

Fuel Cells: A Smart Purchase For Your Greenfield or Brownfield Facility

 *plugpower*  GenDrive[®]

Today's Fuel Cells for proven, reliable power.

Make An Educated Fuel Cell Purchasing Decision for Your Greenfield or Brownfield Facility

Whether it's moving pallets laden with soda, large screen televisions, key parts in the automobile assembly process, or boxes of frozen ice cream at sub-zero temperatures, every material handling business operates with the same objective — to run profitably in the most efficient manner possible.

For the past five decades, lead-acid batteries were the leading choice for lift trucks operating in the retail, grocery, institutional food distribution and manufacturing sectors. However, that is no longer the case.

Over the past five years, customers including Central Grocers, Sysco, Whole Foods, Wegmans and BMW, began shifting their material handling needs from lead-acid batteries to fuel cells, which convert hydrogen fuel into energy through an electrochemical reaction.

These industry leaders opted to make the switch because fuel cells improve business operations through increased productivity. They also lower operational costs, improve space utilization and reduce greenhouse gas emissions. Even more importantly, in large, multi-shift operations, fuel cell-powered forklifts cost 59 percent less to operate and maintain than their battery-powered counterparts.

About Plug Power Inc.

The architects of modern fuel cell technology, Plug Power has revolutionized the industry with cost-effective power solutions, GenDrive®, that increase productivity, lower operating costs and reduce carbon footprints for the customers who use the products. Long-standing relationships with material handling industry leaders forged the path for the company's key accounts, including Walmart, Wegmans, Whole Foods, and FedEx Freight. More than 3,000 GenDrive units have been shipped to material handling customers, accumulating over 8 million hours of runtime. And, with 95 percent of US hydrogen fuelings being performed on Plug Power products, we manufacture tomorrow's incumbent power solutions today.

For more information about Plug Power, or to locate a Plug Power sales representative, visit www.plugpower.com, or call 518.782.4004.



STARTING THE CONVERSATION

Ask a VP of Operations at any leading grocery, institutional food distribution or retail distribution business why they are considering installing hydrogen infrastructure and chances are you'll receive a different response from each of them.

That's because today's fuel cell customers embrace hydrogen for an array of reasons. For some, this includes greater operational efficiency and boosting bottom line numbers. Others are lured by the opportunity to tap into a green fuel source to meet corporate sustainability goals.

Regardless of the reasons, Plug Power Inc. begins its discussion with potential customers by weighing each company's driving goals and objectives. From there, it presents a customized plan designed to help each business maximize its overall efficiency and increase its bottom line.

This paper discusses how material handling facilities facing high labor and electricity costs can make an educated purchase when it comes to fuel cells.

Fuel Cells And Greenfield Sites: A Win-Win Partnership

There is a common misconception that lift trucks and lead-acid batteries are the primary components of a thriving distribution center.

However, the reality is that every high throughput distribution center also requires a dedicated 3,000–5,000-square-foot battery storage room which construction costs typically exceed \$1 million.

Storage rooms also contain a multitude of expensive investments to keep a company's lead-acid battery-driven operation up and running. This includes:

- Multiple reserve lead-acid batteries with sticker prices in excess of \$4,000;
- Battery chargers and heavy duty rack storage systems;
- Miles of copper wiring to bring electricity to these chargers;
- Adequate venting to eliminate buildup of emissions in the facility that are created as charging takes place;
- Specialized lifting equipment to remove batteries from their racks and install them onto the trucks;
- Dedicated washing stations to clean residual lead-acid spilled from these batteries; and,
- Dedicated personnel needed to change, service and maintain the batteries.

By creating a hydrogen infrastructure inside a brand new facility (or “greenfield site”), companies can immediately recover more than 5,000-square-feet in valuable cubic storage space, while also eliminating all of the associated battery room costs. Customers can now design the facility with out having to worry about expansion of battery room growth. Customers can also downsize the facility backup generators.

A move to hydrogen also brings additional year-over-year labor savings. Instead of having dedicated personnel taking up to 15 minutes to handle constant battery changes at all hours of the day and night — something that's especially prevalent in larger facilities running 150–200 trucks — fuel cell-powered forklift trucks can be refueled in just two to three minutes by the forklift operator.

The elimination of battery changes (versus hydrogen refueling) provides businesses with an immediate six to 10 percent increase in productivity gains, since battery-changing personnel can now find value somewhere else within the organization.



For example, by creating a hydrogen infrastructure from the design stage of its perishable distribution center in Balzac, Alberta in November 2010, **Walmart-Canada** avoided costs associated with installing, maintaining and operating traditional lead-acid battery systems.



Fuel Cells And Greenfield Sites: A Win-Win Partnership CONTINUED...

Walmart executives report the 71 fuel cell lift trucks in operation are also reducing carbon dioxide emissions by 72 percent compared to batteries charged from the grid, which is helping the Fortune 500 company support a more sustainable operation. The Balzac fuel cell fleet is expected to deliver operational cost savings of more than \$2 million over a seven-year period. Walmart has expanded its use of fuel cells at the company, deploying at an additional two sites, bringing their total to over 500 GenDrive-powered lift trucks.



Central Grocers in Joliet, IL is another example of a customer that built its facility with an expanding hydrogen fuel cell-powered lift truck fleet in mind.

In 2008, the member-owned grocery wholesaler purchased 220 fuel cell units over traditional lead-acid batteries as a cost effective solution to power its entire lift truck fleet for a new, \$90 million distribution center.

Because Central Grocers opted to install fuel cells during the center's preliminary schematic sketches, the need to build battery charging and changing infrastructure was eliminated. This not only reduced capital investment, but also opened up valuable floor space for the distribution business.

Since 2009, when fuel cell-powered trucks began operating at the facility, productivity has flourished. Truck operators spend more time moving product and less time dealing with depleted batteries. What's more, Central Grocers has significantly reduced its greenhouse gas emissions as a result of the elimination of lead-acid battery charging and changing equipment.

For businesses contemplating a switch to hydrogen during the design phase of a new distribution center, it is important to recognize that a hydrogen infrastructure does include some expense. For instance, new customers will need to install a fenced-in concrete pad behind their facility, in addition to phone and electric hook up for remote monitoring of the equipment.

However, since most hydrogen equipment (i.e. the OSHA-certified tank that houses the liquid hydrogen and tubing required to carry the hydrogen gas into the building) is leased directly from an industrial gas company, capital investment costs are minimal.

Furthermore, the use of fuel cells makes material handling fleet expansion easy for the customer. During busy seasons, customers are able to ramp up production without the hassle to invest in more lead acid batteries, chargers and associated racking. With ease, the customer can deploy additional fuel cell-powered trucks to accommodate their growing business.

OTHER GREENFIELD CUSTOMERS



A Power Play At Brownfield Sites

Finance executives often assume that “hydrogen savings” are only attainable at sites with extensive blueprints to create new warehouse space. In fact, nothing could be further from the truth.

Companies currently utilizing lead-acid batteries for their material handling needs, known as brownfield facilities, can also realize financial paybacks — often in as little as 12 months — by converting to a hydrogen infrastructure.

Productivity And Energy Savings Lead The Way

The most significant brownfield savings occur in productivity enhancements, since companies can now eliminate operator downtime spent swapping power sources. Battery installation technicians can then be redeployed to other value-added tasks such as picking goods, moving pallets, and loading trucks.

Energy costs provide another compelling reason for switching over to hydrogen. Each day businesses pay up to 14 cents per kWh to charge up to 250 lift truck batteries. In addition, they are levied up to 10 cents per kWh for using brief spikes of power from the grid. These “peak demand” charges, which are designed to help share a local utility’s infrastructure and maintenance costs, can account for up to 70 percent of a large company’s electric bill.

By eliminating the electricity costs associated with charging hundreds of lift truck batteries — coupled with peak demand charges — businesses can reclaim \$75,000 to \$225,000 per year, a significant financial savings, even for a large business.



Coca-Cola Refreshments USA (CCR) removed its lead-acid battery charging, changing and maintenance infrastructure and deployed 37 Class-1 sit down counterbalanced lift trucks at its 250,000-square-foot bottling and distribution center in San Leandro, CA.

The results had an immediate impact on the facility’s bottom line. CCR officials report that electrical consumption has been reduced by 1.6 million kWh per year, while also providing the business with a 15 percent carbon reduction savings.

Room For More Product

As previously noted, fuel cells require a significantly smaller footprint, which enables businesses to recover valuable warehouse space for additional product storage. In San Leandro, CA, for example, CCR reported recovering more than 2,000-square-feet of facility space that is now being used for other business operations.



Meantime, Houston, TX-based Sysco Corporation, a marketer and distributor of food service products, experienced even greater space savings when it converted to a hydrogen economy. By ordering 100 hydrogen fuel cell-powered lifts and pallet jacks for its

Front Royal, Virginia, Baugh Northeast Co-op, Inc. redistribution facility, the company freed up 5,000-square-feet of facility space that previously housed lead-acid battery charging, changing and maintenance equipment.

A Hot Product For Cold Storage

Although fuel cells provide an array of performance, cost and productivity benefits in both greenfield and brownfield environments, their benefits and cost savings are even more pronounced in cold storage applications where temperatures need to be regulated to as low as -30 degrees Celsius.

Unlike lead-acid batteries whose performance degradations are amplified in cold environments, fuel cells work just like a car. If the system has fuel, it has full power.

Forklifts powered by fuel cells also run up to twice as long per fill-up compared to battery-powered units. This not only allows operators to stay in their aisle longer moving goods around, a significant productivity gain, but also means fuel cells trucks can remain in the cold storage facility for longer periods of time.

Fuel cell's productivity gains in refrigerated warehouse operations have certainly not gone unnoticed. Companies like Central Grocers have purchased forklift "freezer" units capable of operating at sub-zero temperatures to help power their distribution centers. The grocery wholesaler anticipates that by using fuel cell power it will reap \$1.5 million in savings over the next decade.

A Valuable Marketing Tool



Another key selling point for both brownfield and greenfield sites is the marketing muscle fuel cells provide.

Businesses utilizing "grid independent" technology have an opportunity to set themselves apart from the competition — and reach additional consumers — by touting how they are moving goods using power sources that produce zero harmful emissions.

BMW Manufacturing provides an excellent case study of a company that is creatively promoting its use of fuel cells to solidify its position as a leading sustainable automobile manufacturer.

In 2010, the German automobile giant deployed a fleet of 100 forklifts, tuggers and stackers in the new assembly hall that produces the X3 Sports Activity Vehicle at its Spartanburg, SC automobile manufacturing plant.

Since hydrogen is the only source of energy for the fuel cells being used at the facility, BMW Manufacturing estimates the project avoids 1.8 million kWh per-year of electricity consumption at the plant that would have been used to charge a battery-powered fleet. At the same time, it is experiencing savings of around 1,200 tons of carbon dioxide emissions.

As consumers become smarter about their buying habits and base more of their purchasing decisions on what kind of impact companies have on the environment, BMW's hydrogen fuel cell fleet — in conjunction with the company's successful landfill gas to energy initiative that powers 50 percent of the plant's total energy requirements using methane from a local landfill — continue to provide the company with excellent material to weave into its marketing campaigns.



It Pays To Consider A Hydrogen Economy

Recently, the productivity and financial benefits offered by fuel cells have generated an ever-growing list of satisfied customers in the retail and grocery distribution and manufacturing sectors, each of which is now maximizing the overall effectiveness of their business.

This is no more evident than in greenfield environments where hydrogen infrastructure is factored into a new distribution center's initial design concepts. Marquee companies like Walmart, Procter and Gamble and Sysco Corporation have jumped at the opportunity to save anywhere from \$3 to \$5 million over a five-to 10-year period — a payback on their investment that continues to take place year after year.

Although investment returns at brownfield sites are more modest by comparison, businesses can still achieve measurable productivity gains and significant financial savings that didn't previously exist. For an upfront investment of around \$1 million, for example, companies, like AWG and Kroger, can expect to harvest hundreds of thousands of dollars in yearly payback on their expenditure over a five-to 10-year period.

Hydrogen fuel cells have a 10 year lifespan, more than double that of a lead-acid battery. This syncs up with the electric lift truck so the customer is able to purchase and maintain the entire fleet as one piece of equipment. In fact, preventative maintenance cycles of the fuel cells line up with that of the electric lift truck to ensure the truck is off the floor for as little time as possible.

Lesson learned: it pays to consider a hydrogen economy.

FUEL CELLS PROVIDE A HOST OF BENEFITS TO ANY HIGH-THROUGHPUT WAREHOUSING, DISTRIBUTION AND MANUFACTURING OPERATIONS. THESE BENEFITS INCLUDE:

- **Increased Productivity** — Lead-acid batteries provide up to six hours of run time before the battery must be recharged, whereas a completely filled hydrogen fuel cell forklift can run up to twice as long. By switching forklift fleet power to fuel cells, companies can reduce wasted time changing batteries. Instead, workers can use the time more productively on the floor picking goods, moving pallets, and loading trucks — the key activities of any thriving distribution hub.
- **Reduced Operational Costs** — Fuel cells operate like a fully charged lead-acid battery 100 percent of the time, resulting in less wear and tear on the forklift's electronic system. Each fuel cell lasts eight to 10 years, that's double the life of a lead-acid battery.
- **Undiminished Power** — Battery-powered lift trucks lose approximately 14 percent of their speed over the last half of the battery charge. On the other hand, fueled fuel cells run at full speed throughout the entire shift, enabling businesses to move more goods through their production facility. And, in cold storage facilities with sub-zero temperatures, an environment in which batteries experience significant power degradation, fuel cells meet or exceed performance requirements.
- **Quick and Easy Fueling** — Fuel cells refuel quickly — just one or two minutes by the forklift operator, compared to 15 minutes for each battery swap. The fueling infrastructure is extremely compact, especially when compared to battery charging rooms, leaving more valuable warehouse space for operational activities. There is no need to invest in battery swapping and charging equipment, extra batteries and battery storage, as well as personnel dedicated to this task.
- **Decreased Carbon Footprint** — Fuel cells produce zero harmful emissions and eliminate the costs associated with handling and storing toxic materials. Sites can reduce greenhouse gas emissions by up to 80 percent. And, by running independently of the grid, customers reduce peak power demand, eliminating high-cost electricity.
- **Sound Investment** — On a lifecycle cost basis, studies show that fuel cell-powered forklifts require up to 50 percent less investment than lead-acid battery-powered trucks in high-throughput applications. In some cases, fuel cell-powered forklifts may require more capital investment than their lead-acid counterparts, but they always offer substantial savings in both operation and maintenance.

References and Notes

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