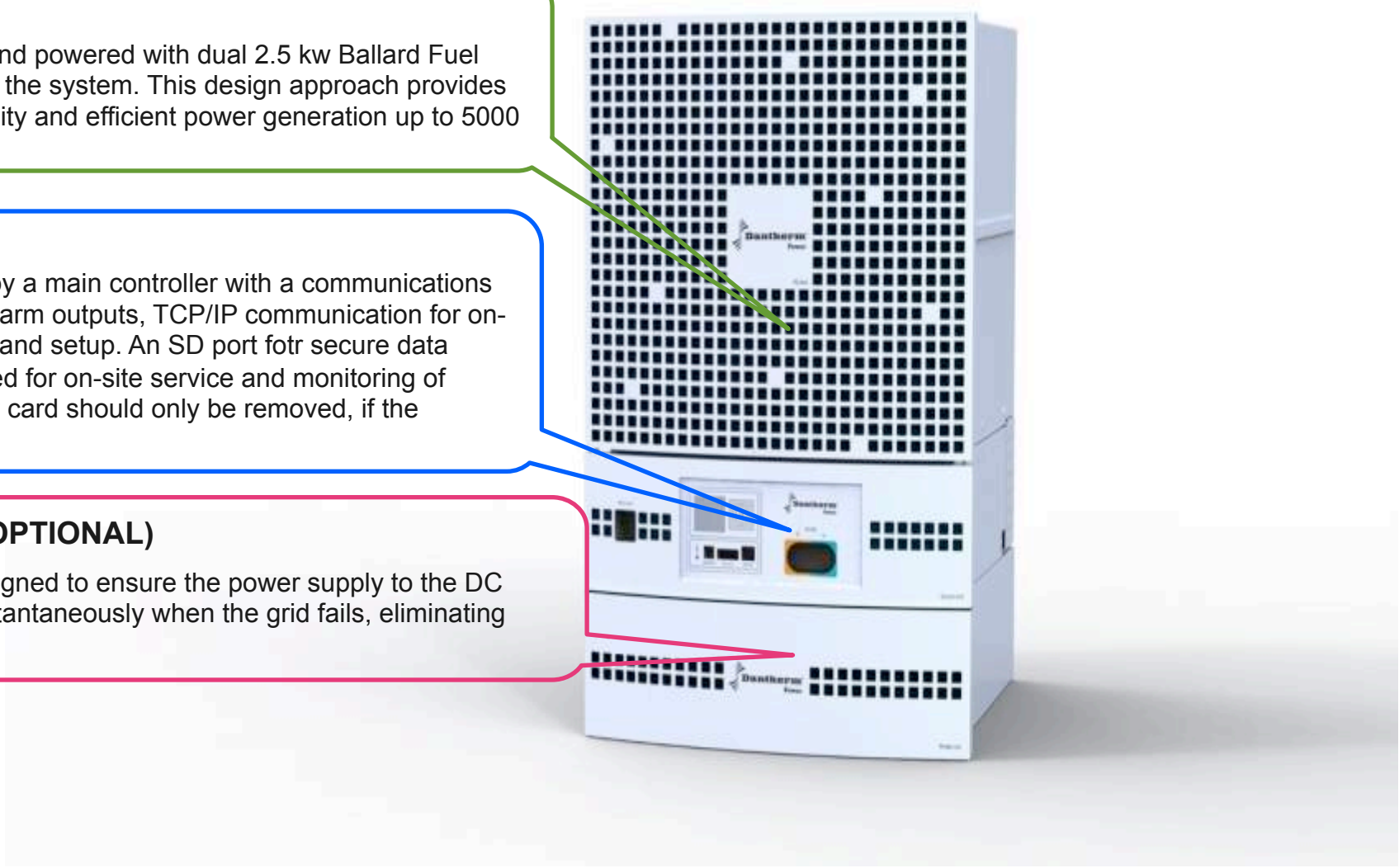
ElectraGen is air cooled and powered with dual 2.5 kw Ballard Fuel Cell Stacks at the heart of the system. This design approach provides the highest level or reliability and efficient power generation up to 5000 watts each.

Controller

ElectraGen is controlled by a main controller with a communications interface, including e.g. alarm outputs, TCP/IP communication for on-site or remote monitoring and setup. An SD port fotr secure data memory cards can be used for on-site service and monitoring of logged data. The memory card should only be removed, if the controller is changed.

DIB Power Module (OPTIONAL)

The power module is designed to ensure the power supply to the DC line. Customer load is instantaneously when the grid fails, eliminating the need for batteries.

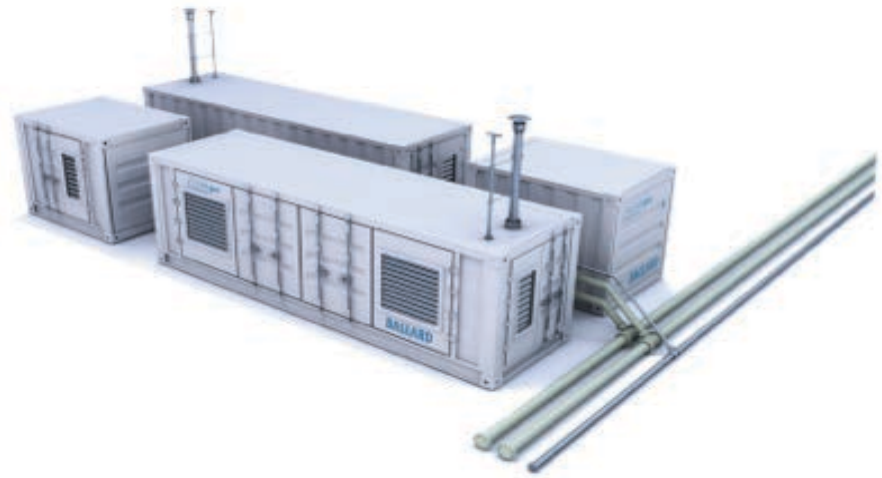


Multi-MW Hydrogen Fuel Cell for Distributed Generation

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CLEARgen™

Power	Scalable in 500kW increments
Packaging	Custom ISO container
Fuel efficiency	50%, based on HHV
Output voltage	370 VAC
Output heat load	950 kWt/MW
Available water temp	60-65˚C
Siting	Self-contained systems, simple integration with plant



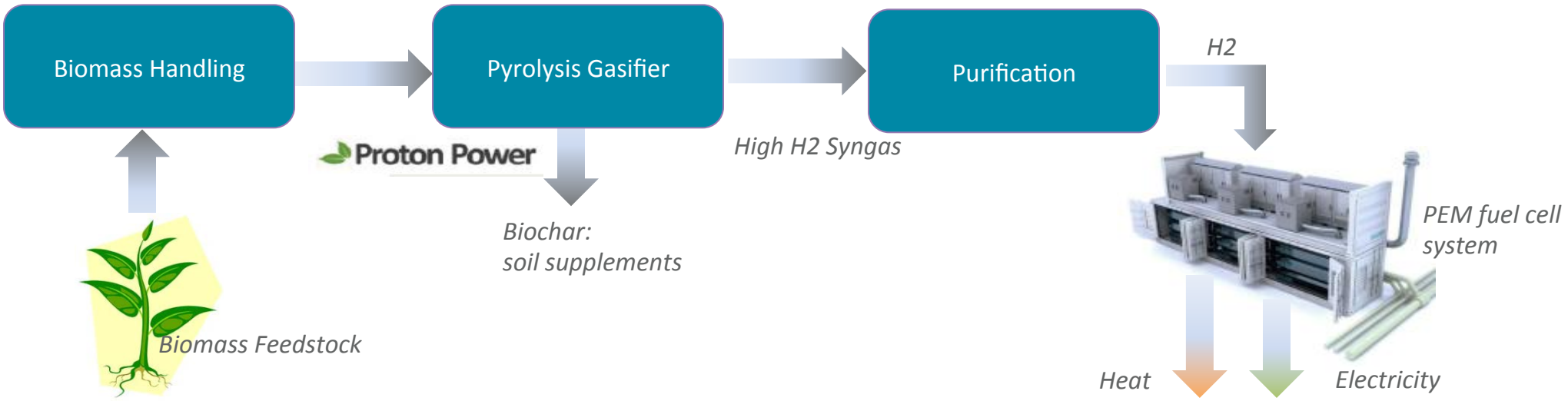
- Product differentiation:
  - Zero-emission power production
  - Compact & scalable
  - Efficient, reliable and safe
  - Fast start-up and low temperature
  - Rapid response to changes in power demand
  - Durable across wide variety of duty cycles

Biomass to Fuel Cell Power Solution

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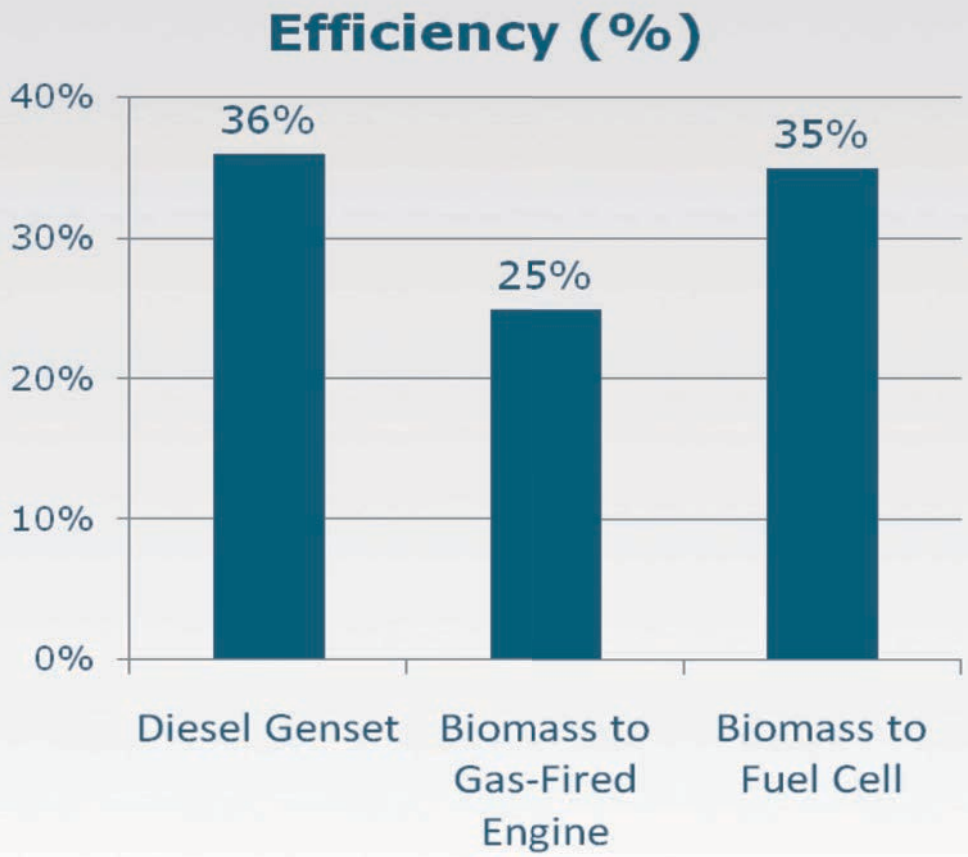
Best solution for high efficiency, low emission power production

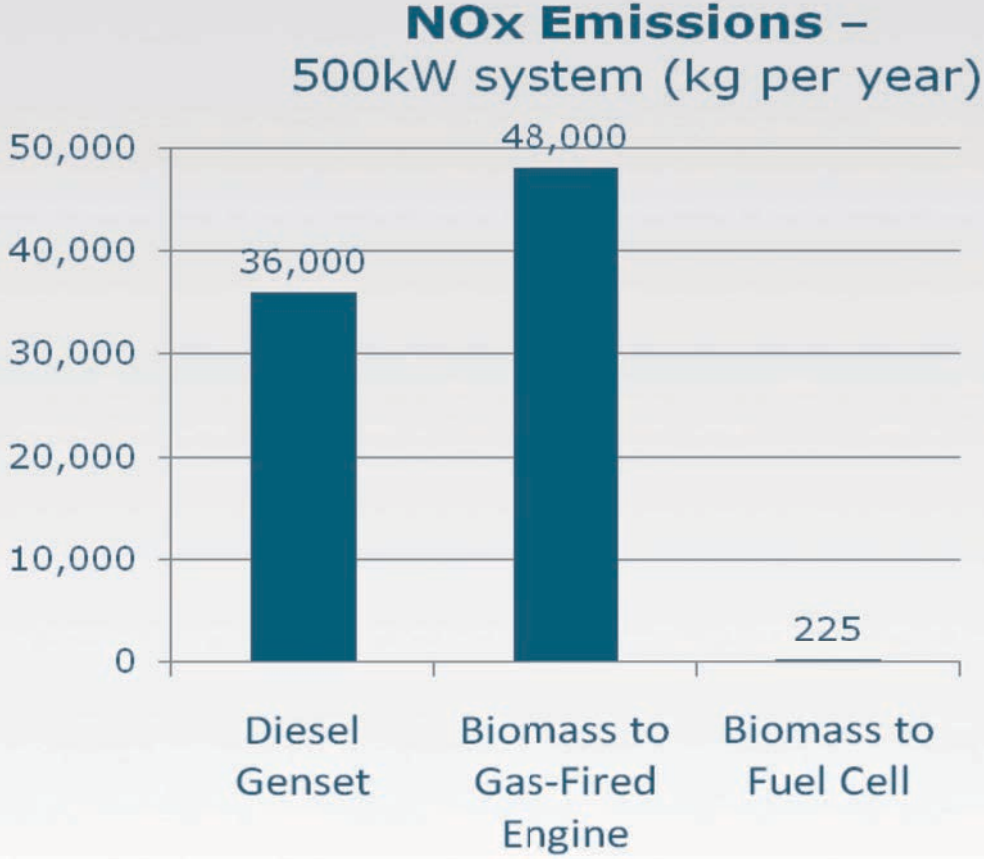
- **Scalable solution (150kW to multi-MW)**
- **Cost competitive alternative to diesel gensets in remote communities today**
- **Flexible feedstock options**



Technology Comparison

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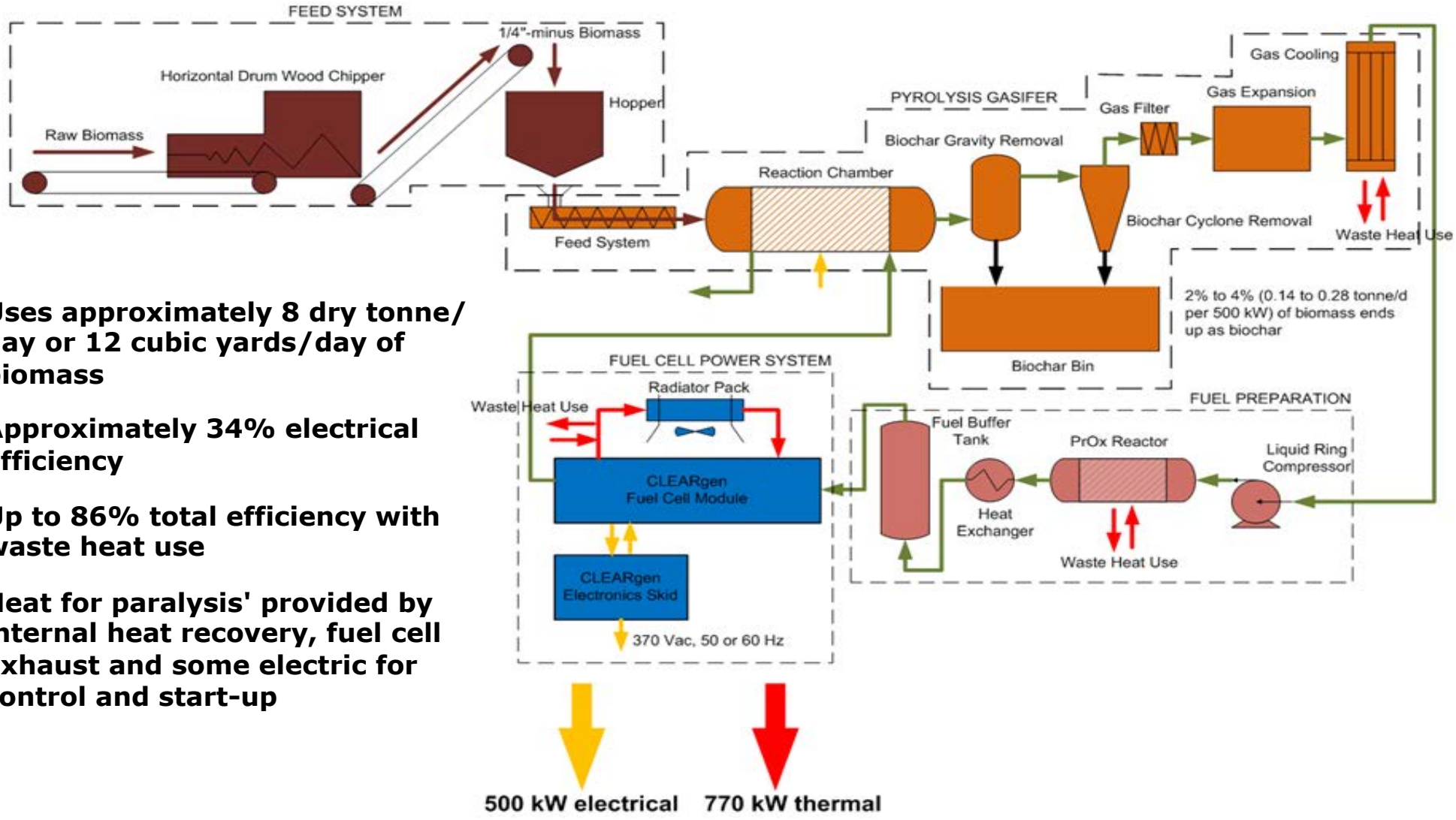




Process Diagram

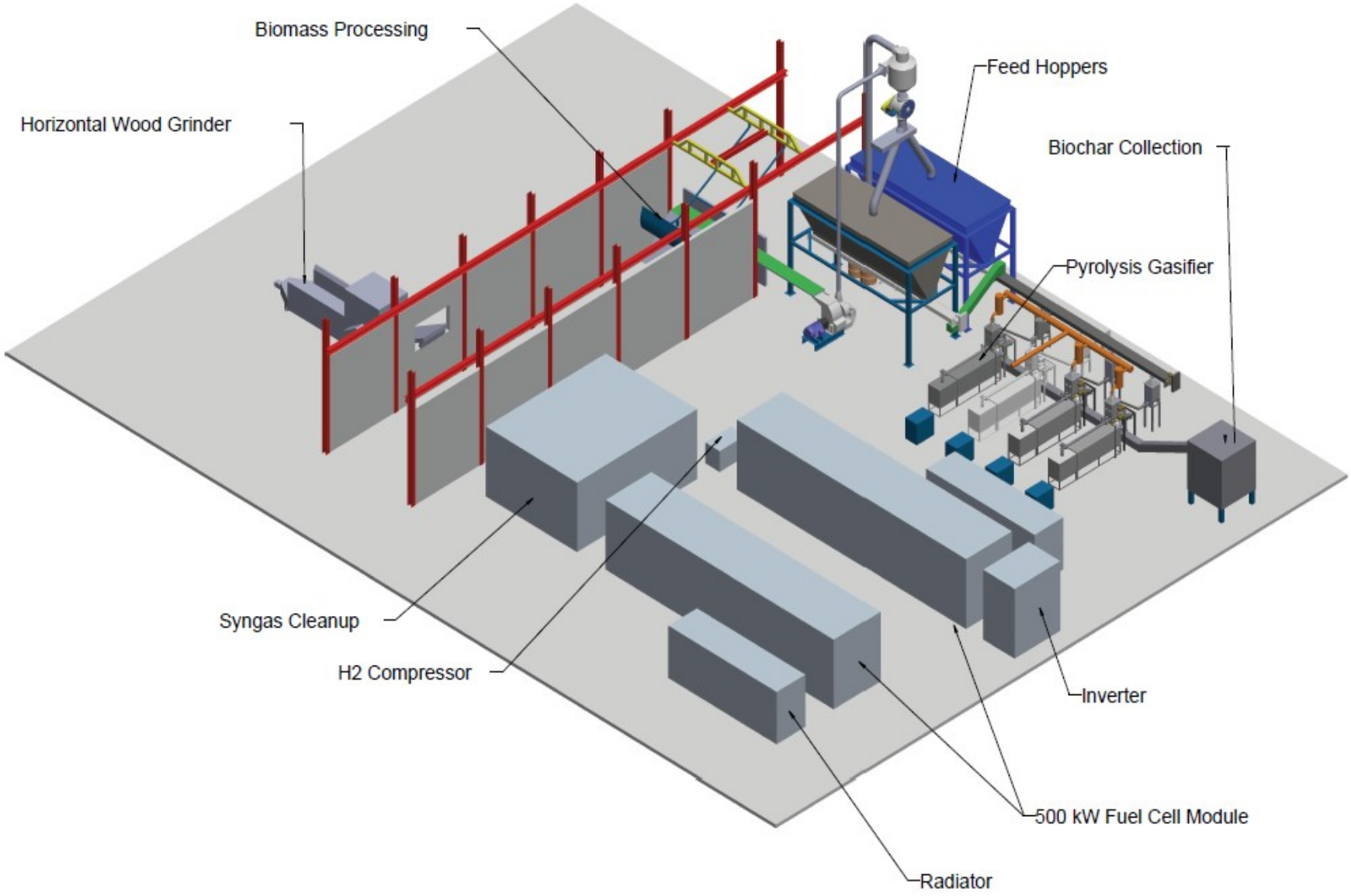
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- **Uses approximately 8 dry tonne/ day or 12 cubic yards/day of biomass**
- **Approximately 34% electrical efficiency**
- **Up to 86% total efficiency with waste heat use**
- **Heat for paralysis' provided by internal heat recovery, fuel cell exhaust and some electric for control and start-up**



Biomass to Fuel Cell Power

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ElectraGen™-ME (Methanol Fuel Cell)

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Next Generation Reformer-Based Backup Power Fuel Cell System



Run Time	Load
40 hours	5 kW
100 hours	2 kW
140 hours	1 kW

Product Configurations

- **2.5 kW** or **5 kW**
- **24 Vdc** or - **48 Vdc**
- Standard (**-5C** to **46C**) or Cold (**-40C** to **46C**)
- Fuel: **HydroPlus** (Methanol-Water liquid fuel)
- **CE** and ANSI/CSA **FC-1** certified

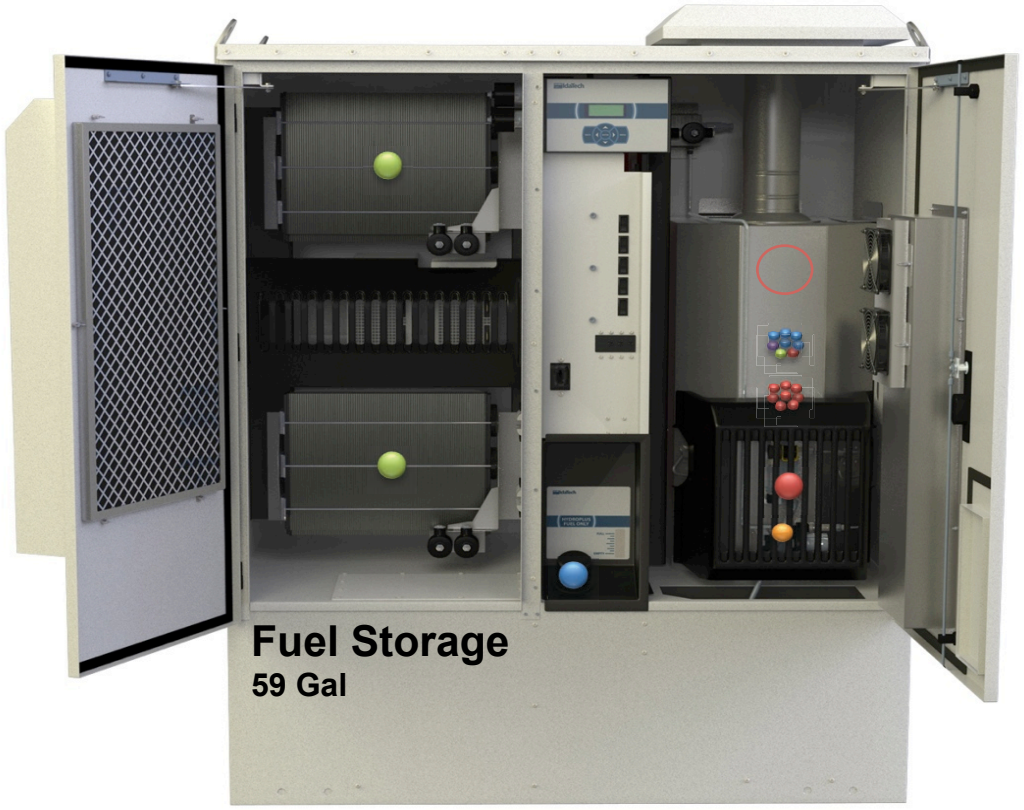
Key Features

- Integrated fuel cell (PEM) + reformer system
- 225 liter tank (up to 40 hrs autonomy @ 5kW)
- Weight < 300 kg (dry)
- 2 x 2.5 kW stack design (alternate usage, redundancy)
- 4,000 hours life time
- Customer user interface keypad with LCD display for set-up and diagnostics (no PC required)
- Dry contacts (8) + SNMP interface

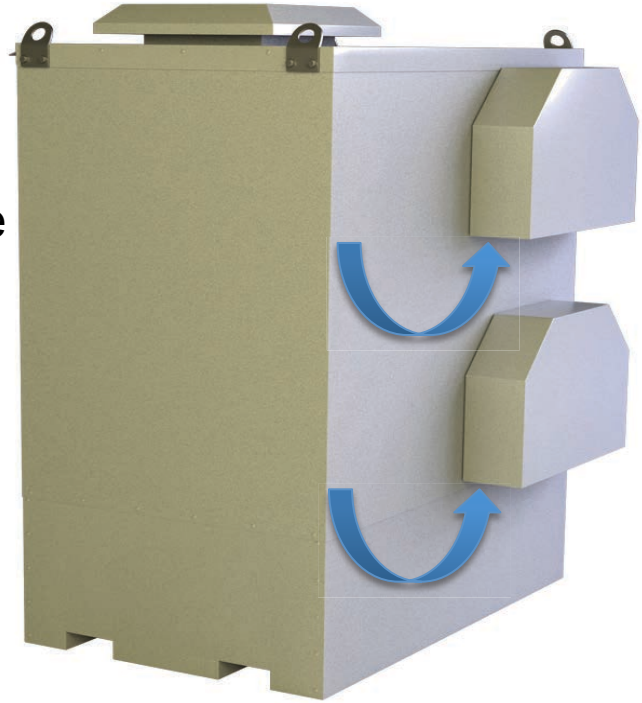
ElectraGen™-ME Functionality

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H_2O Vapor Formation



H_2O Dissipation Through Back Exhausts



Purification Stage

Reformation Stage

Vaporization Stage

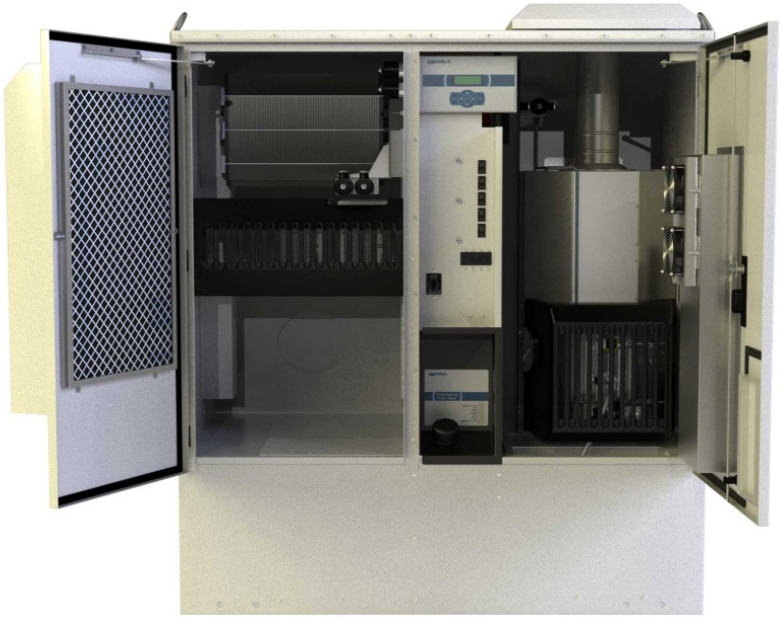
Heating Stage

O_2 from Ambient Air

System Upgrade

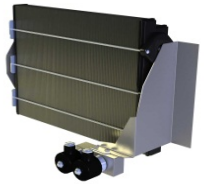
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Easy System Upgrade from 2.5kW to 5kW



ElectraGen™ ME 2.5 kW

+



Upgrade Kit includes
2.5kW Fuel Cell Stack,
DC/DC Converter, and Impeller

=



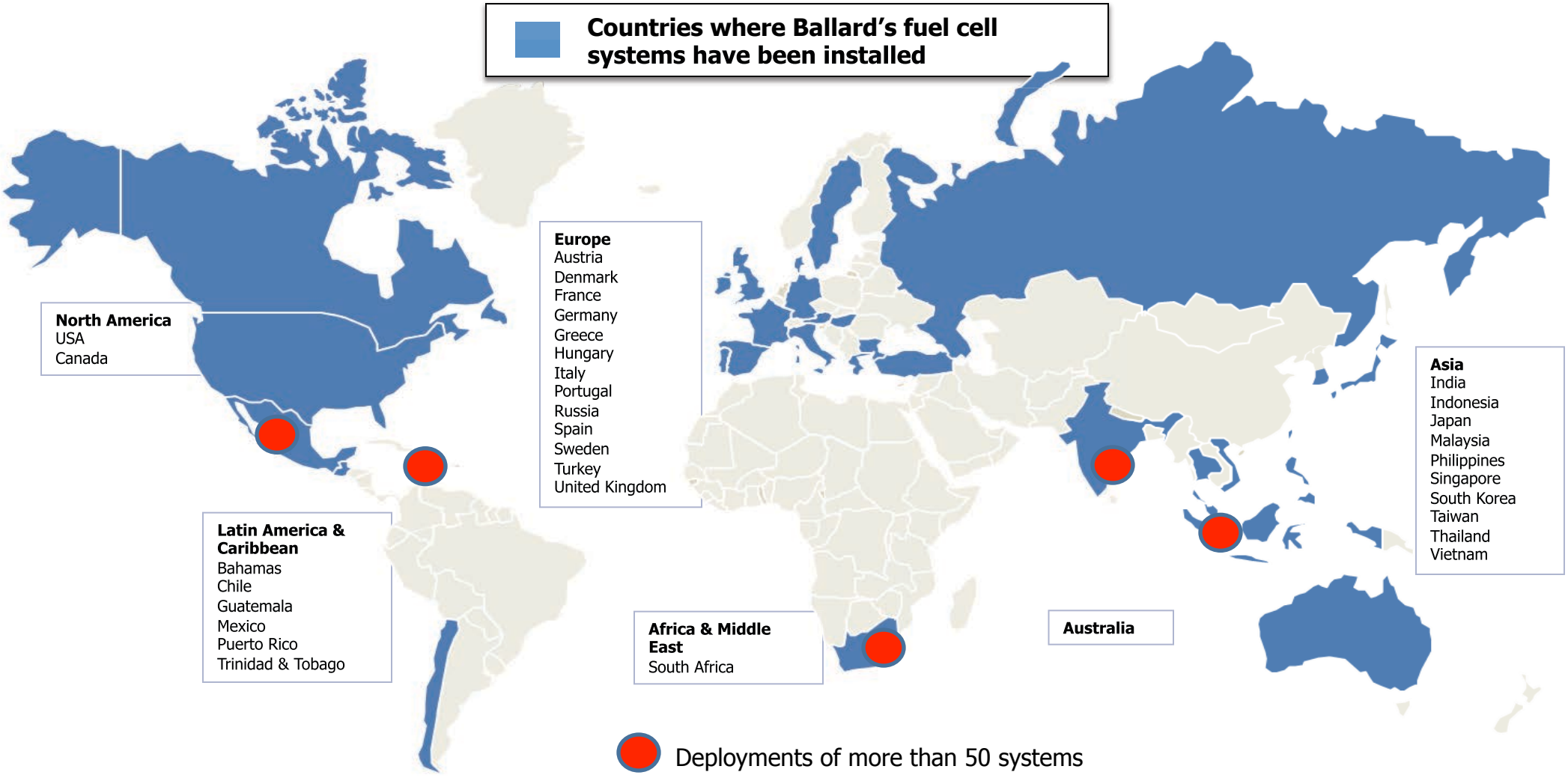
ElectraGen™ ME 5 kW

Industry Adoption of Fuel Cell Systems

Industry Adoption

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Over 4000+ Fuel Cell Systems Installed Worldwide



Grasim Industries Chlor-Alkali Plant in Madhya Pradesh

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The Aditya Birla chemical plant in Madhya Pradesh, a rayon-grade caustic soda manufacturing unit of Grasim Industries, was set up at Nagda in 1972, with an initial capacity of 33,000 tpa. This was subsequently enhanced to 258,000 tpa, making it India's second largest caustic soda unit. The plant produces a large amount of by-product hydrogen which can be utilized in powering every telecom tower using Hydrogen Fuel Cells in MPCG Circle.



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Case Study: 1.7kW Systems for IDEA Cellular Network

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Customer:
- IDEA Cellular Network
- Location: Nagda Cluster, Madhya Pradesh
- Industry: Telecommunications

Challenge:
- Provide backup power to IDEA Cellular Network
- Maintenance & full logistics chain for hydrogen supply for backup power

Solution: ElectraGen™-H2
- 1.7kW fuel cell system and hydrogen integrated in outdoor cabinets deployed at 30 sites
- Load (average): 1.2kW @ 48Vdc
- Product: Air-cooled hydrogen fuel cell system
- Fuel: Hydrogen gas

Advantages:
- Site autonomy
- Cost competitive with diesel genset
- Improved site availability
- Zero emission, low noise



Easily scalable to higher capacity by adding more fuel cell modules without any additional footprint

Standard Hydrogen Cylinders @150bar

Controller

DBX2000 Fuel Cell Module

Example 10 kW Hydrogen Fuel Cell System

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10 kW indoor installation in 19” rack



Master Module with Interface for remote monitoring

ElectraGen H2 – 5kW Module

ElectraGen H2 – 5kW Module

Case Study: *30kW System for Deutsche Telekom*

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Customer:
- Deutsche Telekom
- Location: Berlin, Germany
- Industry: Telecommunication

Challenge:
- Provide clean, zero emission backup power to central switch

Solution: ElectraGen™-H2
- 30kW Rack Mount backup power fuel cell system deployed
- Load (average): 500W – 30kW @ 48Vdc
- Product: Six 5kW fuel cell systems
- Fuel: Hydrogen gas

Advantages:
- Site Autonomy
- Improved site availability
- Zero emission, low noise

Deutsche Telekom



Case Study: *Backup Power Systems for Hutchison Telecom*

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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
- 500 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





Telecom Installations

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NTT docomo (Japan)



(South Africa)





T · ·Mobile (USA)



telcel (Mexico)



TSTT (Trinidad)



Telefónica movistar (Chile)

ElectraGen ME Installations in South East Asia

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5.0 kW
ElectraGen™ME
Hub (Indonesia)



Vietnamobile



indosat

5.0 kW
ElectraGen™ME
(Indonesia)



Bakrie Telecom

ElectraGen™ME
(Indonesia)





AXIS

2.5 kW
ElectraGen™ME
Hub (Indonesia)



ElectraGen™ME
(Indonesia)

Installation in South Africa

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Solution:
- 200+ fuel cell systems installed to date
- Location: South Africa
- Product: 2.5kW or 5kW ElectraGen™ ME
- Fuel: Methanol-Water liquid fuel
- Site autonomy: 100 hours @ 2kW
  40 hours @ 5kW



Site Data: 98-day duration
- 131 hours run time
- 28 cycles





Roof Top Installations

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Rooftop Installation in Indonesia











Case Study: *Fuel Cell Backup Power System for Vodacom*

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Customer:
- Vodacom, a leading African communications group
- Location: South Africa
- Industry: Telecommunications

Challenge:
- Remote location
- Unreliable grid
- Aim to reduce maintenance costs
- Minimize impact on environment

Solution: ElectraGen™-ME
- Configuration: 5kW, 48 Vdc
- Fuel: HydroPlus™ (Methanol-Water liquid fuel)

Advantages:
- High efficiency
- Improved reliability
- Minimal maintenance
- Renewable energy supply
- Zero emission

vodacom



Case Study: *Fuel Cell Backup Power System in Chile*

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Customer:
- Interexport Telecommunications
- Location: Santiago de Chile
- Industry: Telecommunications

Challenge:
- Need backup power for critical telecom site
- Telluric movement
- Seismic zone
- Planned power outages
- Local community issues (generator noise)

Solution: ElectraGen™-ME
- Product: Fifteen 5kW fuel cell systems deployed
- Fuel: HydroPlus™ (Methanol-Water liquid fuel)

Advantages:
- Site autonomy
  - 100 hours @ 2kW (225 liter tank)
  - 40 hours @ 5kW (225 liter tank)
- Small footprint
- Quiet operation



inter export Telecomunicaciones



Case Study: ElectraGen™-ME *in Prime Power Trial*

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Vodafone trial in Turkey ElectraGen™-ME

- Power was provided continuously 24/7 from February to August 2011
- 3,431hours of operation
- 5,892 kW hours of power generated
- Average Load 1.7 kW
- No faults, warning or shutdowns

Telkomsel trial in Indonesia ElectraGen™-ME

- Power was provided continuously 24/7 from September 22nd to December 4, 2011
- 1,364 hours of operation
- 2,700 kW hours of power generated
- Average Load 2.98 kW
- No faults, warning or shutdowns

vodafone





TELKOMSEL

ElectraGen ME Installations in South East Asia

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5.0 kW
ElectraGen™ME
Hub (Indonesia)



Vietnamobile



indosat

5.0 kW
ElectraGen™ME
(Indonesia)



Bakrie Telecom

ElectraGen™ME
(Indonesia)





AXIS

2.5 kW
ElectraGen™ME
Hub (Indonesia)



ElectraGen™ME
(Indonesia)

Roof Top Installations

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Rooftop Installation in Indonesia











150KW Fuel Cell Backup Power Systems inside Container

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Close container of 150KW Systems



Open container of 150KW Systems



150KW, zero-emission fuel cell of deployed at Anglo American to provide power at one of its mining operations plant in South Africa.

Case Study: Demonstration of MW Mobile Fuel Cell System

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- Megawatt-scale utility applications
- 5 year demonstration at large Ohio utility
- Provides generating capacity during peak usage periods in the months of May through September
- Zero GHG emissions
- Sufficient to power more than 600 homes
- Housed in a tractor-trailer for mobility

Tata Motors Bus built using Ballard Fuel Cell Technology

Tata Motors displayed the first fuel cell bus built in India at Auto Expo 2012 in New Delhi. Tata Motors have plan to deploy 12 Hydrogen fuel cell buses in India this year.



Fuel Cell Integration into a Hybrid Drive System

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FCvelocity™-HD6



- 6th generation fuel cell technology
- Enhanced fuel cell durability
- Improved efficiency
- Reduced cost
- Industry leading 12,000 hr/5yr warranty



Case Study: Fuel Cell powered underground mining locomotive in South Africa, on 09 May 2012.

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Summary

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- Fuel Cells are more reliable, efficient, scalable, perform longer, and are cleaner than traditional backup sources.
- There is a comprehensive portfolio of Hydrogen & Methanol fuel cell power generation products available and already adopted worldwide by 5 out of top 10 telecom operators.
- There are various sustainable source of Hydrogen e.g. By-Product Hydrogen from Chlor-Alkali Plants, Steam-reformation of Methanol, Biomass to Hydrogen and Electrolysis from renewable energy sources.
- Fuel Cell power generation systems are commercially attractive clean energy solution to replace diesel generator.






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Thank You
“Putting Fuel Cells to Work”

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