

READY TO ROLL

Following successful field trials of its fuel cells at the world's largest DC, one company is ready to expand the technology into other vehicle and power-related applications

The focus on delivering value to customers has been Cellex's mission since the company's inception – and this approach has caught the attention of senior executives at the largest distribution companies in North America and Europe. 'Let's roll' is the motto that reflects the company's readiness to begin commercialising fuel-cell product solutions to these customers.

Having successfully field-tested the functionality of its fuel-cell powered lift-truck solution at the world's largest distribution companies, Cellex is now armed with real-world field-trials results and expertise. With this background, the company is now expanding into other industrial vehicle applications, and is

offering to develop and deliver functional prototypes to manufacturers of power products so that they can fully evaluate the commercial benefits of fuel cells.

Since 1998, the company has been developing fuel-cell solutions to address the limitations of lead-acid batteries used in electric lift-trucks operating in high-throughput distribution centres at companies such as Wal-Mart, Sysco, Target, Kroger, Argos, Asda, Tesco and Colruyt. These companies must currently bear the cost of purchasing up to three lead-acid batteries per lift-truck, battery-charging equipment, and staff to change the depleted batteries – a process that can occur more than 300 times a day for a large fleet.

Cellex has identified the electric lift-truck market, with emphasis on those vehicles operating in high-throughput distribution centres, as one of the first commercially viable applications for hydrogen fuel cells – preceding cars. Indeed, in January 2005, it successfully completed its alpha field trials at Wal-Mart, where four fuel-cell units powered four electric rider pallet trucks in various applications for two weeks.

Wal-Mart's executive vice-president of Logistics and Supply Chain, Rollin Ford said: "These fuel-cell power units provided us with the opportunity to gain insight into the potential of fuel-cell power. We were impressed with the operational benefits. Working with Cellex enables Wal-Mart to forge ahead with its environmental leadership by embracing new technologies such as fuel cells."

Cellex plans to start lift-truck beta trials of its fuel-cell solutions in mid-2006, with early commercial sales taking place

A CX-P150 power unit on board a Class 3 rider pallet truck used in in customer field trials



in 2007, and full commercialisation of its initial product offering in 2008.

First to market

The industrial-vehicle market provides Cellex with the opportunity to be first to market, with fuel-cell solutions that offer customers a compelling economic benefit and justifying the replacement of the battery and charger systems used today. It also puts Cellex in pole position when it comes to developing a wide range of fuel cell-based products for use in distribution centres and within logistical operations, such as auxiliary power units (APUs) and refrigeration units in trailers/lorries. For example, the centralised hydrogen refuelling stations can not only be used to fuel lift-trucks located inside distribution centres, but also to fuel trailers/lorries with refrigeration units. Hydrogen fuel produced on site for multiple applications can therefore show greater cost effectiveness than the grid.

In addition to opportunities within distribution centres, Cellex is looking at providing fuel-cell solutions for airport ground support equipment, mining vehicles, personnel carriers, sweepers and scrubbers, ice resurfacers, and more.

The following services are therefore offered to OEMs:

- Applications and duty-cycle analysis;
- Product design;
- Integration of the fuel-cell engine into industrial vehicles;
- Testing and field trials;
- Hydrogen fuelling;
- Product service and support;
- Value proposition development.

Cellex has a deep understanding of fuel-cell technology and the importance of collaborating with OEMs in the development of new fuel-cell product solutions.

Leading the effort with 30 years of management and commercial applications experience in the materials handling and logistics industry is Tom

Cellex product benefits

Cellex fuel-cell products do not require recharging or changing as they can be refuelled with compressed hydrogen in less than one minute. And unlike batteries that store a limited amount of energy, Cellex products provide a continuous flow of power as long as they have fuel – like an engine in a battery box. In this way, they provide fleet users with the refuelling convenience of an engine-powered truck, while providing the benefits of electric trucks with zero emissions.

The benefits of using Cellex fuel-cell products include:

- Reduced operating and maintenance costs by eliminating battery changing, charging and associated infrastructure;
- Increased productivity by providing longer run times and consistent power at all times;
- Refuelling in under one minute;
- Reduced truck motor maintenance through voltage consistency;
- Improved workplace safety by removing the handling of lead, acid, heavy batteries and their recycling.



Packaged to transparently replace industrial batteries for easy customer adoption

Hoying, Cellex's vice-president of sales and marketing. Cellex has IP-protected technology that allows a fuel-cell stack (equivalent to an engine block) to become a functional electric engine with a low-cost and required durability approach to meet application requirements. The company is also a recognised leader in the development and implementation of safety systems and certification, and is helping to lead the drafting of UL standards for fuel cell use in electric lift-trucks.

Since 1998, Cellex has developed and tested six generations of its hybrid fuel-cell products, producing continuous improvements in performance, durability, efficiency and cost. In addition, it has developed industry-leading competencies in systems engineering, applications analysis, product integration, hydrogen fuelling, product safety, testing, value proposition development, product support and power electronics and controllers.

A disciplined approach is required to successfully navigate a product development process in this rapidly changing technical environment. With these challenges in mind, the company





CLOCKWISE FROM ABOVE: **System design and product integration expertise is aimed at delivering the best customer solutions; fueling with compressed hydrogen takes less than a minute; power electronics is one of many core capabilities**

adheres to a 'gated' process to ensure it fully understands customer requirements as well as cost, performance and durability targets.

In the case of fuel-cell technology, the issues of reliability and cost have led the company to focus on solutions that optimise (or minimise) the amount of fuel cell used through hybridisation, enabling it to meet rigorous customer requirements and progress rapidly through its gated development process.

The whys and why nots of fuel cells

Fuel cells generate electricity by reacting hydrogen with oxygen in a simple electrochemical 'cell'. This reaction is very efficient and occurs at low temperatures, making it unique among the many ways to produce power. The reaction's only by-products are heat and water.

Cellex is developing a family of products that take immediate advantage of these characteristics, providing new functionality for conventional industrial vehicles users. Cellex products can extend the range and improve the performance of these vehicles while making their operation clean and quiet.

The oxygen required by fuel cells is usually extracted from the air. Hydrogen, on the other hand, is rarely found in its pure form and can be generated from water via electrolysis or extracted/reformed from hydrogen-rich fuels such as methanol, natural gas or propane. These fuel reformers can be located on board the industrial vehicle or as part of a hydrogen refueling system. On board an industrial vehicle, pure hydrogen can be stored in several forms such as a compressed gas or within a metal hydride storage system.

There are many benefits:

- Long run times: a fuel cell will continue to produce electricity as long as it is continually supplied with fuel;
- Highly efficient: by converting fuel directly into energy through an electrochemical reaction, fuel cells extract more power out of the same quantity of fuel than can be achieved by traditional combustion;
- Fuel flexibility: in most cases, fuel cells require hydrogen fuel that can be fed directly to the fuel cell or reformed from any of the common fossil fuels available today;
- Site flexibility: with their inherently quiet operation, zero to minimal emissions and reduced permitting requirements, fuel cells can be located in a variety of areas, both residential and commercial, indoors and outside;
- Zero to low emissions: when hydrogen is the fuel, water, heat and electricity are the by-products of the electrochemical reaction instead of carbon dioxide, nitrogen oxides, sulphur oxides and particulate matter inherent to fossil-fuel combustion. When fossil fuels are reformed into hydrogen, emissions of CO₂, nitrous oxides, sulphur oxides and other pollutants are a fraction of those produced through the combustion of the same amount of fuel.
- Reduction in environmental damage: when the hydrogen is produced from renewable sources, fuel cells avoid the environmental damage associated with the extraction of fossil fuels. In the event of a hydrogen release, the hydrogen gas would be rapidly dissipated because it is lighter than air. This is a dramatic departure from the pollution that oil drilling, transportation and refining have left on the Earth.
- Low operating temperatures and pressures: fuel cells operate at between 80°C to over 1,000°C, depending on the type of fuel cell. These numbers might seem high, but compare that to the temperature inside your vehicle's internal combustion engine, which can reach over 2,300°C.
- Cogeneration capability: when waste heat from the fuel cell's electrochemical reaction is captured, it can be utilised for water, heating and cooling. With cogeneration capabilities, the efficiencies achieved by a fuel cell system approach 90%.

Looking forward, Cellex is committed to advancing its product line as fuel-cell technology continues to be refined. It will continue collaborating with interested parties to develop solutions for their industrial vehicles and/or operations.

The company is uniquely positioned to solve customer problems and offer products that provide economic value with an environmental edge. By focusing on product innovation and customer value, Cellex has become a world leader in

developing and commercialising fuel-cell power solutions for industrial vehicles. With its applications engineers, system design and integration team, Cellex is ready to roll into other vehicle and power-related applications. **ivt**
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