Fuel Cells for Forklifts
April 20, 2017

NEESC is funded through a contract with the U.S. Small Business Administration
House Keeping

All participants are in “Listen-Only” mode. Select “Use Mic & Speakers” to avoid toll charges and use your computer’s VOIP capabilities. Or select “Use Telephone” and enter your PIN onto your phone key pad.

Submit your questions at any time by typing in the Question Box and hitting Send.

This webinar is being recorded

You will find a recording of this webinar, as well as previous NEESC webinars online at:

http://neesc.org/events/past-events/

NEESC is funded through a contract with the U.S. Small Business Administration
The Northeast Electrochemical Energy Storage Cluster (NEESC) is a network of industry, academic, government and non-governmental leaders working together to help businesses provide energy storage solutions. The cluster is focused on businesses that provide the innovative development, production, promotion and deployment of hydrogen fuels and fuel cells to meet the pressing demand for energy storage solutions.

The cluster spans an area in the northeastern United States from New Jersey to Maine. Its formal organization is funded by the US Small Business Administration’s Regional Cluster Initiative. NEESC is administered by the Connecticut Center for Advanced Technology, Inc. (CCAT) and its local state partners:

NEESC is funded through a contract with the U.S. Small Business Administration
Today's Guest Speakers

Chris Tully, Vice President of Sales – Eastern Region, Plug Power

David Saoud, Co-President, FreezPak

NEESC is funded through a contract with the U.S. Small Business Administration
Infinite Drive: Hydrogen and Fuel Cells for Material Handling Applications
Powering Possibilities with Infinite Drive

• The partner trusted to take your business into the future.
  
  • Innovative manufacturing facilities in NY and WA
  
  • Premier list of customers: P&G, Walmart, Kroger, BMW, Home Depot
  
  • More than 14,000 units in the field
    • >121 million hours of runtime by material handling customers
  
  • Focused Expansion Opportunities
    • 180+ issued patents
    • Hydrogen storage & generation
    • Motive power applications

Plug Power holds more than 90% of the fuel cell market in the material handling industry.
Plug Power Market Presence

Repeat NA Customer Base

Expansion in Europe: Product Qualification and Deployment

Honda - UK

Colruyt - Belgium
GenKey: Transition to Fuel Cells is Seamless

• “One-stop-shopping” option couples:
  • GenDrive fuel cell system
  • GenFuel hydrogen & fueling infrastructure
  • GenCare customer service

• Plug Power handles power, fueling and service so customers don't have to

Increased Performance leads to Economic ROI
GenDrive: Powering Your Possibilities

**Class 1 Suite**
Sit-down Lift Trucks
11 kW, 12 kW

**Class 2 Suite**
Stand-Reach Trucks
11 kW, 1up 2 kW

**Class 3 Suite**
Rider Pallet Trucks
2.9 kW, 4 kW

---

### Capital Savings with Environmental Benefits

- Reduce electricity needs
- Reduce demand charges
- Increase productivity
- 90 second refill
- No emissions
- GHG savings
- Constant full power
- Easier to provide emergency facility power

---

*Kw based on 15-min power ratings
GenDrive Value Proposition

Key Benefits of GenDrive® Systems Implementation

**Increased Productivity**
- Forklifts operate at **consistent full speed** & power at all times
- Refuel in **less than 2 minutes** versus 10 – 20 minutes per battery change
- Increase **floor space** for product storage

**Reduced Operational Expenses**
- Economic lifetime up to **1.5x – 2.0x** longer than lead acid batteries
- Proven **productivity gains and operational savings**
- Higher throughput or repurpose / reduction of workforce

**Environmental Benefits**
- **Zero emissions**, recyclable
- **85% reduction** in Greenhouse Gases
- Elimination of personnel contact with toxic materials

**Increased Commercial Efficiency**
- Battery rooms eliminated – **more room for revenue generating activities**
- Drop in replacement solution

---

**Greenfield IRR**
- Payback **< 1 yr**
- ~$3M in savings

**Reduce carbon footprint up to 80%**

**15%**
- Increase productivity up to 15%

---

**85%**
- Zero emissions, recyclable
- 85% reduction in Greenhouse Gases
- Elimination of personnel contact with toxic materials

---

**Key Benefits of GenDrive® Systems Implementation**

- **Economic lifetime up to 1.5x – 2.0x longer than lead acid batteries**
- Proven **productivity gains and operational savings**
- Higher throughput or repurpose / reduction of workforce
- Forklifts operate at **consistent full speed** & power at all times
- Refuel in **less than 2 minutes** versus 10 – 20 minutes per battery change
- Increase **floor space** for product storage

---

**Environmental Benefits**
- **Zero emissions**, recyclable
- **85% reduction** in Greenhouse Gases
- Elimination of personnel contact with toxic materials

---

**Increased Commercial Efficiency**
- Battery rooms eliminated – **more room for revenue generating activities**
- Drop in replacement solution

---

**Greenfield IRR**
- Payback **< 1 yr**
- ~$3M in savings

---

**Reduce carbon footprint up to 80%**

**15%**
- Increase productivity up to 15%

---

**85%**
- Zero emissions, recyclable
- 85% reduction in Greenhouse Gases
- Elimination of personnel contact with toxic materials

---

**Key Benefits of GenDrive® Systems Implementation**

- **Economic lifetime up to 1.5x – 2.0x longer than lead acid batteries**
- Proven **productivity gains and operational savings**
- Higher throughput or repurpose / reduction of workforce
- Forklifts operate at **consistent full speed** & power at all times
- Refuel in **less than 2 minutes** versus 10 – 20 minutes per battery change
- Increase **floor space** for product storage

---

**Environmental Benefits**
- **Zero emissions**, recyclable
- **85% reduction** in Greenhouse Gases
- Elimination of personnel contact with toxic materials

---

**Increased Commercial Efficiency**
- Battery rooms eliminated – **more room for revenue generating activities**
- Drop in replacement solution

---

**Greenfield IRR**
- Payback **< 1 yr**
- ~$3M in savings

---

**Reduce carbon footprint up to 80%**

**15%**
- Increase productivity up to 15%

---

**85%**
- Zero emissions, recyclable
- 85% reduction in Greenhouse Gases
- Elimination of personnel contact with toxic materials

---

**Key Benefits of GenDrive® Systems Implementation**

- **Economic lifetime up to 1.5x – 2.0x longer than lead acid batteries**
- Proven **productivity gains and operational savings**
- Higher throughput or repurpose / reduction of workforce
- Forklifts operate at **consistent full speed** & power at all times
- Refuel in **less than 2 minutes** versus 10 – 20 minutes per battery change
- Increase **floor space** for product storage

---

**Environmental Benefits**
- **Zero emissions**, recyclable
- **85% reduction** in Greenhouse Gases
- Elimination of personnel contact with toxic materials

---

**Increased Commercial Efficiency**
- Battery rooms eliminated – **more room for revenue generating activities**
- Drop in replacement solution

---

**Greenfield IRR**
- Payback **< 1 yr**
- ~$3M in savings

---

**Reduce carbon footprint up to 80%**

**15%**
- Increase productivity up to 15%

---

**85%**
- Zero emissions, recyclable
- 85% reduction in Greenhouse Gases
- Elimination of personnel contact with toxic materials

---

**Key Benefits of GenDrive® Systems Implementation**

- **Economic lifetime up to 1.5x – 2.0x longer than lead acid batteries**
- Proven **productivity gains and operational savings**
- Higher throughput or repurpose / reduction of workforce
- Forklifts operate at **consistent full speed** & power at all times
- Refuel in **less than 2 minutes** versus 10 – 20 minutes per battery change
- Increase **floor space** for product storage

---

**Environmental Benefits**
- **Zero emissions**, recyclable
- **85% reduction** in Greenhouse Gases
- Elimination of personnel contact with toxic materials

---

**Increased Commercial Efficiency**
- Battery rooms eliminated – **more room for revenue generating activities**
- Drop in replacement solution

---

**Greenfield IRR**
- Payback **< 1 yr**
- ~$3M in savings

---

**Reduce carbon footprint up to 80%**

**15%**
- Increase productivity up to 15%

---

**85%**
- Zero emissions, recyclable
- 85% reduction in Greenhouse Gases
- Elimination of personnel contact with toxic materials

---

**Key Benefits of GenDrive® Systems Implementation**

- **Economic lifetime up to 1.5x – 2.0x longer than lead acid batteries**
- Proven **productivity gains and operational savings**
- Higher throughput or repurpose / reduction of workforce
- Forklifts operate at **consistent full speed** & power at all times
- Refuel in **less than 2 minutes** versus 10 – 20 minutes per battery change
- Increase **floor space** for product storage

---

**Environmental Benefits**
- **Zero emissions**, recyclable
- **85% reduction** in Greenhouse Gases
- Elimination of personnel contact with toxic materials

---

**Increased Commercial Efficiency**
- Battery rooms eliminated – **more room for revenue generating activities**
- Drop in replacement solution

---

**Greenfield IRR**
- Payback **< 1 yr**
- ~$3M in savings

---

**Reduce carbon footprint up to 80%**

**15%**
- Increase productivity up to 15%

---

**85%**
- Zero emissions, recyclable
- 85% reduction in Greenhouse Gases
- Elimination of personnel contact with toxic materials

---

**Key Benefits of GenDrive® Systems Implementation**

- **Economic lifetime up to 1.5x – 2.0x longer than lead acid batteries**
- Proven **productivity gains and operational savings**
- Higher throughput or repurpose / reduction of workforce
- Forklifts operate at **consistent full speed** & power at all times
- Refuel in **less than 2 minutes** versus 10 – 20 minutes per battery change
- Increase **floor space** for product storage

---

**Environmental Benefits**
- **Zero emissions**, recyclable
- **85% reduction** in Greenhouse Gases
- Elimination of personnel contact with toxic materials

---

**Increased Commercial Efficiency**
- Battery rooms eliminated – **more room for revenue generating activities**
- Drop in replacement solution

---

**Greenfield IRR**
- Payback **< 1 yr**
- ~$3M in savings

---

**Reduce carbon footprint up to 80%**

**15%**
- Increase productivity up to 15%

---

**85%**
- Zero emissions, recyclable
- 85% reduction in Greenhouse Gases
- Elimination of personnel contact with toxic materials

---

**Key Benefits of GenDrive® Systems Implementation**

- **Economic lifetime up to 1.5x – 2.0x longer than lead acid batteries**
- Proven **productivity gains and operational savings**
- Higher throughput or repurpose / reduction of workforce
- Forklifts operate at **consistent full speed** & power at all times
- Refuel in **less than 2 minutes** versus 10 – 20 minutes per battery change
- Increase **floor space** for product storage

---

**Environmental Benefits**
- **Zero emissions**, recyclable
- **85% reduction** in Greenhouse Gases
- Elimination of personnel contact with toxic materials

---

**Increased Commercial Efficiency**
- Battery rooms eliminated – **more room for revenue generating activities**
- Drop in replacement solution

---

**Greenfield IRR**
- Payback **< 1 yr**
- ~$3M in savings

---

**Reduce carbon footprint up to 80%**

**15%**
- Increase productivity up to 15%

---

**85%**
- Zero emissions, recyclable
- 85% reduction in Greenhouse Gases
- Elimination of personnel contact with toxic materials

---

**Key Benefits of GenDrive® Systems Implementation**

- **Economic lifetime up to 1.5x – 2.0x longer than lead acid batteries**
- Proven **productivity gains and operational savings**
- Higher throughput or repurpose / reduction of workforce
- Forklifts operate at **consistent full speed** & power at all times
- Refuel in **less than 2 minutes** versus 10 – 20 minutes per battery change
- Increase **floor space** for product storage

---

**Environmental Benefits**
- **Zero emissions**, recyclable
- **85% reduction** in Greenhouse Gases
- Elimination of personnel contact with toxic materials

---

**Increased Commercial Efficiency**
- Battery rooms eliminated – **more room for revenue generating activities**
- Drop in replacement solution

---

**Greenfield IRR**
- Payback **< 1 yr**
- ~$3M in savings

---

**Reduce carbon footprint up to 80%**

**15%**
- Increase productivity up to 15%

---

**85%**
- Zero emissions, recyclable
- 85% reduction in Greenhouse Gases
- Elimination of personnel contact with toxic materials

---
Plug Power proprietary dispensers: intelligent dispensers that gather and communicate fuel and fuel cell data.
H₂ – Facts on Alternative Energy

• Lightest and smallest element
• Odorless, colorless and tasteless
• Non-toxic and non-poisonous, renewable energy source, unlike methane and gasoline
• Rapid dispersion
  • Rises at a speed of 20 meters/second
• 3 times the energy content of gasoline (by weight)
• When used in energy production:
  • Hydrogen is at least 60% efficient; Gasoline is 33-35% efficient.
  • Efficiency increases result in a 50% reduction in fuel consumption
• U.S. produces more than 9M tons annually
  • Chemical, food and electronics industries
H$_2$ Storage & Dispensing Solution

- Q1 2014
  - First GenFuel site – Walmart Pottsville
- 36 installed sites
- GenFuel Infrastructure:
  - >130 hydrogen dispensers
  - More than 5.7M fills to date
  - More than 10,000 fills per day

Cost effective hydrogen is the critical enabler to be the full service provider – power, infrastructure, molecule & service
GenCare: Guaranteed Uptime

• 5 Year Contracts
  • Parts
  • Labor
• 10 Year Contracts
  • Hydrogen Infrastructure

• Responsive on-site support drives continual product improvement

• Work towards 99% uptime at every site

• Remote monitoring driving efficiency

Dedicated care allows Plug Power to guarantee 97% uptime
GenCare: SiteView

- 24/7 SiteView for GenCare customers:
  - Proprietary software, provides fleet diagnostics, fueling data, and performance metrics
  - Remote access, diagnostics, and reporting tools to monitor every fleet deployed
  - Enables proactive maintenance, guaranteeing a minimum of 97% uptime at each location
Infinite Drive with Plug Power

- Leader in fuel cells for material handling industry at an inflection point for growth

- Proven GenKey solution used by 90% of customers, globally

- Referenceable and repeat customer base

- Significant opportunities in Europe and Asia through strategic partnerships
FreezPak Logistics

Best-in-class cold storage warehousing
Who is FreezPak?

- Leading New Jersey-based frozen food distributor
- Owned and operated by Saoud Enterprises
  - David Saoud
  - Michael Saoud
- 2 facilities:
  - Carteret, NJ
  - Paterson, NJ
The Situation

- 5-7 day operation
- Multi-shift each day
- Refrigerated and -20F freezer facilities
- Cold depletes batteries faster
  - Multiple 15 minute breaks morning/afternoon + lunchtime to fast-charge batteries
  - Drooping energy meant choosing between power for the forklift and heat for operator comfort and safety

Critical Business Issues
- Production volume
- Staff morale
- Efficiency
- Safety
SERVICES

- Frozen/Refrigerated Storage
- Freight Consolidation
- Crossdocking

- USDA Inspection
- Container Unloading Repacking

25,000 Pallet Freezer • 7 Million Cubic Feet
26 Dock Doors • 30,000 Sq Ft Loading Dock
Oversized Truck Yard - Capacity for 96 Trailers
VNA (Very Narrow Aisle) Turret Truck System

Plug Power H2 Pad
Moving to Plug Power Hydrogen and Fuel Cells

- **Carteret facility**
  - Started with 24 and now uses 43 GenDrive fuel cells
  - Pico GenFuel station: outdoor storage and 2 indoor dispensers
  - GenCare service for the fuel cells and hydrogen system

- **Paterson facility**
  - Uses 9 GenDrive fuel cells
  - “Hub & spoke” hydrogen model - transporting hydrogen from Carteret to Paterson’s smaller facility - provides affordable hydrogen to make this project work.
  - GenCare service

Drivers fuel their own vehicles with hydrogen in a couple minutes at strategically placed GenFuel dispensers.
Hydrogen refueling takes 2-4 minutes per shift vs. Battery managing time wasting labor/shift - lost time ~60 mins/shift

Annual productivity gained = 590 hours per truck in a 2 shift operation

Lower electric bills by 31.5% after switching to fuel cells

More production space to grow the business

We move 40% more volume during a 9-hour shift with fuel cells than we did with batteries.
Fuel cell forklifts operate at full power all shift long, even in the freezer
  › Faster lifts, faster stocking
  › Faster trailer loading and unloading
More productive workforce
Power for both heat and headlights

Our drivers are happier because they can do their jobs efficiently and comfortably.
Clean energy is safe energy

- Zero-emission power reduces greenhouse gases
- No battery acid, no crushed fingers, no electrical shocks

Our customers look to us for progressive technology.
100% Fuel Cell Powered

www.freezpak.com
Questions

Chris Tully  
VP of Sales – Eastern Region  
Plug Power  
ctully@plugpower.com

David Saoud  
Co-President  
FreezPak  
dave@freezpak.com

Alexander Barton  
Energy Specialist  
NEESC  
abarton@neesc.org

NEESC is funded through a contract with the U.S. Small Business Administration