ISSUE
15
May
2012

# Technology Feature: Hydrogen PEM Fuel Cells

## About Us

GreenTechEurope.com (GTE) is a production of London Research International (LRI), a global research and consulting firm with expertise in the energy, environment, and chemical sectors. GTE is a video-based technology platform showcasing innovative technologies from Europe.

## The GTE Newsletter

Our interview-based newsletter features innovative energy technologies and businesses from around the world.

## Announcements

GreenTechEurope.com was on the road last month at the Hannover Messe tradeshow. We interviewed over a dozen companies about their technologies and what makes them unique. Check-in to see the latest interviews with a variety of different technology providers.

## *Featuring: Nedstack*

*In the latest edition of our newsletter, LRI Staff interviewed Nedstack CEO, Mr. Olivier Scheele. Nedstack is a manufacturer and producer of PEM (proton exchange membrane) fuel cells based in The Netherlands. Active throughout China, India, and Indonesia, Nedstack provides fuel cell power source solutions primarily to system integrators within the telecommunication and chemical sectors. In a recent demonstration project, Nedstack delivered a 1-MW power plant for Solvay at their chlorine plant in Belgium, the largest PEM fuel cell plant in the world.*

## *Reliable and Versatile Fuel Cell Stacks*

The origins of Nedstack are found in the early fuel cell work of chemical giant, AkzoNobel. In the late 1990's, AkzoNobel restructured its R&D unit, creating an opportunity for their fuel cell research team to "spin-off". The result was Nedstack, established with the intent of taking nascent fuel cell technology and producing it at full-scale. Nedstack uses PEM (proton exchange membrane) fuel cells, the most mature fuel cell technology. Nedstack entered the commercial market in 2006 with several demonstration projects, including a 70 kW fuel cell power plant at an AkzoNobel's chlorine site in The Netherlands. At the plant, by-product hydrogen is run through the fuel cells and converted back into electricity. Recently, Nedstack completed a 1 MW unit for Solvay at a chlorine plant in Belgium. Nedstack is the largest PEM fuel cell stack producer in Europe, and second largest in the world.

***How PEM Fuel Cells Work***

A fuel cell combines hydrogen and oxygen to produce electricity. The core of each fuel cell consists of an electrolyte and two electrodes. At the negative anode, a fuel such as hydrogen is being oxidized, while at the positive cathode, oxygen is reduced. Ions are transported through the electrolyte from one side to the other and create an electric charge—this is how electricity is produced. The basic principle of the fuel cell is illustrated in the figure below.

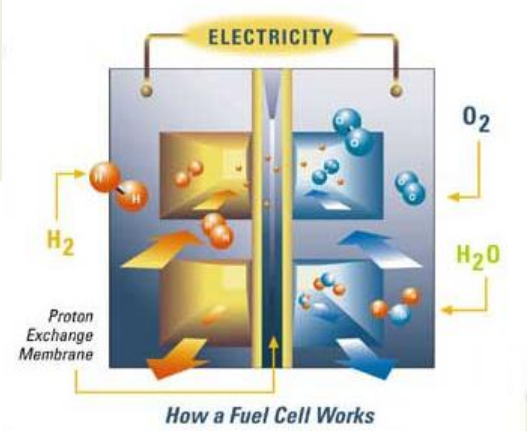



Photo Credit: California Fuel Cell Partnership

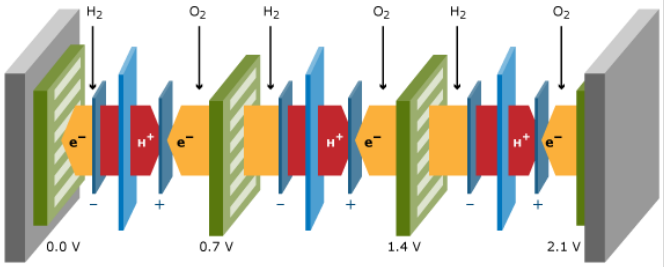
*Copyright London Research International*

## Competitive Edge

*What makes Nedstack different?*

Nedstack's fuel cells have several features that make them particularly competitive. The design of the stacks is such that it requires a low pressure drop over the air and hydrogen channels. On the system integration side, this means that when bringing gas through the stack, blowers can be substituted for the costly pumps that regular fuel cells require.

Nedstack's fuel cells are also water-cooled, which allows them to last longer and to provide more power. This enables Nedstack to size their stacks more appropriately to the customer's needs. Most of Nedstack's competitors can only provide fuel cell stacks that go up to 2 kW, while Nedstack offers a 2 kW to 10 kW range. This higher power capacity is especially favourable in the telecom market, where the trend is to have multiple telecom operators located at a single tower site. In this infrastructure-sharing arrangement, Nedstack's fuel cells can be utilized by several different cell phone operators.




# Nedstack Fuel Cells

*Power Output:* 2kW to 10 kW

*Cost:* €3,000 to €15,000

*Lifetime:* 4,000 to 20,000 hours

### *Markets and Regions*

Nedstack has been focusing heavily on those commercial and industrial applications that require uninterruptible power supplies; in particular, within the growing telecommunications (telecom) sector. Nedstack seeks out and works with system integrators who build network power supply systems. These system integrators constitute the critical mass of Nedstack's customer base. They operate mainly in developing countries where the telecom networks are being rolled out at a faster pace than the electricity grid. In countries such as—China, Turkey, India, Indonesia, Africa, Latin America —there is a need for a continuous on-site power option for rural cell phone towers. In the past, this back-up power was provided by diesel generator sets, but these are increasingly being replaced by fuel cell systems.

### *Ranges and Costs*

With its versatile power range, Nedstack is able to offer different assemblies to best match their client's needs at a competitive price. Nedstack offers cheaper fuel cell options that last for 4,000 hours with a power output of 2 kW and cost around €3,000. At the other end of the range, Nedstack provides 10 kW solutions that run for 20,000 hours and cost roughly €15,000 per stack. Nedstack predicts that as volumes increase in the near future that these prices will fall. One of the drivers to this scale-up will be the growth of fuel cell demand from the automotive industry. The membranes that will be used in these fuel cells are the same type that Nedstack uses in its own stacks. Although Nedstack will not be catering to this vehicle market, the largest cost of Nedstack's fuel cells are the membrane electrode assemblies, thus as their membrane suppliers reach greater volumes of scale, then the cost of Nedstack's products should markedly decrease.

### *Why PEM Fuel Cells?*

Nedstack chose to focus on PEM technology for two key reasons. First, the origins of the company were deeply rooted in the knowledge and technology of AkzoNobel, which used PEM's in their electrolysis process to produce chloride. Although this was the impetus of their company, Nedstack chose to stay with PEM stacks given their maturity among fuel cell technologies. Currently, around 95% of fuel cells in the world are based on PEM technology. PEM fuel cells can be quickly started-up and operated, have a low operating temperature, and tend to be less expensive. The chart below shows a comparison between PEM fuel cells and other comparable fuel cell types on the market.

| | Operating temp. (°C) | Fuel | Electrolyte |
|---|---|---|---|
| PEMFC | 40-90 | $H_2$ (/$CO_2$) | Polymer |
| AFC | 40-200 | $H_2$ | KOH |
| DMFC | 60-130 | Methanol | Polymer |
| PAFC | 200 | $H_2$ (/$CO_2$) | Phosphoric Acid |
| MCFC | 650 | $CH_4$, $H_2$, CO | Molten Carbonate |
| SOFC | 600-950 | $CH_4$, $H_2$, CO | Solid Oxide |

Noble metals | Noble metals/non-noble metals | Non-noble metals

Copyright London Research International

## *Expansion and Long-term Growth*

Nedstack's large scale projects, such as the 1 MW stack for Solvay, were largely demonstration projects to show that PEM technology is mature enough to be commercially feasible. Since delivering these projects, Nedstack's business model has moved away from assembling full systems and they are now actively focused on selling and manufacturing fuel cell stacks. Nedstack is confident, however, that other parties will build large-scale projects using their fuel cells, most likely in the chemical and telecom industries.

Nedstack is currently working most within China, India, and Indonesia, but is preparing to enter Latin America and Turkey. The fuel cell market as a whole is not very competitive at present, said Mr. Scheele. The market is growing so fast that there is currently space for everybody, and it's too early to speak of a competitive market. Looking to the future, Nedstack sees four large markets for PEM fuel cells, including: the automotive sector, combined heat and power (CHP) applications for industry and buildings, uninterruptible power supplies for telecom and utilities, and material handling vehicles (e.g. forklifts). Nedstack plans on playing a large role in all of these except the automotive sector, with the exception of buses. The fuel cells that Nedstack produces are built for long-life and efficiency, and not for the high power density required in passenger cars. Buses and material handling vehicles, however, have the space for a stack and their durability requirements make Nedstack's PEM fuel cells a natural fit.

## Integrating Renewables and Grid Stabilizing

One of our customers is very advanced with regards to multiple power source integration. They have a system comprised of both fuel cell stacks and an electrolyser, allowing them to connect to the grid and produce hydrogen through their electrolyser when power is available. When the grid fails, this hydrogen is used to produce electricity via the fuel cells. This electrolyser can also connect to a solar PV or wind energy source, which likewise produces hydrogen when the sun is shining or the wind is blowing. With respect to large-scale storage or grid balancing, I'm still sceptical about the scale necessary in order to balance our grids in the developed world. With increasing amounts of wind power and the scale at which you can use fuel cells—it's gigawatts (GW) versus megawatts (MW). Our 1 MW stack for Solvay is the largest in the world, so I think it will be a long time until fuel cells reach the scale where they can adequately balance the variability of intermittent renewable sources.

-Olivier Scheele, CEO, Nedstack

## Work with Nedstack

Nedstack is very interested in opening up new communication with system integrators in Turkey, Latin America, and Africa, and welcome interest in new business relationships. In terms of investment, Nedstack is also currently considering new financing routes outside their existing shareholder base.

## Contact Points

*Mr. Olivier Scheele*
*CEO*
*Olivier.Scheele@nedstack.com*

***Nedstack***
Westervoortsedijk 73
6827 AV ARNHEM
The Netherlands
(T) +31 (0)26 319 7600
(F) +31 (0)26 319 7601

For more information:

- Visit Nedstack's website.

Nedstack
PEM FUEL CELLS

*Unless otherwise noted, all photo credits are via Nedstack

*Copyright London Research International*

*GreenTechEurope.com and the GTE Newsletters are productions of London Research International*

Stay in touch with LRI

Follow on Twitter

Join on Facebook

## Related Upcoming Events – Fuel Cells

• **World Hydrogen Energy Conference**

3-7 June 2012 | Toronto, Canada

The event will host more than 1,000 attendees and include 300 presenters, 200 poster displays and delegates from 55 countries. The event gives numerous opportunities to network and partner with global leaders in the business, government and scientific communities.

• **World Cities Summit 2012**

1-4 July 2012 | Singapore

The World Cities Summit is the global platform for government leaders and industry experts to address liveable and sustainable city challenges, share innovative urban projects and forge partnerships.

• **China Fuel Cell and Hydrogen International Conference**

20-21 September 2012 | Nanjing, Canada

China's National Hydrogen Energy Conference, the largest hydrogen event in China, has been held for over 10 years. The purpose of the conference is to show advanced foreign hydrogen and fuel cell technology and products to Chinese FCH stakeholders so that partnerships can be developed between Chinese and foreign FCH organizations.

**Want to feature your company on GTE? It's easy.**

**Use the Upload function for your existing videos**
**OR**
**Let us know about the next exhibition you plan to attend.**
**If we're in attendance, we can visit your booth for an interview.**
**We are at the All-Energy Exhibition in Aberdeen and Sustainabilitylive! in Birmingham this month.**

**- NEXT ISSUE-**

**Clean Coal**

London Research International

Elizabeth House, First Floor, Block 2
39 York Road
London, SE1 7NQ
Tel: +44(0)20 7378 7300 Fax: +44(0)20 7183 1899
http://www.londonresearchinternational.com/

*Copyright London Research International*